2nd Review
PRCCP20230970
Jan 2024

Stormwater Site Plan

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230723.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2023

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Principal

DATE:

November 2023

11/21/2023

I hereby state that this Stormwater Site Plan for the East Town Crossing project has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Table of Contents

Appendices

Appendix A

Exhibits

Added CSWPP appendices here. The document is also bookmarked

1.0 Project Overview

1.1 Purpose and Scope

This Stormwater Site Plan accompanies the site development plans for the East Town Crossing project located on Tax Parcels 0420264021, 0420264053, 0420264054, 0420351066, 0420351030, 0420351029, 0420351026. The site is bordered by E Pioneer to the north, Shaw Road E to the west, commercial businesses to the south, and vacant land to the east. The seven parcels contain approximately 10.93 acres that will be disturbed. Refer to Appendix A, Figure A-1 for a Vicinity Map.

This Stormwater Site Plan is for storm drainage approval. This report describes the design and analysis of the basic treatment, detention, and conveyance facilities proposed as part of the site improvements. This report will demonstrate that the stormwater design for this project will meet the requirements of the 2019 Department of Ecology (DOE) *Stormwater Management Manual for Western Washington* (*SMMWW*), as adopted by the City of Puyallup.

1.2 Existing Conditions Summary

Revised discussion

1.2.1 Existing Site Features

The existing area is approximately 10.93 acres and is currently developed and undeveloped land cover. Within the seven parcels, a network of dirt and gravel access roads connect E Pioneer, Shaw Rd E, and the commercial property to the south. In the southwest parcels, there is an existing residential structure and a vacant residential lot. The majority of the landcover is made up of tall grass, shrubs, and a few trees.

Actually very little runoff generated onsite discharges to the eastern stream channel. [Storm Report; Pg 5 of 448]

The site contains a detention pond that receives runoff from the commercial property to the south before overflowing into the existing channel lining the east and north of the property. Apart from the detention pond, the site generally slopes from southeast to northwest with sections of the eastern side of the site discharging to the natural channel to the east The large majority of runoff discharges to the northern portion of the channel. A topographical survey of the project was prepared by Abbey Road Group. that shows existing site conditions. See Appendix A, Exhibit A-2 for the Existing Conditions Map.

See comments on the 'Existing Conditions Map'. [Storm Report; Pg 5 of 448]

Revised Existing Conditions Map

1.2.2 Soils

The National Resources Conservation Service (NRCS) classifies the onsite soils as Briscot Loam in the northern two-thirds of the site and Puyallup fine sandy loam in the lower third of the site. Appendix A, Exhibit A-4 provides the NRCS soil map. Briscot Loam is classified as hydrologic soil group B/D with poorly draining characteristics. Puyallup fine sandy loam is classified as hydrologic soil group A with well-draining characteristics.

Krazan & Associates, Inc prepared a geotechnical report for the site. On March 4, 2021, two large-scale pilot infiltration tests were completed. Based on the results presented in the Geotechnical Report, it was determined that the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Migizi Group, Inc., confirmed in their Project Infiltration Letter, dated August 25, 2023 (provided as Appendix B, Exhibit B-1) that Krazan & Associates, Inc.'s findings result in a calculated 0 inches per hour infiltration rate. Thus, in opposition of the NRCS report, the entire site is not recommended for any infiltration due to the presence of unfavorable soils.

See Appendix B, Exhibit B-1 for the Krazan & Associates, Inc. Geotechnical Engineering Report and Appendix B-2 for the Migizi Group Geotechnical Letter.

BioPod

CLARIFY-Biopod?
[Storm Report; Pg 6 of 448]

Noted

Please be aware that the existing storm facility's berm has been breached by the stream on the east side of the site due to lack of maintenance of the pond. The stream is currently being conveyed through the facility and outlet structure, then northward to Pioneer Way ditch via the 15in storm main.
[Storm Report; Pg 6 of 448]

1.3 Proposed Conditions Summary

The proposed improvements include storm conveyance, detention, grading, paving, and striping. Stormwater in proposed paved areas will be collected in a new collection system which will drain to detention tanks located throughout the site. The detention tanks will drain to a water quality Modular Wetland before water is discharged to the existing channel to the north of the site.

See Appendix A, Exhibit A-3, for the Developed Conditions Map.

2.0 Offsite Analysis Report

Actually the existing storm facility releases through a control structure which is conveyed to the Pioneer Way ditch located at the north property line via a 15in storm pipe...revise accordingly.
[Storm Report; Pg 6 of 448]

Revised discussion

2.1 Upstream Analysis

In existing conditions, the commercial property to the south drains to the detention pond located on the southeastern parcel of the site and discharges to the channel lining the eastern portion of the site. The detention pond will be maintained in Phase 1 of construction, however, will be replaced by an underground detention system in Phase 2.

Noted

Shaw Road E to the west contains its own stormwater collection and conveyance system which prevents discharge to the site. However, Pioneer E to the north drains into channels on either side of the road, including the channel on the north end of the project site. Frontage improvements are proposed in this project that will contain a stormwater collection and conveyance system that will redirect runoff to the downstream connection.

Prior to PH2 approval, provide a backwater analysis of the Pioneer Avenue conveyance system as outlined in City Standards Section 204.3 considering the tailwater elevation (OHWM) of the Pioneer Avenue north ditch, west of Shaw Road. The analysis shall include runoff from onsite (developed conditions) and offsite (existing conditions) basins tributary to the discharge location.
[Storm Report; Pg 6 of 448]

2.2 Downstream Analysis

In existing condition, stormwater leaves the site via the channel that runs around the east and north of the site. A culvert collects the water from the channel and directs it northwest under the intersection of E Pioneer and Shaw Road E. A channel then runs across E Pioneer on the roadside of the railroad before it intersects another culvert directing water to the Puyallup River less than a mile away.

In the proposed plans for the project, the existing channel will be enhanced within the bounds of the site.

Revised

Very little surface runoff generated on the site is released to the east channel. With the exception of the existing storm pond serving the properties to the south, most of the onsite surface water either collects in the NW corner of the site or enters the Pioneer Way ditch...revise accordingly.
[Storm Report; Pg 6 of 448]

3.0 Permanent Stormwater Control Plan

BioPod

This project is a new development that includes more than 5,000 square feet of impervious surfaces; therefore, all Minimum Requirements (MR) apply to this project. Refer to Appendix A, Exhibit A-5 for the Flow Chart for Determining Requirements for New Development.

CLARIFY-Biopod?
[Storm Report; Pg 6 of 448]

VERIFY-"east"?
[Storm Report; Pg 6 of 448]

East

The existing channel to the north and south of the site will be enhanced, while a new proposed system is proposed to collect all stormwater generated onsite as well as directed to the site. The proposed system will include catch basins that will convey stormwater to three R-Tanks located around the site. A fourth R-Tank is proposed for Phase 2 to detain the runoff from the commercial property to the south. Stormwater from the R-Tanks will flow through a control structure that is designed to release water at flow rates similar to the natural forested condition before being treated in a Modular Wetland. The Water Quality Structure is designed for enhanced treatment. From this proposed manhole, the stormwater will flow through a 12" by 12" Mirafi-wrapped, washed rock channel into the enhanced stream. The stream will direct water to the Puyallup River less than a mile to the west-northwest. Refer to Sections 4.6 and 4.7 for more information on the proposed water quality and flow control plans.

Treatment before detention

Revised

The WQ biopod is located upstream of the RTanks.
[Storm Report; Pg 6 of 448]

VERIFY-12in pipe called out on civils.
[Storm Report; Pg 6 of 448]

This is final design

FYI-It is more than a mile to the Puyallup River along the project's release route which includes the Pioneer Way north ditch and main stem of Deer Creek.
[Storm Report; Pg 6 of 448]

Revised

the

the?

VERIFY- Exhibit D2 seems more applicable for WQ. [Storm Report; Pg 7 of 448]

Revised

Refer to he Developed Conditions Map (Appendix A, Exhibit A-3) for the areas used to size the proposed water quality facility and Appendix D for the Flow Control Modeling and the Water Quality Modeling.

4.0 Summary of Minimum Requirements

4.1 MR 1 – Preparation of Stormwater Site Plans

This report and project plans have been prepared to provide justification of the water quality and flow control design proposed for this project.

4.2 MR 2 - Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (CSWPPP) has been prepared to satisfy MR 2 and is included as Appendix E of this report.

4.3 MR 3 – Source Control of Pollution

The proposed project is required to provide source control of pollution. Following are proposed measures to be implemented as part of the civil plans.

- All discharges to the city storm system require City of Puyallup approval.
- All pollutants, including waste materials and demolition debris created onsite during construction, shall be handled and disposed of in a manner that does not cause contamination of surface water.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles that may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures such as drip pans.
- Concrete Handling (BMP C151) shall be used to prevent or treat contamination of surface water runoff by pH modifying sources.

Revised

The CSWPPP provides details on the control of pollution during construction.

See comment in Section 2.2. [Storm Report; Pg 7 of 448]

4.4 MR 4 – Preservation of Natural Drainage Systems and Outfalls

The existing land cover drains to the channel that wraps around the parcels east and north borders before running alongside E Pioneer and into the Puyallup River. The discharge to the channel will be maintained during developed conditions. Under proposed conditions, treated runoff will be discharged to the northwestern section of the channel where it will enter an existing culvert that redirects the stream diagonally across the intersection of E Pioneer and Shaw Road E, travel alongside E Pioneer and join the Puyallup River.

4.5 MR 5 – Onsite Stormwater Control

Onsite stormwater management Best Management Practices (BMPs) are not practical for the site due to native site soils, which have no infiltrative properties. With that in mind, per the Flow Chart for Determining MR #5 Requirements, refer to Appendix A, Exhibit A-6, List #2 of the List

Approach is required. Below is a summary of the findings of List #2, refer to Appendix A, Exhibit A-7 for the Infeasibility Checklists.

Surface Type: Lawn and Landscaped Areas:
Chosen BMP: T5.13: Post-Construction Soil Quality and Depth.

BioPod

Surface Type: Roofs:
All options on the List Approach are infeasible, runoff from roofs will be directed towards a detention system.

CLARIFY-Biopod?
[Storm Report; Pg 8 of 448]

Surface Type: Other Hard Surfaces:
All options on the List Approach are infeasible, runoff will be directed towards a detention system.

Given the infeasibility of the List Approach BMPs, the proposed storm system will utilize R-Tanks and an Oldcastle Biopod system to provide flow control and water quality to mitigate stormwater onsite. The R-Tanks have been sized with MGS Flood to meet flow duration curves and the Modular Wetland has been designed using the flows from the MGS Flood model and DOE GULD standards, refer to Appendix D, Exhibit D-2 for the water quality calculations. The MGS Flood Report for flow control is attached in Appendix D, Exhibit D-3.

CLARIFY-three tanks are indicated in Phase 1 (#1, #2, and #3).
[Storm Report; Pg 8 of 448]

Revised, 3 in PH1, 1 more in PH2

The multifamily buildings, commercial buildings and associated surfaces utilize catch basins and roof drains to collect stormwater runoff that is conveyed to five underground biopods to treat runoff before conveying to two separate R-Tanks. Note: a third R-Tank is to be added in phase 2. These two R-Tanks are connected by a flat, 24" CPEP pipe that is being used as added detention not included in the calculations. Stormwater within these two R-Tanks is released by a control structure at flow rates matching existing forested conditions into a temporary outlet and pumped into the city storm conveyance system. Flow is to be conveyed through proposed outlet in enhanced stream in phase 2.

This project includes two bypass areas which could not be collected due to topographical challenges and the location of the enhanced stream These areas have been included in the flow control model.

Show Bypass basins on an exhibit.
[Storm Report; Pg 8 of 448]

Revised

Refer to Appendix D, Exhibit D-1 for the Conveyance Calculations and Analysis. This analysis, performed using Storm and Sanitary Sewer Analysis, shows that the proposed stormwater conveyance system has sufficient capacity to convey and contain the 25-year storm flow event of the fully developed project site. No proposed structures overtop and over 6-inches of freeboard is shown between the maximum hydraulic grade line and the proposed rim elevations of all proposed structures.

CLARIFY-please add commentary that the pumping is only during the construction phase and the permanent condition will be gravity release.
[Storm Report; Pg 8 of 448]

Revised

4.6 MR 6 – Runoff Treatment

Discuss Shaw Road frontage, Pioneer Way frontage, and future Phase 2 WQ aspects.

[Storm Report; Pg 8 of 448]

Revised

Over 5,000 square feet of pollution-generating surface (PGIS) will be added as part of these improvements; therefore, water quality treatment will be provided. Four 6' by 8' Biopods, and one 4' by 6' Biopod are proposed to provide treatment for stormwater runoff and will be located upstream of the detention system. Per the DOE GULD standard specifications, the system is sized at a hydraulic load rating of 1.6 gallon per minute per square foot of media surface area of which the flow is based off the water quality design flow rate using the peak 15-minute flow rate using WWHM.

Refer to Appendix D, Exhibit D-2 for the Water Quality Calculations and a copy of the GULD standards.

Phase 1 only?
[Storm Report; Pg 8 of 448]

Correct

Noted

Ref Ecology Section III-2.4 too.

FYI ONLY-the City's expectation is that the future replacement storm facility match flow control and water quality constraints of the original pond design (CES, Inc. design; single-event methodology). However, it is acceptable to redesign the facility using current storm regulations (continuous simulation modeling) although it seems counterintuitive due to the increase in facility size necessary to meet the continuous simulation methodology. Similarly, routing the upstream offsite existing flows through the proposed East Town flow control facilities also seems counterintuitive due to the impact to those facilities...particularly since there is an existing pipe outfall at Pioneer Way which serves the existing storm pond. Either way, most important will be to show that the release rates from the future facility, either stand-alone or combined with East Town's facilities, are equal or less than the release rates (2yr/10yr/100yr) of the original facility. [Storm Report; Pg 9 of 448]

Noted

4.7 MR 7 – Flow Control

Revised plan

Future RTank is not shown on the plans. [Storm Report; Pg 9 of 448]

The proposed stormwater system will include collection and conveyance systems that will direct stormwater to three separate R-Tanks. Two R-Tanks are located in the southern portion of the site and work in tandem to detain water from the residential portion of the project. These two tanks are connected by a 24” CPEP pipe being utilized for added detention that is not included in the calculations as an additional factor of safety. At the end of one of the R-Tanks, a control structure controls the release of flow into a third R-Tank that serves to detain stormwater from the commercial area as well as provide flow through for the residential areas. A second control structure at the end of the third R-Tank controls the release of flow from the site into the enhanced stream at the north end of the site.

Discuss Shaw Road frontage and Pioneer Way frontage flow control aspects. [Storm Report; Pg 9 of 448]

Added

In Phase 2 of the project, an additional R-Tank will be connected to the tandem R-Tanks to replace the existing detention pond that serves the commercial property south of the project site. The plans show the approximate location as well as the rough size this R-Tank will be, however it will not be fully sized and modeled until the submittal of Phase 2 documents. To accompany the added volume of stormwater to the system, the two control structures will be replaced with new ones. Calculations and details for these modifications will be included with the submittal of Phase 2 documents.

Refer to Appendix D, Exhibit D-3 for the Flow Control Calculations.

Add commentary that the RTanks can support the EV outrigger loads and include the manufacturer's confirmation letter. [Storm Report; Pg 9 of 448]

Added

4.8 MR 8 – Wetland Protection

It is to our knowledge that no wetlands exist on or adjacent to the site that would be impacted by the proposed site development.

Refer to Appendix A, Exhibit A-8 and A-9 for the FEMA Map and FEMA Letter of Map Revision.

4.9 MR 9 – Operation and Maintenance

See Appendix C for a copy of the Operations and Maintenance Manual. This manual shall be readily available for inspection by the City of Puyallup. The maintenance and operations shall be the responsibility of the owner of the East Town Crossing project.

5.0 Wells and Septic Systems

The Department of Ecology (DOE) Well Report Map does not identify any wells present on the site. Any wells located will be decommissioned following the Tacoma-Pierce County Health Department (TPCHD) removal regulations.

Two septic systems were located in the 2019 survey provided by Abbey Road Group at the existing residential parcels. Both will be removed following TPCHD sewer removal regulations.

6.0 Fuel Tanks

To our knowledge, there are no existing fuel tanks on the site. If located during construction, the fuel tanks will be abandoned according to TPCHD and DOE standards.

7.0 Construction Stormwater Pollution Prevention Plan

A Temporary Erosion Control Plan is included with the plan set, and a CSWPPP for the project is included as Appendix E of this report.

Added additional special report

VERIFY-no additional studies associated with the PH2 stream relocation? [Storm Report; Pg 10 of 448]

8.0 Special Reports and Studies

A Geotechnical Report was prepared by Krazen & Associates, Inc., dated April 11, 2019. Refer to Appendix B-1. In addition, a letter from Migizi Group is included as Appendix B-2.

The project site is not within a 100-year flood plain, as seen in Appendix A, Exhibit A-6.

9.0 Other Permits

A State Environmental Policy Act (SEPA) Checklist has been completed for this project. At the time of writing, a Clear, Fill, and Grade Permit was readied for issuance as Permit # PRGR-2023-0972. Coverage under DOE's Construction Stormwater General Permit must be obtained.

10.0 Operations and Maintenance Manual

Added

Refer to Appendix C for the Maintenance Standards for the proposed drainage facilities and the Maintenance Checklist for the finished project site.

Add: "A Stormwater Maintenance Agreement will be recorded at the time of Occupancy in accordance with City Standards." [Storm Report; Pg 10 of 448]

11.0 Conclusion

Based on our understanding and the attached documentation, we believe the proposed improvements conform to City of Puyallup and Washington State Department of Ecology standards. We conclude that this project, as proposed, will not have adverse impacts to the site or the downstream drainage system.

This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry.

AHBL, Inc.

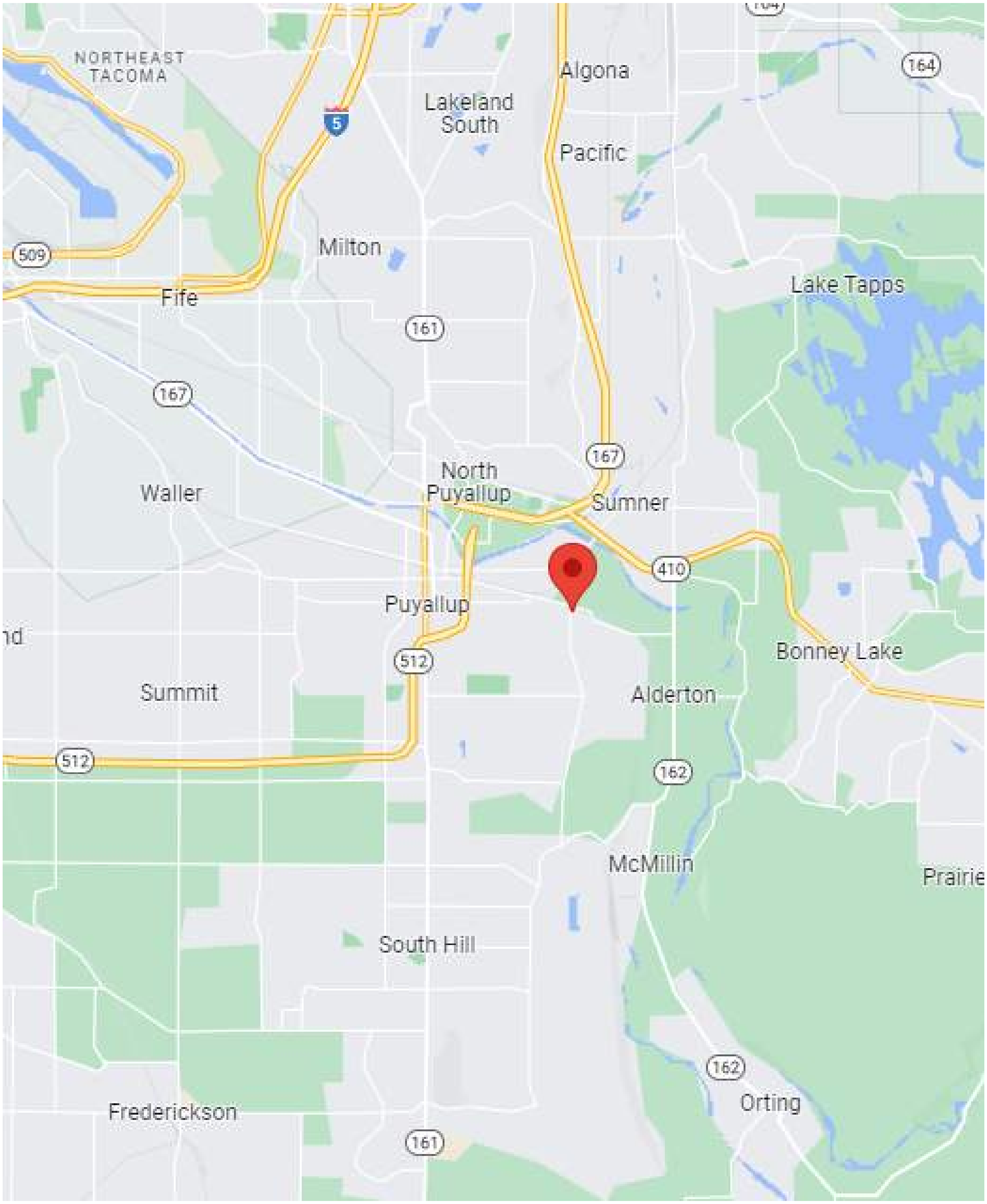
Christopher Watt
Project Engineer

CJW/

November 2023
\\ahbl.com\data\Projects\2023\2230752\10_CIV\NON_CAD\REPORTS\SSP\20231020 Rpt (SSP) 2230723.10.docx

Appendix A

Exhibits



AHBL
2215 North 30th Street,
Suite 300,
Tacoma, WA 98403
253.383.2422 TEL
253.383.2572 FAX

VICINITY MAP	2230752
EAST TOWN CROSSING	A-1

MAPPING NOTE

THE BOUNDARY AND TOPOGRAPHIC MAPPING USED FOR THIS PROJECT WAS PREPARED BY MCINNIS ENGINEERING ON THEIR DRAWING DATED 12/19/2019 TITLED "EAST TOWN CROSSING BOUNDARY AND TOPOGRAPHIC SURVEY"

FYI...Section 1.2.1 states that Abbey Road Group was the surveyor. [Storm Report; Pg 13 of 448]

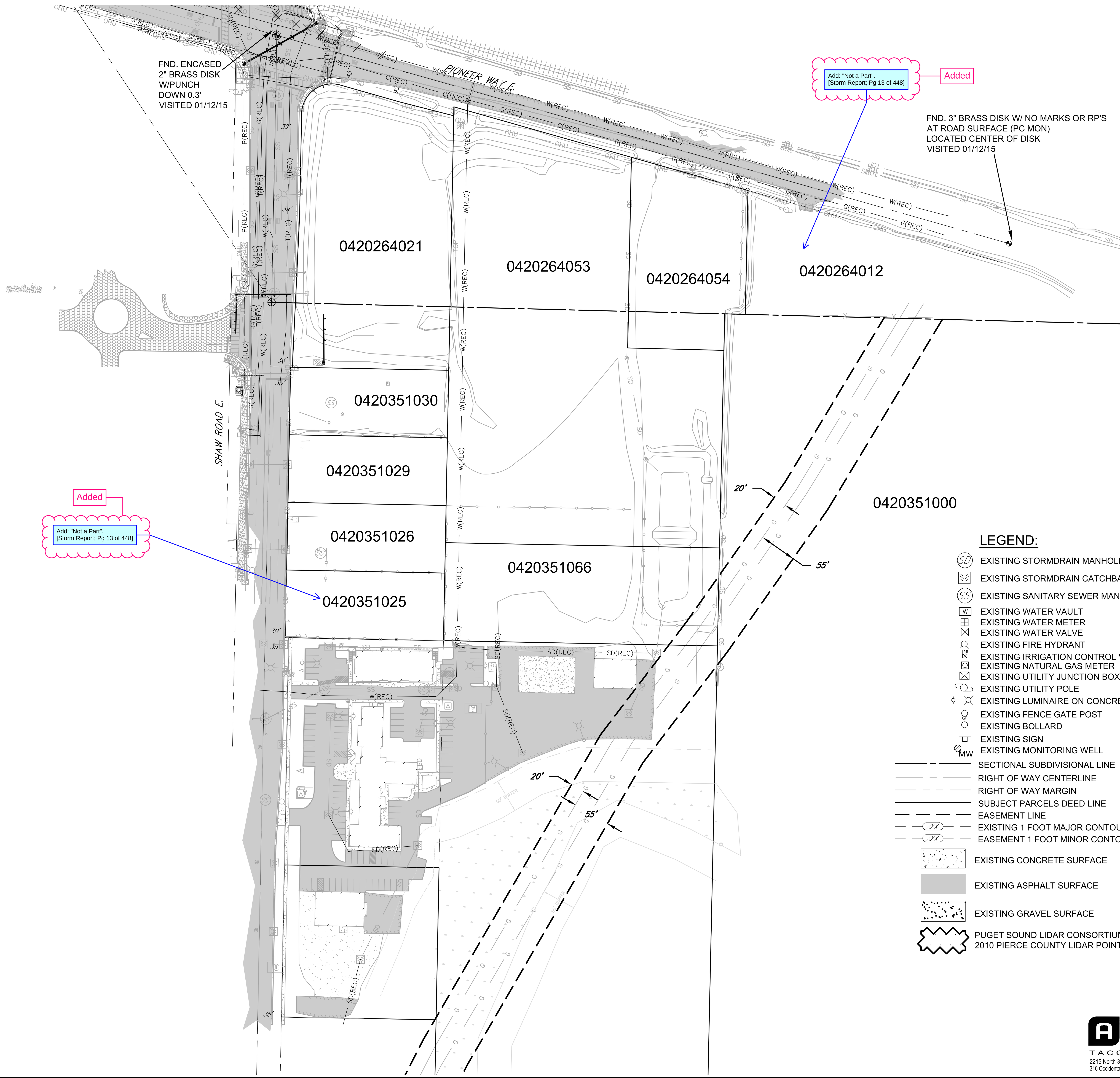
Revised to Abbey Road

N

GRAPHIC SCALE

0 40 80 160

1" = 80 FEET



SURVEYOR'S NOTES

1. **HORIZONTAL DATUM:** BASIS OF BEARING AND SURVEY DATA PER WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE.

2. **BASIS OF BEARING:** HELD S 01° 21' 28" W OBSERVED ALONG THE EAST LINE OF THE NORTHEAST QUARTER OF SEC. 35, T. 20 N. R. 4 E. BETWEEN THE NORTHEAST CORNER OF THE NORTHEAST QUARTER MONUMENT AND THE SOUTHEAST CORNER OF THE NORTHEAST QUARTER MONUMENT OF THE SAID SECTION AS SHOWN HEREON.

3. **VERTICAL DATUM:** NAVD88
AS DEFINED BY THE NATIONAL GEODETIC SURVEY (NGS)
PROJECT BENCHMARK:
DESIGNATION: 21 010
PID: DL2774

PUBLISHED ELEVATION: 75.70 FEET (NAVD 88)
DESCRIPTION: ENCASED STEEL ROD LOCATED IN EASTERLY GRAVEL SHOULDER AT THE INTERSECTION OF PIONEER WAY AND 134TH AVE. E.

4. ALL UTILITY LOCATES HAVE BEEN DETERMINED BY SURFACE LOCATION ONLY EITHER BY PHYSICAL STRUCTURES OR PAINT MARKINGS
AS DETERMINED BY UNDERGROUND + UTILITY LOCATE, INC. AND/OR UTILITY COMPANY. GAS PIPE LOCATION WITH IN THE PROPERTY DETERMINED BY MAP PROVIDE BY PUGET SOUND ENERGY, INC. ACTUAL UNDERGROUND LOCATION MAY VARY. EXISTING UTILITIES AS SHOWN MAY NOT BE THE SAME AFTER THIS DATE AS MAJOR CONSTRUCTION IS IN PROGRESS.

5. REFERENCE SURVEYS:
   1. 200303315001
   2. SP 9303315001
   3. ROS 8210040207

6. METHOD OF SURVEYING WAS:
   1. CONVENTIONAL TRAVERSE USING A TOPCON 800A TOTAL STATION.
   2. MONUMENTS FOUND MARCH 2008

TOPOGRAPHIC NOTE

THE EXISTING CULTURAL AND TOPOGRAPHICAL DATA SHOWN ON THESE DRAWINGS HAS BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, MCINNIS ENGINEERING CANNOT ENSURE ACCURACY AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THAT INFORMATION OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO THESE DRAWINGS AS A RESULT.

SITE INFORMATION

PARCEL: 0420264021, 0420264054, 0420264053, 0420351066, 0420351030, 0420351029, 0420351026
ADDRESS: 2902 E PIONEER
PUYALLUP, WA 98372
ZONING: CG AND MF

SURVEYOR

MCINNIS ENGINEERING
CONTACT: LARRY WALKER
202 E 34TH ST
TACOMA, WA 98404
OFFICE: 253-414-1992

FYI...Section 1.2.1 states that Abbey Road Group was the surveyor. [Storm Report; Pg 13 of 448]

Revised to Abbey Road

LEGEND:

- EXISTING STORMDRAIN MANHOLE
- EXISTING STORMDRAIN CATCHBASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING WATER VAULT
- EXISTING WATER METER
- EXISTING WATER VALVE
- EXISTING FIRE HYDRANT
- EXISTING IRRIGATION CONTROL VALVE
- EXISTING NATURAL GAS METER
- EXISTING UTILITY JUNCTION BOX
- EXISTING UTILITY POLE
- EXISTING LUMINAIRE ON CONCRETE BASE
- EXISTING FENCE GATE POST
- EXISTING BOLLARD
- EXISTING SIGN
- EXISTING MONITORING WELL
- SECTIONAL SUBDIVISIONAL LINE
- RIGHT OF WAY CENTERLINE
- RIGHT OF WAY MARGIN
- SUBJECT PARCELS DEED LINE
- EASEMENT LINE
- EXISTING 1 FOOT MAJOR CONTOUR INTERVAL
- EASEMENT 1 FOOT MINOR CONTOUR INTERVAL
- EXISTING CONCRETE SURFACE
- EXISTING ASPHALT SURFACE
- EXISTING GRAVEL SURFACE
- PUGET SOUND LIDAR CONSORTIUM 2010 PIERCE COUNTY LIDAR POINT CLOUD DATA

AHBL
TACOMA · SEATTLE
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

EXISTING CONDITIONS MAP

EAST TOWN CROSSING

A-2

Identify/Delineate subasins (Upper, Lower, Bypass) used in the modeling. [Storm Report; Pg 14 of 448]

Identified on exhibit A-3a

Please provide a surface area breakdown by phase and basin name. For example, PH1 MF Roof area = ______sf (ac); PH2 MF Roof area = ______sf (ac); etc. Provide a total for each basin breakdown. Also, include the frontage bypass basins. [Storm Report; Pg 14 of 448]

Added areas and table on exhibit A-3a

Identify "Future" detention facility location serving existing properties to the south. [Storm Report; Pg 14 of 448]

Added

AHBL
TACOMA · SEATTLE
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

DEVELOPED CONDITIONS MAP

EAST TOWN CROSSING

A-3

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Pierce County Area, Washington

APPENDIX A-4

October 26, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

122° 15' 22" W
122° 15' 10" W
47° 11' 9" N
47° 10' 57" N
556350
556390
556430
556470
556510
556550
556590
5226070
5226030
5225990
5225950
5225910
5225870
5225830
5225790
5225750
E Pioneer
Pioneer
Shaw
6A
31A
Soil Map may not be valid at this scale.
Map Scale: 1:1,720 if printed on A portrait (8.5" x 11") sheet.
Meters
0 25 50 100 150
Feet
0 50 100 200 300
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

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 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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: Pierce County Area, Washington
Survey Area Data: Version 19, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	8.8	72.1%
31A	Puyallup fine sandy loam	3.4	27.9%
Totals for Area of Interest		**12.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Pierce County Area, Washington

6A—Briscot loam

Map Unit Setting

National map unit symbol: 2hrc
Elevation: 20 to 250 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 160 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Briscot, drained, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Briscot, Drained

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: loam
H2 - 11 to 38 inches: stratified fine sand to silt loam
H3 - 38 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 35 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: F002XA007WA - Puget Lowlands Wet Forest
Forage suitability group: Seasonally Wet Soils (G002XN202WA)
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

Minor Components

Briscot, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

31A—Puyallup fine sandy loam

Map Unit Setting

National map unit symbol: 2hq9
Elevation: 0 to 390 feet
Mean annual precipitation: 35 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 170 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Puyallup and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Puyallup

Setting

Landform: Terraces, flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 13 inches: ashy fine sandy loam
H2 - 13 to 29 inches: loamy fine sand
H3 - 29 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 79 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Droughty Soils (G002XN402WA)
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Minor Components

Briscot, undrained

Percent of map unit: 2 percent

Landform: Depressions
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

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APPENDIX A-5

Figure I-3.1: Flow Chart for Determining Requirements for New Development

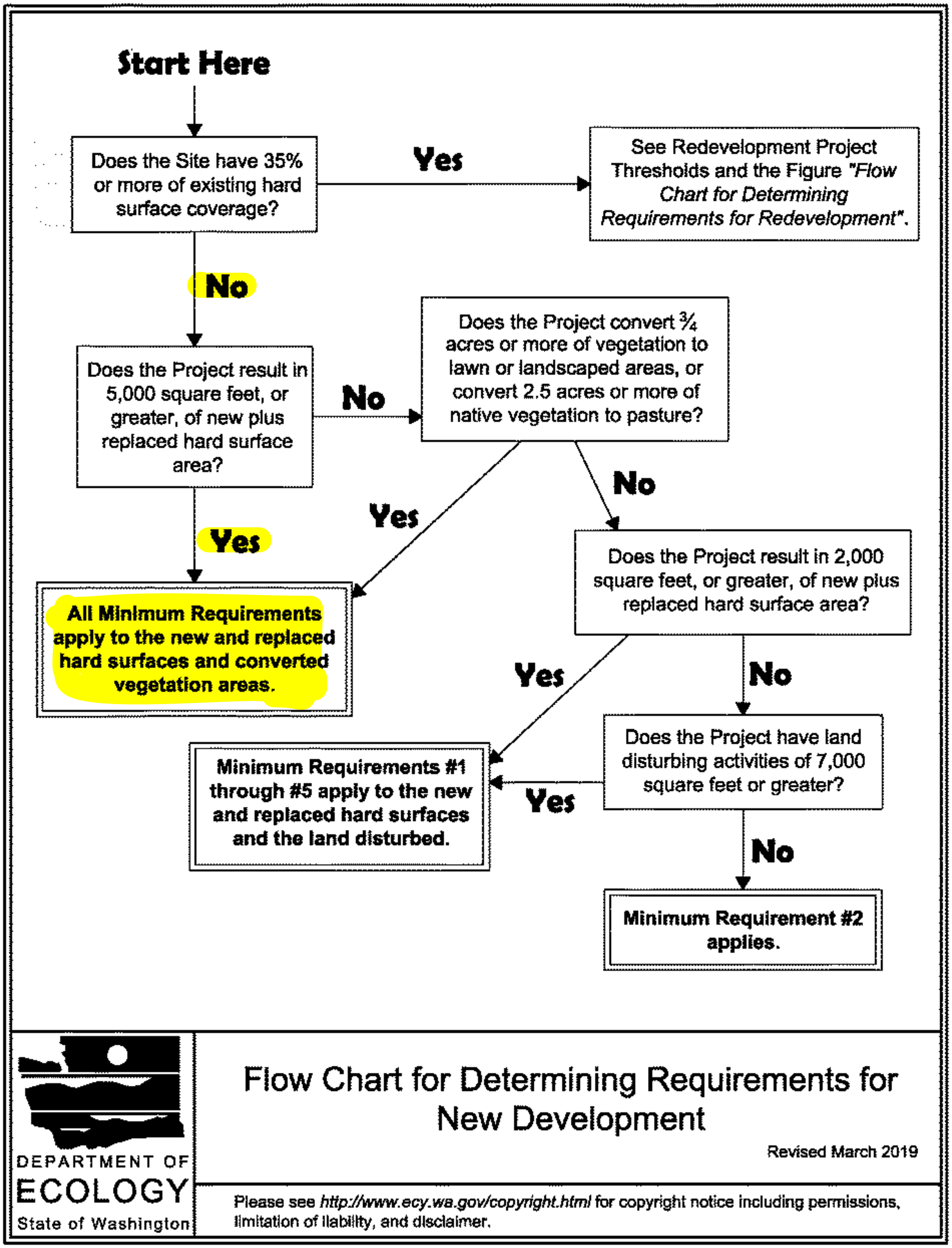
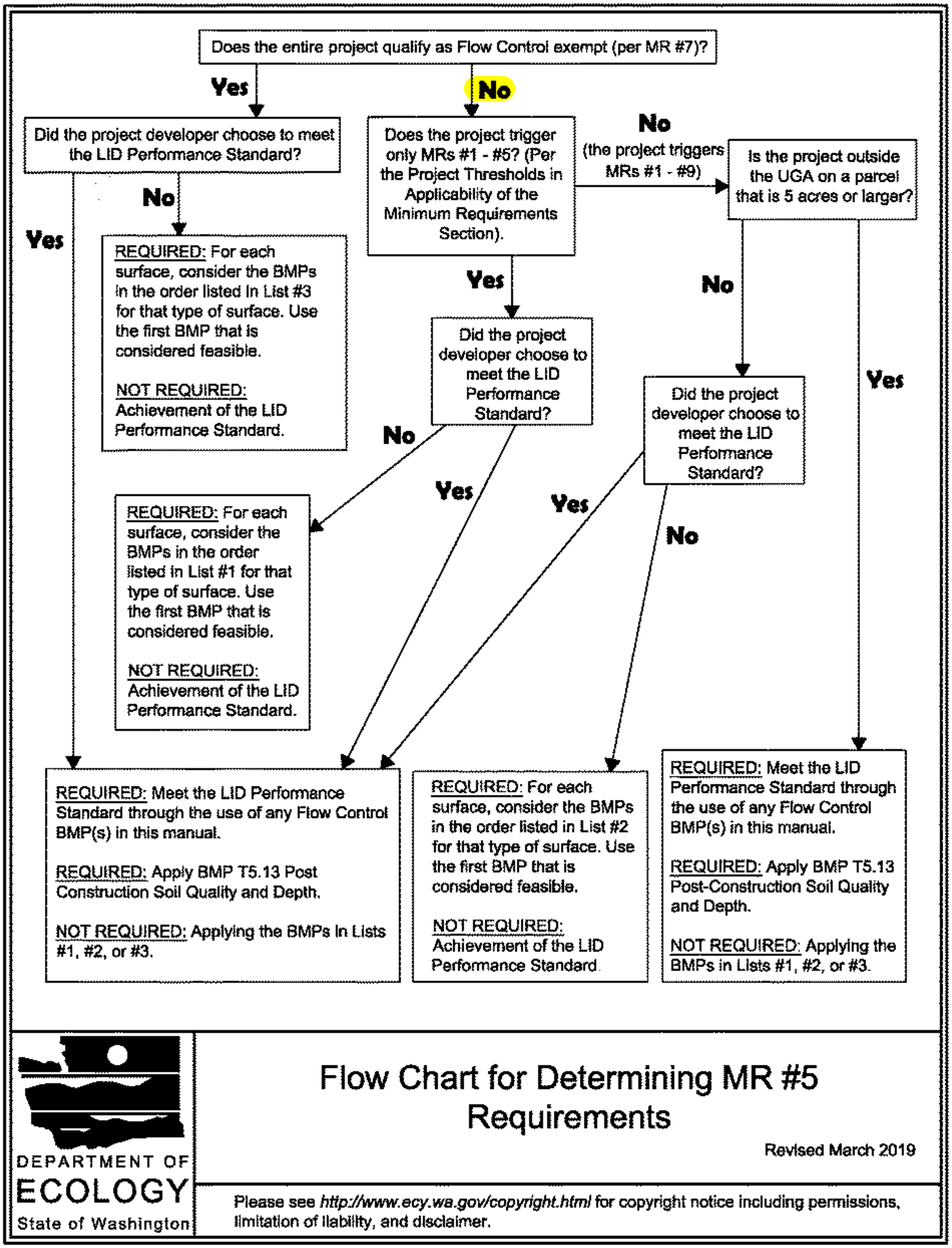


Figure I-3.3: Flow Chart for Determining MR #5 Requirements



Appendix A-7:

Surface Type: Lawn and Landscaped Areas

Infeasibility Checklist BMP T5.13 Post Construction Soil Quality and Depth				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-2 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	**Can the soil amendments be placed on slopes less than 33%?**	☒	☐	☐
2	**Will installing sheet flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (2a-2e).**	☐	☒	☐
2a	**Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act**	☐		
2b	**Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts**	☐		
2c	**Public health and safety standards**	☐		
2d	**Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way**	☐		
2e	**Critical Area Preservation Ordinance**	☐		

Surface Type: Roofs

Infeasibility Checklist BMP T5.30 Full Dispersion				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-9 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	Can the flow spreader and dispersion areas be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the flow spreader and dispersion areas be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the dispersion areas be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the dispersion areas be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the dispersion area be located outside of critical areas, critical area buffers, streams, or lakes?	☐	☐	☐

6	Can the flow spreader and dispersion area maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
8	Will installing a full dispersion system cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (8a-8e).	☐	☐	☐
8a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
8b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
8c	Public health and safety standards		☐	
8d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
8e	Critical Area Preservation Ordinance		☐	
9	Can the design standards in BMP T5.30 be met?	☐	☐	☐
9a	Describe the design standard that cannot be met:			
Questions #10 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
10	Will the use of a full dispersion cause erosion or flooding problems onsite or on adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist
BMP T5.10A Downspout Full Infiltration

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-7 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the infiltration trench or drywell be placed 10 feet or more from any building structure?	☐	☐	☐
2	Can the infiltration trench or drywell be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the infiltration trench or drywell be placed 50 feet or more from the top of any slope 20% or greater?	☐	☐	☐
4	Can the infiltration trench or drywell be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the infiltration trench or drywell meet setback requirements from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Will installing an infiltration trench or drywell cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (6a-6e).	☐	☐	☐
6a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
6b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	

6c	Public health and safety standards	☐		
6d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
6e	Critical Area Preservation Ordinance	☐		
7	Can the design standards in BMP T5.10A be met?	☐	☐	☐
7a	Describe the design standards that cannot be met:			
Questions #8-10 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
8	Was the soil classified as being clay, sandy clay, clay loam, silty clay loam, sandy clay loam, or silt according to the USDA Textural Soil Triangle? (An answer of yes means this BMP is not feasible).	☐	☒	☐
9	Is the depth from proposed final grade to the seasonal high groundwater table or other impermeable layer equal to or greater than 3 feet?	☐	☒	☐
10	Is the depth from the bottom of the infiltration trench or drywell to the seasonal high groundwater table equal to or greater than 1 foot?	☐	☒	☐

Infeasibility Checklist BMP T5.14 Rain Gardens				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-18 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	**Can the rain garden be placed 10 feet or more from any building structure?**	☐	☒	☐
2	Can the rain garden be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the rain garden be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the rain garden be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the rain garden be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
6	Can the rain garden be located greater than 100 feet from an underground storage tank whose capacity including tank and underground connecting pipe is 1100 gallons or more?	☐	☐	☐
7	Can the rain garden be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the rain garden be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the rain garden be located greater than 100 feet from drinking water well or a spring used for drinking water supply?	☐	☐	☐

10	Can the rain garden be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the rain garden be located on slopes less than 8%?	☐	☐	☐
12	Is the rain garden compatible with the surrounding drainage system (e.g., project drains to an existing stormwater system whose elevation precludes proper connection to a rain garden)?	☐	☐	☐
13	For properties with known soil or groundwater contamination, can the rain garden be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
14	For properties with known soil or groundwater contamination, can the rain garden be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐
15	For properties with known soil or groundwater contamination, can the rain garden be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
16	For properties with known soil or groundwater contamination, can the rain garden be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
17	For rain gardens that are constructed with imported compost materials, can the rain garden be located greater than ¼ mile from a phosphorus-sensitive waterbody? (Does not apply to discharges to Wapato Lake).	☐	☐	☐
18	Will installing a rain garden cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (18a-18e).	☐	☐	☐
18a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
18b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
18c	Public health and safety standards		☐	
18d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
18e	Critical Area Preservation Ordinance		☐	
Questions #19-20 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
19	Is the depth from the lowest level of the rain garden soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 1 foot?	☐	☒	☐
20	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
Questions 21-28 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
21	Will the proposed rain garden location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
22	Will the proposed rain garden location allow for a safe overflow pathway to the City stormwater system or a private stormwater system?	☐	☐	☐
23	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐

24	Is the project located in an area whose groundwater drains into an erosion hazard or landslide hazard area? (An answer of yes means the BMP is infeasible).	☐	☐	☐
25	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
26	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
27	Is there lack of usable space onsite for rain gardens at redevelopment sites? (An answer of yes means the BMP is infeasible).	☐	☐	☐
28	For public road projects, is there insufficient space within the ROW to install a rain garden? (An answer of yes means this BMP is infeasible).	☐	☐	☐

Infeasibility Checklist
BMP T7.30 Bioretention

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach

Questions #1-18 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.

Question Number	Question	Yes	No	NA
1	**Can the bioretention facility be placed 10 feet or more from any building structure?**	☐	☒	☐
2	Can the bioretention facility be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the bioretention facility be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the bioretention facility be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the bioretention facility be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
6	Can the bioretention facility be located greater than 100 feet from an underground storage tank whose capacity including tank and underground connecting pipe is 1100 gallons or more?	☐	☐	☐
7	Can the bioretention facility be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the bioretention facility be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the bioretention facility be located greater than 100 feet from drinking water well or a spring used for drinking water supply?	☐	☐	☐
10	Can the bioretention facility be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the bioretention facility be located on slopes less than 8%?	☐	☐	☐
12	Is the bioretention facility compatible with the surrounding drainage system (e.g., project drains to an existing stormwater system whose elevation precludes proper connection to the bioretention facility)?	☐	☐	☐
13	For properties with known soil or groundwater contamination, can the bioretention facility be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
14	For properties with known soil or groundwater contamination, can the bioretention facility be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐

15	For properties with known soil or groundwater contamination, can the bioretention facility be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
16	For properties with known soil or groundwater contamination, can the bioretention facility be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
17	For bioretention facilities that are constructed with imported compost materials, can the bioretention facility be located greater than ¼ mile from a phosphorus-sensitive waterbody? (Does not apply to discharges to Wapato Lake).	☐	☐	☐
18	Will installing a bioretention facility cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (18a-18e).	☐	☐	☐
18a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
18b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
18c	Public health and safety standards		☐	
18d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
18e	Critical Area Preservation Ordinance		☐	
Questions #19-21 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
19	Is the depth from the lowest level of the bioretention soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 1 foot? This applies only if the contributing area to the bioretention facility has less than 5,000 square feet of pollution-generating impervious surface, and less than 10,000 square feet of impervious surface, and less than ¾ acre pervious surface.	☐	☒	☐
20	Is the depth from the lowest level of the bioretention soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 3 feet? This applies only if the contributing area to the bioretention facility has: 5,000 square feet or greater of pollution-generating impervious surface, or 10,000 square feet or greater of impervious surface, or more ¾ acre pervious surface AND the bioretention facility cannot be broken down into amounts smaller than those listed above.	☐	☒	☐
21	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
Questions 22-29 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
22	Will the proposed bioretention facility location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
23	Will the proposed bioretention facility location allow for a safe overflow pathway to the City stormwater system or a private stormwater system?	☐	☐	☐
24	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐
25	Is the project located in an area whose groundwater drains into an erosion hazard or landslide hazard area? (An answer of yes means the BMP is infeasible).	☐	☐	☐
26	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐

27	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
28	Is there lack of usable space onsite for bioretention facilities at redevelopment sites? (An answer of yes means the BMP is infeasible).	☐	☐	☐
29	For public road projects, is there insufficient space within the ROW to install a bioretention facility? (An answer of yes means this BMP is infeasible).	☐	☐	☐

Infeasibility Checklist
BMP T5.10B Downspout Dispersion

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-10 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the dispersion trench or splashblocks be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the dispersion trench or splashblocks be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the dispersion trench or splashblocks be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the dispersion trench or splashblocks be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the dispersion trench or splashblock maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to maintain or construct a vegetated flowpath of at least 25 feet from the outlet of a dispersion trench and any property line, structure, stream, wetland, other infiltration or dispersion system, or impervious surface?	☐	☒	☐
7	Is it possible to maintain or construct a vegetated flowpath of at least 50 feet from the outlet of a dispersion trench and any slope greater than 15%?	☐	☐	☐
8	Is it possible to maintain or construct a vegetated flowpath of at least 50 feet from the outlet of splashblock and any property line, structure, slope over 15%, stream, wetland, other infiltration or dispersion system, or impervious surface?	☐	☐	☐
9	Will installing a dispersion trench or splashblocks cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (9a-9e).	☐	☐	☐
9a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
9b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
9c	Public health and safety standards		☐	
9d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
9e	Critical Area Preservation Ordinance		☐	
10	Can the design standards in BMP T5.10B be met?	☐	☐	☐
10a	Describe the design standard that cannot be met:			

Questions #11 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).

11	Will the use of a dispersion trench or splashblocks cause erosion or flooding problems onsite or on adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist BMP T5.10C: Perforated Stub-out Connections				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-7 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	Can the perforated stub-out connection be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the perforated stub-out connection be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the perforated stub-out connection be placed 50 feet or more from the top of any slope 20% or greater?	☐	☐	☐
4	Can the perforated stub-out connection be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the perforated stub-out connection meet setback requirements from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Will installing a perforated stub-out connection cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (6a-6e).	☐	☐	☐
6a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
6b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
6c	Public health and safety standards	☐		
6d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
6e	Critical Area Preservation Ordinance	☐		
7	Can the design standards in BMP T5.10C be met?	☐	☐	☐
7a	Describe the design standard that cannot be met:			
Questions #8 relates to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
8	Is the depth from the bottom of the perforated stub-out connection to the seasonal high groundwater table equal to or greater than 1 foot?	☐	☒	☐

Surface Type: Other Hard Surfaces

Infeasibility Checklist BMP T5.15 Permeable Pavement
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.
Questions #1-24 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a

Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	**Can the permeable pavement be placed 10 feet or more from any building structure?**	☐	☐	☐
2	Can the permeable pavement be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the permeable pavement be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the permeable pavement be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the permeable pavement be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
7	Can the permeable pavement be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the permeable pavement be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the permeable pavement be located greater than 100 feet from drinking water well or a spring used for drinking water supply if the permeable pavement is (or has run-on from) a pollution-generating hard surface?	☐	☐	☐
10	Can the permeable pavement be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the permeable pavement be constructed such that the subgrade is less than 6%?	☐	☐	☐
12	Can the permeable pavement be constructed such that the wearing course is less than 6% (after reasonable attempts have been made to design the grade)?	☐	☐	☐
13	Is the location for permeable pavement a multi-level parking garage, above a culvert, or a bridge? An answer of yes means the BMP is not feasible.	☐	☐	☐
14	Does the road receive more than very low traffic volumes? (Roads with a projected average daily traffic volume of 400 vehicles or less). This infeasibility criterion cannot be used for sidewalks or non-traffic bearing surfaces. An answer of yes means the BMP is not feasible.	☐	☐	☐
15	Does the road receive more than very low truck traffic? (Roads not subject to through truck traffic but may receive up to weekly use by utility trucks, daily school bus use, and multiple daily use by pick-up trucks, mail/parcel delivery trucks, and maintenance vehicles.). This infeasibility criterion cannot be used for sidewalks or non-traffic bearing surfaces. An answer of yes means the BMP is not feasible.	☐	☐	☐
16	Does the area typically generate high concentrations of oil due to high traffic turnover or frequent transfer of oil? (See SWMM for additional guidance.) An answer of yes means the BMP is not feasible.	☐	☐	☐
17	Can the permeable pavement be located outside of areas with industrial activity as identified in 40 CFR 122.26(b)14?	☐	☐	☐
18	Can permeable pavement be located outside of areas where the risk of concentrated pollutant spills is likely such as gas stations, truck stops, and industrial chemical storage areas?	☐	☐	☐
19	Can permeable pavement be located outside of areas likely to have long-term excessive sediment deposition after construction?	☐	☐	☐
20	For properties with known soil or groundwater contamination, can the permeable pavement be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
21	For properties with known soil or groundwater contamination, can the permeable pavement be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐

22	For properties with known soil or groundwater contamination, can the permeable pavement be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
23	For properties with known soil or groundwater contamination, can the permeable pavement be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
24	Will installing permeable pavement cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (24a-24e).	☐	☐	☐
24a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
24b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
24c	Public health and safety standards		☐	
24d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
24e	Critical Area Preservation Ordinance		☐	
Questions #25-28 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
25	Is the depth from the lowest layer designed as part of the permeable pavement section to the seasonal high groundwater elevation, bedrock, or other impermeable layer equal to or greater than 1 foot?	☐	☐	☐
26	For pollution generating pervious pavement surfaces, can the soil suitability criteria for treatment be met? (See SWMM – BMP T5.15)	☐	☐	☐
27	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
28	Is the existing impervious surface that will be replaced non-polluting generating and located over an outwash soil with a saturated hydraulic conductivity of 4 inches/hour or greater?	☐	☐	☐
Questions 29-40 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
29	Will the proposed permeable pavement location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
30	Will infiltrating and ponded water compromise existing adjacent impervious pavements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
31	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐
32	Can the permeable pavement be located outside area whose groundwater drains into an erosion hazard or landslide hazard area?	☐	☐	☐
33	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
34	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
35	Can permeable pavement be located away from the bottom of steep, erosion prone areas that are likely to erode sediment?	☐	☐	☐
36	Can permeable pavement be located away from fill soils that can become unstable when saturated?	☐	☐	☐
37	Will permeable pavement construction on steep slopes cause erosion and structural failure? (An answer of yes means the BMP is infeasible).	☐	☐	☐

38	Will permeable pavement construction on steep slopes cause runoff velocities that preclude adequate infiltration at the pavement surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
39	Can permeable pavement provide sufficient strength to support the anticipated loads?	☐	☐	☐
40	Are underlying soils suitable for supporting traffic loads when saturated?	☐	☒	☐

Infeasibility Checklist
BMP T5.12: Sheet Flow Dispersion

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-9 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the sheet flow dispersions system be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the sheet flow dispersion system be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the sheet flow dispersion system be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the sheet flow dispersion system be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the sheet flow dispersion system maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to provide a vegetated flowpath width of 10 feet or greater for up to 20 feet of width of paved or impervious surface?	☐	☒	☐
7	For paved or impervious surfaces widths 20 feet or greater, is it possible to provide a vegetated flowpath width of 20 feet or greater (additional 10 feet of width must be added for each increment of 20 feet or more in width)?	☐	☒	☐
8	Will installing sheet flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (8a-8e).	☐	☐	☐
8a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act		☐	
8b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts		☐	
8c	Public health and safety standards		☐	
8d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
8e	Critical Area Preservation Ordinance		☐	
9	Can the design standards in BMP T5.12 be met?	☐	☐	☐
9a	Describe the design standard that cannot be met:			
Questions #10 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
10	Will the use of sheet flow dispersion cause erosion or flooding problems onsite or an adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist BMP T5.11: Concentrated Flow Dispersion				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-8 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	Can the concentrated flow dispersion system be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the concentrated flow dispersion system be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the concentrated flow dispersion system be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the concentrated flow dispersion system be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the concentrated flow dispersion system maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to maintain or construct a vegetated flowpath of at least 25 feet from the discharge location and any property line, structure, slope greater than 15%, surface water, or other hard surface?	☐	☒	☐
7	Will installing concentrated flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (7a-7e).	☐	☐	☐
7a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
7b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
7c	Public health and safety standards	☐		
7d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
7e	Critical Area Preservation Ordinance	☐		
8	Can the design standards in BMP T5.11 be met?	☐	☐	☐
8a	Describe the design standard that cannot be met:			
Questions #9 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
9	Will the use of concentrated flow dispersion cause erosion or flooding problems onsite or an adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

APPENDIX A-8

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Pierce County GIS, WA DNR, WSDOT, USFWS, Washington State Department of Ecology, and Puget Sound Regional Council. This information was compiled at scales of 1:1,200 to 1:24,000 during the time period 1995-2012.

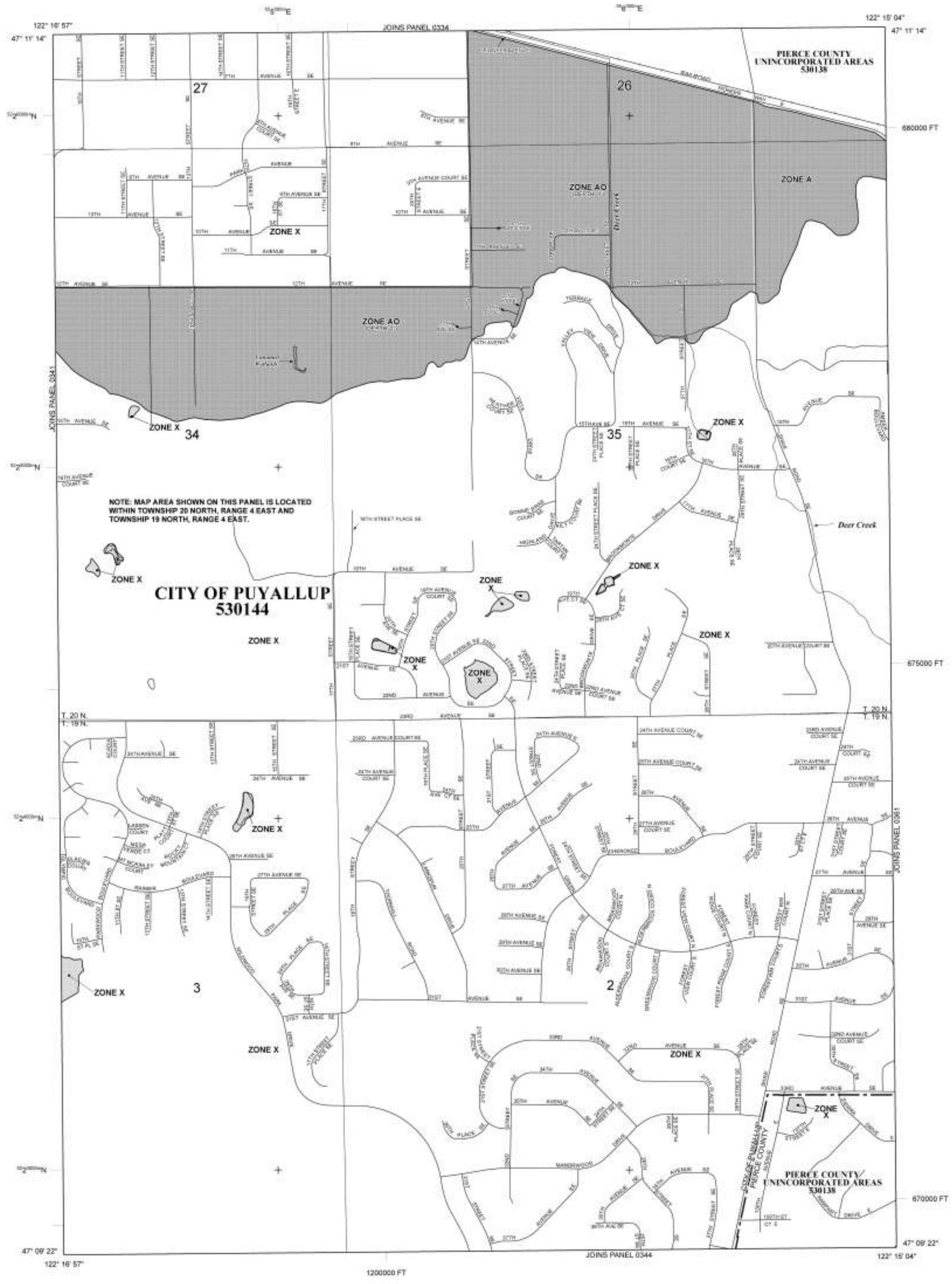
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - - 23	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
N	1000-meter Universal Transverse Mercator grid values, zone 10
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
March 7, 2017

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0342E

FIRM

FLOOD INSURANCE RATE MAP

PIERCE COUNTY, WASHINGTON AND INCORPORATED AREAS

PANEL 342 OF 1375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PIERCE COUNTY	530138	0342	E
PUYALLUP, CITY OF	530144	0342	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 53053C0342E

EFFECTIVE DATE MARCH 7, 2017

Federal Emergency Management Agency

APPENDIX A-9

 | Issue Date: April 27, 2022 | Effective Date: September 8, 2022 | Case No.: 21-10-0191P | LOMR-APP

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Puyallup Pierce County Washington COMMUNITY NO.: 530144	CHANNELIZATION CULVERT DETENTION BASIN	HYDROLOGIC ANALYSIS 1D HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA
IDENTIFIER	06-171 East Town Crossing	APPROXIMATE LATITUDE & LONGITUDE: 47.184, -122.254 SOURCE: Other DATUM: WGS 84	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 53053C0342E DATE: March 7, 2017 TYPE: FIRM NO.: 53053C0361E DATE: March 7, 2017	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: March 7, 2017 PROFILE(S): 363P, 365P(NEW), AND 366P(NEW) SUMMARY OF DISCHARGES TABLE: 2

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map

FLOODING SOURCE(S) & REVISED REACH(ES) See Page 2 for Additional Flooding Sources

Deer Creek - Pioneer - From just downstream of E Pioneer Ave & Shaw Road E to approximately 1,520 feet upstream of E Pioneer Ave & Shaw Road E
Pioneer South Creek - From just downstream of E Pioneer Ave & Shaw Road E to approximately 1,530 feet upstream of E Pioneer Ave & Shaw Road E

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Deer Creek – Pioneer	No BFEs*	BFEs	YES	NONE
	Zone X (unshaded)	Zone AE	YES	NONE
Pioneer South Creek	No BFEs	BFEs	YES	NONE
	Zone A	Zone AE	YES	NONE

* BFEs - Base (1-percent-annual-chance) Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

OTHER FLOODING SOURCES AFFECTED BY THIS REVISION

FLOODING SOURCE(S) & REVISED REACH(ES)

Pioneer South Creek Tributary - From confluence with Pioneer South Creek to approximately 1,860 feet upstream of confluence with Pioneer South Creek

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Pioneer South Creek Tributary	No BFEs*	BFEs	YES	NONE
	Zone A	Zone AE	YES	YES

* BFEs - Base (1-percent-annual-chance) Flood Elevations

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Kristen Meyers
Director, Mitigation Division
Federal Emergency Management Agency, Region X
Federal Regional Center
130 228th Street, Southwest
Bothell, WA 98021-8627
(425) 487-4543

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp

LOCAL NEWSPAPER

Name: *The News Tribune*

Dates: May 4, 2022 and May 11, 2022

Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

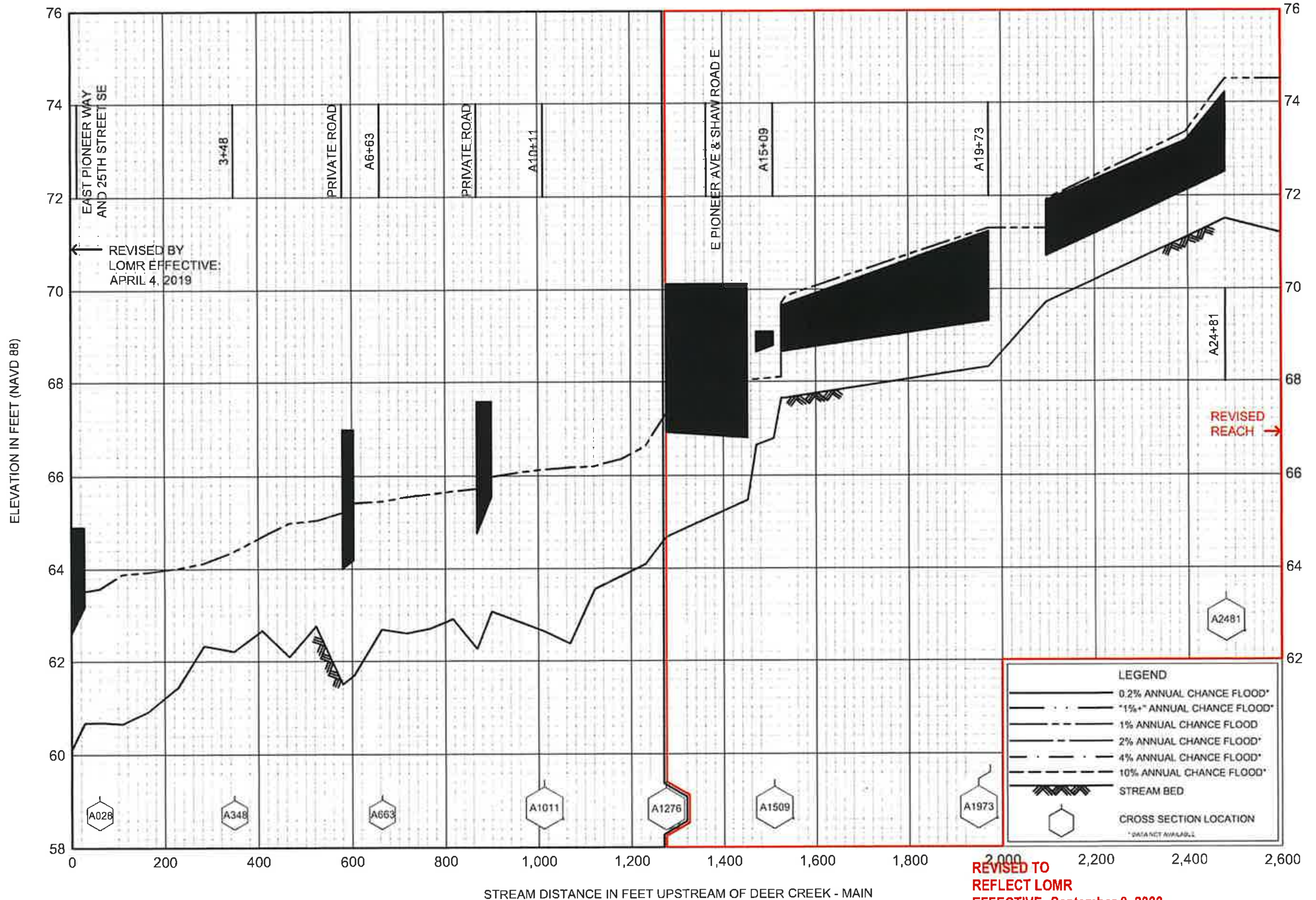
REVISED TO REFLECT LOMR EFFECTIVE: April 4, 2019

REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

Table 2 – Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
DEBRA JANE CREEK					
At Mouth	1.3	45	62	69	85
At Confluence with Bonney Lake Outflow	0.8	26	34	38	48
At Upstream End of Debra Jane Lake	0.1	9	12	14	17
DEER CREEK					
At the BNSF Railroad crossing near E. Pioneer Way and 23rd Street SE	2.4	N/A	N/A	220	N/A
DEER CREEK - PIONEER					
Upstream of Shaw Road E	0.8	N/A	N/A	11	N/A
PIONEER SOUTH CREEK					
Upstream of Shaw Road E	1.7	N/A	N/A	35	N/A
PIONEER SOUTH CREEK TRIBUTARY					
At confluence with Pioneer South Creek	0.2	N/A	N/A	3	N/A

Revised Data



FLOOD PROFILES

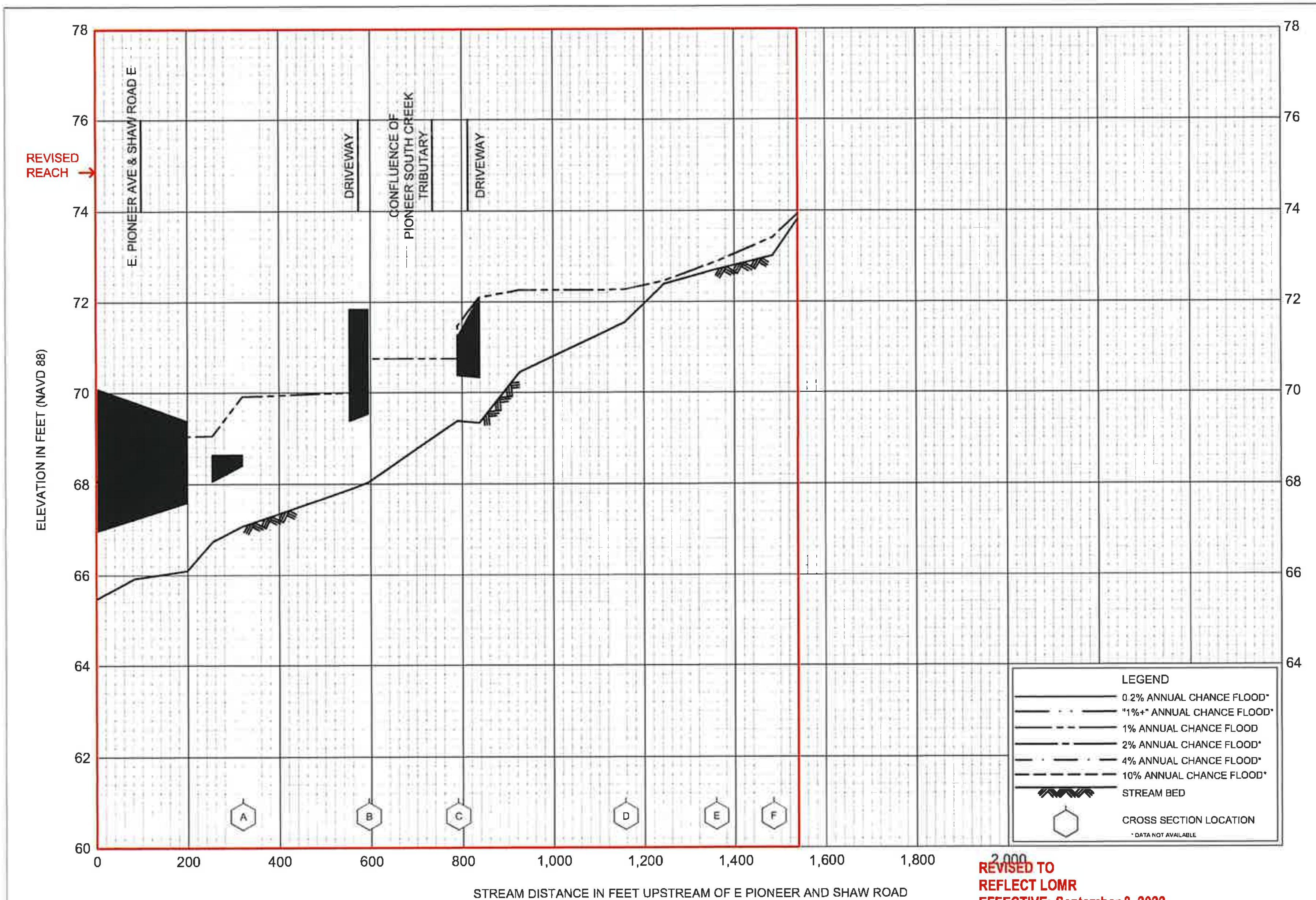
DEER CREEK - PIONEER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PIERCE COUNTY, WA

AND INCORPORATED ARES

363P



REVISED TO
REFLECT LOMR
EFFECTIVE: September 8, 2022

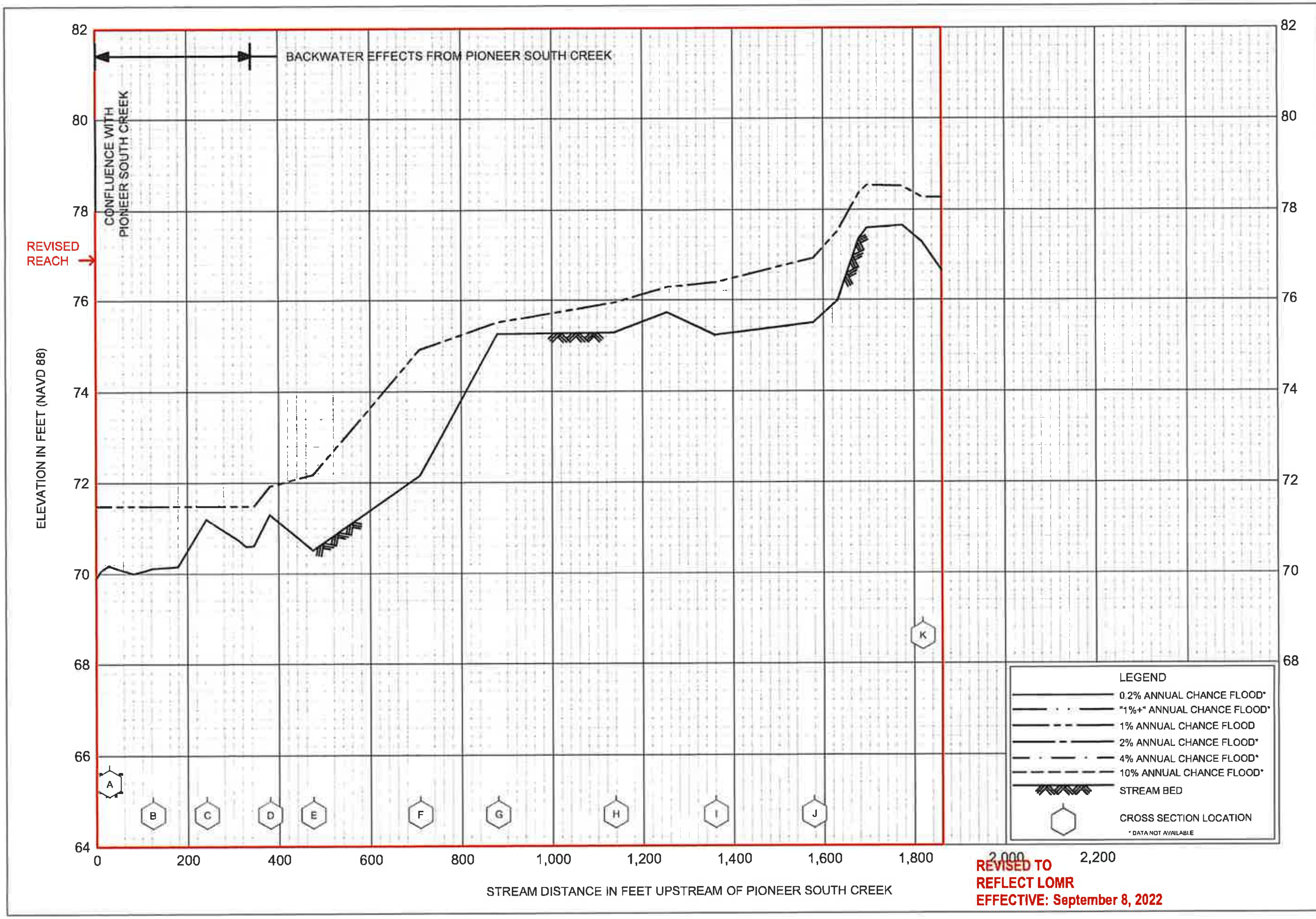
FLOOD PROFILES

PIONEER SOUTH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

PIERCE COUNTY, WA

AND INCORPORATED AREAS



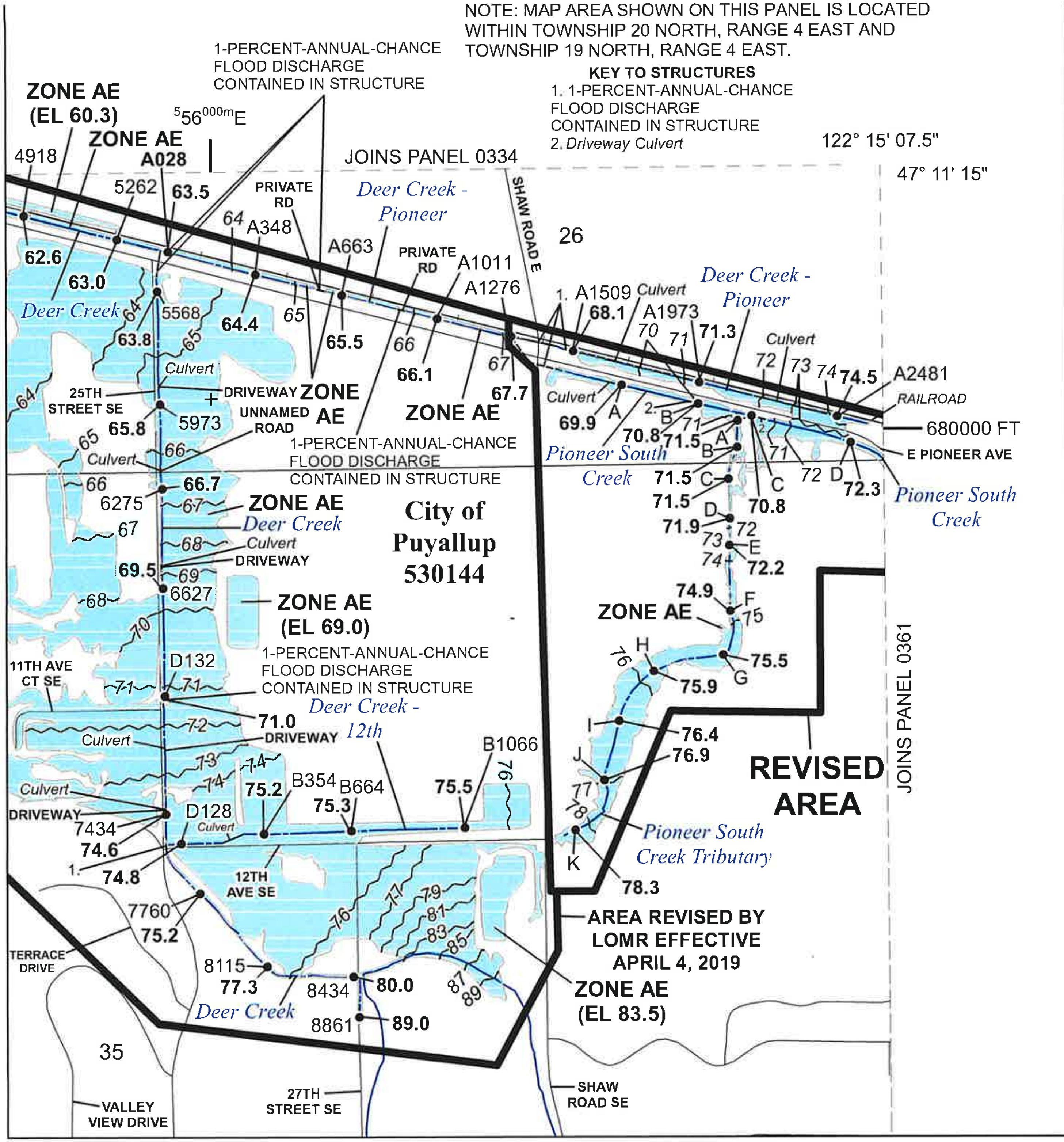
FLOOD PROFILES

PIONEER SOUTH CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

PIERCE COUNTY, WA

UNINCORPORATED AREAS



SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99 With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes. Zone X

SCALE

Map Projection:
NAD 1983 UTM Zone 10N;
Western Hemisphere; Vertical Datum: NAVD 88

N

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PIERCE COUNTY, WASHINGTON
and Incorporated Areas

PANEL 342 OF 1375

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
PIERCE COUNTY	530138	0342	E
PUYALLUP, CITY OF	530144	0342	E

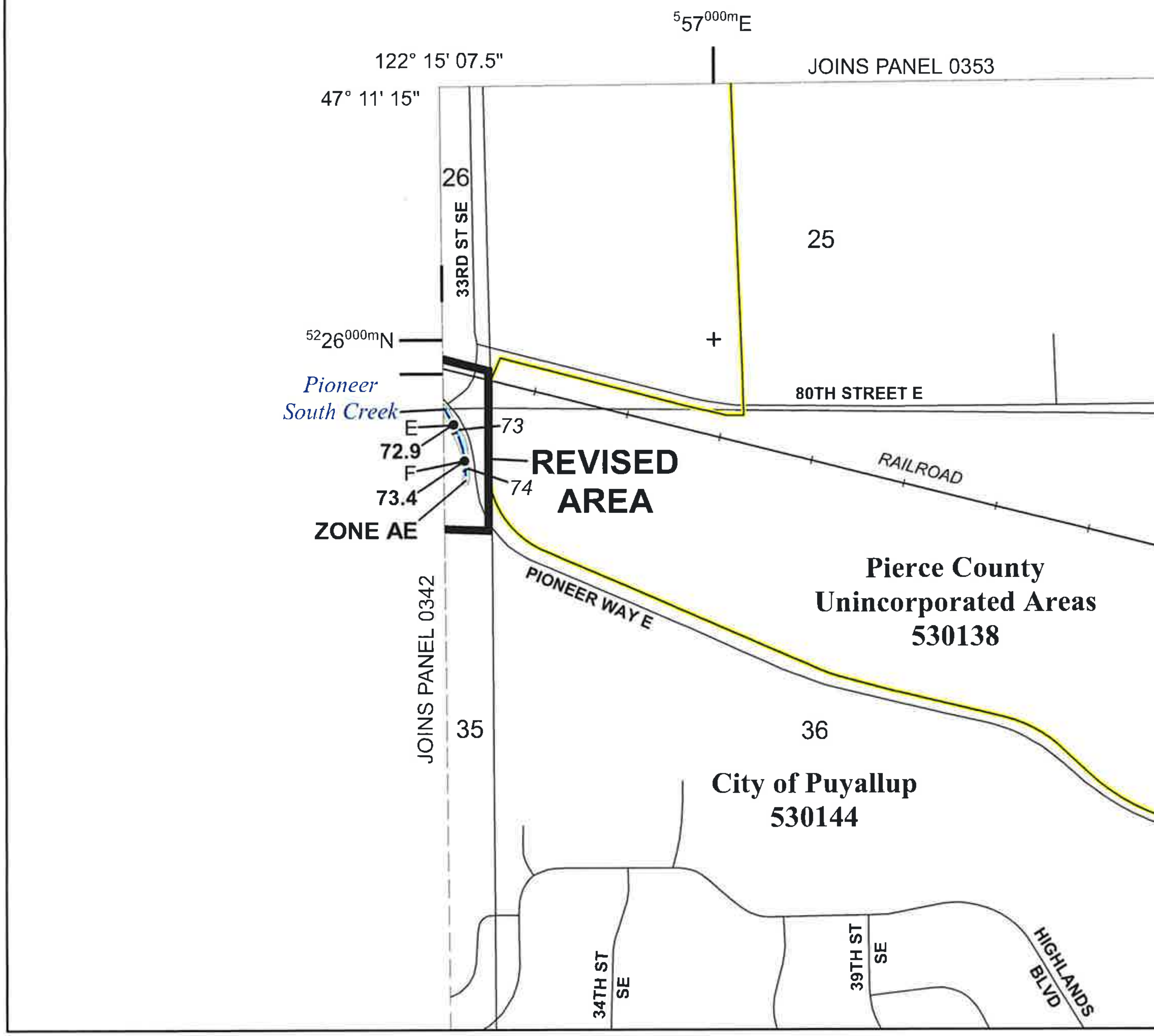
REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

VERSION NUMBER
2.1.3.0

MAP NUMBER
53053C0342E

EFFECTIVE DATE
MARCH 7, 2017

MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 19 NORTH, RANGE 4 EAST, TOWNSHIP 19 NORTH, RANGE 5 EAST, TOWNSHIP 20 NORTH, RANGE 4 EAST, AND TOWNSHIP 20 NORTH, RANGE 5 EAST.



SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes. Zone X

SCALE

Map Projection:
NAD 1983 UTM Zone 10N;
Western Hemisphere; Vertical Datum: NAVD 88

N

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

PIERCE COUNTY, WASHINGTON

and Incorporated Areas

PANEL 361 OF 1375

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
PIERCE COUNTY	530138	0361	E
PUYALLUP, CITY OF	530144	0361	E
SUMNER, CITY OF	530147	0361	E

FEMA

REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

VERSION NUMBER
2.1.3.0

MAP NUMBER
53053C0361E

EFFECTIVE DATE
MARCH 7, 2017

Appendix B

APPENDIX B-1

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

April 11, 2019

KA Project No. 062-19005

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Mr. Gil Hulsmann

Email: Gil.Hulsmann@AbbeyRoadGroup.com
Tel: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan

Theresa R. Nunan
Project Engineer

TRN:MR

Geotechnical Engineering Investigation
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road & E. Pioneer Way
Puyallup, Washington

Project No. 062-19005
April 11, 2019

Prepared for:

Abbey Road Group Land Development Services Company, LLC
Attn: Mr. Gil Hulsmann
PO Box 1224
Puyallup, WA 98371

Prepared by:

Krazan & Associates, Inc.
Geotechnical Engineering Division
825 Center Street, Ste A
Tacoma, Washington 98409
(253) 939-2500

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

TABLE OF CONTENTS

April 11, 2019

KA Project No. 062-19005

GEOTECHNICAL ENGINEERING INVESTIGATION
EAST TOWN CROSSING
PARCEL NOS. 0420264053, 0420264054, 0420351066
SE CORNER OF EAST SHAW ROAD AND EAST PIONEER WAY
PUYALLUP, WASHINGTON

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed East Town Crossing project located near the southeast corner of East Shaw Road and East Pioneer Way in Puyallup, Washington, as shown on the Vicinity Map in Figure 1. Discussions regarding site conditions are presented in this report, together with conclusions and recommendations pertaining to site preparation, excavations, structural fill, utility trench backfill, drainage and landscaping, erosion control, foundations, concrete floor slabs and exterior flatwork, lateral earth pressures, and pavement.

A Site Plan showing the approximate exploratory boring and monitoring well locations is presented following the text of this report in Figure 2. Appendix A includes USCS Soil Classification information, as well as a description of the field investigation, exploratory boring logs, and the laboratory testing results. Appendix B contains a guide to aid in the development of earthwork specifications. Pavement design guidelines are presented in Appendix C. The recommendations in the main text of the report have precedence over the more general specifications in the appendices.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the subsurface soil and groundwater conditions at the site, to develop geotechnical engineering recommendations for use in design of specific construction elements, and to provide criteria for site preparation and earthwork construction.

Our scope of services was performed in general accordance with our proposal for this project, dated January 25, 2019 (Proposal Number G19001WAT) and included the following:

- Exploration of the subsurface soil and groundwater conditions by conducting approximately three (3) geotechnical borings and installing two (2) groundwater level monitoring wells using a subcontracted drill rig;

- Provide a site plan showing the geotechnical boring and monitoring well locations;

- Provide comprehensive boring and monitoring well logs, including soil stratification and classification, and groundwater levels where applicable;
- Recommended foundation type for the proposed structures;
- Allowable foundation bearing pressure, anticipated settlements (both total and differential), coefficient of horizontal friction for footing design, and frost penetration depth;
- Recommendations for seismic design considerations including site coefficient and ground acceleration based on the 2015 IBC;
- Recommendations for structural fill materials, placement, and compaction;
- Recommendations for suitability of on-site soils as structural fill;
- Recommendations for temporary excavations;
- Recommendations for site drainage and erosion control;
- Recommendations for flexible and rigid pavements, as well as permeable pavement.

PROPOSED CONSTRUCTION

Based on the Overall Site Plan prepared by Abbey Road Group Land Development Services, dated December 12, 2018, we understand that the proposed development will include construction of six residential structures (designated Buildings A through E) and a club house/office building. Site drainage systems will include a subsurface stormwater system located in the southern portion of the property, and a rain garden along the northern and eastern edges of the site. We have not been provided with details regarding construction of the subsurface stormwater system. The planned development will also include utility installation, and paved parking areas and driveways. For the purpose of our analyses, we have assumed that the residential buildings and club house will be 1- to 2-story structures with a slab-on-grade floor system. We have also assumed only minor grading up to 1 foot of cut or fill will be required to establish planned elevations for the site.

SITE LOCATION AND DESCRIPTION

The site consists of three undeveloped parcels encompassing approximately 7 acres of land located south and east of the intersection of Shaw Road with East Pioneer Way. The site is bordered to the north by East Pioneer Way, to the south by commercial property, to the east by undeveloped land and a creek, and to the west by undeveloped land and abandoned residences. The site is roughly rectangular in shape and relatively level at approximately Elevation 72 to 74 feet. A dirt road runs north-south through the center of the site, and also extends from the center of the site westward towards Shaw Road. An existing storm pond is located in the southeast corner of the site, with the bottom at Elevation 69 feet. A wetland that has been field verified by others is located within the western central edge of the site. A creek runs along the eastern boundary of the site.

Most of the property is covered with seasonal vegetation, brambles, and a few trees located within the central portion of the site. Some trash and an abandoned trailer are located in the north central portion of the site. The southern portion of the site is currently being used by the adjacent business for container storage.

We understand that past construction activities for the undeveloped parcel to the west of the site that borders Shaw Road and East Pioneer Way consisted of the placement of fill material to raise the existing grades, based on the Geotechnical Evaluation and Additional Recommendations report prepared by Krazan & Associates, dated March 13, 2007. Those fill activities did not extend into this site.

GEOLOGIC SETTING

The site lies within the central Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances and retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and nonglacial sediments.

The Washington Division of Geology and Earth Resources, Geologic Map of the South Half of the Tacoma Quadrangle, Washington (Open File Report 87-3) indicates that the property is located in an area that is predominantly underlain by recent alluvium deposited by the Puyallup River. The recent alluvium consists of interbedded silt, sandy silt, silty sand, sand, gravel, local areas of peat and clay. The finer material represents overbank material and local lacustrine deposits, and the coarser materials most likely represent deposits in abandoned channels of the Puyallup River.

FIELD INVESTIGATION

A field investigation consisting of three (3) exploratory soil borings and installation of two (2) monitoring wells was completed to evaluate the subsurface soil and groundwater conditions at the project location. The soil borings were completed on March 11, 2019 by a Krazan subcontractor utilizing a hollow stem auger drill rig. The soil borings were advanced to depths ranging from 21.5 to 38.5 feet below the existing ground surface (bgs). A geotechnical engineer from Krazan and Associates was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the explorations.

Representative samples of the subsurface soils encountered in the borings were collected and sealed in plastic bags. These samples were transported to our laboratory for further examination and testing. The soils encountered in the exploratory borings were continuously examined and visually classified in accordance with the Unified Soil Classification System (USCS).

SOIL PROFILE AND SUBSURFACE CONDITIONS

The geotechnical subsurface exploration for this project consisted of soil borings and monitoring wells advanced to depths of approximately 21.5 to 38.5 feet bgs. The locations of the soil borings and monitoring wells are shown on the Site Plan in Figure 2.

Beneath 5 to 8 inches of surficial topsoil, the borings encountered alluvial soils to their explored depths. The topsoil was underlain by 4.5 to 7 feet of brown silty sand (SM) and poorly graded sand (SP) with relative densities in the loose to medium dense range. The sand soils were underlain by a 3-foot thick stratum of interbedded sandy silt (ML) that exhibited medium stiff to stiff consistencies and silty sand (SM) soils with relative densities in the loose to medium dense range.

Boring B-1 encountered a layer of silty clay and clayey silt beneath the sandy silt and silty sands from 7.5 to 11.0 feet bgs. The silty clay (CL) and clayey silt (ML) exhibited a very soft consistency with a Standard Penetration Test (SPT) resistance (N-value) of 1/12 inches and a moisture content of 51 percent.

The clayey silt in boring B-1 and the silty sand/sandy silt stratum in borings B-2 and B-3 were underlain by silty sand, sand, and gravel soils with varying silt contents to the termination depths of 21.5, 38.5, and 21.5 feet bgs, respectively. These granular soils exhibited relative densities in the loose to very dense range with N-values ranging from 8 to 60/8" blows per foot.

Gradation and Atterberg Limits tests were conducted on representative samples of the soils for classification purposes and for determination of engineering properties. The gradation and Atterberg Limits results are graphically depicted in Appendix A. For additional information about the soils encountered, please refer to the boring logs in Appendix A.

Monitoring Wells: Two monitoring wells, designated W-1 and W-2, were installed at the site on March 11, 2019 using a subcontracted driller and track mounted drill rig. Monitoring well W-1 was installed within borehole B-1. The boreholes for monitoring wells W-1 and W-2 were advanced to a depth of 21.5 feet and 20 feet below the existing ground surface, respectively, using 4¼-inch diameter hollow stem augers. A 10-foot long section of slotted PVC pipe attached to a 10-foot section of solid PVC pipe was inserted into the borehole, and the annular space between the pipe and the augers was backfilled with filter sand to a depth of 8 feet bgs followed by bentonite chips to the ground surface. A metal well cap was then installed over the pipe and cemented in-place to protect the well from unauthorized access. The installation log for monitoring wells W-1 and W-2 are included in Appendix A.

GROUNDWATER

Groundwater was encountered during the drilling operations at a depth of about 7 to 8 feet below the existing ground surface. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, climatic conditions, as well as other factors. Therefore, water levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

GEOLOGIC HAZARDS

Erosion Concern/Hazard

The Natural Resources Conservation Services (NRCS) map for Pierce County Area, Washington, classifies the site area as Briscot loam. The NRCS classifies the Briscot loam as Hydrologic Soil Group B/D with low potential for erosion in a disturbed state.

It has been our experience that soil erosion can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, i.e., silt fences, hay bales, mulching, control ditches or diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The 2015 International Building Code (IBC), Section 1613.3.2, refers to Chapter 20 of ASCE-7 for Site Class Definitions. It is our opinion that the overall soil profile corresponds to Site Class D as defined by Table 20.3-1 "Site Class Definitions," according to the 2010 ASCE-7 Standard. Site Class D applies to a "stiff soil" profile. The seismic site class is based on a soil profile extending to a depth of 100 feet. The soil borings on this site extended to a maximum depth of 38.5 feet and this seismic site class designation is based on the assumption that similar soil conditions continue below the depth explored.

We referred to the U.S. Geological Survey (USGS) Earthquake Hazards Program Website and 2012/2015 IBC to obtain values for S_S, S_{MS}, S_{DS}, S_1, S_{M1}, S_{D1}, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The seismic design parameters for this site are as follows:

Seismic Design Parameters
(Reference: 2015 IBC Section 1613.3.2, ASCE, and USGS)

Seismic Item	Value
Site Coefficient F_a	1.003
S_s	1.243 g
S_{MS}	1.247 g
S_{DS}	0.831 g
Site Coefficient F_v	1.524
S_1	0.476 g
S_{M1}	0.726 g
S_{D1}	0.484 g

Additional seismic considerations include liquefaction potential and amplification of ground motions by loose/soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. Soil liquefaction is a state where soil particles lose contact with each other and become suspended in a viscous fluid. This suspension of the soil grains results in a complete loss of strength as the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events.

We have reviewed "Liquefaction Susceptibility Map of Pierce County, Washington" by Stephen P. Palmer et al., (WA DNR, 2004). The map indicates that the site area is located in a zone of high liquefaction susceptibility. At the request of our client, we have conducted a site-specific liquefaction analysis for this project.

To evaluate the liquefaction potential of the site, we analyzed the following factors:

1) Soil type
2) Groundwater depth
3) Relative soil density
4) Initial confining pressure
5) Maximum anticipated intensity and duration of ground shaking

Liquefaction Analysis: The commercially available liquefaction analysis software, LiquefyPro from CivilTech, was used to evaluate the liquefaction potential and the possible liquefaction induced settlement for the site soil and groundwater conditions based on our explorations. The analysis was performed using the information from the soil test boring and laboratory gradation analyses. Maximum

Considered Earthquake (MCE) was selected in accordance with the 2015 International Building Code (IBC) Chapter 16 and the U.S. Geological Survey (USGS) Earthquake Hazards Program website. For this analysis, a maximum earthquake magnitude of 7.11 and peak horizontal ground surface acceleration of 0.5g were used. Our analysis assumed a groundwater depth of 7.0 feet during the earthquake.

The maximum liquefaction induced settlement for this type of seismic event is estimated to be on the order of about 2 inches. The differential settlements are estimated to be on the order of about 1-inch.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the planned improvements at this site are feasible, provided that the geotechnical engineering recommendations presented in this report are included in the project design. Based on our explorations, it is our opinion that conventional spread foundations supported on medium dense/stiff or firmer native soil, or on structural fill extending to the medium dense/stiff or firmer native soil would be appropriate for the new buildings.

We recommend that organic topsoil, undocumented fill, and loose/soft soils be stripped to expose the underlying medium dense/stiff or firmer native soil. Footings should extend through any organic or loose soil and be founded on the underlying medium dense or firmer native soil, or structural fill extending to the competent native soils.

Exploration boring B-1 was drilled in the northern portion of the site, in the area of the planned rain garden between Pioneer Way and the Club House and Residential Building E. Boring B-1 encountered a layer of very soft silty clay between 7.5 and 11 feet below the existing ground surface. These materials are not considered suitable to support foundations and will need to be removed where they are encountered. Test pits should be conducted prior to the construction phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 (drilled within the eastern and southern portions of the site) and monitoring well W-2 (installed within the central portion of the site) encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs, respectively; however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

The soils encountered on this site are considered moisture-sensitive and will be easily disturbed and difficult to compact when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas.

Site Preparation

General site clearing should include removal of any undocumented fill, organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas. Additional recommendations for preparation of specific areas are provided in **the Foundations, Pavement Design** and **Exterior Flatwork** subsections of this report.

The soils that will be encountered during site development are considered extremely moisture-sensitive and may disturb easily in wet conditions. The prepared subgrade should be protected from construction traffic and surface water should be diverted around prepared subgrade. We recommend that the site be developed only during extended periods of dry weather.

During wet weather conditions, subgrade stability problems and grading difficulties may develop due to excess moisture, disturbance of sensitive soils and/or the presence of perched groundwater. Construction during the extended periods of wet weather could result in the need to remove wet disturbed soils if they cannot be suitably compacted due to elevated moisture contents. The onsite soils have significant silt content in the explored areas and are moisture sensitive, and can be easily disturbed when wet. If over-excavation is necessary, it should be confirmed through continuous monitoring and testing by a qualified geotechnical engineer or geologist. Soils that have become unstable may require drying to near their optimal moisture content before compaction is feasible. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry, warm weather (typically during the summer months). If the soils cannot be dried back to a workable moisture condition, remedial measures may be required. General project site winterization should consist of the placement of aggregate base and the protection of exposed soils during the construction phase. It should be understood that even if Best Management Practices (BMP's) for wintertime soil protection are implemented and followed there is a significant chance that moisture disturbed soil mitigation work will still be required.

Any buried structures encountered during construction should be properly removed and backfilled. Excavations, depressions, or soft and pliant areas extending below the planned finish subgrade levels should be excavated to expose firm undisturbed soil, and backfilled with structural fill. In general, any septic tanks, underground storage tanks, debris pits, cesspools, or similar structures should be completely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the geotechnical engineer. The resulting excavations should be backfilled with structural fill.

We understand that backfilling of the wetland in the central western edge of the site that has been field identified by others will be permitted for construction of the paved parking area and subsurface storm system. We also understand that proposed Residential Building C will be constructed within the area currently occupied by an existing storm pond. Our field explorations were not specifically conducted within either of these areas. Any organic, silt or clay soils, or accumulations of sediment, encountered within the wetland area or the existing storm pond should be removed down to firm undisturbed soil, and backfilled with structural fill to the planned finish grades.

A representative of our firm should be present during all site clearing and grading operations to observe, test and evaluate earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The geotechnical engineer may reject any material that does not meet compaction and stability requirements. Further recommendations, contained in this report, are predicated upon the assumption that earthwork construction will conform to the recommendations set forth in this section and in the Structural Fill section below.

Temporary Excavations

The onsite soils have variable cohesion strengths, therefore the safe angles to which these materials may be cut for temporary excavations is limited, as the soils may be prone to caving and slope failures in temporary excavations. Temporary excavations in the loose to medium dense native soils should be sloped no steeper than 2H:1V (horizontal to vertical) where room permits.

All temporary cuts should be in accordance with Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. The temporary slope cuts should be visually inspected daily by a qualified person during construction work activities and the results of the inspections should be included in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and minimizing slope erosion during construction. The temporary cut slopes should be covered with plastic sheeting to help minimize erosion during wet weather and the slopes should be closely monitored until the permanent retaining systems are complete. Materials should not be stored and equipment operated within 10 feet of the top of any temporary cut slope.

A Krazan & Associates geologist or geotechnical engineer should observe, at least periodically, the temporary cut slopes during the excavation work. The reasoning for this is that all soil conditions may not be fully delineated by the limited sampling of the site from the geotechnical explorations. In the case of temporary slope cuts, the existing soil conditions may not be fully revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of the temporary slope will need to be evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed smoothly and required deadlines can be met. If any variations or undesirable conditions are encountered during construction, Krazan & Associates should be notified so that supplemental recommendations can be made.

Structural Fill

Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the Site Preparation subsection of this report prior to beginning fill placement.

Best Management Practices (BMP's) should be followed when considering the suitability of the existing materials for use as structural fill. The on-site soils are generally considered suitable for re-use as structural fill, provided the soil is free of organic material and debris, and it is within ± 2 percent of the optimum moisture content. If the native soils are stockpiled for later use as structural fill, the stockpiles should be covered to protect the soil from wet weather conditions. We recommend that a representative of Krazan & Associates be on site during the excavation work to determine which soils are suitable for use as structural fill.

Imported, all weather structural fill material should consist of well-graded gravel or a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). All structural fill material should be submitted for approval to the geotechnical engineer at least 48 hours prior to delivery to the site.

Fill soils should be placed in horizontal lifts not exceeding 8 inches in thickness prior to compaction, moisture-conditioned as necessary (moisture content of soil shall not vary by more than ±2 percent of optimum moisture), and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM D1557 Test Method. In-place density tests should be performed on all structural fill to document proper moisture content and adequate compaction. Additional lifts should not be placed if the previous lift did not meet the compaction requirements or if soil conditions are not considered stable.

Foundations

Our exploratory borings encountered loose to medium dense granular soils underlain by a 3-foot thick stratum of interbedded sandy silt and silty sand, followed by loose to very dense granular alluvial soils to the explored depths. Boring B-1, drilled at the proposed rain garden area in the northern end of the site, encountered a 3.5-foot thick layer of very soft silty clay at a depth of 7.5 feet bgs.

The very soft clay encountered in Boring B-1 between 7.5 and 11 feet below the existing ground surface is not considered suitable to support foundations and will need to be removed where it is encountered.

Further exploration of this area with test pits should be conducted during the planning phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 and monitoring well W-2, drilled within the eastern, southern, and central portions of the site, encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs, however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

Pending the findings of further explorations in the northern portion of the site, the proposed structures may be supported on a shallow foundation system. Where loose/soft soils are encountered at the planned footing elevations, the subgrade should be over-excavated to expose suitable bearing soil. The foundation excavations should be evaluated by Krazan & Associates prior to structural fill placement to verify that the foundations will bear on suitable material.

Building foundations should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Footing widths should be based on the anticipated loads and allowable soil bearing pressure, and should conform to current International Building Code (IBC) guidelines. Water should not be allowed to accumulate in foundation excavations. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing capacity of 2,000 pounds per square foot (psf) may be used for foundation design for this project. A representative of Krazan and Associates should evaluate the foundation bearing soil prior to footing form construction.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.35 acting between the bases of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 150 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglecting the upper 12 inches). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A 1/3 increase in the above values may be used for short duration wind and seismic loads.

For foundations constructed as recommended, the total static settlement is not expected to exceed 1-inch. Differential settlement, along a 20-foot exterior wall footing, or between adjoining column footings should be less than ½ inch. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils become flooded or saturated. It should be noted that the estimated settlement provided herewith is a static settlement and does not include liquefaction induced settlement. Static settlement is induced by the applied dead load from the structures.

Up to 2 inches of total settlement and 1 inch of differential settlement could occur during and/or following a seismic event. The foundation elements, i.e. spread and wall footings, could be structurally tied together to create a stiffer structure. It should be noted that this measure would not mitigate the anticipated seismic settlement; however, it may reduce the damage associated with the anticipated seismic settlement, particularly the effects of differential settlement on a structure.

Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed structures, should not be permitted to flood and/or saturate foundation subgrade soils. To prevent the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter rigid perforated PVC pipe, sloped to drain, with perforations placed near the bottom and enveloped in all directions by washed rock and wrapped with filter fabric to limit the migration of silt and clay into the drain.

Lateral Earth Pressures and Retaining Walls

We understand that a below grade stormwater vault is planned for this project. We have developed criteria for the design of retaining or below grade walls for the stormwater vault. Our design parameters are based on retention of the native soils. The parameters are also based on level, well-drained wall backfill conditions. Walls may be designed as "restrained" retaining walls based on "at-rest" earth pressures, plus any surcharge on top of the walls as described below, if the walls are braced to restrain movement and/or movement is not acceptable. Unrestrained walls may be designed based on "active" earth pressure, if the walls are not part of the buildings and some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of "active" earth pressure values for design. We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 38 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls or loads imposed by construction equipment, foundations, back slopes or roadways (surcharge loads). Groundwater was encountered in each of the borings at 7 to 8 feet below the ground surface. Portions of the vault that will extend below the groundwater level will need to be designed to resist hydrostatic pressures and buoyant forces. Equivalent fluid densities for buoyant soil pressure under yielding conditions would be 20 pcf and 30 pcf for nonyielding conditions. The allowable buoyant passive pressure would be 100 pcf with a factor of safety of 2.0.

Floor Slabs and Exterior Flatwork

Before the placement of concrete floors or pavements on the site, or before any floor supporting fill is placed, the loose soils and undocumented fill must be removed to expose medium dense or firmer undisturbed native soil. The subgrade should then be proof-rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of yielding soils should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirements of structural fill. Fill soils should be placed in horizontal lifts not exceeding 8 inches loose thickness, moisture-conditioned as necessary, (moisture content of soil shall not vary by more than ±2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557.

Floor slabs may be designed using a modulus of subgrade reaction value of k = 200 pounds per cubic inch (pci) for slabs supported on medium dense or firmer native soils or on structural fill extending to medium dense or firmer native soil.

In areas where it is desired to reduce floor dampness, such as areas covered with moisture sensitive floor coverings, we recommend that concrete slab-on-grade floors be underlain by a water vapor retarder system. According to ASTM guidelines, the water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 4-inches of compacted clean (less than 5 percent passing the U.S. Standard No. 200 Sieve), open-graded angular rock of ¾-inch maximum size. The vapor retarder sheeting should be protected from puncture damage.

It is recommended that the utility trenches within the building pads be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the drainage and irrigation adjacent to the buildings is recommended. Grading should establish drainage away from the structures and this drainage pattern should be maintained. Water should not be allowed to collect adjacent to the structures. Excessive irrigation within landscaped areas adjacent to the structure should not be allowed to occur. In addition, ventilation of the structure may be prudent to reduce the accumulation of interior moisture.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to minimize the transportation of sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. As a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features of the site:

1) Phase the soil, foundation, utility and other work, requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be undertaken during the wet season (generally October through April), but it should also be known that this may increase the overall cost of the project.

2) All site work should be completed and stabilized as quickly as possible.

3) Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.

4) Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited, other filtration methods will need to be incorporated.

Groundwater Influence on Structures and Earthwork Construction

The soil borings were checked for the presence of groundwater during exploratory operations. Groundwater was encountered in all of our borings at approximately 7 to 8 feet bgs. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, groundwater levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

If groundwater is encountered during construction, we should observe the conditions to determine if dewatering will be needed. Design of temporary dewatering systems to remove groundwater should be the responsibility of the contractor. If earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated. These soils may "pump," and the materials may not respond to densification techniques. Typical remedial measures include: disking and aerating the soil during dry weather; mixing the soil with drier materials; removing and replacing the soil with an approved fill material. A qualified geotechnical engineering firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Drainage

The ground surface should slope away from building pads and pavement areas, toward appropriate drop inlets or other surface drainage devices. It is recommended that adjacent exterior grades be sloped a minimum of 2 percent for a minimum distance of 5 feet away from structures. Roof drains should be tightlined away from foundations. Roof drains should not be connected to the footing drains.

Pavement areas should be inclined at a minimum of 1 percent and drainage gradients should be maintained to carry all surface water to collection facilities and suitable outlets. These grades should be maintained for the life of the project.

Specific recommendations for and design of storm water disposal systems or septic disposal systems are beyond the scope of our services and should be prepared by other consultants that are familiar with design and discharge requirements.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized; cyclic wetting and drying of excavation side slopes should be avoided.

All utility trench backfill should consist of suitable on-site material or imported granular material. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Pavement Design

Based on our explorations, the near surface soils at the site are interpreted as loose to medium dense silty sand and sand soils to depths of approximately 4.5 to 7.0 feet bgs. Due to the loose nature of the anticipated pavement subgrade soils, we recommend that subgrade modification techniques be considered. Subgrade modification typically includes the over-excavation of unsuitable materials, the placement of a geotextile fabric at the bottom of the over-excavated area, and then the placement of structural fill, with the structural fill consisting of clean crushed rock, rock spalls, or Controlled Density Fill (CDF). We recommend the use of a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent, for the geotextile. Subgrade modification such as this is intended to disperse surcharge loads and therefore aid in pavement performance.

Where loose soils are encountered in the pavement subgrade, we recommend over-excavation of the loose soil to at least 12 inches below the planned pavement subgrade elevation. The exposed grade after the over-excavation should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. We recommend that a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent, then be placed over the compacted soil. After the fabric is placed, the area should be filled to the planned slab subgrade elevation with structural fill. The structural fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In-place density tests should be performed to verify proper moisture content and adequate compaction.

In areas where the pavement subgrade soil consists of firm and unyielding native soils, a proof roll of the pavement subgrade soil may be performed in lieu of the compaction and in-place density tests. It should be noted that subgrade soils that have relatively high silt contents may be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Traffic loads were not provided, however, based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (delivery and fire trucks). Pavement design life of 20 years was assumed for our analysis. Recommendations for an asphaltic concrete flexible pavement section and Portland Cement Concrete (PCC) rigid pavement section are provided in Tables 1 and 2 below.

Table 1: ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

Asphaltic Concrete	Aggregate Base	Compacted Subgrade**
3.0 in.	6.0 in.	12.0 in.

Table 2: PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT
4000 psi with FIBER MESH

Min. PCC Depth	Aggregate Base	Compacted Subgrade**
6.0 in.	4.0 in.	12.0 in.

***** A proof roll may be performed in lieu of in-place density tests***

The asphaltic concrete depth listed in Table 1 for the flexible pavement section should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½-inch Hot Mix Asphalt (HMA). The pavement specification in Appendix C provides additional recommendations, including aggregate base material.

<u>Testing and Inspection</u>

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. We should also be present during the construction of stormwater management system to evaluate the soils. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

Geotechnical engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences improves. Although your site was analyzed using the most appropriate current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to improvements in the field of geotechnical engineering, physical changes in the site either due to excavation or fill placement, new agency regulations or possible changes in the proposed structure after the time of completion of the soils report may require the soils report to be professionally reviewed. In light of this, the owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. Our report, design conclusions and interpretations should not be construed as a warranty of the subsurface conditions. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The findings and conclusions of this report can be affected by the passage of time, such as seasonal weather conditions, manmade influences, such as construction on or adjacent to the site, natural events such as earthquakes, slope instability, flooding, or groundwater fluctuations. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The geotechnical engineer should be notified of any changes so that the recommendations can be reviewed and reevaluated.

Misinterpretations of this report by other design team members can result in project delays and cost overruns. These risks can be reduced by having Krazan & Associates, Inc. involved with the design teams' meetings and discussions after submitting the report. Krazan & Associates, Inc. should also be retained for reviewing pertinent elements of the design team's plans and specifications. Contractors can also misinterpret this report. To reduce this, risk Krazan & Associates. Inc. should participate in pre-bid and preconstruction meetings, and provide construction observations during the site work.

This report is a geotechnical engineering investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands. Any statements or absence of statements, in this report or on any soils log regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessments.

The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments. We emphasize that this report is valid for this project as outlined above, and should not be used for any other site. Our report is prepared for the exclusive use of our client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

04/11/19

MICHAEL D. RUNDQUIST
STATE OF WASHINGTON
41415
REGISTERED
PROFESSIONAL ENGINEER

Theresa R. Nunan

Michael D. Rundquist, P.E.
Senior Project Manager

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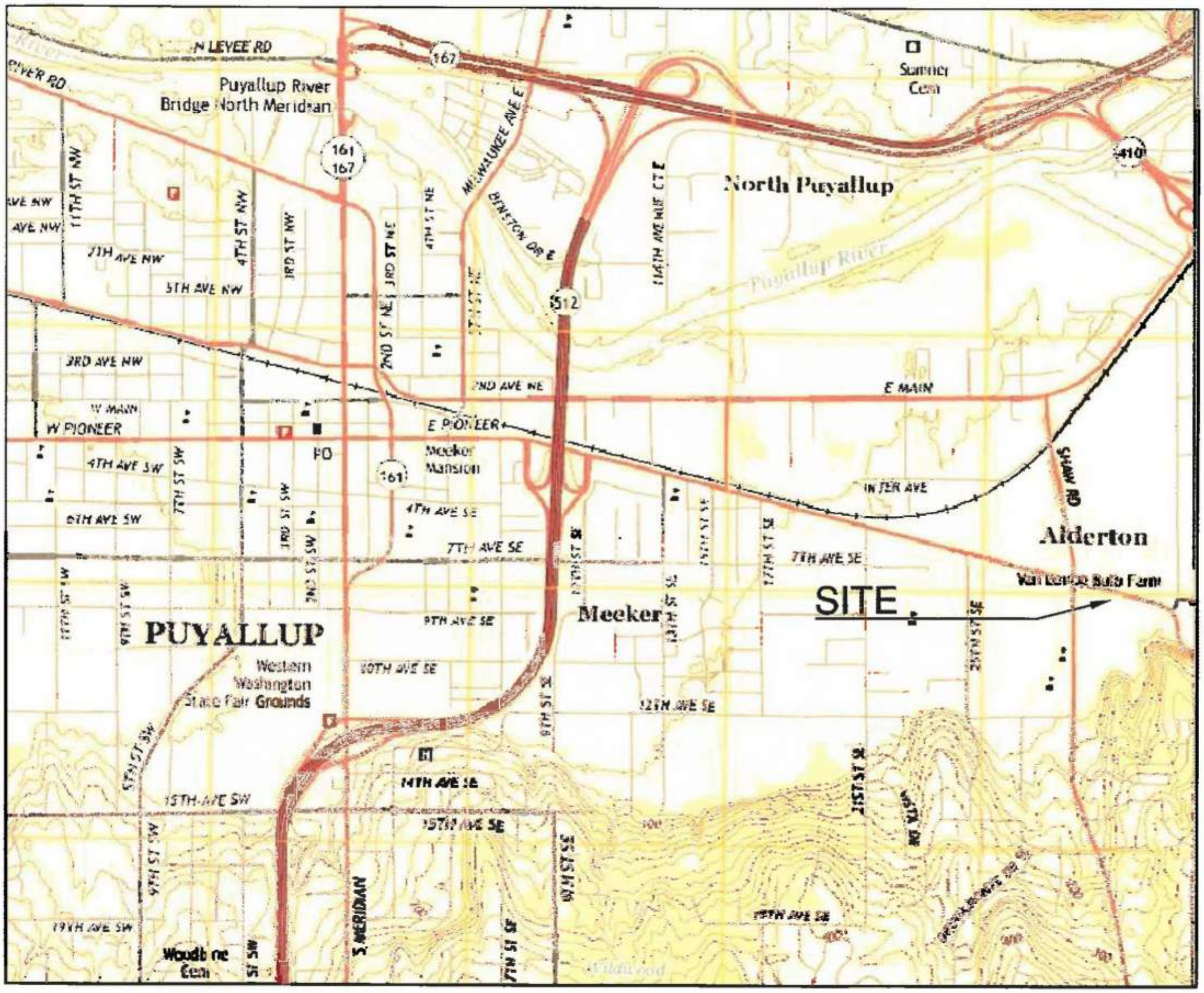
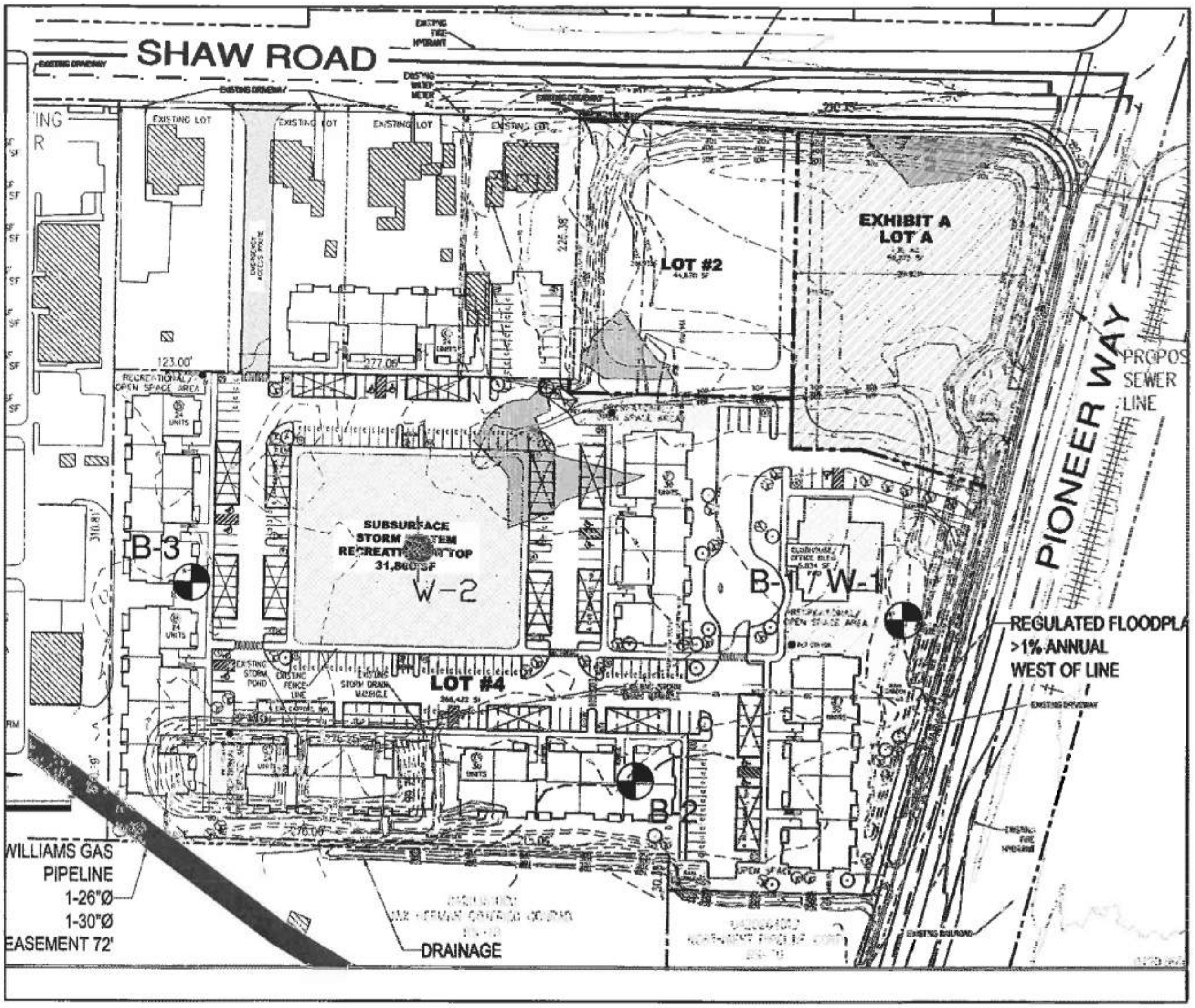
TRN:MDR



Reference: USGS topographic map website, Puyallup, WA, dated 2017.

Vicinity Map

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale



LEGEND

B-1 Number and Approximate Location of Borings

W-1 Approximate Location of Monitoring Well

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan	
East Town Crossing	Figure 2
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Exploratory borings and monitoring wells were drilled and sampled for subsurface exploration at this site. The soil explorations reached depths of approximately 38.5 feet below the existing ground surface. The approximate exploratory boring locations are shown on the Site Plan (Figure 2). The logs of the soil explorations and monitoring wells are presented in this appendix. The depths shown on the attached logs are from the existing ground surface at the time of our exploration.

The drilled borings were advanced using a subcontracted drilling rig. Soil samples were obtained by using the Standard Penetration Test (SPT) as described in ASTM Test Method D1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring logs in this appendix. The resistance, or "N" value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field during the exploration and are described in general accordance with the Unified Soil Classification System (USCS). All samples were returned to our laboratory for evaluation.

Laboratory Testing

The laboratory testing program was developed primarily to determine the index properties of the soils. Test results were used for soil classification and as criteria for determining the engineering suitability of the surface and subsurface materials encountered.

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No. B-1
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hollow Stem Augers
Notes: Monitoring Well W-1 installed in borehole.	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual
Ground Surface Elevation: 72 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 21.5 ft.

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 6 to 8-inch thick stiff sandy clay layers, medium dense, moist	
		SPT	1-1	1 6 9	15			
							Brownsih Grey Poorly Graded SAND (SP), fine grained, medium dense, moist	
	5	SPT	1-2A 1-2B	4 5 5	10		Alternating 4 to 12-inch thick layers of brown Sandy SILT (ML) and Silty SAND (SM), medium stiff/loose, moist to wet	% Si/Cl = 78.5 % MC = 35.4
	▼	SPT	1-3A 1-3B	1 1/12"	1/12"		Dark Brownish Grey Silty CLAY (CL) with marsh grass, seams of peat and thin roots, very soft, wet	LL = 35 PI = 1 % F. Sa = 19.8 % Si/Cl = 79.1 % MC = 51.2
	10	SPT	1-4	1 2 6	8		--- Becomes Clayey SILT (ML), with fine sand and thin roots, very soft	
							Dark Grey/Black Silty SAND (SM), fine to medium grained, loose, wet	
	15	SPT	1-5	5 4 4	8		--- Same	
	20	SPT	1-6	4 12 12	24		--- Becomes Poorly Graded SAND (SP-SM) with Silt, fine to medium grained, medium dense, wet	
							End of Boring at 21.5 Feet	
	25							

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Roac Group	Boring No. B-2
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Gec cgic Drill Partners
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hol cw Stem Augers
Notes:	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb Manual
Ground Surface Elevation: 73 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 38.5 ft.

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							5 inches Grass and Topsoil	
		SPT	2-1	2 2 5	7		Brown Silty SAND (SM), fine grained, with occassional sandy clay seams, loose, moist	
	5	SPT	2-2	3 4 2	6		- - - Same	% Si/Cl = 42.9 % MC = 29.3
		SPT	2-3	4 8 11	19		Brownish Grey Sandy SILT (ML), fine grained, with occassional 1 to 2-inch thick seams dark grey fine sand, moist to wet, stiff	% Si/Cl = 88.2 % MC = 37.0
	10	SPT	2-4	5 8 8	16		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	% Si/Cl = 14.5 % MC = 25.0
	15	SPT	2-5	28 12 12	24		- - - Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense	% Grav = 0 % Sa = 90.8 % Si/Cl = 8.9 % MC = 22.6
							- - - At 18 feet, drilling choppy due to lots of gravel	
	20	SPT	2-6	18 40 20/8"	60/8"		Dark Grey/Black Poorly Graded GRAVEL (GP-GM) with sand and silt, very dense, wet	
	25							

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No.	B-2
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners	
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat	
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hollow Stem Augers	
Notes:	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual	
Ground Surface Elevation: 73 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 38.5 ft	

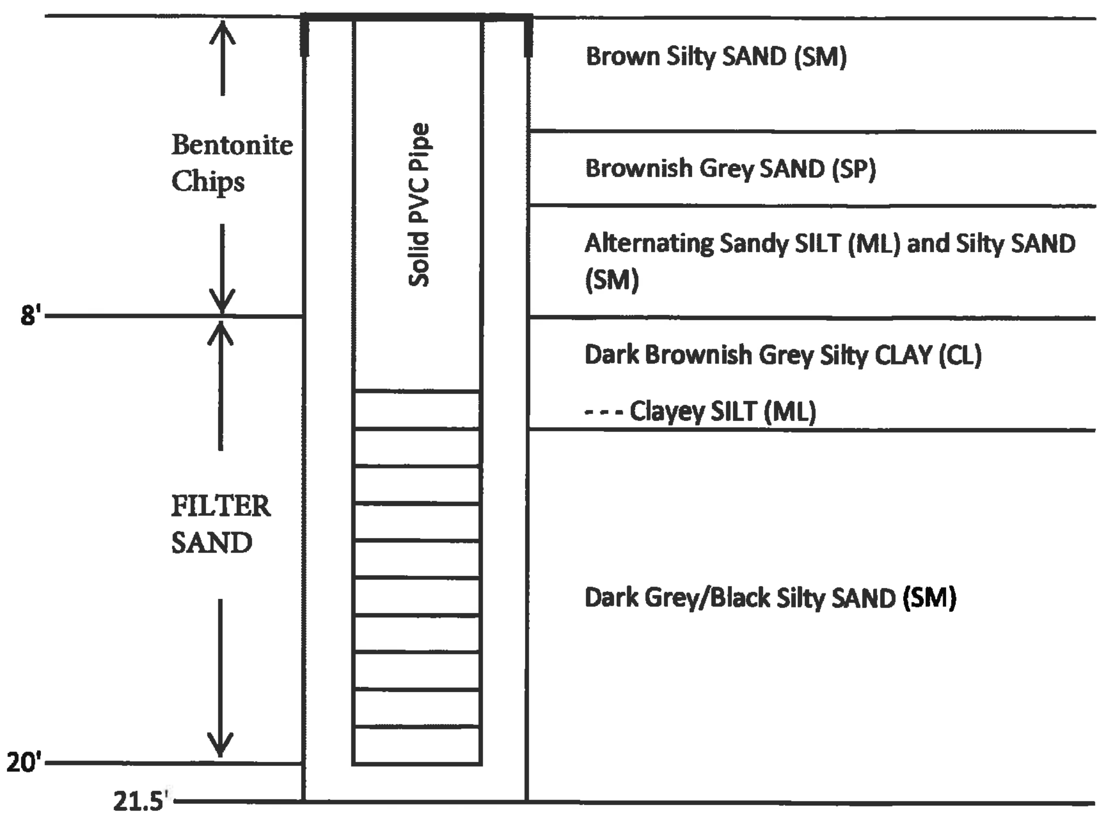
Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
	25	SPT	2-7	10 9 14	23		Dark Grey SAND (SP-SM) with Silt, trace gravel, fine to coarse grained, with occassional 3 to 4-inch thick seams gravel (GP-GM) with silt, medium dense, wet	
	30	SPT	2-8	4 4 15	19		--- Same	% Grav = 9.0 % Sa = 82.5 % Si/Cl = 8.5 % MC = 18.8
	35	SPT	2-9	6 5 10	15		At 33 feet, alternating 4 to 12-inch thick layers of Dark Grey/Black SAND (SP-SM) with gravel and silt AND Dark Grey/Black GRAVEL (GP-GM) with sand and silt, medium dense, wet	% Si/Cl = 5.6 % MC = 18.9
		SPT	2-10	37 20 17	37		--- Becomes dense	% Grav = 44.8 % Sa = 47.4 % Si/Cl = 7.8 % MC = 9.4
	40						**End of Boring at 38.5 Feet**	
	45							
	50							

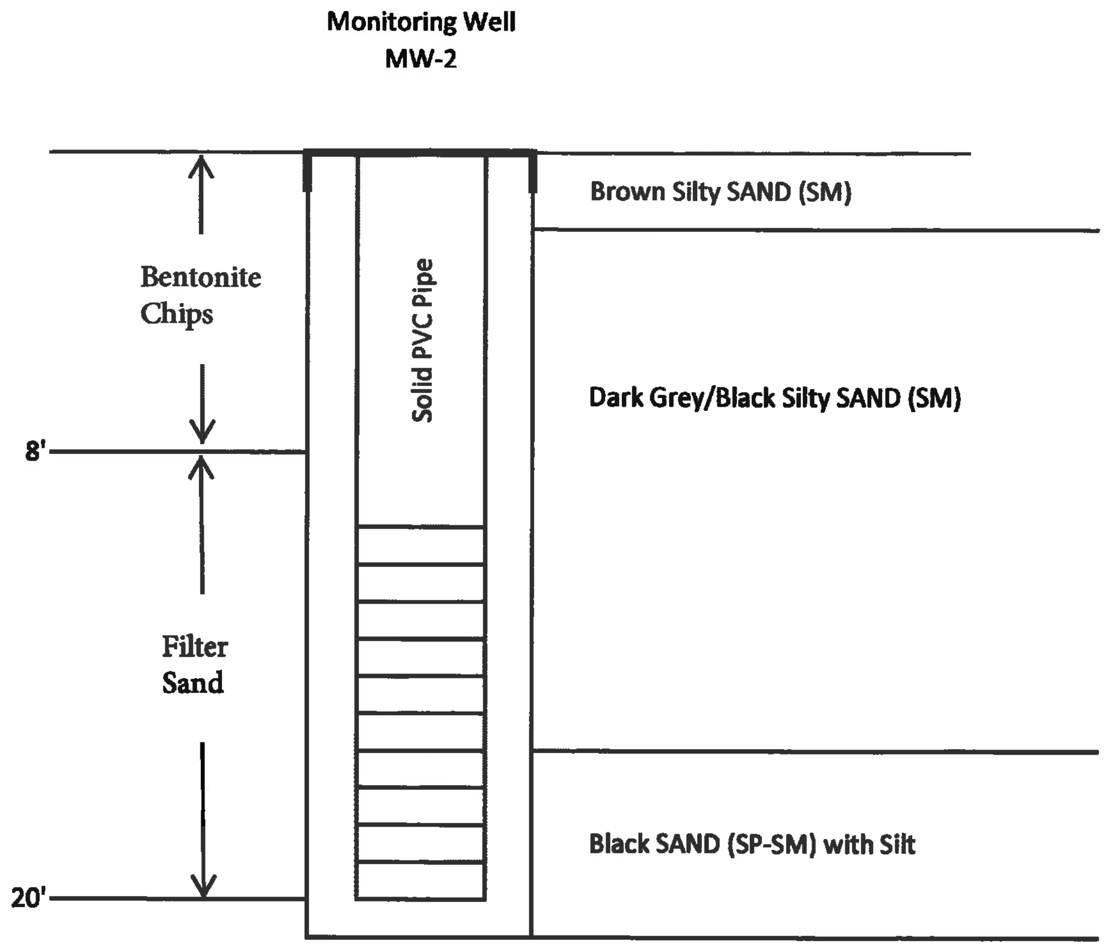
Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No. B-3
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners
Project Manager: Theresa Nunan	Date – Started: 3.11.2019		Equipment: Track Bobcat
Field Engineer: Theresa Nunan	Date – Completed: 3.11.2019		Drilling Method: Hollow Stem Augers
Notes:	Date – Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual
Ground Surface Elevation: 74 +/- feet MSL	Groundwater Depth: 7 feet		Total Depth of Boring: 21.5 ft.

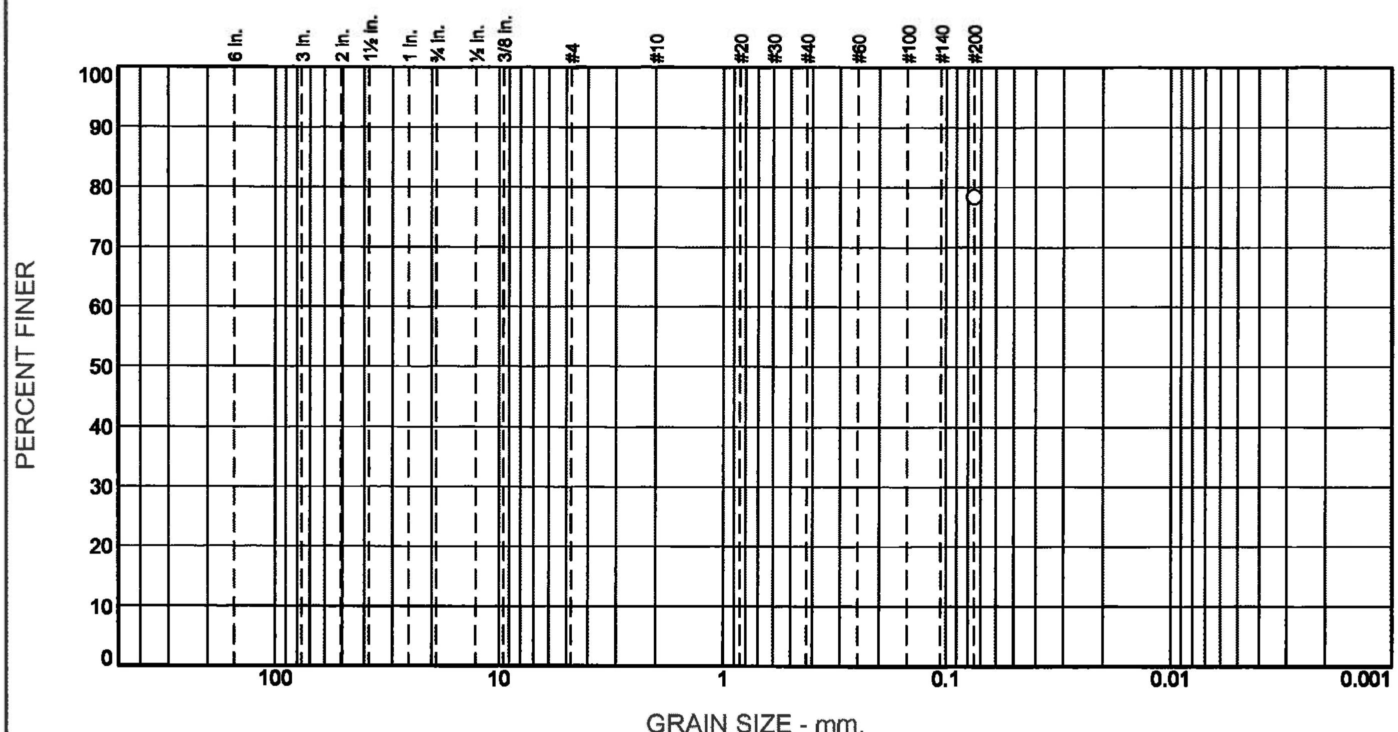
Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
	0–2						Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 2 to 3-inch thick stiff sandy clay layers, loose, moist	
		SPT	3-1	2 4 5	9			
	2–6						Brownish Grey Sandy SILT (ML), fine grained, with occassional 0.5 to 2-inch thick seams dark grey fine sand, stiff, moist to wet, stiff	
	5	SPT	3-2	4 6 6	12			
	7 (groundwater)							
		SPT	3-3	5 5 5	10		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	
	10	SPT	3-4	3 5 7	12			
							--- Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense, wet	
	15	SPT	3-5	6 10 7	17			
							Dark Grey/Black Silty SAND (SM), fine to medium grained, with a 4-inch thick seam of peat at 20 feet, medium dense, wet	
	20	SPT	3-6	4 6 8	14			
							End of Boring at 21.5 Feet	
	25							

Monitoring Well
MW-1




Monitoring Well
MW-2
Brown Silty SAND (SM)
Bentonite
Chips
Solid PVC Pipe
Dark Grey/Black Silty SAND (SM)
8'
Filter
Sand
Black SAND (SP-SM) with Silt
20'

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						78.5

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	78.5		

* (no specification provided)

Material Description

Brown Sandy SILT

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L131
Sample Date:3-11-19
Moisture Content = 35.4 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

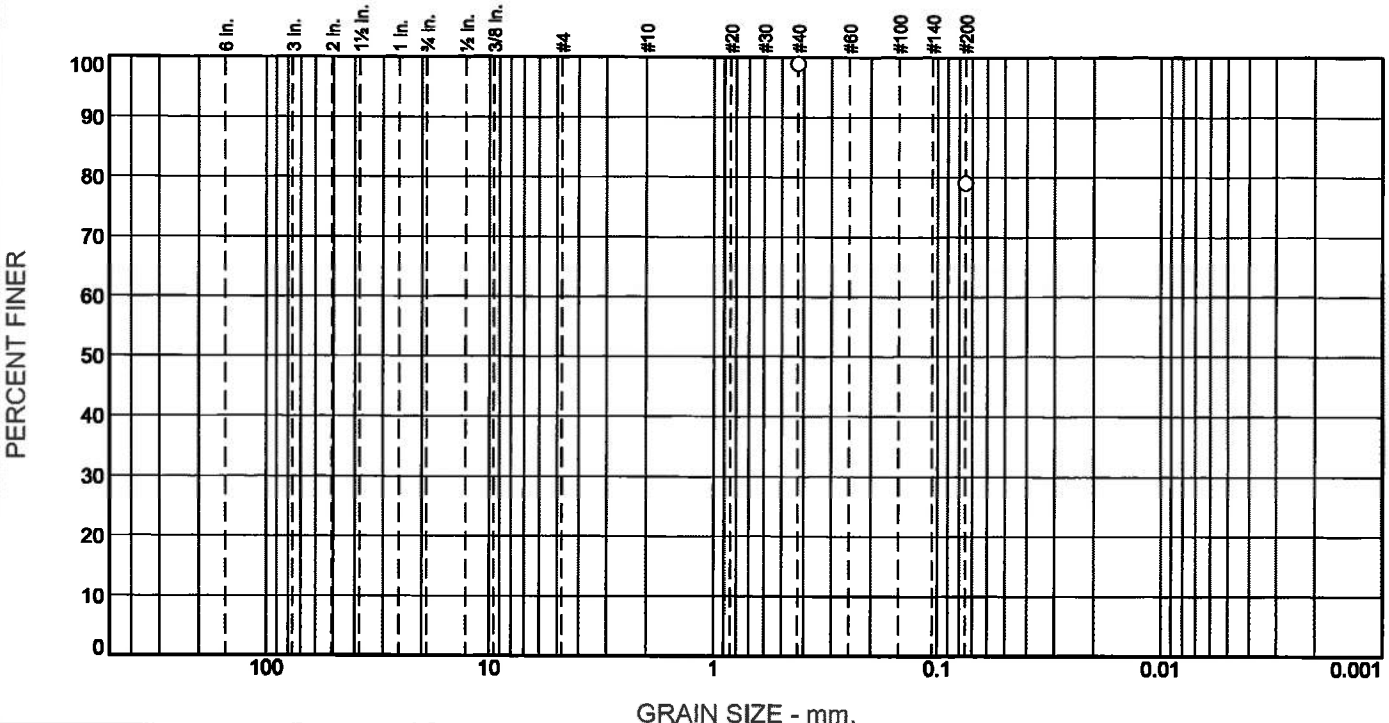
Location: B-1 Sample 1-2B **Date Sampled:** 3-11-19
Sample Number: 19L131 **Depth:** 5'-6.5'

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
					19.8	79.1

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#40	98.9		
#200	79.1		

* (no specification provided)

Material Description

Grey Clayey SILT with fine sand

Atterberg Limits (ASTM D 4318)

PL= 33.5 LL= 34.9 PI= 1.4

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= 0.1948 D_{85}= 0.1258 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L120
Sample Date:3-11-19
Moisture Content = 51.2 %

Date Received: 3-15-19 **Date Tested:** 3-15-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

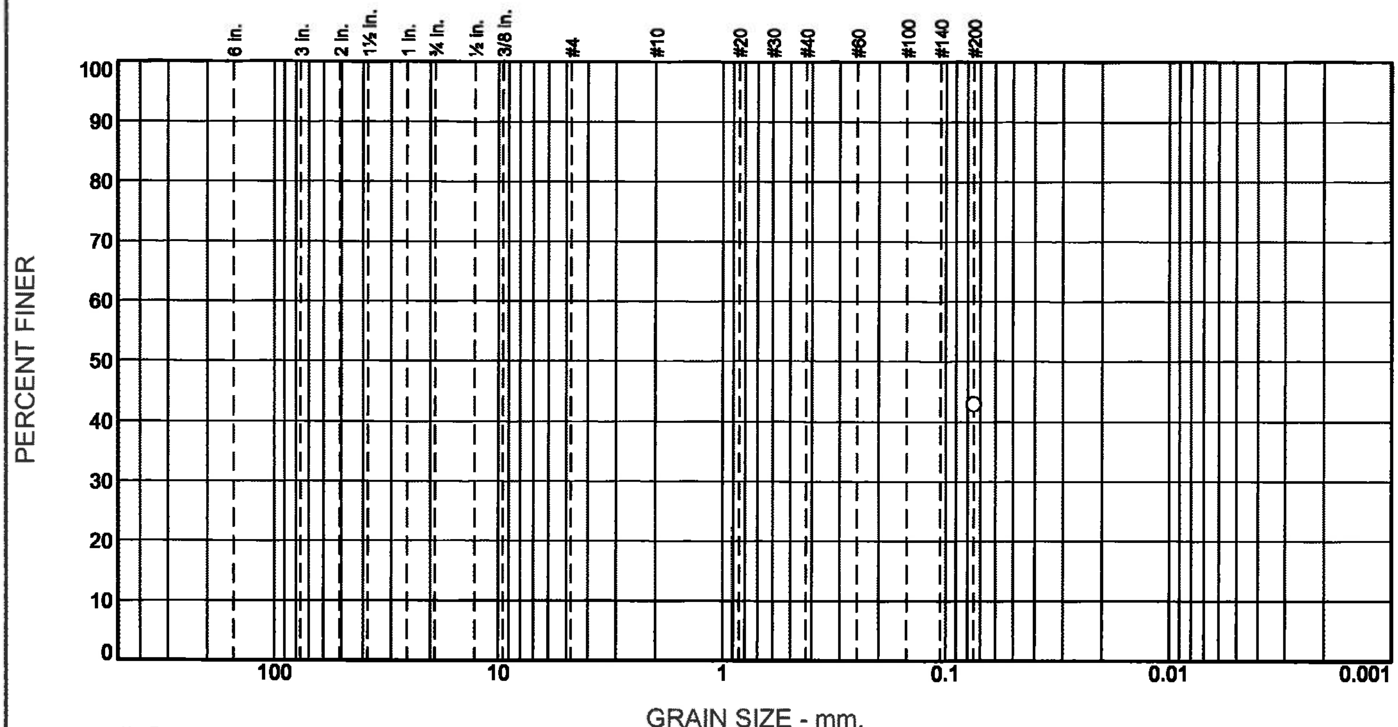
Location: B-1 Sample 1-3B
Sample Number: 19L120 **Depth:** 7.5'-9' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						42.9

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	42.9		

* (no specification provided)

Material Description

Brown silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L132
Sample Date:3-11-19
Moisture Content = 29.3 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

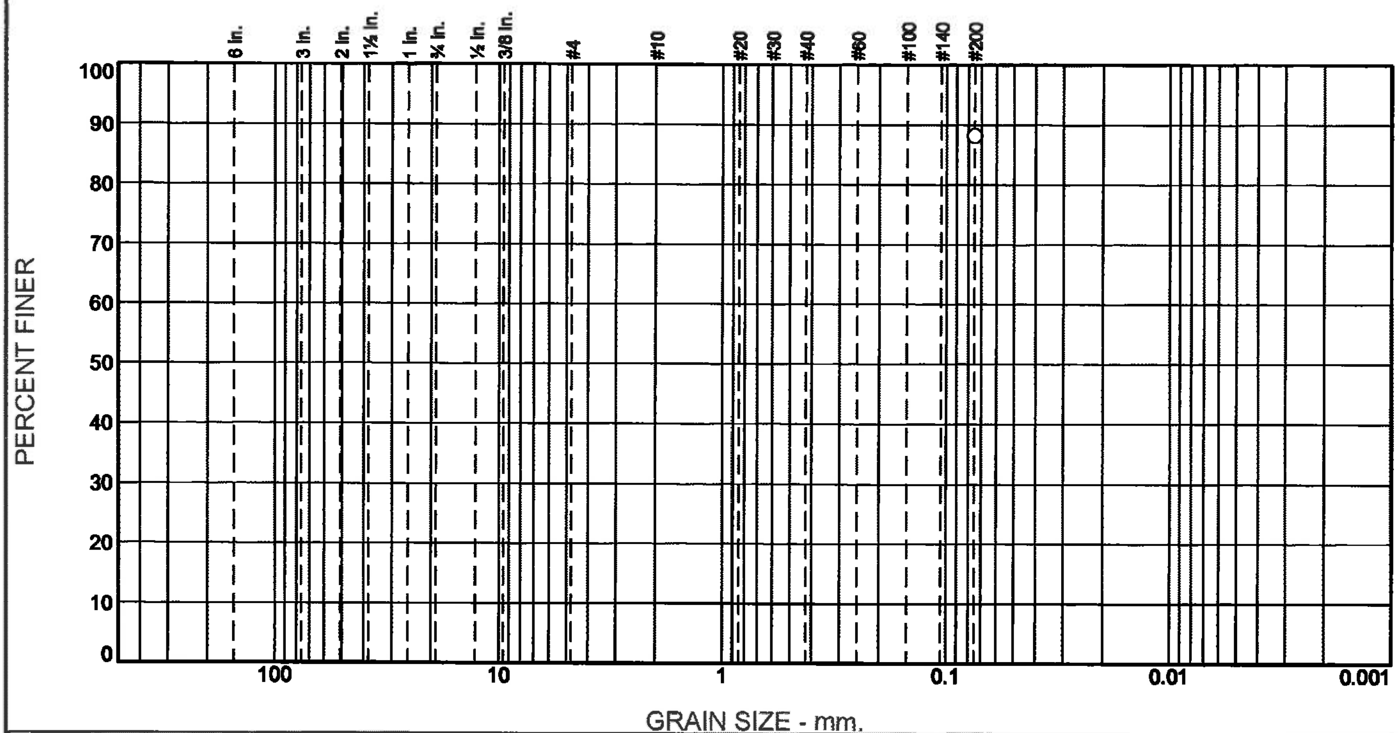
Location: B-2 Sample 2-2
Sample Number: 19L132 **Depth:** 5'-6.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						88.2

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	88.2		

* (no specification provided)

Material Description

Brown sandy silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}=	D_{85}=	D_{60}=
D_{50}=	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Sample ID:19L133
Sample Date:3-11-19
Moisture Content = 37.0%

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-3
Sample Number: 19L133 **Depth:** 7.5'-9' **Date Sampled:** 3-11-19

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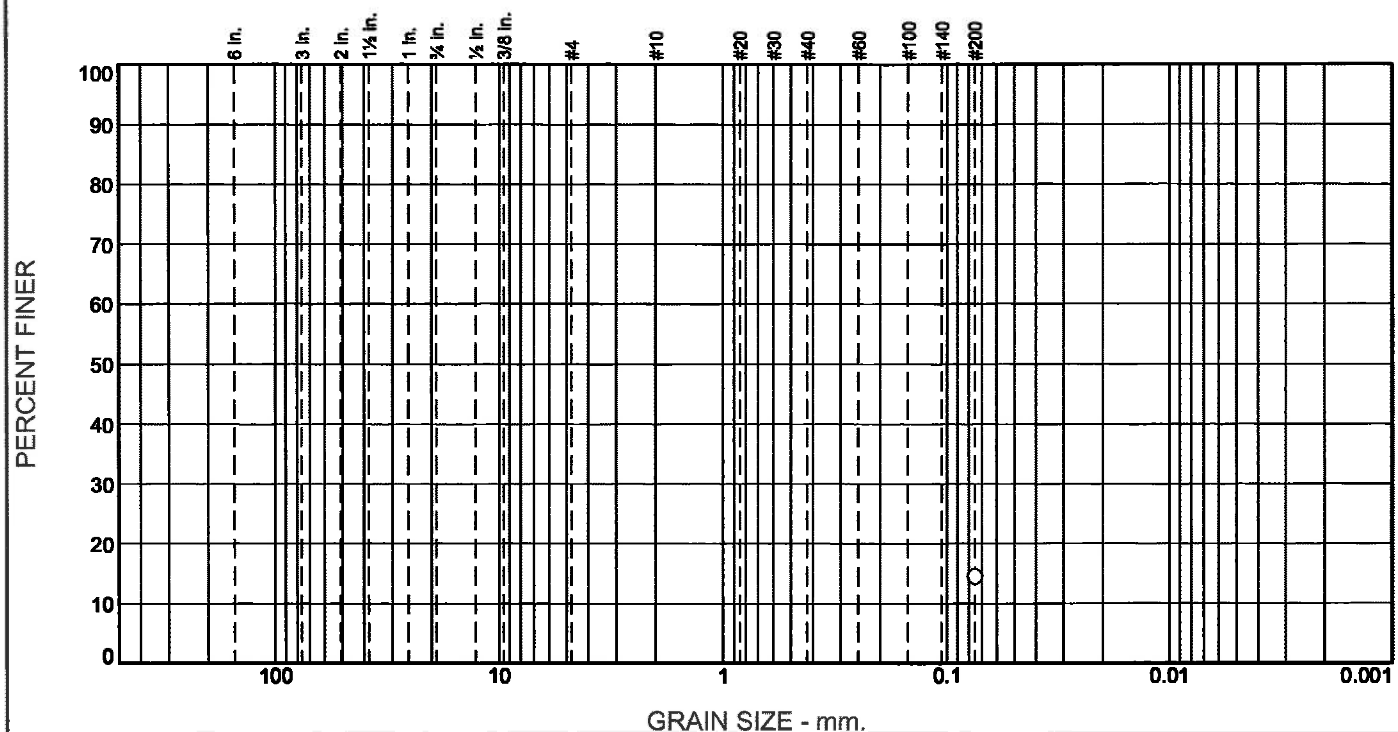
Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						14.5

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	14.5		

* (no specification provided)

Material Description

Dark Grey/Black silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L134
sample Date:3-11-19
Moisture Content = 25.0 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-4
Sample Number: 19L134 **Depth:** 10'-11.5'
Date Sampled: 3-11-19

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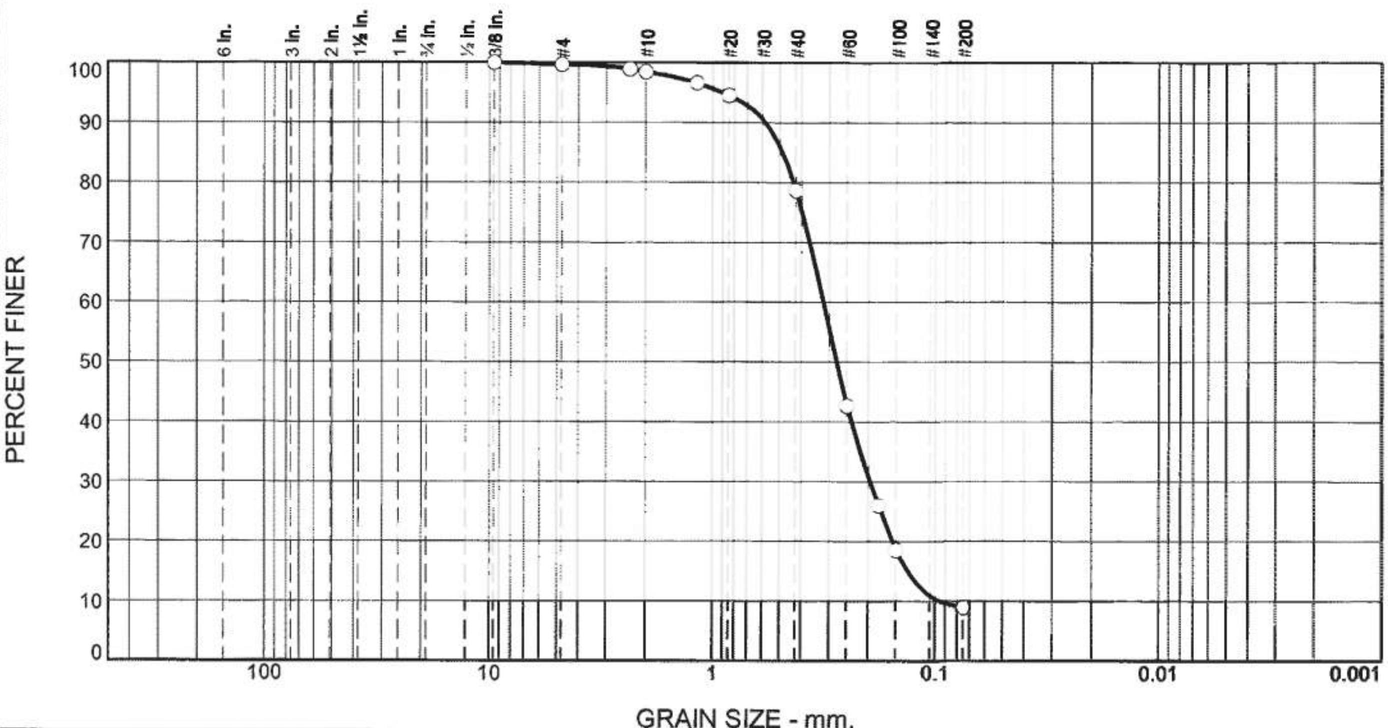
Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.3	1.2	19.8	69.8	8.9

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.7		
#8	98.9		
#10	98.5		
#16	96.6		
#20	94.5		
#40	78.7		
#60	42.7		
#80	26.0		
#100	18.5		
#200	8.9		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

Coefficients

D_{90}= 0.5827 D_{85}= 0.4892 D_{60}= 0.3205
D_{50}= 0.2792 D_{30}= 0.1966 D_{15}= 0.1334
D_{10}= 0.0956 C_u= 3.35 C_c= 1.26

Remarks

Sample ID:19L121
Sample Date:3-11-19
Moisture Content = 22.6 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials laboratory Manager

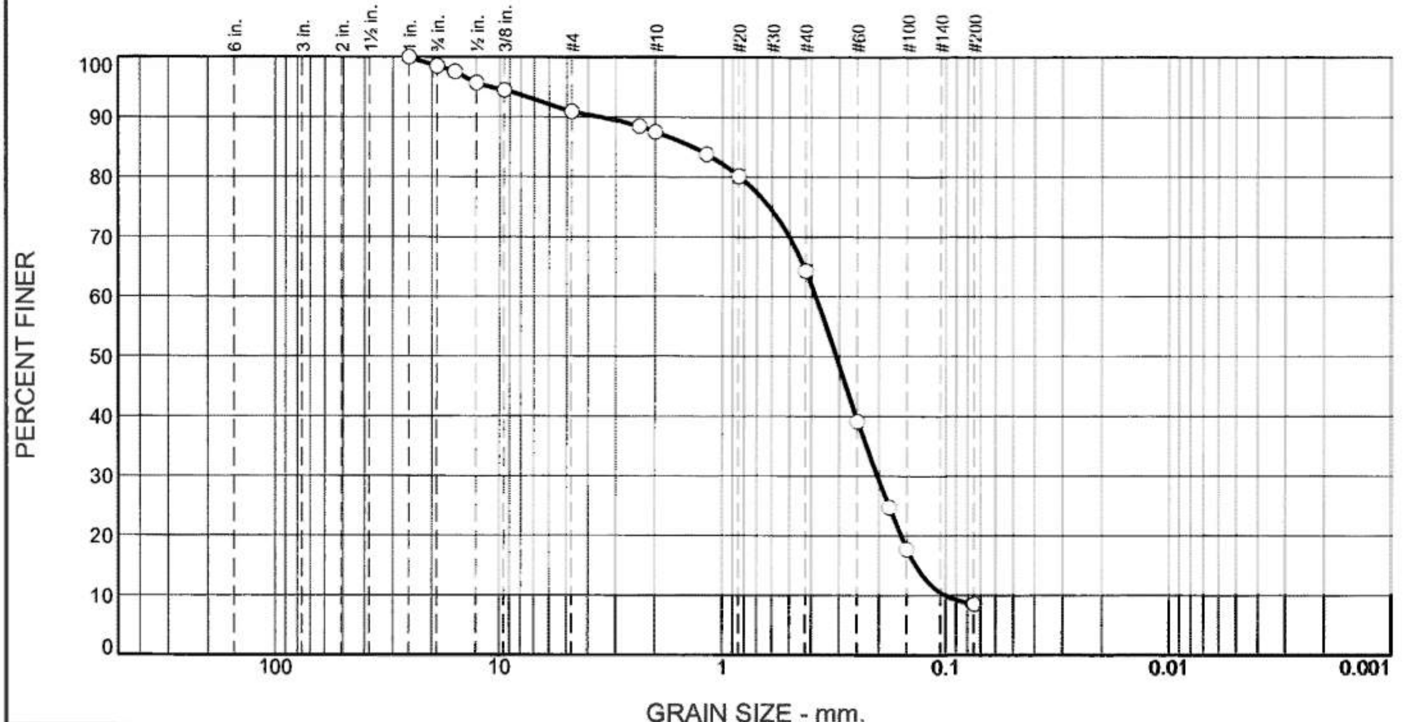
Location: B-2 Sample 2-5
Sample Number: 19L121 **Depth:** 15'-16.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	1.4	7.6	3.5	23.3	55.7	8.5

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	98.6		
.625	97.6		
.5	95.7		
.375	94.5		
#4	91.0		
#8	88.5		
#10	87.5		
#16	83.8		
#20	80.2		
#40	64.2		
#60	39.1		
#80	24.7		
#100	17.7		
#200	8.5		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

Coefficients

D_{90}= 3.5671 D_{85}= 1.3567 D_{60}= 0.3839
D_{50}= 0.3115 D_{30}= 0.2039 D_{15}= 0.1371
D_{10}= 0.1011 C_u= 3.80 C_c= 1.07

Remarks

Sample ID:19L122
Sample Date:3-11-19
Moisture Content = 18.8 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

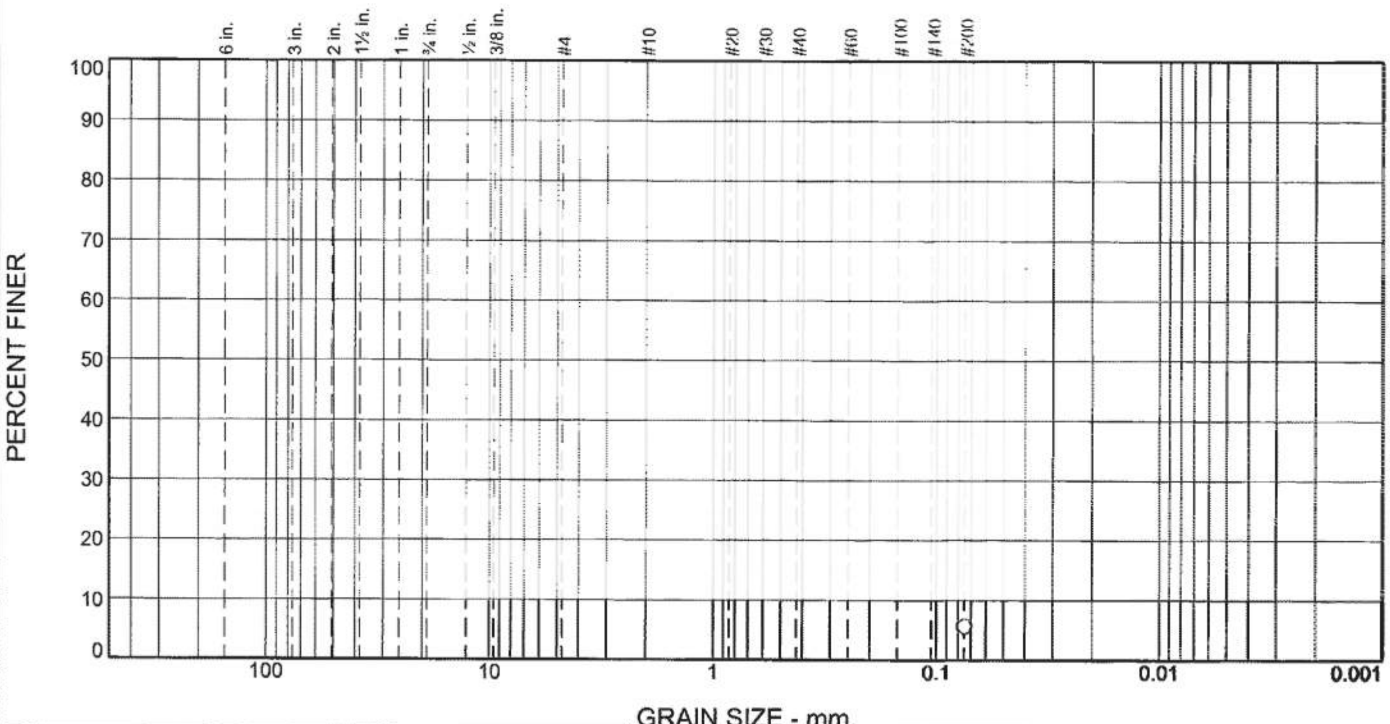
Location: B-2 Sample 2-8 **Date Sampled:** 3-11-19
Sample Number: 19L122 **Depth:** 30'-31.5'

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						5.6

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	5.6		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L135
Sample Date:3-11-19
Moisture Content = 18.9 %

Date Received: 3-15-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

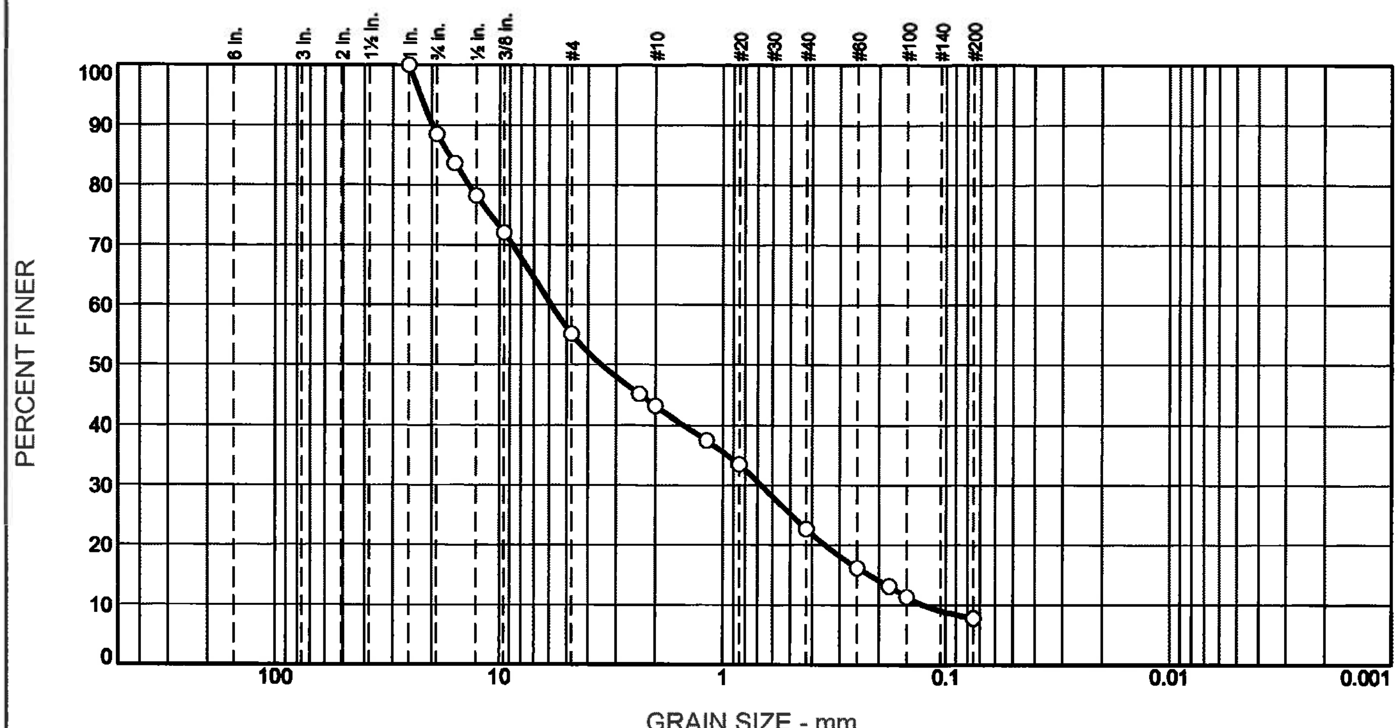
Location: B-2 Sample 2-9
Sample Number: 19L135 **Depth:** 35'-36.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	11.5	33.3	12.0	20.5	14.9	7.8

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	88.5		
.625	83.7		
.5	78.3		
.375	72.1		
#4	55.2		
#8	45.1		
#10	43.2		
#16	37.5		
#20	33.5		
#40	22.7		
#60	16.2		
#80	13.2		
#100	11.4		
#200	7.8		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt and gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-a

Coefficients

D_{90}= 19.9452 D_{85}= 16.7747 D_{60}= 5.8717
D_{50}= 3.4968 D_{30}= 0.6741 D_{15}= 0.2194
D_{10}= 0.1253 C_u= 46.85 C_c= 0.62

Remarks

Sample ID:19L123
Sample Date:3-11-19
Moisture Content = 9.4 %

Date Received: 3-11-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-10
Sample Number: 19L123 **Depth:** 37'-38.5'

Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, **the recommendations in the report have precedence**.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and Civil Engineer are the Owner's representatives. If the contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density of not less than 95 percent of maximum dry density as determined by ASTM Test Method D1557 as specified in the technical portion of the Geotechnical Engineering Report. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Geotechnical Engineer.

SOIL AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the contractor for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including Court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

General site clearing should include removal of any organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas.

SUBGRADE PREPARATION: Subgrade should be prepared as described in our site preparation section of this report.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Geotechnical Engineer. All materials utilized for constructing site fills shall be free from vegetable or other deleterious matter as determined by the Geotechnical Engineer.

PLACEMENT, SPREADING, AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer.

Both cut and fill shall be surface compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. **DEFINITIONS** – The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

2. **SCOPE OF WORK** – This portion of the work shall include all labor, materials, tools, and equipment necessary for and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. **PREPARATION OF THE SUBGRADE** – Subgrade should be prepared as described in our site preparation and pavement design sections of this report.

4. **AGGREGATE BASE** – The aggregate base shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base should conform to WSDOT Standard Specification for Crushed Surfacing Base Course or Top Course (Item 9-03.9(3)). The base material shall be compacted to a minimum compaction of 95% as determined by ASTM D1557. Each layer of subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. **ASPHALTIC CONCRETE SURFACING** – Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The drying, proportioning, and mixing of the materials shall conform to WSDOT Specifications.

The prime coat, spreading and compaction equipment, as well as the process of spreading and compacting the mixture, shall conform to WSDOT Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with combination steel-wheel and pneumatic rollers, as described in WSDOT Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

6. **TACK COAT** – The tack (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of WSDOT Specifications.

Steep Slope Addendum Letter

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

July 31, 2020

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide our opinion regarding the nearby steep slopes. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019.

Based on our communication with you, it is our understanding that the City of Puyallup has requested to provide our opinion on the hazards and risks to the site due to the site being within 300 feet of steep slopes.

We have reviewed Washington State Department of Natural Resources (DNR), City of Puyallup, and Pierce County published landslide hazard maps and web data. We have also reviewed the Landslide Inventory, Susceptibility, and Exposure Analysis of Pierce County, Washington (DNR), prepared by Katherine A. Mickelson et al., and dated July 2017.

Based on our review, we understand that steep slopes are located roughly 300 feet to the south and east from the site. These nearby slopes are mapped moderate to high for shallow landslide susceptibility, and moderate for deep susceptibility. However, there are no historic landslides or debris mapped at the nearby slopes. The closest landslide mapped is located roughly 1 mile southeast of the site.

There is an existing developed property between the nearby southern slope and the southern boundary of the site. There is a partially developed property between the nearby eastern slope and the eastern boundary of the site. In our opinion, these properties to the south and east create a buffer between the nearby slopes and the site. Based on our review of available published documents and maps, it is our opinion that there is minimum to no risk to the planned development from the nearby slopes.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

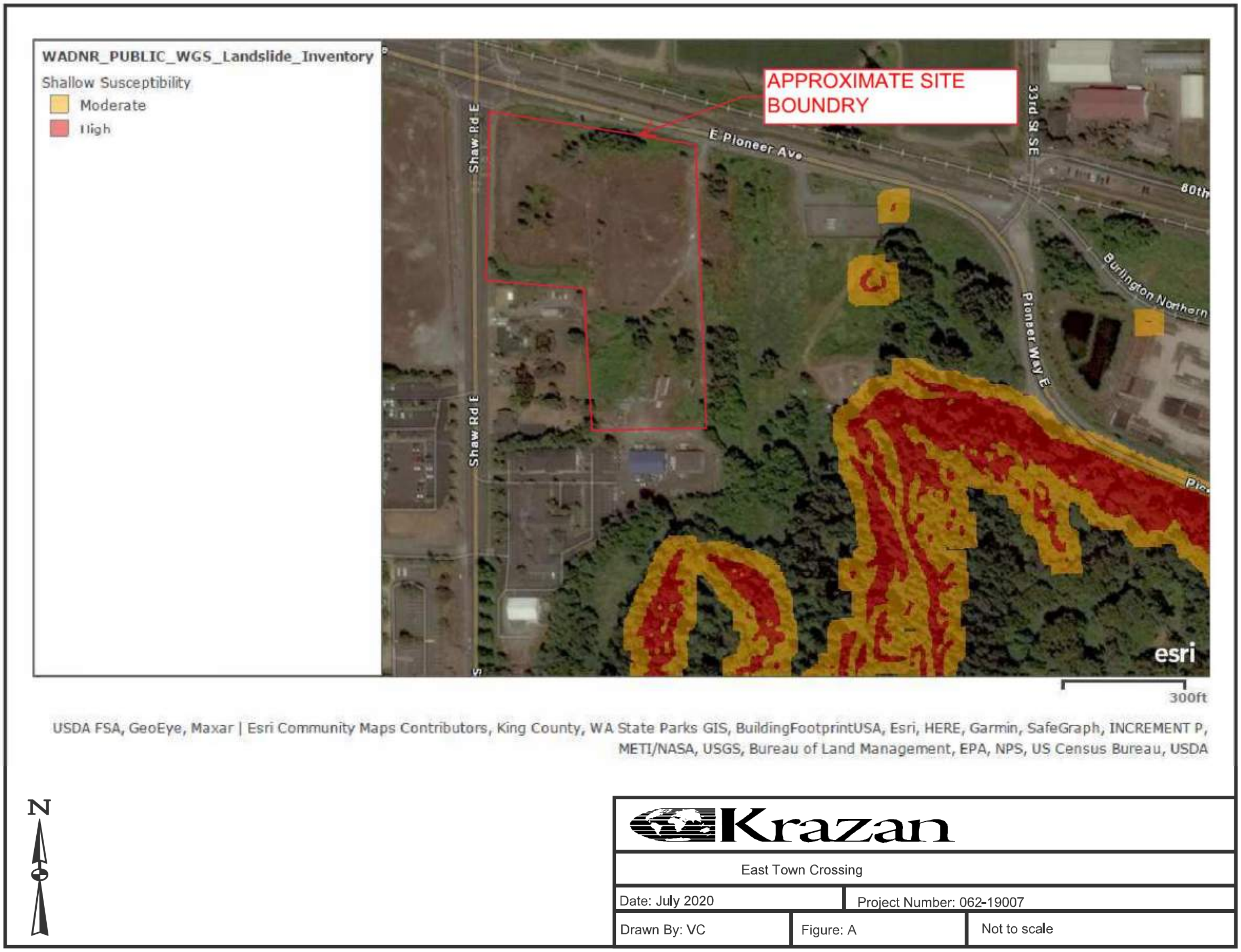
07/31/20

Theresa Nunan

Vijay Chaudhary, P.E.
Project Engineer

Theresa R. Nunan
Project Manager

Attachments: WA DNR Landslide Inventory Maps (Figures A, B, and C)



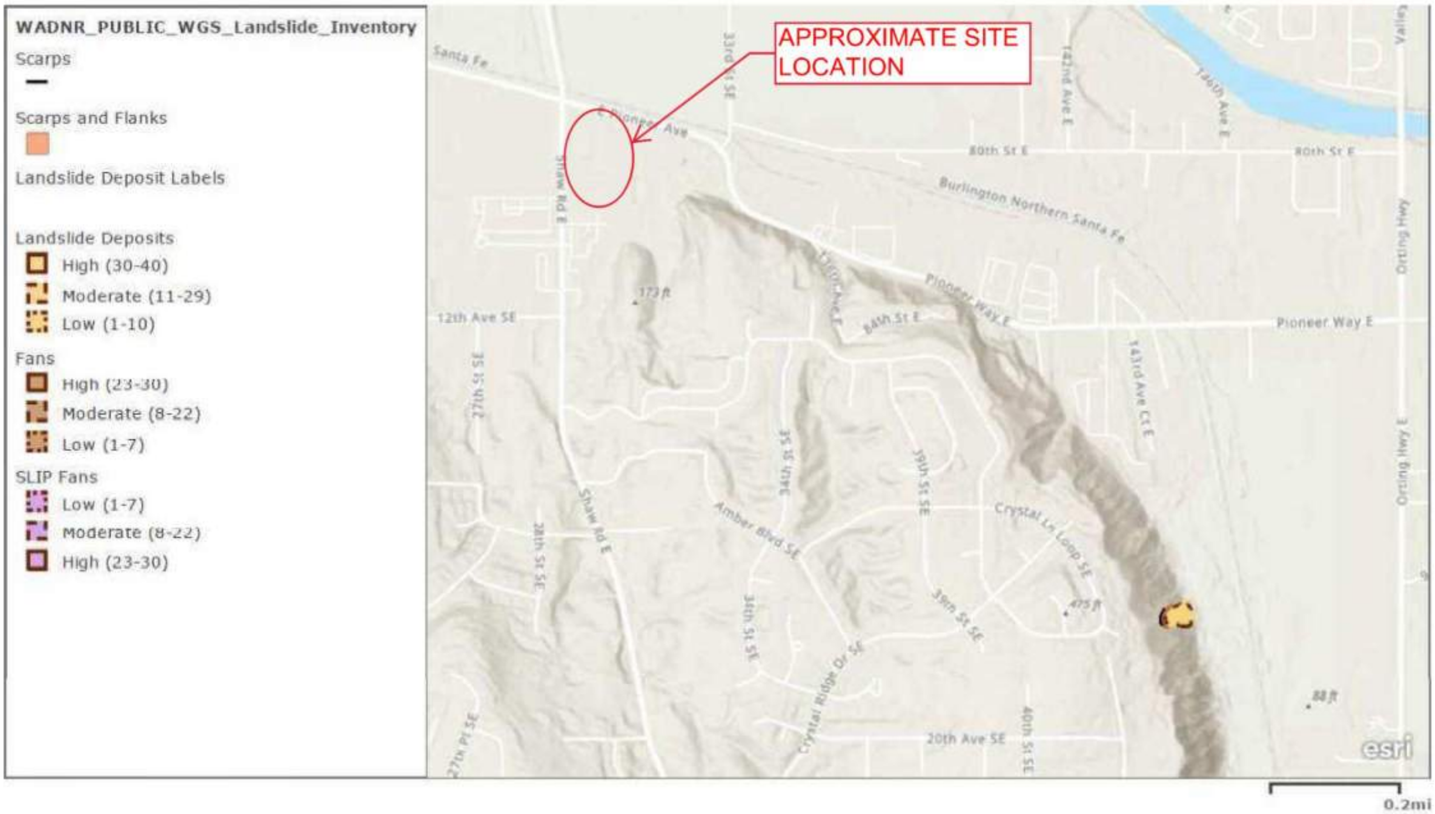
Krazan		
East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: A	Not to scale

USDA FSA, GeoEye, Maxar | Esri Community Maps Contributors, King County, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan

East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: B	Not to scale



Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, King County, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan		
East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: C	Not to scale

March 19, 2021

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide the results of two (2) Large-Scale Pilot Infiltration Tests (PITs) we conducted at the above-referenced site. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019, as well as an addendum letter dated July 31, 2020 that addressed the nearby steep slopes.

Large-Scale PITs

Two (2) test pits, designated P-1 and P-2, were excavated near Monitoring Wells MW-1 and MW-2, respectively, on March 4, 2021 at the approximate locations indicated on the Site Plan, Figure 1, in order to conduct large-scale infiltration tests in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The infiltration test locations were selected in the field by the client and excavated using a client provided excavator and operator. The bottom of each pit was excavated 10-feet wide by 10-feet long, which met the minimum required horizontal surface area of 100 square feet (sf). Each test pit was initially excavated to a depth of 2 feet below the existing ground surface (bgs), which exposed silty sand (SM) soils at the pit bottom. Water was observed seeping from the sides of pit P-1 during excavation, and was observed ponded at the ground surface at several locations in the vicinity of pit P-1. Test pits P-1 and P-2 encountered undocumented fill to a depth of 1.8 feet and 0.5 feet bgs, respectively, followed by native brown silty sand (SM) with trace gravel and occasional sandy silt and sandy clay seams and layers to the bottom of the test pits. The soils exposed at the PIT test depth were similar to those encountered in the geotechnical borings conducted during our original exploration of the site.

The infiltration test procedure includes a pre-soak period, followed by steady-state and then falling head infiltration rate testing. Each pit was filled with water to a depth of 12 inches above the bottom of the pit for the pre-soak period. After two (2) hours of pre-soak, the water hose was turned off as even just a slight trickle caused the water level in the pit to continue to rise. Water level readings were obtained for an additional 4 hours in pit P-2 with no change in the water level, while the water level in pit P-1 increased ¾-inches which we attributed to seepage from the sides of this pit which were observed during its excavation. Since the water in pits P-1 and P-2 was not infiltrating, we left the pits open overnight, and returned to the site to record the water level. Since it had commenced to rain just prior to our leaving the site, a 5-gallon bucket was left at the location of pit P-2 to obtain an estimate of the amount of rain that fell overnight. We recorded 0.6 inches of rain in the bucket the following morning. On the morning of March 5, 2021, the water level in pit P-1 had risen another 1.2 inches, while the water level in pit P-2 rose about 0.3 inches. Figure 2 includes photos of pits P-1 and P-2 taken on March 5, 2021. The pits were not over-excavated due to the presence of water. The contractor had excavated three test pits within the northwestern corner of the site on March 4, 2021. We observed about 8 to 10 inches of water in the bottom of two of the test pits on March 5, 2021.

Evaluation of Infiltration Feasibility: One of the Site Suitability Criteria (SSC) presented in Section 3.3.7, Volume III, 2014 SWMMWW, **SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer**, states that the base of all infiltration basins or trench systems shall be greater than or equal to 5 feet above the seasonal high-water mark, bedrock (or hardpan), or other low permeability layer. Based on the results of our field exploration and large-scale PITs, the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Based on the results of our general site assessment and field testing, the low permeability soils encountered at the site do not meet the requirements of Site Suitability Criteria SSC-5 and it is therefore our opinion that onsite infiltration of stormwater using basin or trench system is not considered feasible for the proposed development. **However,** consideration may be given to the use of permeable pavement and other Best Management Practices (BMPs), depending on the final site grading plan.

Limitations

This letter has been prepared for the exclusive use of the Abbey Road Group and their assigns, for the specific application to the site. The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

This letter does not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands or other biological conditions. The information presented herein is based upon professional interpretation using standard industry practices and engineering conservatism that we consider proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

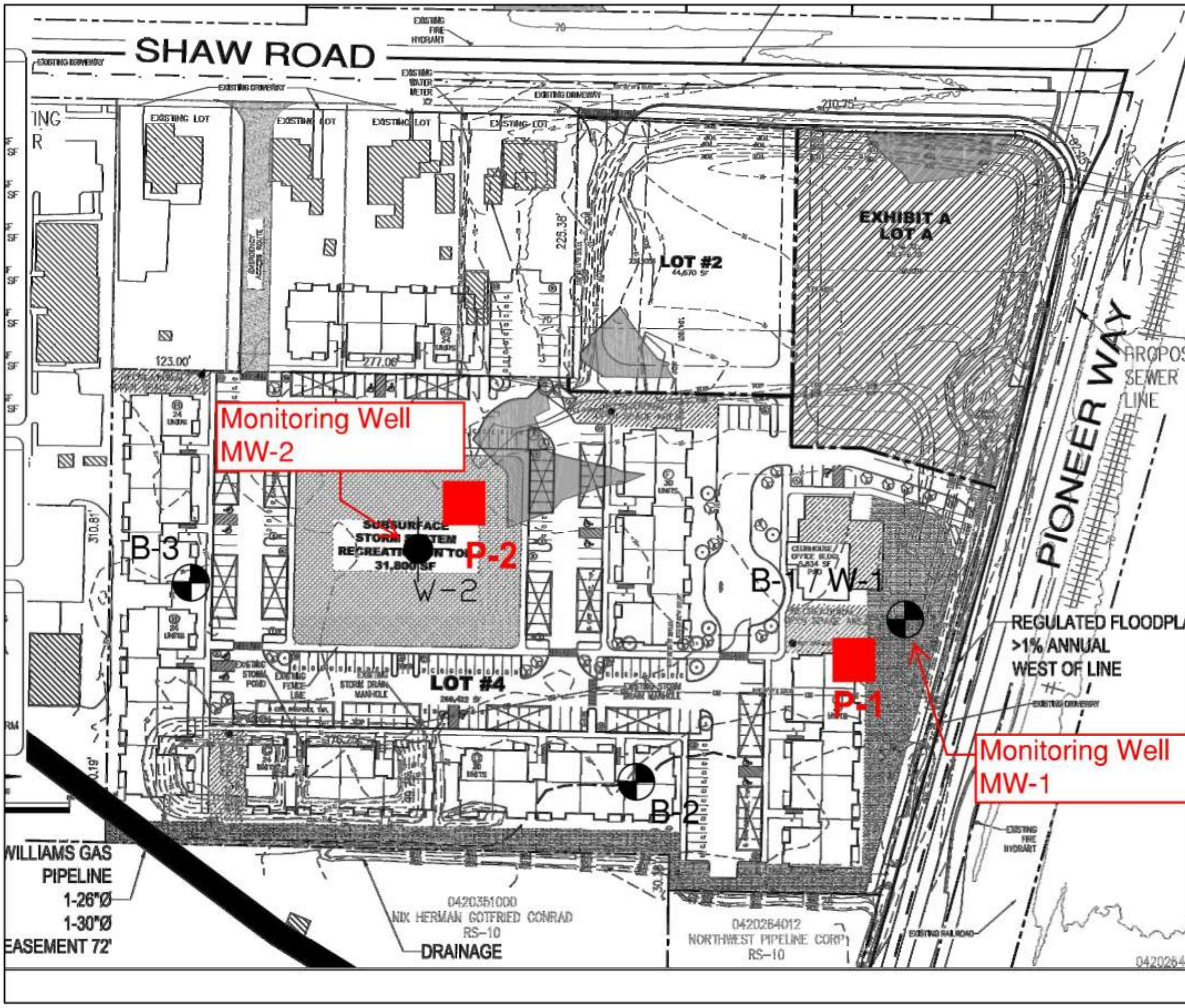
3/19/21

VIJAY CHAUDHARY
STATE OF WASHINGTON
51061
REGISTERED
PROFESSIONAL ENGINEER

Theresa R. Nunan
Project Manager

Vijay Chaudhary, P.E.
Assistant Regional Engineering Manager

Attachments: Figure 1 – Site Plan
Figure 2 – Photos



LEGEND

⊕	B-1	Number and Approximate Location of Borings
⊕	W-1	Approximate Location of Monitoring Well
■	P-1	Approximate Location of Pilot Infiltration Test

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: March 2021
Krazan & ASSOCIATES, INC.	Not to Scale

Water in Pit P-1 on March 5, 2021.

Water in Pit P-2 on March 5, 2021.

Water in Test Pit on March 5, 2021. Test pit was excavated in NE portion of site on March 4, 2021.

Figure 2 - Photos (March 5, 2021)

December 10, 2021 KA Project No. 062-21033

Abbey Road Group, LLC
P.O. Box 11489
Olympia, WA 98508

Attn: Mr. Gil Hulsmann
Tel: 253-435-3699 x1510
Email: gil.hulsmann@abbeyroadgroup.com

Reference: **Laboratory Testing – Recycled Glass**
East Town Crossing Project
SE Corner of E Shaw Road & E Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

The gradation and proctor test results for the two recycled glass samples, one designated "clean" and the other designated "with fines", supplied by Dan Lloyd Construction are attached to this letter. The gradation tests were conducted on the samples 'as received' and again after completing the Proctor compaction tests. As can be seen in the summary of test results, Table 1 attached to this letter, the glass pierces broke down significantly due to the compaction efforts.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

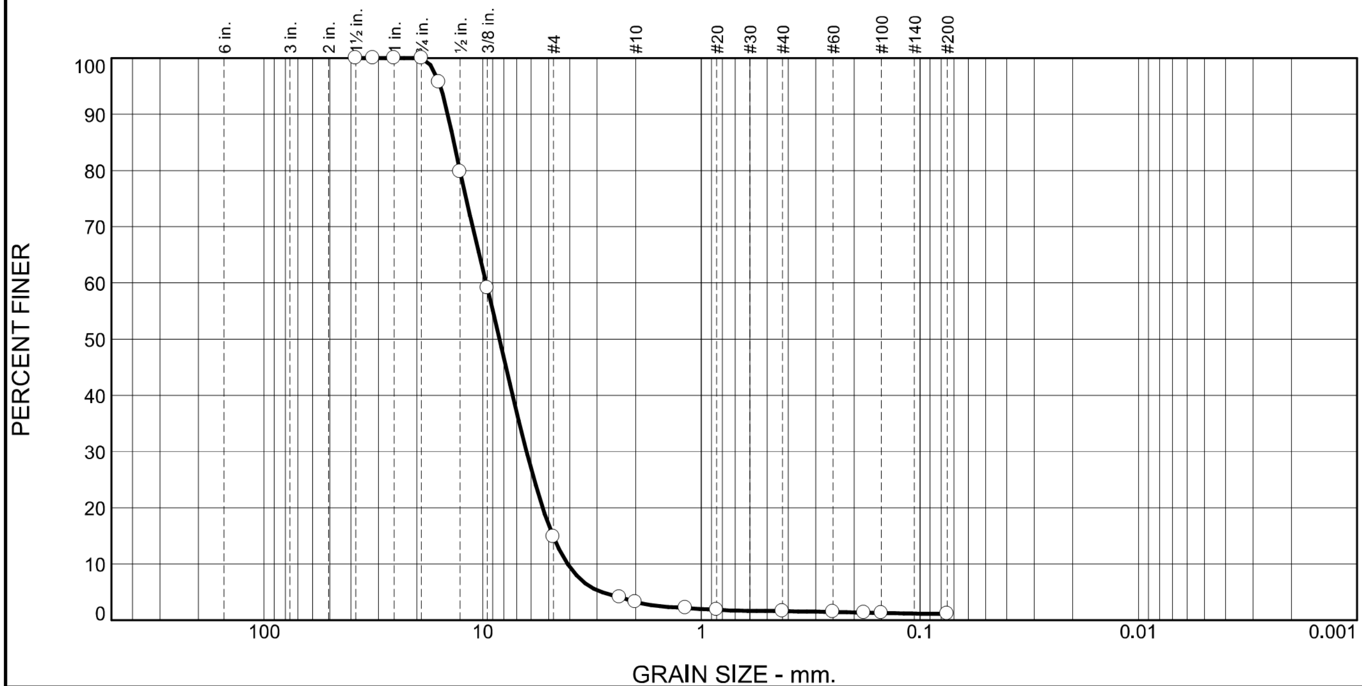
KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan

Theresa R. Nunan
Project Manager

Attachments: Recycled Glass Gradation and Proctor Test Results – "Clean" Sample
Recycled Glass Gradation and Proctor Test Results – "With Fines" Sample
Table 1 – Summary of Recycled Glass Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	85	12	1	1	1	

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	96		
.5	80		
.375	59		
#4	15		
#8	4		
#10	3		
#16	2		
#20	2		
#40	2		
#60	1		
#80	1		
#100	1		
#200	1.2		

* (no specification provided)

Material Description

Recycled Glass Clean - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 14.4630 D_{85}= 13.5519 D_{60}= 9.6467
D_{50}= 8.3902 D_{30}= 6.2995 D_{15}= 4.7699
D_{10}= 4.0959 C_u= 2.36 C_c= 1.00

Remarks

Sample ID:21L892
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

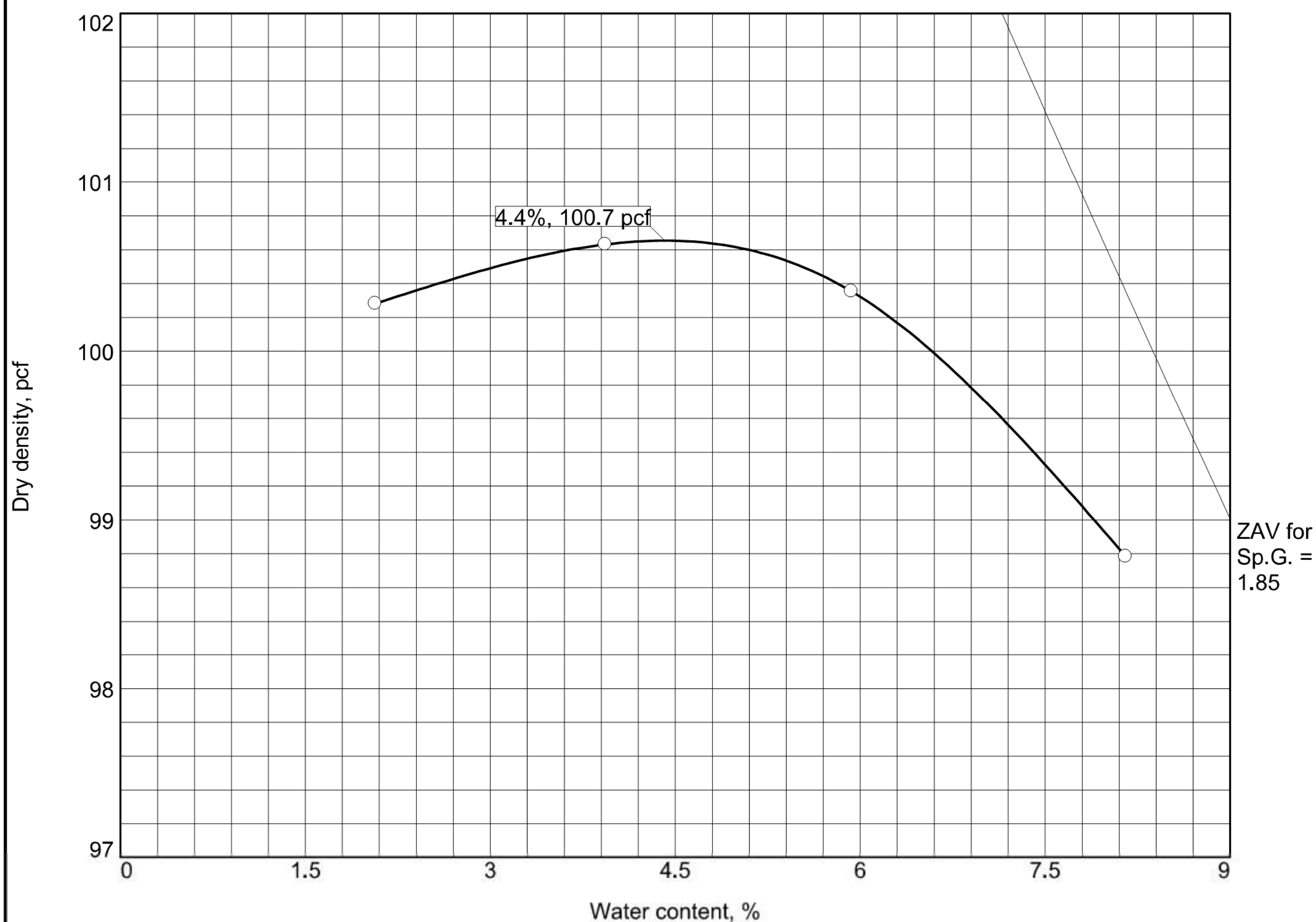
Source of Sample: Dan Lloyd Construction
Sample Number: 21L892
Date Sampled: 11-29-21

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GP	A-1-a		1.85	NV	NP	0	1.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 100.7 pcf Optimum moisture = 4.4 %	Recycled Glass Clean. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services

Project: East Town Crossing Lab Testing - Recycled Glass

○**Source of Sample:** Dan Lloyd Construction **Sample Number:** 21L892

Krazan

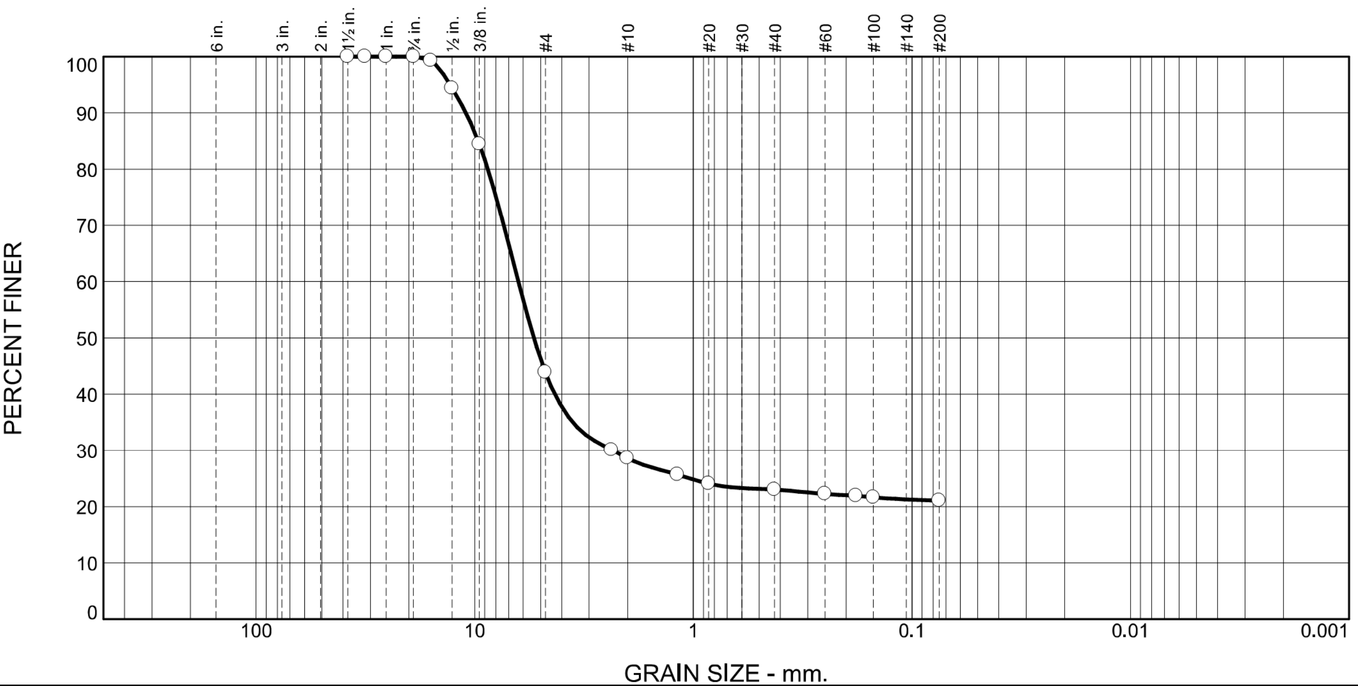
Remarks:

Sample ID:21L892
Sample Date:11-29-21
Void Ratio:0.14
Porosity:12%

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	56	15	6	2	21	

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	99		
.5	94		
.375	84		
#4	44		
#8	30		
#10	29		
#16	26		
#20	24		
#40	23		
#60	22		
#80	22		
#100	22		
#200	21		

* (no specification provided)

Material Description

Recycled Glass Clean - After Compaction
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 10.9683 D_{85}= 9.6367 D_{60}= 6.3112
D_{50}= 5.3536 D_{30}= 2.3352 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:21L893
Sample Date: 11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: I.Teriong
Title: Project Manager

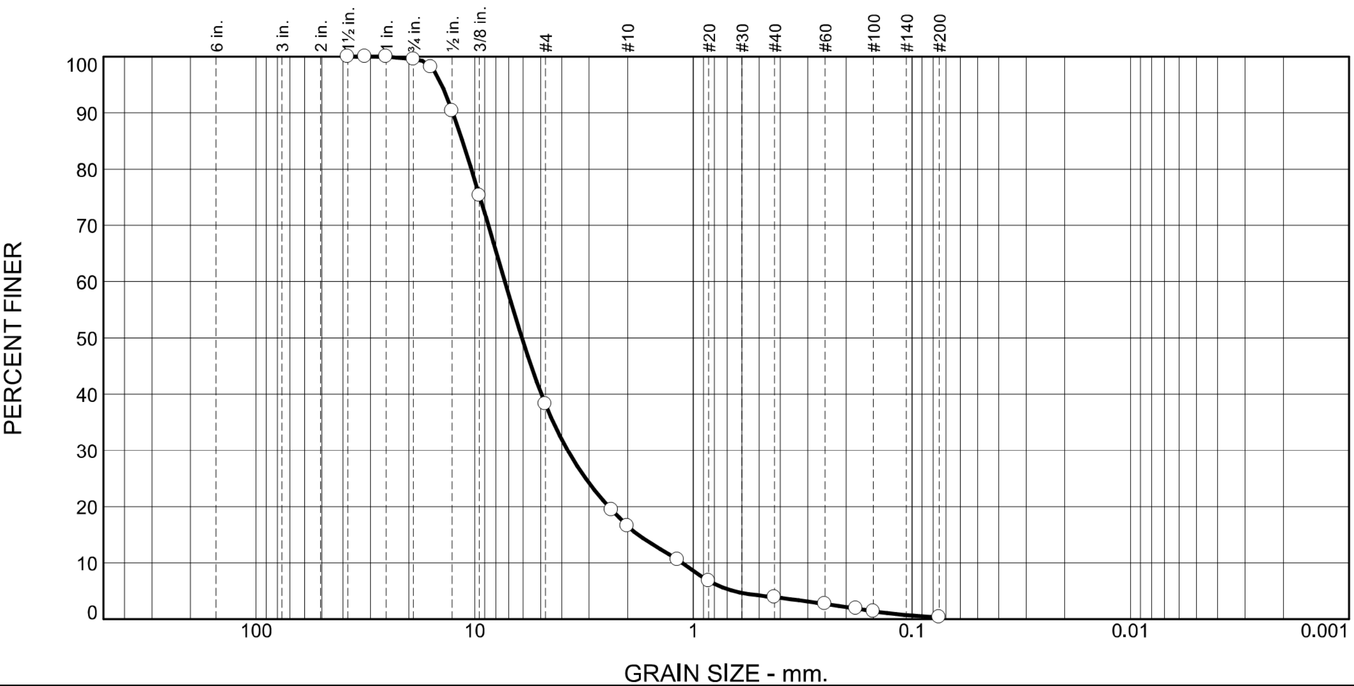
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L892

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	62	21	13	4	0	

Test Results (C-136 & c-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	98		
.5	90		
.375	75		
#4	38		
#8	19		
#10	17		
#16	11		
#20	7		
#40	4		
#60	3		
#80	2		
#100	1		
#200	0.4		

* (no specification provided)

Material Description

Recycled Glass With Fines - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 12.6020 D_{85}= 11.3802 D_{60}= 7.2823
D_{50}= 6.0733 D_{30}= 3.7592 D_{15}= 1.7859
D_{10}= 1.1229 C_u= 6.49 C_c= 1.73

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

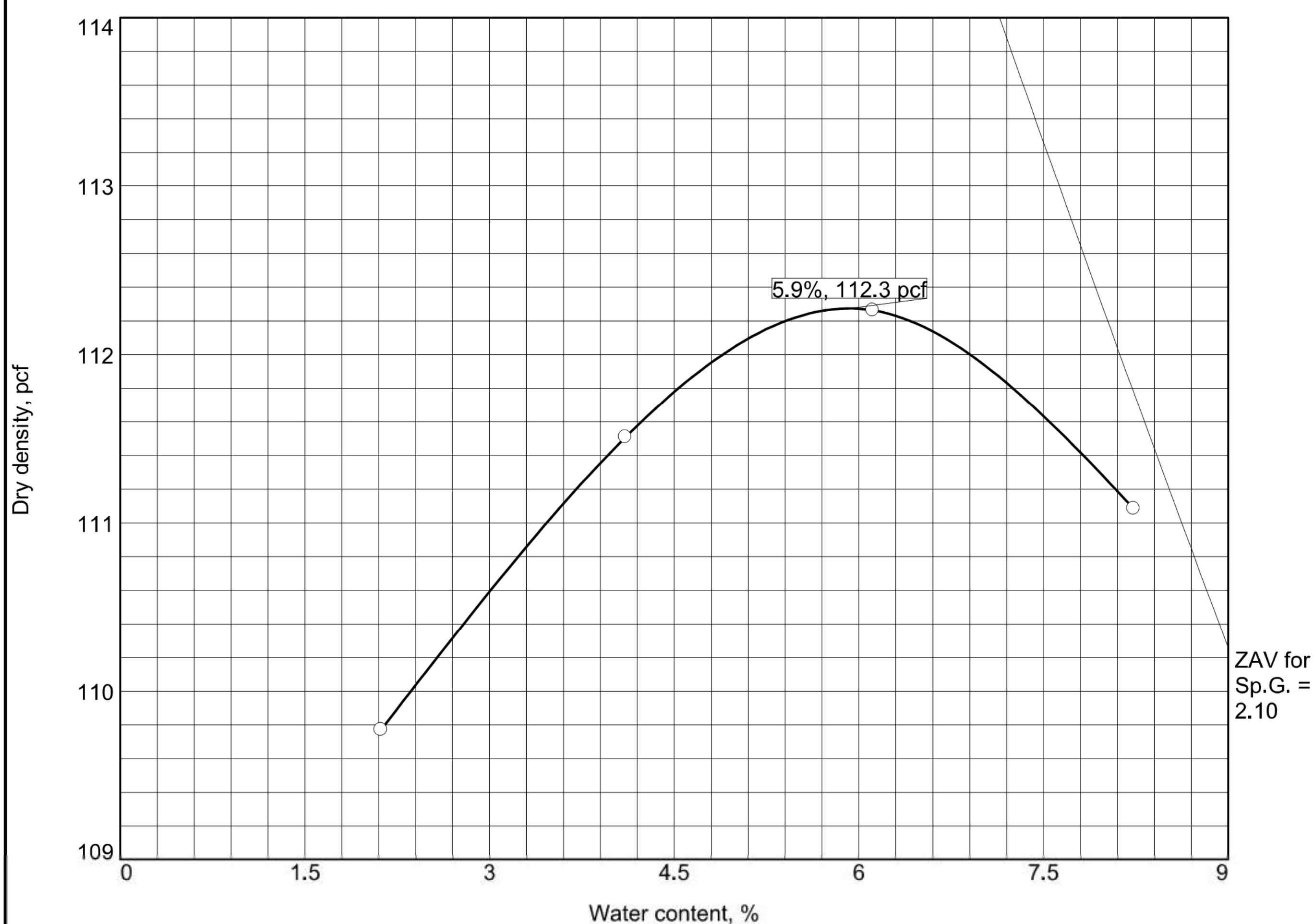
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L893

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	GW	A-1-a		2.1	NV	NP	0	0.4

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.3 pcf Optimum moisture = 5.9 %	Recycled Glass With Fines. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services

Project: East Town Crossing Lab Testing - Recycled Glass

○ **Source of Sample:** Dan Lloyd Construction **Sample Number:** 21L893

Krazan

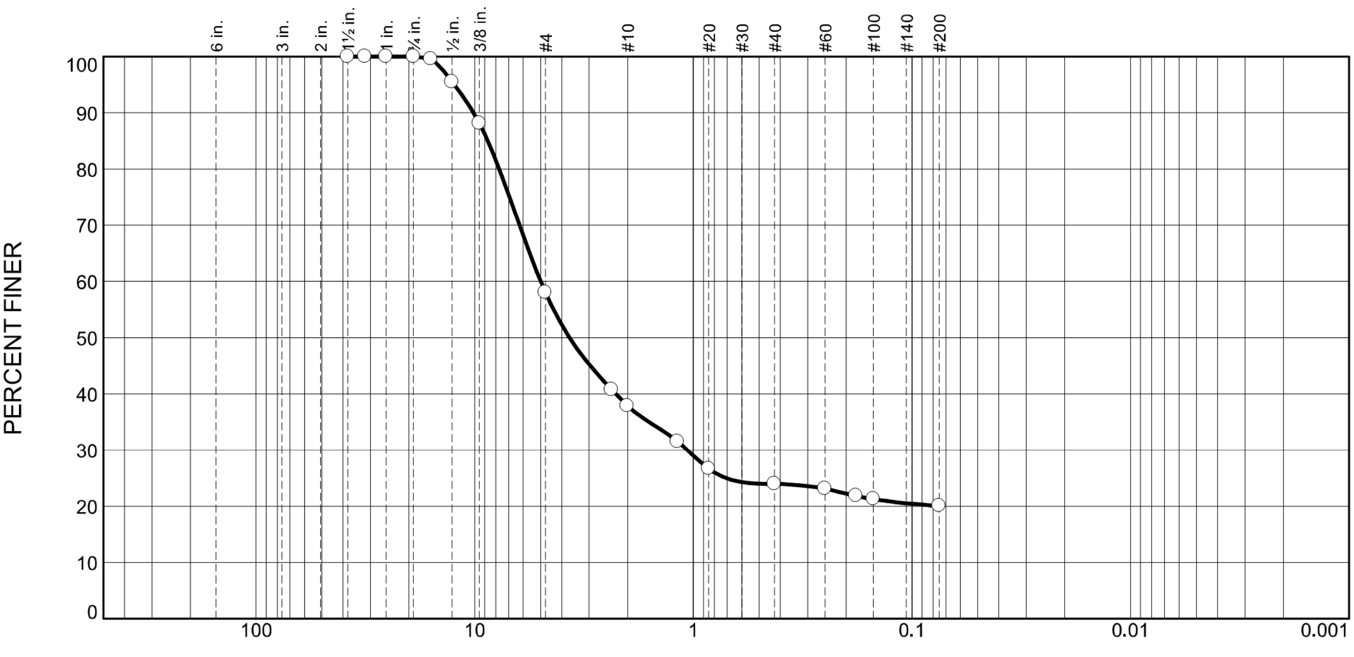
Remarks:

Sample ID:21L893
Sample Date:11-29-21
Void Ratio:0.16
Porosity:14%

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	42	20	14	4	20	

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	100		
.5	95		
.375	88		
#4	58		
#8	41		
#10	38		
#16	32		
#20	27		
#40	24		
#60	23		
#80	22		
#100	21		
#200	20		

* (no specification provided)

Material Description

Recycled Glass With Fines - After Compaction.
Sampled by the Supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 10.1195 D_{85}= 8.7171 D_{60}= 4.9887
D_{50}= 3.6862 D_{30}= 1.0651 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

Source of Sample: Dan Lloyd Construction
Sample Number: 21L893
Date Sampled: 11-29-21

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

APPENDIX B-2

MIGIZI GROUP, INC.

PO Box 44840
Tacoma, Washington 98448

PHONE (253) 537-9400
FAX (253) 537-9401

August 25, 2023

Absher Construction
1001 Shaw Road
Puyallup, WA 98372

Attention: Greg Helle
Executive VP, Operations

Subject: **Project Infiltration Feasibility Letter**
Proposed East Town Crossing Development
13102 East Pioneer Rd.
Puyallup, WA 98372
Parcel No. 0420264053, 0420264054, 0420351066

MGI Project Z0582

Dear Mr. Helle:

Migizi Group, Inc. (MGI) is pleased to submit this letter discussing the long-term feasibility of infiltration facilities and permeable pavement at the proposed East Town Crossing development along East Pioneer Road in Puyallup, WA. Previous geotechnical studies for this site were performed by Krazan & Associates and are attached. This includes a *Geotechnical Engineering Investigation* report, dated April 11, 2019, and a March 19, 2021, *Addendum Letter*.

The purpose of this letter is to summarize our geologic research for the project area and immediate region, our review of the previous site reconnaissance, geologic explorations, and infiltration testing performed by Krazan & Associates, and provide MGI's professional recommendations for infiltration feasibility at the site.

SITE AND PROJECT DESCRIPTION

The project site consists of three contiguous parcels, creating a roughly rectangular project area 10.00 acres in size, located along the south side of East Pioneer Road, just east of downtown Puyallup, WA, as shown on the enclosed Topographic and Location Map (Figure 1). The entire parcel is currently undeveloped. The vegetated property is bordered to the north by E Pioneer Rd., to the east by undeveloped land, to the west by Shaw Road, and to the south by a commercial property that houses Absher Construction Office.

The proposed improvements generally consist of eight three-story, wood framed, multi-family apartment buildings, with associated parking stalls, covered car ports, recreational and landscaping areas. A club house will also be constructed at the north end of the site. A total of 70 one-bedroom and 108 two-bedroom units will be created. Three underground storage stormwater facilities, called R-Tank modules, are planned for the detention of generated stormwater. A modular wetland will provide treatment.

Biopod?

BioPod

In addition to the R-Tank modules, stormwater management procedures will also involve the implementation of Low Impact Development (LID) best management practices (BMPs) to facilitate treatment and infiltration of onsite generated stormwater. This could also include implementation of shallow-depth LID BMPs such as pervious pavement roadways and rain gardens, which are common in developments where deeper infiltration has been proven infeasible due to shallow groundwater tables and/or hydraulically restrictive soils.

LOCAL GEOLOGY

The project area is located along the southern edge of the Puyallup River Valley and at the toe of the Puyallup Highlands slope, roughly between Sumner and Puyallup. The *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington (2015)*, identifies the project area as Qa – Holocene Alluvium. Deposits tend to vary from massive deposits of loose fluvial silts, sands, and gravels, and can locally include sandy to silty estuarine deposits. Puyallup River deposits typically contain local deposits of peat or larger woody debris at depth. An excerpt of the geologic map of the immediate project area (Figure 2) can be found below:

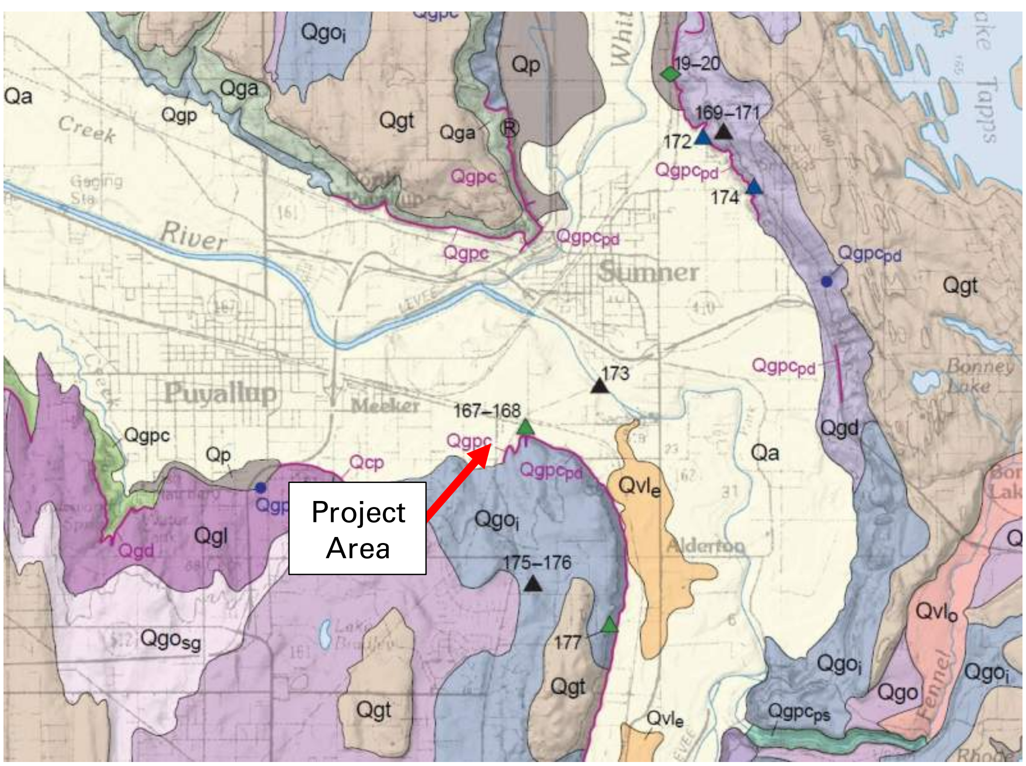


Figure 2: Immediate project area; excerpt of Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington, WSDNR, Schuster et al. 2015.

PREVIOUS PROJECT RECONNAISSANCE AND EXPLORATIONS

Previous explorations by Krazan & Associates included three hollow stem auger borings drilled across the site. In addition, two groundwater monitoring wells also installed at the same time. Drilling was conducted on March 11, 2019, which is within the wet season defined by Department of Ecology guidelines.

According to Krazan, shallow soils encountered in the borings are typical of alluvium deposits, ranging from poorly graded sand and silty sand to silty clay with interbedded seams of peat. Soils were generally observed to be moist to wet, and soft to medium dense or stiff. During drilling operations, groundwater was encountered at depths of between 7 to 8 feet below grade.

PREVIOUS INFILTRATION TESTING

On March 4-5, 2021, Krazan conducted follow up infiltration testing of the project area adjacent to monitoring wells W-1 and W-2, as described in the attached *Addendum Letter*. Krazan elected to conduct two Large-Scale Pilot Infiltration Tests (PITs), labeled P-1 and P-2, with procedures outlined in the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The excavations passed through shallow undocumented fill and into the native silty sand at approximately 2 feet below grade.

The Krazan *Addendum* indicates that field testing used the procedures listed in the 2014 SWMMWW. The two excavations were filled with water and allowed to presoak for the requisite timeframe. Water level measurements taken after presoak indicated that no head change was observed within P-2 and a head increase of 0.75 inches was measured in P-1. Due to a lack of infiltration during the testing period, tests were left open overnight, and measurements were taken the following morning. Measurements taken show that water levels had again risen, with 1.2 inches of head increase in P-1, and 0.3-inch head increase in P-2.

Based on these results, Krazan and Associates concluded that shallow soils of the upper three feet of the project area represented a hydraulic restrictive layer, with the calculated infiltration rate of **0 inches per hour**, based on Site Suitability Criteria of Vol. III, Section 3.3.7 of the 2014 SWMMWW.

PERMEABLE PAVEMENT FEASIBILITY

Currently, the City of Puyallup's stormwater management has adopted the 2019 Washington State Department of Ecology's *Stormwater Management Manual for Western Washington* (SWMMWW). Volume V covers runoff treatment, flow control, and the low impact development (LID) best management practices (BMP) library. Beginning on Page 748 through 751, V-5.6 considers the BMP Permeable Pavements, the Applications and Limitations, and the Infeasibility Criteria. The manual states on page 748:

The following infeasibility criteria describe conditions that make permeable pavement infeasible when applying The List Approach within I-3.4.5 MR5: On-Site Stormwater Management. If a project proponent wishes to use a permeable pavement BMP even though one of the infeasibility criteria within this section are met, they may propose a functional design to the local government.

These criteria also apply to impervious pavements that would employ stormwater collection from the surface of impervious pavement with redistribution below the pavement.

Any of the following circumstances allow the designer to determine permeable pavement as "infeasible" when applying the The List Approach within I-3.4.5 MR5: On-Site Stormwater Management:

Specifically, three bullet points listed on page 750 of the manual note that:

- Where seasonal high ground water or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the permeable pavement BMP. The bottom of the permable pavement BMP is the bottom of the lowest layer that has been designed to be part of the BMP, such as the lowest gravel base course or a sand layer used for treatment below the permeable pavement.
- Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
- Where appropriate field testing indicates soils have a measured (a.k.a., initial) native soil saturated hydraulic conductivity (K_{sat}) less than 0.3 inches per hour. See V-5.4 Determining the Design Infiltration Rate of the Native Soils. (Note: In these instances, unless other infeasibility restrictions apply, roads and parking lots may be built with an underdrain, preferably elevated within the base course, if Flow Control benefits are desired.)

Volume III Chapter 3 section 2, beginning on page 468 of the 2019 Dept. of Ecology *Stormwater Management Manual*, considers the steps of preparing a stormwater site plan. Step 1 – "Analyze Existing Site Conditions to Determine LID Feasibility" states that a **hydraulic restrictive layer** is "ground water, soil layer with less than 0.3 in/hr Ksat, bedrock, etc." Field testing conducted by Krazan during the western Washington wet season, as described above, confirms that shallow onsite soils in the upper 3 feet are classified as a hydraulicly restrictive layer and are therefore unsuitable for infiltration of site produced stormwater. These shallow soils would be the exposed subgrade base for any proposed pervious pavement subgrade reservoir in areas of pavement for the East Town Crossing development.

CONCLUSIONS

Based on the infiltration testing information provided in the *Geotechnical Engineering Investigation* (April 11, 2019), and the *Addendum Letter* (March 19, 2021) written by Krazan & Associates, and the Criteria guidelines cited in Volumes III and V of the 2019 SWMMWW, it is our opinion that shallow infiltration through the use of permeable pavement is infeasible in the onsite native soils across the project area. Without significant improvement to the in-situ subgrade soils, which could seriously comprise the infiltration characteristics, soil-supported permeable asphalt would likely fail under long term dynamic load usage, such as HS20 loading conditions.

Based on the above, it is our opinion that any generated onsite stormwater should be directed to underground R-Tank modules for detention.

CLOSURE

We appreciate the opportunity to be of service on this project. If you have any questions regarding this letter or any aspects of the project, please feel free to contact our office.

Sincerely,

MIGIZI GROUP, INC.

08/25/23

Randall V. Conger-Best, L.G.
Senior Staff Geologist

James E. Brigham, P.E.
Senior Principal Engineer

Attachments: *Krazan and Associates, Geotechnical Engineering Investigation,* April 11, 2019
Krazan and Associates, Addendum Letter, March 19, 2021

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

April 11, 2019

KA Project No. 062-19005

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Mr. Gil Hulsmann

Email: Gil.Hulsmann@AbbeyRoadGroup.com
Tel: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan

Theresa R. Nunan
Project Engineer

TRN:MR

GEOTECHNICAL ENGINEERING INVESTIGATION
EAST TOWN CROSSING
PARCEL NOS. 0420264053, 0420264054, 0420351066
SE CORNER OF E. SHAW ROAD & E. PIONEER WAY
PUYALLUP, WASHINGTON

PROJECT NO. 062-19005
APRIL 11, 2019

Prepared for:

ABBEY ROAD GROUP LAND DEVELOPMENT SERVICES COMPANY, LLC
ATTN: MR. GIL HULSMANN
PO BOX 1224
PUYALLUP, WA 98371

Prepared by:

KRAZAN & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING DIVISION
825 CENTER STREET, STE A
TACOMA, WASHINGTON 98409
(253) 939-2500

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SE CORNER OF EAST SHAW ROAD AND EAST PIONEER WAY
PUYALLUP, WASHINGTON

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed East Town Crossing project located near the southeast corner of East Shaw Road and East Pioneer Way in Puyallup, Washington, as shown on the Vicinity Map in Figure 1. Discussions regarding site conditions are presented in this report, together with conclusions and recommendations pertaining to site preparation, excavations, structural fill, utility trench backfill, drainage and landscaping, erosion control, foundations, concrete floor slabs and exterior flatwork, lateral earth pressures, and pavement.

A Site Plan showing the approximate exploratory boring and monitoring well locations is presented following the text of this report in Figure 2. Appendix A includes USCS Soil Classification information, as well as a description of the field investigation, exploratory boring logs, and the laboratory testing results. Appendix B contains a guide to aid in the development of earthwork specifications. Pavement design guidelines are presented in Appendix C. The recommendations in the main text of the report have precedence over the more general specifications in the appendices.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the subsurface soil and groundwater conditions at the site, to develop geotechnical engineering recommendations for use in design of specific construction elements, and to provide criteria for site preparation and earthwork construction.

Our scope of services was performed in general accordance with our proposal for this project, dated January 25, 2019 (Proposal Number G19001WAT) and included the following:

- Exploration of the subsurface soil and groundwater conditions by conducting approximately three (3) geotechnical borings and installing two (2) groundwater level monitoring wells using a subcontracted drill rig;
- Provide a site plan showing the geotechnical boring and monitoring well locations;

- Provide comprehensive boring and monitoring well logs, including soil stratification and classification, and groundwater levels where applicable;
- Recommended foundation type for the proposed structures;
- Allowable foundation bearing pressure, anticipated settlements (both total and differential), coefficient of horizontal friction for footing design, and frost penetration depth;
- Recommendations for seismic design considerations including site coefficient and ground acceleration based on the 2015 IBC;
- Recommendations for structural fill materials, placement, and compaction;
- Recommendations for suitability of on-site soils as structural fill;
- Recommendations for temporary excavations;
- Recommendations for site drainage and erosion control;
- Recommendations for flexible and rigid pavements, as well as permeable pavement.

PROPOSED CONSTRUCTION

Based on the Overall Site Plan prepared by Abbey Road Group Land Development Services, dated December 12, 2018, we understand that the proposed development will include construction of six residential structures (designated Buildings A through E) and a club house/office building. Site drainage systems will include a subsurface stormwater system located in the southern portion of the property, and a rain garden along the northern and eastern edges of the site. We have not been provided with details regarding construction of the subsurface stormwater system. The planned development will also include utility installation, and paved parking areas and driveways. For the purpose of our analyses, we have assumed that the residential buildings and club house will be 1- to 2-story structures with a slab-on-grade floor system. We have also assumed only minor grading up to 1 foot of cut or fill will be required to establish planned elevations for the site.

SITE LOCATION AND DESCRIPTION

The site consists of three undeveloped parcels encompassing approximately 7 acres of land located south and east of the intersection of Shaw Road with East Pioneer Way. The site is bordered to the north by East Pioneer Way, to the south by commercial property, to the east by undeveloped land and a creek, and to the west by undeveloped land and abandoned residences. The site is roughly rectangular in shape and relatively level at approximately Elevation 72 to 74 feet. A dirt road runs north-south through the center of the site, and also extends from the center of the site westward towards Shaw Road. An existing storm pond is located in the southeast corner of the site, with the bottom at Elevation 69 feet. A wetland that has been field verified by others is located within the western central edge of the site. A creek runs along the eastern boundary of the site.

Most of the property is covered with seasonal vegetation, brambles, and a few trees located within the central portion of the site. Some trash and an abandoned trailer are located in the north central portion of the site. The southern portion of the site is currently being used by the adjacent business for container storage.

We understand that past construction activities for the undeveloped parcel to the west of the site that borders Shaw Road and East Pioneer Way consisted of the placement of fill material to raise the existing grades, based on the Geotechnical Evaluation and Additional Recommendations report prepared by Krazan & Associates, dated March 13, 2007. Those fill activities did not extend into this site.

GEOLOGIC SETTING

The site lies within the central Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances and retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and nonglacial sediments.

The Washington Division of Geology and Earth Resources, Geologic Map of the South Half of the Tacoma Quadrangle, Washington (Open File Report 87-3) indicates that the property is located in an area that is predominantly underlain by recent alluvium deposited by the Puyallup River. The recent alluvium consists of interbedded silt, sandy silt, silty sand, sand, gravel, local areas of peat and clay. The finer material represents overbank material and local lacustrine deposits, and the coarser materials most likely represent deposits in abandoned channels of the Puyallup River.

FIELD INVESTIGATION

A field investigation consisting of three (3) exploratory soil borings and installation of two (2) monitoring wells was completed to evaluate the subsurface soil and groundwater conditions at the project location. The soil borings were completed on March 11, 2019 by a Krazan subcontractor utilizing a hollow stem auger drill rig. The soil borings were advanced to depths ranging from 21.5 to 38.5 feet below the existing ground surface (bgs). A geotechnical engineer from Krazan and Associates was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the explorations.

Representative samples of the subsurface soils encountered in the borings were collected and sealed in plastic bags. These samples were transported to our laboratory for further examination and testing. The soils encountered in the exploratory borings were continuously examined and visually classified in accordance with the Unified Soil Classification System (USCS).

SOIL PROFILE AND SUBSURFACE CONDITIONS

The geotechnical subsurface exploration for this project consisted of soil borings and monitoring wells advanced to depths of approximately 21.5 to 38.5 feet bgs. The locations of the soil borings and monitoring wells are shown on the Site Plan in Figure 2.

Beneath 5 to 8 inches of surficial topsoil, the borings encountered alluvial soils to their explored depths. The topsoil was underlain by 4.5 to 7 feet of brown silty sand (SM) and poorly graded sand (SP) with relative densities in the loose to medium dense range. The sand soils were underlain by a 3-foot thick stratum of interbedded sandy silt (ML) that exhibited medium stiff to stiff consistencies and silty sand (SM) soils with relative densities in the loose to medium dense range.

Boring B-1 encountered a layer of silty clay and clayey silt beneath the sandy silt and silty sands from 7.5 to 11.0 feet bgs. The silty clay (CL) and clayey silt (ML) exhibited a very soft consistency with a Standard Penetration Test (SPT) resistance (N-value) of 1/12 inches and a moisture content of 51 percent.

The clayey silt in boring B-1 and the silty sand/sandy silt stratum in borings B-2 and B-3 were underlain by silty sand, sand, and gravel soils with varying silt contents to the termination depths of 21.5, 38.5, and 21.5 feet bgs, respectively. These granular soils exhibited relative densities in the loose to very dense range with N-values ranging from 8 to 60/8" blows per foot.

Gradation and Atterberg Limits tests were conducted on representative samples of the soils for classification purposes and for determination of engineering properties. The gradation and Atterberg Limits results are graphically depicted in Appendix A. For additional information about the soils encountered, please refer to the boring logs in Appendix A.

Monitoring Wells: Two monitoring wells, designated W-1 and W-2, were installed at the site on March 11, 2019 using a subcontracted driller and track mounted drill rig. Monitoring well W-1 was installed within borehole B-1. The boreholes for monitoring wells W-1 and W-2 were advanced to a depth of 21.5 feet and 20 feet below the existing ground surface, respectively, using 4¼-inch diameter hollow stem augers. A 10-foot long section of slotted PVC pipe attached to a 10-foot section of solid PVC pipe was inserted into the borehole, and the annular space between the pipe and the augers was backfilled with filter sand to a depth of 8 feet bgs followed by bentonite chips to the ground surface. A metal well cap was then installed over the pipe and cemented in-place to protect the well from unauthorized access. The installation log for monitoring wells W-1 and W-2 are included in Appendix A.

GROUNDWATER

Groundwater was encountered during the drilling operations at a depth of about 7 to 8 feet below the existing ground surface. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, climatic conditions, as well as other factors. Therefore, water levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

GEOLOGIC HAZARDS

Erosion Concern/Hazard

The Natural Resources Conservation Services (NRCS) map for Pierce County Area, Washington, classifies the site area as Briscot loam. The NRCS classifies the Briscot loam as Hydrologic Soil Group B/D with low potential for erosion in a disturbed state.

It has been our experience that soil erosion can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, i.e., silt fences, hay bales, mulching, control ditches or diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The 2015 International Building Code (IBC), Section 1613.3.2, refers to Chapter 20 of ASCE-7 for Site Class Definitions. It is our opinion that the overall soil profile corresponds to Site Class D as defined by Table 20.3-1 "Site Class Definitions," according to the 2010 ASCE-7 Standard. Site Class D applies to a "stiff soil" profile. The seismic site class is based on a soil profile extending to a depth of 100 feet. The soil borings on this site extended to a maximum depth of 38.5 feet and this seismic site class designation is based on the assumption that similar soil conditions continue below the depth explored.

We referred to the U.S. Geological Survey (USGS) Earthquake Hazards Program Website and 2012/2015 IBC to obtain values for S_S, S_{MS}, S_{DS}, S_1, S_{M1}, S_{D1}, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The seismic design parameters for this site are as follows:

Seismic Design Parameters
(Reference: 2015 IBC Section 1613.3.2, ASCE, and USGS)

Seismic Item	Value
Site Coefficient F_a	1.003
S_s	1.243 g
S_{MS}	1.247 g
S_{DS}	0.831 g
Site Coefficient F_v	1.524
S_1	0.476 g
S_{M1}	0.726 g
S_{D1}	0.484 g

Additional seismic considerations include liquefaction potential and amplification of ground motions by loose/soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. Soil liquefaction is a state where soil particles lose contact with each other and become suspended in a viscous fluid. This suspension of the soil grains results in a complete loss of strength as the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events.

We have reviewed "Liquefaction Susceptibility Map of Pierce County, Washington" by Stephen P. Palmer et al., (WA DNR, 2004). The map indicates that the site area is located in a zone of high liquefaction susceptibility. At the request of our client, we have conducted a site-specific liquefaction analysis for this project.

To evaluate the liquefaction potential of the site, we analyzed the following factors:

1) Soil type
2) Groundwater depth
3) Relative soil density
4) Initial confining pressure
5) Maximum anticipated intensity and duration of ground shaking

Liquefaction Analysis: The commercially available liquefaction analysis software, LiquefyPro from CivilTech, was used to evaluate the liquefaction potential and the possible liquefaction induced settlement for the site soil and groundwater conditions based on our explorations. The analysis was performed using the information from the soil test boring and laboratory gradation analyses. Maximum

Considered Earthquake (MCE) was selected in accordance with the 2015 International Building Code (IBC) Chapter 16 and the U.S. Geological Survey (USGS) Earthquake Hazards Program website. For this analysis, a maximum earthquake magnitude of 7.11 and peak horizontal ground surface acceleration of 0.5g were used. Our analysis assumed a groundwater depth of 7.0 feet during the earthquake.

The maximum liquefaction induced settlement for this type of seismic event is estimated to be on the order of about 2 inches. The differential settlements are estimated to be on the order of about 1-inch.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the planned improvements at this site are feasible, provided that the geotechnical engineering recommendations presented in this report are included in the project design. Based on our explorations, it is our opinion that conventional spread foundations supported on medium dense/stiff or firmer native soil, or on structural fill extending to the medium dense/stiff or firmer native soil would be appropriate for the new buildings.

We recommend that organic topsoil, undocumented fill, and loose/soft soils be stripped to expose the underlying medium dense/stiff or firmer native soil. Footings should extend through any organic or loose soil and be founded on the underlying medium dense or firmer native soil, or structural fill extending to the competent native soils.

Exploration boring B-1 was drilled in the northern portion of the site, in the area of the planned rain garden between Pioneer Way and the Club House and Residential Building E. Boring B-1 encountered a layer of very soft silty clay between 7.5 and 11 feet below the existing ground surface. These materials are not considered suitable to support foundations and will need to be removed where they are encountered. Test pits should be conducted prior to the construction phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 (drilled within the eastern and southern portions of the site) and monitoring well W-2 (installed within the central portion of the site) encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs, respectively; however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

The soils encountered on this site are considered moisture-sensitive and will be easily disturbed and difficult to compact when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas.

Site Preparation

General site clearing should include removal of any undocumented fill, organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas. Additional recommendations for preparation of specific areas are provided in the **Foundations**, **Pavement Design** and **Exterior Flatwork** subsections of this report.

The soils that will be encountered during site development are considered extremely moisture-sensitive and may disturb easily in wet conditions. The prepared subgrade should be protected from construction traffic and surface water should be diverted around prepared subgrade. We recommend that the site be developed only during extended periods of dry weather.

During wet weather conditions, subgrade stability problems and grading difficulties may develop due to excess moisture, disturbance of sensitive soils and/or the presence of perched groundwater. Construction during the extended periods of wet weather could result in the need to remove wet disturbed soils if they cannot be suitably compacted due to elevated moisture contents. The onsite soils have significant silt content in the explored areas and are moisture sensitive, and can be easily disturbed when wet. If over-excavation is necessary, it should be confirmed through continuous monitoring and testing by a qualified geotechnical engineer or geologist. Soils that have become unstable may require drying to near their optimal moisture content before compaction is feasible. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry, warm weather (typically during the summer months). If the soils cannot be dried back to a workable moisture condition, remedial measures may be required. General project site winterization should consist of the placement of aggregate base and the protection of exposed soils during the construction phase. It should be understood that even if Best Management Practices (BMP's) for wintertime soil protection are implemented and followed there is a significant chance that moisture disturbed soil mitigation work will still be required.

Any buried structures encountered during construction should be properly removed and backfilled. Excavations, depressions, or soft and pliant areas extending below the planned finish subgrade levels should be excavated to expose firm undisturbed soil, and backfilled with structural fill. In general, any septic tanks, underground storage tanks, debris pits, cesspools, or similar structures should be completely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as reecommended by the geotechnical engineer. The resulting excavations should be backfilled with structural fill.

We understand that backfilling of the wetland in the central western edge of the site that has been field identified by others will be permitted for construction of the paved parking area and subsurface storm system. We also understand that proposed Residential Building C will be constructed within the area currently occupied by an existing storm pond. Our field explorations were not specifically conducted within either of these areas. Any organic, silt or clay soils, or accumulations of sediment, encountered within the wetland area or the existing storm pond should be removed down to firm undisturbed soil, and backfilled with structural fill to the planned finish grades.

A representative of our firm should be present during all site clearing and grading operations to observe, test and evaluate earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The geotechnical engineer may reject any material that does not meet compaction and stability requirements. Further recommendations, contained in this report, are predicated upon the assumption that earthwork construction will conform to the recommendations set forth in this section and in the Structural Fill section below.

Temporary Excavations

The onsite soils have variable cohesion strengths, therefore the safe angles to which these materials may be cut for temporary excavations is limited, as the soils may be prone to caving and slope failures in temporary excavations. Temporary excavations in the loose to medium dense native soils should be sloped no steeper than 2H:1V (horizontal to vertical) where room permits.

All temporary cuts should be in accordance with Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. The temporary slope cuts should be visually inspected daily by a qualified person during construction work activities and the results of the inspections should be included in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and minimizing slope erosion during construction. The temporary cut slopes should be covered with plastic sheeting to help minimize erosion during wet weather and the slopes should be closely monitored until the permanent retaining systems are complete. Materials should not be stored and equipment operated within 10 feet of the top of any temporary cut slope.

A Krazan & Associates geologist or geotechnical engineer should observe, at least periodically, the temporary cut slopes during the excavation work. The reasoning for this is that all soil conditions may not be fully delineated by the limited sampling of the site from the geotechnical explorations. In the case of temporary slope cuts, the existing soil conditions may not be fully revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of the temporary slope will need to be evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed smoothly and required deadlines can be met. If any variations or undesirable conditions are encountered during construction, Krazan & Associates should be notified so that supplemental recommendations can be made.

Structural Fill

Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the Site Preparation subsection of this report prior to beginning fill placement.

Best Management Practices (BMP's) should be followed when considering the suitability of the existing materials for use as structural fill. The on-site soils are generally considered suitable for re-use as structural fill, provided the soil is free of organic material and debris, and it is within ± 2 percent of the optimum moisture content. If the native soils are stockpiled for later use as structural fill, the stockpiles should be covered to protect the soil from wet weather conditions. We recommend that a representative of Krazan & Associates be on site during the excavation work to determine which soils are suitable for use as structural fill.

Imported, all weather structural fill material should consist of well-graded gravel or a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). All structural fill material should be submitted for approval to the geotechnical engineer at least 48 hours prior to delivery to the site.

Fill soils should be placed in horizontal lifts not exceeding 8 inches in thickness prior to compaction, moisture-conditioned as necessary (moisture content of soil shall not vary by more than ±2 percent of optimum moisture), and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM D1557 Test Method. In-place density tests should be performed on all structural fill to document proper moisture content and adequate compaction. Additional lifts should not be placed if the previous lift did not meet the compaction requirements or if soil conditions are not considered stable.

Foundations

Our exploratory borings encountered loose to medium dense granular soils underlain by a 3-foot thick stratum of interbedded sandy silt and silty sand, followed by loose to very dense granular alluvial soils to the explored depths. Boring B-1, drilled at the proposed rain garden area in the northern end of the site, encountered a 3.5-foot thick layer of very soft silty clay at a depth of 7.5 feet bgs.

The very soft clay encountered in Boring B-1 between 7.5 and 11 feet below the existing ground surface is not considered suitable to support foundations and will need to be removed where it is encountered.

Further exploration of this area with test pits should be conducted during the planning phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 and monitoring well W-2, drilled within the eastern, southern, and central portions of the site, encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs; however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

Pending the findings of further explorations in the northern portion of the site, the proposed structures may be supported on a shallow foundation system. Where loose/soft soils are encountered at the planned footing elevations, the subgrade should be over-excavated to expose suitable bearing soil. The foundation excavations should be evaluated by Krazan & Associates prior to structural fill placement to verify that the foundations will bear on suitable material.

Building foundations should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Footing widths should be based on the anticipated loads and allowable soil bearing pressure, and should conform to current International Building Code (IBC) guidelines. Water should not be allowed to accumulate in foundation excavations. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing capacity of 2,000 pounds per square foot (psf) may be used for foundation design for this project. A representative of Krazan and Associates should evaluate the foundation bearing soil prior to footing form construction.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.35 acting between the bases of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 150 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglecting the upper 12 inches). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A 1/3 increase in the above values may be used for short duration wind and seismic loads.

For foundations constructed as recommended, the total static settlement is not expected to exceed 1-inch. Differential settlement, along a 20-foot exterior wall footing, or between adjoining column footings should be less than ½ inch. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils become flooded or saturated. It should be noted that the estimated settlement provided herewith is a static settlement and does not include liquefaction induced settlement. Static settlement is induced by the applied dead load from the structures.

Up to 2 inches of total settlement and 1 inch of differential settlement could occur during and/or following a seismic event. The foundation elements, i.e. spread and wall footings, could be structurally tied together to create a stiffer structure. It should be noted that this measure would not mitigate the anticipated seismic settlement; however, it may reduce the damage associated with the anticipated seismic settlement, particularly the effects of differential settlement on a structure.

Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed structures, should not be permitted to flood and/or saturate foundation subgrade soils. To prevent the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter rigid perforated PVC pipe, sloped to drain, with perforations placed near the bottom and enveloped in all directions by washed rock and wrapped with filter fabric to limit the migration of silt and clay into the drain.

Lateral Earth Pressures and Retaining Walls

We understand that a below grade stormwater vault is planned for this project. We have developed criteria for the design of retaining or below grade walls for the stormwater vault. Our design parameters are based on retention of the native soils. The parameters are also based on level, well-drained wall backfill conditions. Walls may be designed as "restrained" retaining walls based on "at-rest" earth pressures, plus any surcharge on top of the walls as described below, if the walls are braced to restrain movement and/or movement is not acceptable. Unrestrained walls may be designed based on "active" earth pressure, if the walls are not part of the buildings and some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of "active" earth pressure values for design. We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 38 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls or loads imposed by construction equipment, foundations, back slopes or roadways (surcharge loads). Groundwater was encountered in each of the borings at 7 to 8 feet below the ground surface. Portions of the vault that will extend below the groundwater level will need to be designed to resist hydrostatic pressures and buoyant forces. Equivalent fluid densities for buoyant soil pressure under yielding conditions would be 20 pcf and 30 pcf for nonyielding conditions. The allowable buoyant passive pressure would be 100 pcf with a factor of safety of 2.0.

Floor Slabs and Exterior Flatwork

Before the placement of concrete floors or pavements on the site, or before any floor supporting fill is placed, the loose soils and undocumented fill must be removed to expose medium dense or firmer undisturbed native soil. The subgrade should then be proof-rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of yielding soils should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirements of structural fill. Fill soils should be placed in horizontal lifts not exceeding 8 inches loose thickness, moisture-conditioned as necessary, (moisture content of soil shall not vary by more than ±2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557.

Floor slabs may be designed using a modulus of subgrade reaction value of k = 200 pounds per cubic inch (pci) for slabs supported on medium dense or firmer native soils or on structural fill extending to medium dense or firmer native soil.

In areas where it is desired to reduce floor dampness, such as areas covered with moisture sensitive floor coverings, we recommend that concrete slab-on-grade floors be underlain by a water vapor retarder system. According to ASTM guidelines, the water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 4-inches of compacted clean (less than 5 percent passing the U.S. Standard No. 200 Sieve), open-graded angular rock of ¾-inch maximum size. The vapor retarder sheeting should be protected from puncture damage.

It is recommended that the utility trenches within the building pads be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the drainage and irrigation adjacent to the buildings is recommended. Grading should establish drainage away from the structures and this drainage pattern should be maintained. Water should not be allowed to collect adjacent to the structures. Excessive irrigation within landscaped areas adjacent to the structure should not be allowed to occur. In addition, ventilation of the structure may be prudent to reduce the accumulation of interior moisture.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to minimize the transportation of sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. As a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features of the site:

1) Phase the soil, foundation, utility and other work, requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be undertaken during the wet season (generally October through April), but it should also be known that this may increase the overall cost of the project.

2) All site work should be completed and stabilized as quickly as possible.

3) Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.

4) Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited, other filtration methods will need to be incorporated.

Groundwater Influence on Structures and Earthwork Construction

The soil borings were checked for the presence of groundwater during exploratory operations. Groundwater was encountered in all of our borings at approximately 7 to 8 feet bgs. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, groundwater levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

If groundwater is encountered during construction, we should observe the conditions to determine if dewatering will be needed. Design of temporary dewatering systems to remove groundwater should be the responsibility of the contractor. If earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated. These soils may "pump," and the materials may not respond to densification techniques. Typical remedial measures include: disking and aerating the soil during dry weather; mixing the soil with drier materials; removing and replacing the soil with an approved fill material. A qualified geotechnical engineering firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Drainage

The ground surface should slope away from building pads and pavement areas, toward appropriate drop inlets or other surface drainage devices. It is recommended that adjacent exterior grades be sloped a minimum of 2 percent for a minimum distance of 5 feet away from structures. Roof drains should be tightlined away from foundations. Roof drains should not be connected to the footing drains.

Pavement areas should be inclined at a minimum of 1 percent and drainage gradients should be maintained to carry all surface water to collection facilities and suitable outlets. These grades should be maintained for the life of the project.

Specific recommendations for and design of storm water disposal systems or septic disposal systems are beyond the scope of our services and should be prepared by other consultants that are familiar with design and discharge requirements.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized; cyclic wetting and drying of excavation side slopes should be avoided.

All utility trench backfill should consist of suitable on-site material or imported granular material. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Pavement Design

Based on our explorations, the near surface soils at the site are interpreted as loose to medium dense silty sand and sand soils to depths of approximately 4.5 to 7.0 feet bgs. Due to the loose nature of the anticipated pavement subgrade soils, we recommend that subgrade modification techniques be considered. Subgrade modification typically includes the over-excavation of unsuitable materials, the placement of a geotextile fabric at the bottom of the over-excavated area, and then the placement of structural fill, with the structural fill consisting of clean crushed rock, rock spalls, or Controlled Density Fill (CDF). We recommend the use of a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent, for the geotextile. Subgrade modification such as this is intended to disperse surcharge loads and therefore aid in pavement performance.

Where loose soils are encountered in the pavement subgrade, we recommend over-excavation of the loose soil to at least 12 inches below the planned pavement subgrade elevation. The exposed grade after the over-excavation should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. We recommend that a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent, then be placed over the compacted soil. After the fabric is placed, the area should be filled to the planned slab subgrade elevation with structural fill. The structural fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In-place density tests should be performed to verify proper moisture content and adequate compaction.

In areas where the pavement subgrade soil consists of firm and unyielding native soils, a proof roll of the pavement subgrade soil may be performed in lieu of the compaction and in-place density tests. It should be noted that subgrade soils that have relatively high silt contents may be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Traffic loads were not provided, however, based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (delivery and fire trucks). Pavement design life of 20 years was assumed for our analysis. Recommendations for an asphaltic concrete flexible pavement section and Portland Cement Concrete (PCC) rigid pavement section are provided in Tables 1 and 2 below.

Table 1: ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

Asphaltic Concrete	Aggregate Base	Compacted Subgrade**
3.0 in.	6.0 in.	12.0 in.

Table 2: PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT
4000 psi with FIBER MESH

Min. PCC Depth	Aggregate Base	Compacted Subgrade**
6.0 in.	4.0 in.	12.0 in.

*** A proof roll may be performed in lieu of in-place density tests*

The asphaltic concrete depth listed in Table 1 for the flexible pavement section should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½-inch Hot Mix Asphalt (HMA). The pavement specification in Appendix C provides additional recommendations, including aggregate base material.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. We should also be present during the construction of stormwater management system to evaluate the soils. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

Geotechnical engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences improves. Although your site was analyzed using the most appropriate current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to improvements in the field of geotechnical engineering, physical changes in the site either due to excavation or fill placement, new agency regulations or possible changes in the proposed structure after the time of completion of the soils report may require the soils report to be professionally reviewed. In light of this, the owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. Our report, design conclusions and interpretations should not be construed as a warranty of the subsurface conditions. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The findings and conclusions of this report can be affected by the passage of time, such as seasonal weather conditions, manmade influences, such as construction on or adjacent to the site, natural events such as earthquakes, slope instability, flooding, or groundwater fluctuations. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The geotechnical engineer should be notified of any changes so that the recommendations can be reviewed and reevaluated.

Misinterpretations of this report by other design team members can result in project delays and cost overruns. These risks can be reduced by having Krazan & Associates, Inc. involved with the design teams' meetings and discussions after submitting the report. Krazan & Associates, Inc. should also be retained for reviewing pertinent elements of the design team's plans and specifications. Contractors can also misinterpret this report. To reduce this, risk Krazan & Associates. Inc. should participate in pre-bid and preconstruction meetings, and provide construction observations during the site work.

This report is a geotechnical engineering investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands. Any statements or absence of statements, in this report or on any soils log regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessments.

The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments. We emphasize that this report is valid for this project as outlined above, and should not be used for any other site. Our report is prepared for the exclusive use of our client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

04/11/19

MICHAEL D. RUNDQUIST
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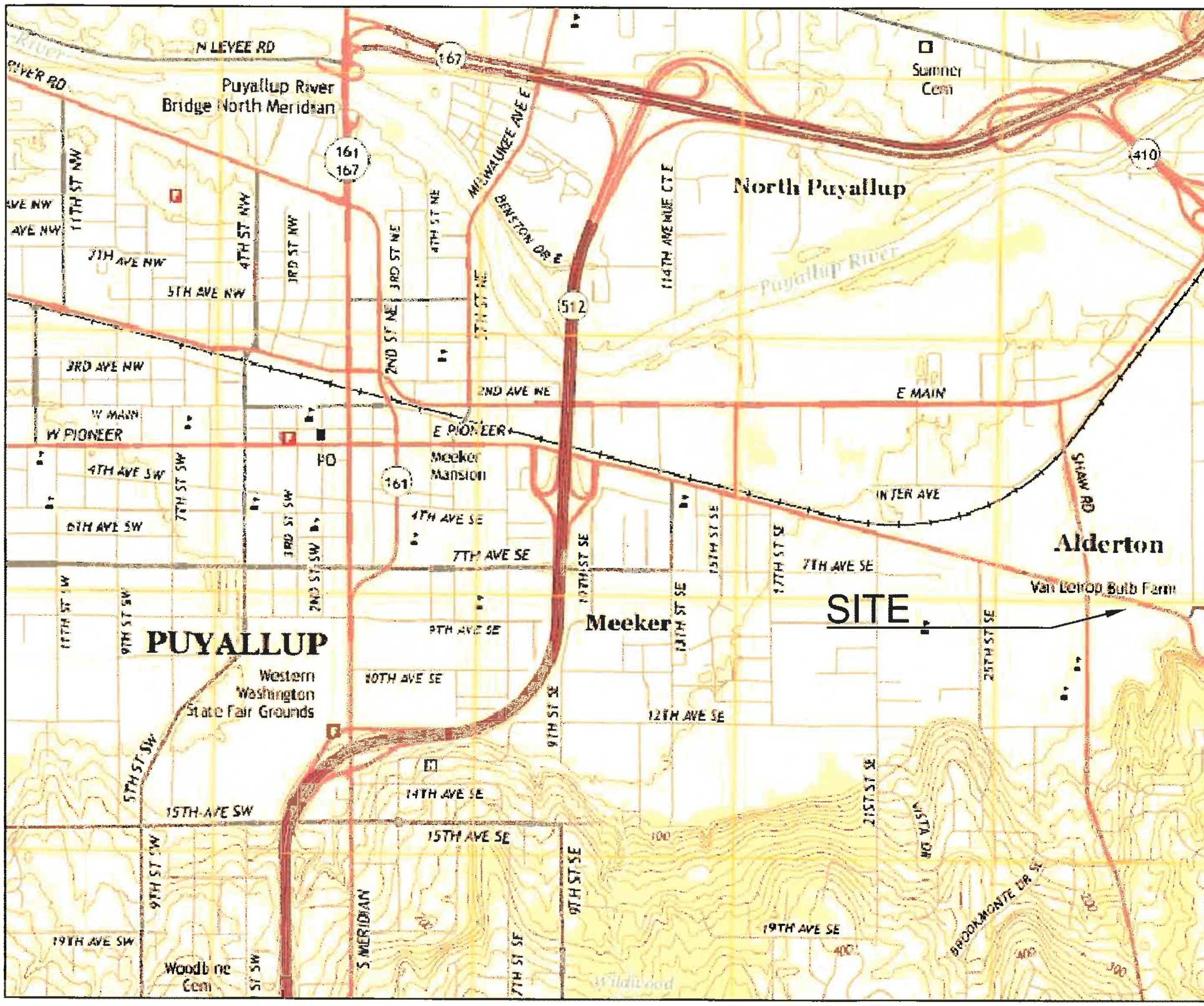
TRN:MDR



Reference: USGS topographic map website, Puyallup, WA, dated 2017.

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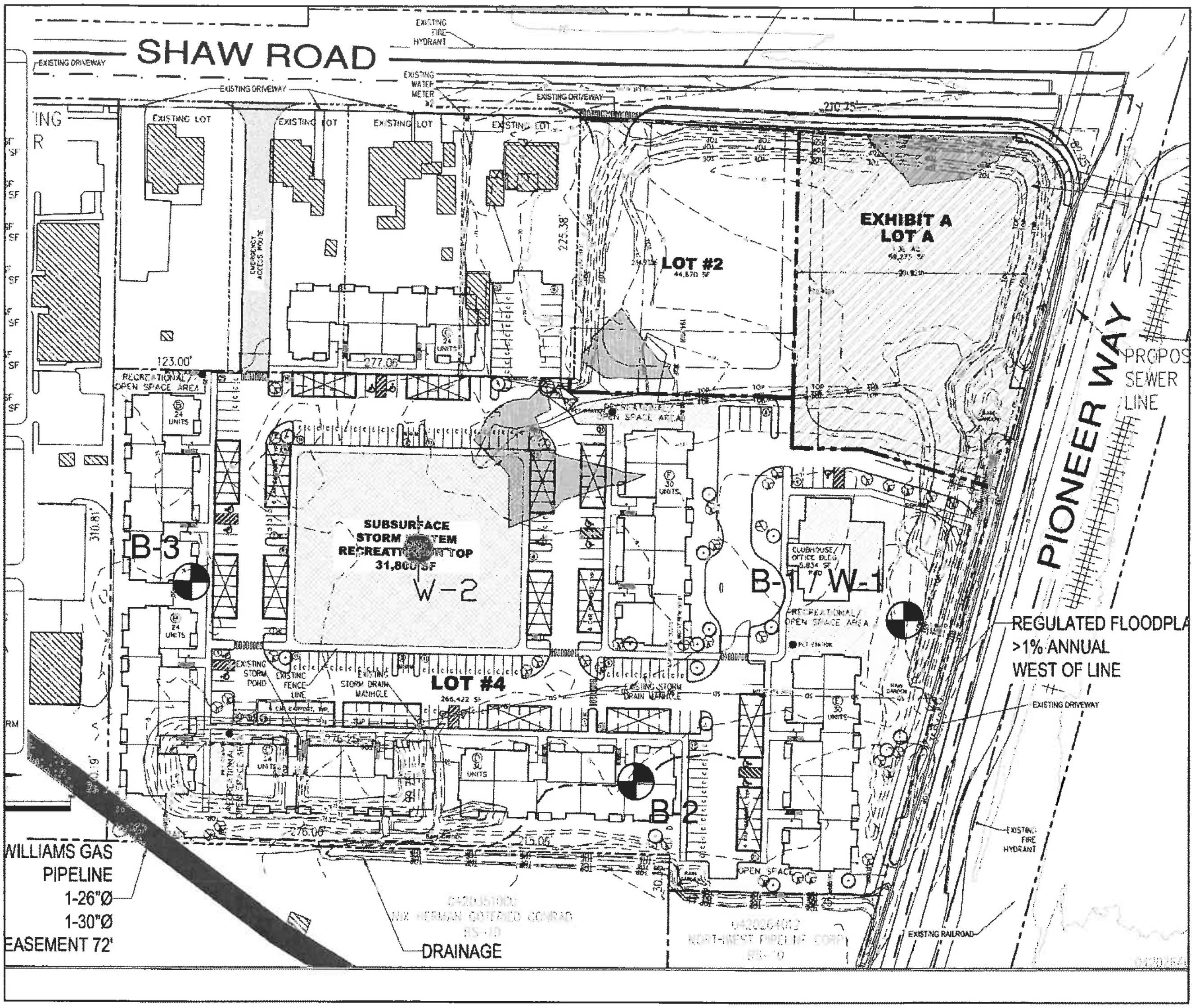
Vicinity Map

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale



LEGEND

B-1 Number and Approximate Location of Borings

W-1 Approximate Location of Monitoring Well

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 2
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Exploratory borings and monitoring wells were drilled and sampled for subsurface exploration at this site. The soil explorations reached depths of approximately 38.5 feet below the existing ground surface. The approximate exploratory boring locations are shown on the Site Plan (Figure 2). The logs of the soil explorations and monitoring wells are presented in this appendix. The depths shown on the attached logs are from the existing ground surface at the time of our exploration.

The drilled borings were advanced using a subcontracted drilling rig. Soil samples were obtained by using the Standard Penetration Test (SPT) as described in ASTM Test Method D1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring logs in this appendix. The resistance, or "N" value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field during the exploration and are described in general accordance with the Unified Soil Classification System (USCS). All samples were returned to our laboratory for evaluation.

Laboratory Testing

The laboratory testing program was developed primarily to determine the index properties of the soils. Test results were used for soil classification and as criteria for determining the engineering suitability of the surface and subsurface materials encountered.

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No.	B-1
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners	
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat	
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hollow Stem Augers	
Notes: Monitoring Well W-1 installed in borehole.	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual	
Ground Surface Elevation: 72 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 21.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 6 to 8-inch thick stiff sandy clay layers, medium dense, moist	
		SPT	1-1	1 6 9	15			
							Brownsih Grey Poorly Graded SAND (SP), fine grained, medium dense, moist	
	5	SPT	1-2A 1-2B	4 5 5	10		Alternating 4 to 12-inch thick layers of brown Sandy SILT (ML) and Silty SAND (SM), medium stiff/loose, moist to wet	% Si/Cl = 78.5 % MC = 35.4
		SPT	1-3A 1-3B	1 1/12"	1/12"		Dark Brownish Grey Silty CLAY (CL) with marsh grass, seams of peat and thin roots, very soft, wet	LL = 35 PI = 1 % F. Sa = 19.8 % Si/Cl = 79.1 % MC = 51.2
	10	SPT	1-4	1 2 6	8		- - - Becomes Clayey SILT (ML), with fine sand and thin roots, very soft	
							Dark Grey/Black Silty SAND (SM), fine to medium grained, loose, wet	
	15	SPT	1-5	5 4 4	8		- - - Same	
	20	SPT	1-6	4 12 12	24		- - - Becomes Poorly Graded SAND (SP-SM) with Silt, fine to medium grained, medium dense, wet	
							End of Boring at 21.5 Feet	
	25							

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No.	B-2
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners	
Project Manager: Theresa Nunan	Date	Started: 3.11.2019	Equipment: Track Bobcat	
Field Engineer: Theresa Nunan		Completed: 3.11.2019	Drilling Method: Hollow Stem Augers	
Notes:		Backfilled: 3.11.2019	Hammer Type: 140-lb. Manual	
Ground Surface Elevation: 73 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 38.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							5 inches Grass and Topsoil	
		SPT	2-1	2 2 5	7		Brown Silty SAND (SM), fine grained, with occassional sandy clay seams, loose, moist	
	5	SPT	2-2	3 4 2	6		- - - Same	% Si/Cl = 42.9 % MC = 29.3
		SPT	2-3	4 8 11	19		Brownish Grey Sandy SILT (ML), fine grained, with occassional 1 to 2-inch thick seams dark grey fine sand, moist to wet, stiff	% Si/Cl = 88.2 % MC = 37.0
	10	SPT	2-4	5 8 8	16		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	% Si/Cl = 14.5 % MC = 25.0
	15	SPT	2-5	28 12 12	24		- - - Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense	% Grav = 0 % Sa = 90.8 % Si/Cl = 8.9 % MC = 22.6
							- - - At 18 feet, drilling choppy due to lots of gravel	
	20	SPT	2-6	18 40 20/8"	60/8"		Dark Grey/Black Poorly Graded GRAVEL (GP-GM) with sand and silt, very dense, wet	
	25							

Krazan & ASSOCIATES, INC.

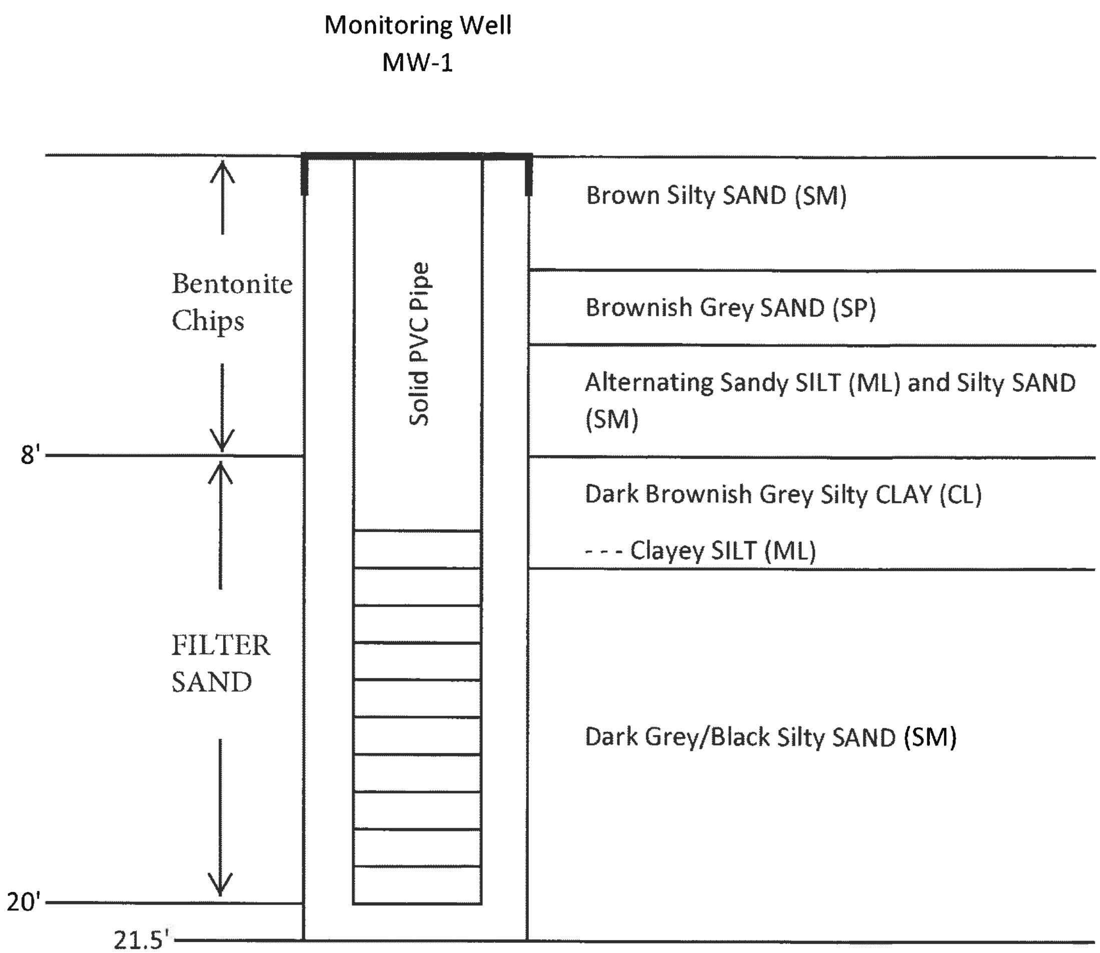
Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No.	B-2
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners	
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat	
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hollow Stem Augers	
Notes:	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual	
Ground Surface Elevation: 73 +/- feet MSL	Groundwater Depth: 8 feet	Groundwater Elev.:	Total Depth of Boring: 38.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
	25	SPT	2-7	10 9 14	23		Dark Grey SAND (SP-SM) with Silt, trace gravel, fine to coarse grained, with occassional 3 to 4-inch thick seams gravel (GP-GM) with silt, medium dense, wet	
	30	SPT	2-8	4 4 15	19		- - - Same	% Grav = 9.0 % Sa = 82.5 % Si/Cl = 8.5 % MC = 18.8
							At 33 feet, alternating 4 to 12-inch thick layers of Dark Grey/Black SAND (SP-SM) with gravel and silt **AND** Dark Grey/Black GRAVEL (GP-GM) with sand and silt, medium dense, wet	
	35	SPT	2-9	6 5 10	15			% Si/Cl = 5.6 % MC = 18.9
		SPT	2-10	37 20 17	37		- - - Becomes dense	% Grav = 44.8 % Sa = 47.4 % Si/Cl = 7.8 % MC = 9.4
							End of Boring at 38.5 Feet	
	40							
	45							
	50							

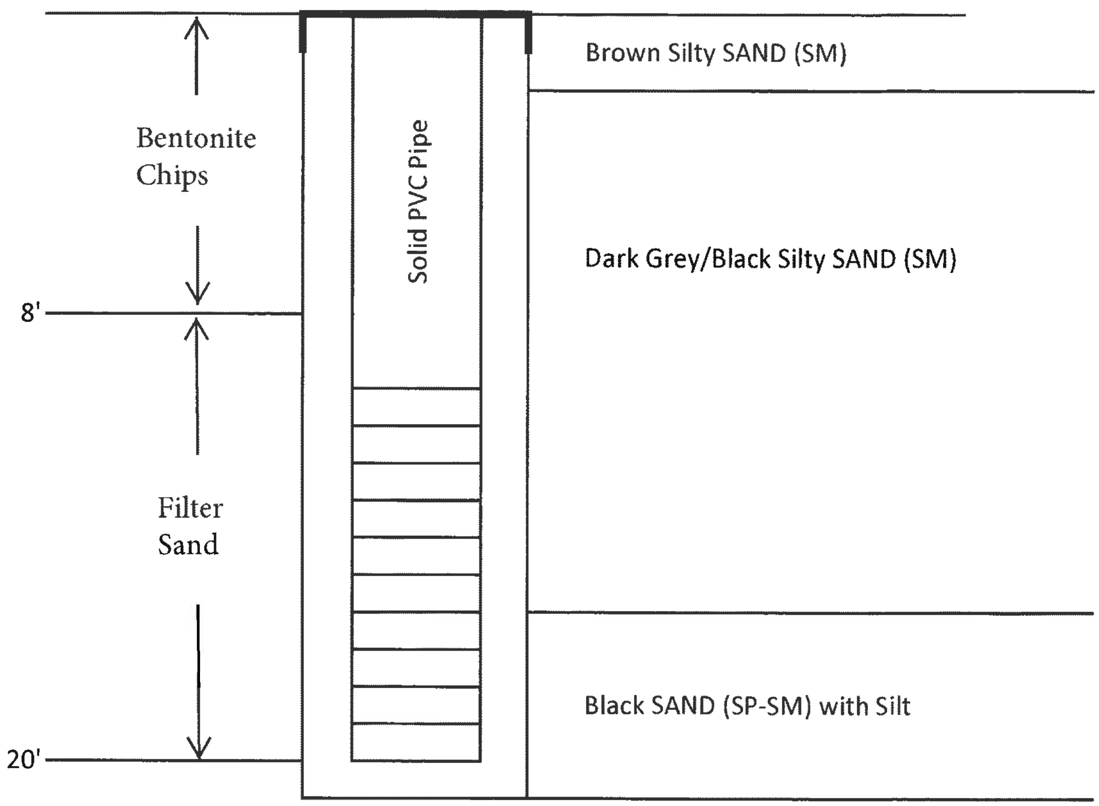
Krazan & ASSOCIATES, INC.

Project: East Town Crossing	Project Number: 062-19007	Client: Abbey Road Group	Boring No.	B-3
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			Drilling Company: Geologic Drill Partners	
Project Manager: Theresa Nunan	Date — Started: 3.11.2019		Equipment: Track Bobcat	
Field Engineer: Theresa Nunan	Date — Completed: 3.11.2019		Drilling Method: Hollow Stem Augers	
Notes:	Date — Backfilled: 3.11.2019		Hammer Type: 140-lb. Manual	
Ground Surface Elevation: 74 +/- feet MSL	Groundwater Depth: 7 feet		Total Depth of Boring: 21.5 ft.	

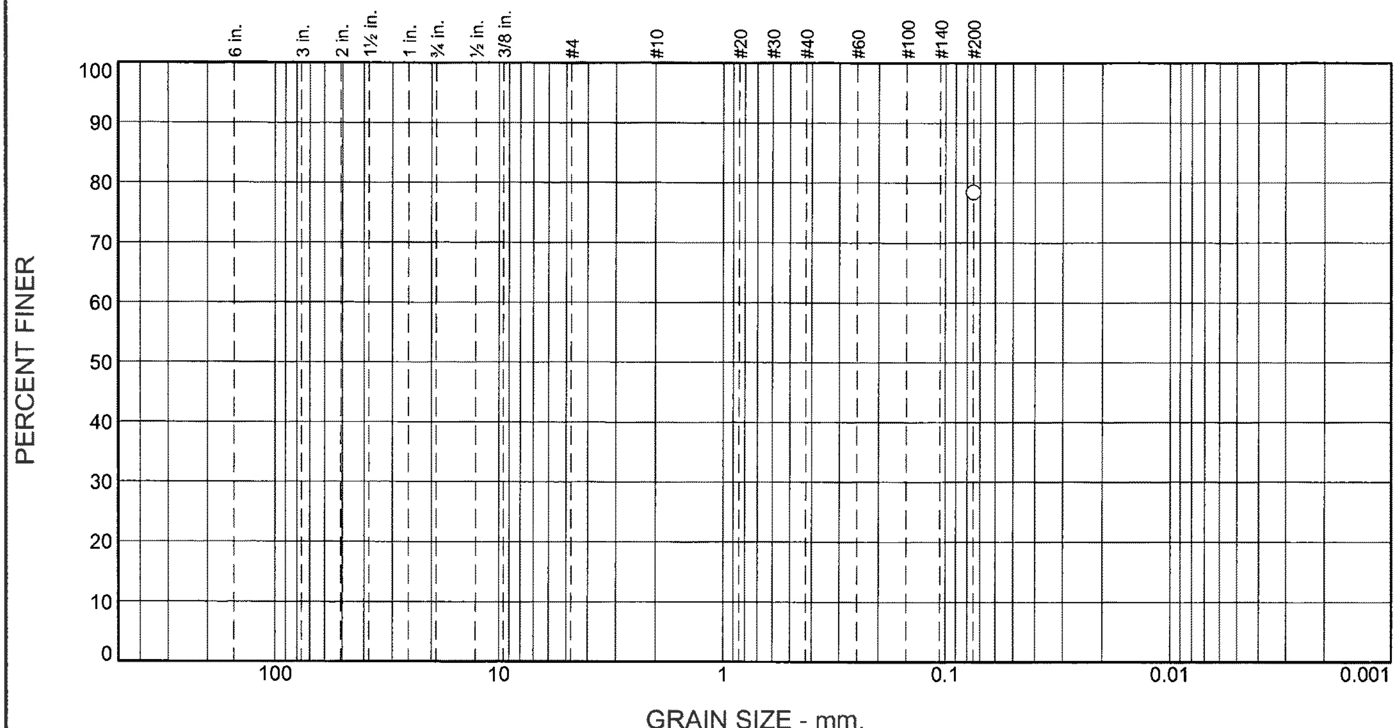
Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 2 to 3-inch thick stiff sandy clay layers, loose, moist	
		SPT	3-1	2 4 5	9			
							Brownish Grey Sandy SILT (ML), fine grained, with occassional 0.5 to 2-inch thick seams dark grey fine sand, stiff, moist to wet, stiff	
	5	SPT	3-2	4 6 6	12			
	▼ (7)							
		SPT	3-3	5 5 5	10		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	
	10	SPT	3-4	3 5 7	12			
							- - - Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense, wet	
	15	SPT	3-5	6 10 7	17			
							Dark Grey/Black Silty SAND (SM), fine to medium grained, with a 4-inch thick seam of peat at 20 feet, medium dense, wet	
	20	SPT	3-6	4 6 8	14			
							End of Boring at 21.5 Feet	
	25							


Monitoring Well
MW-1
Bentonite Chips
Solid PVC Pipe
FILTER SAND
8'
20'
21.5'
Brown Silty SAND (SM)
Brownish Grey SAND (SP)
Alternating Sandy SILT (ML) and Silty SAND (SM)
Dark Brownish Grey Silty CLAY (CL)
--- Clayey SILT (ML)
Dark Grey/Black Silty SAND (SM)

Monitoring Well
MW-2



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						78.5

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	78.5		

* (no specification provided)

Material Description

Brown Sandy SILT

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L131
Sample Date:3-11-19
Moisture Content = 35.4 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

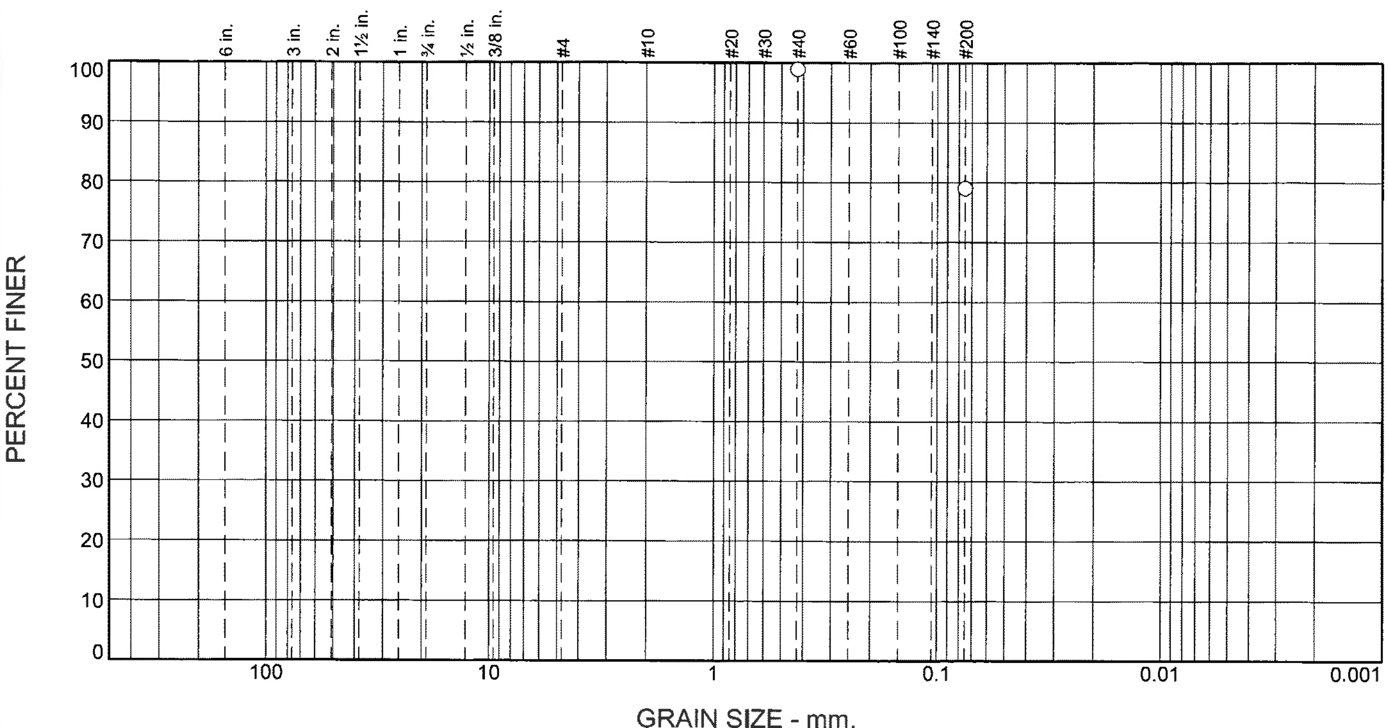
Location: B-1 Sample 1-2B
Sample Number: 19L131 **Depth:** 5'-6.5'
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
					19.8	79.1

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#40	98.9		
#200	79.1		

* (no specification provided)

Material Description

Grey Clayey SILT with fine sand

Atterberg Limits (ASTM D 4318)

PL= 33.5 **LL=** 34.9 **PI=** 1.4

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 0.1948 D_{85}= 0.1258 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L120
Sample Date:3-11-19
Moisture Content = 51.2 %

Date Received: 3-15-19 **Date Tested:** 3-15-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

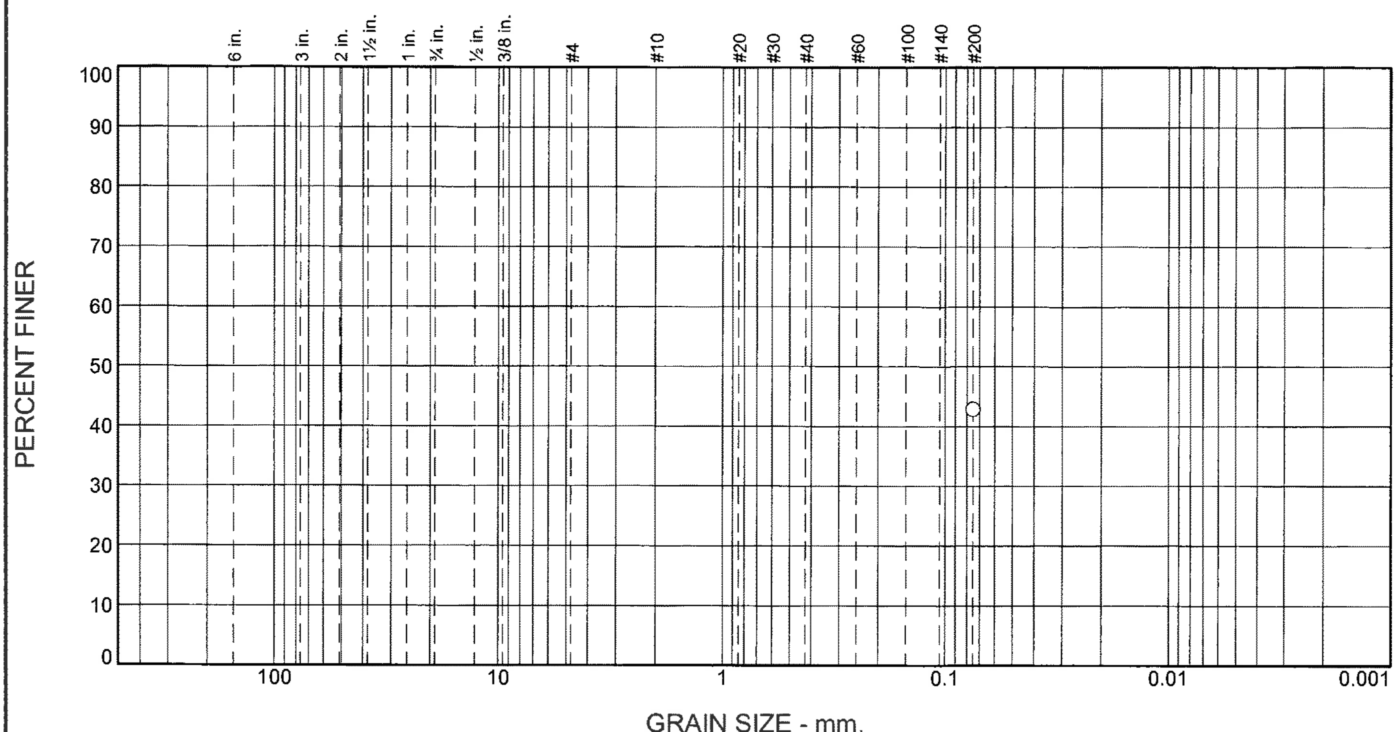
Location: B-1 Sample 1-3B
Sample Number: 19L120 **Depth:** 7.5'-9' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						42.9

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	42.9		

* (no specification provided)

Material Description

Brown silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L132
Sample Date:3-11-19
Moisture Content = 29.3 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

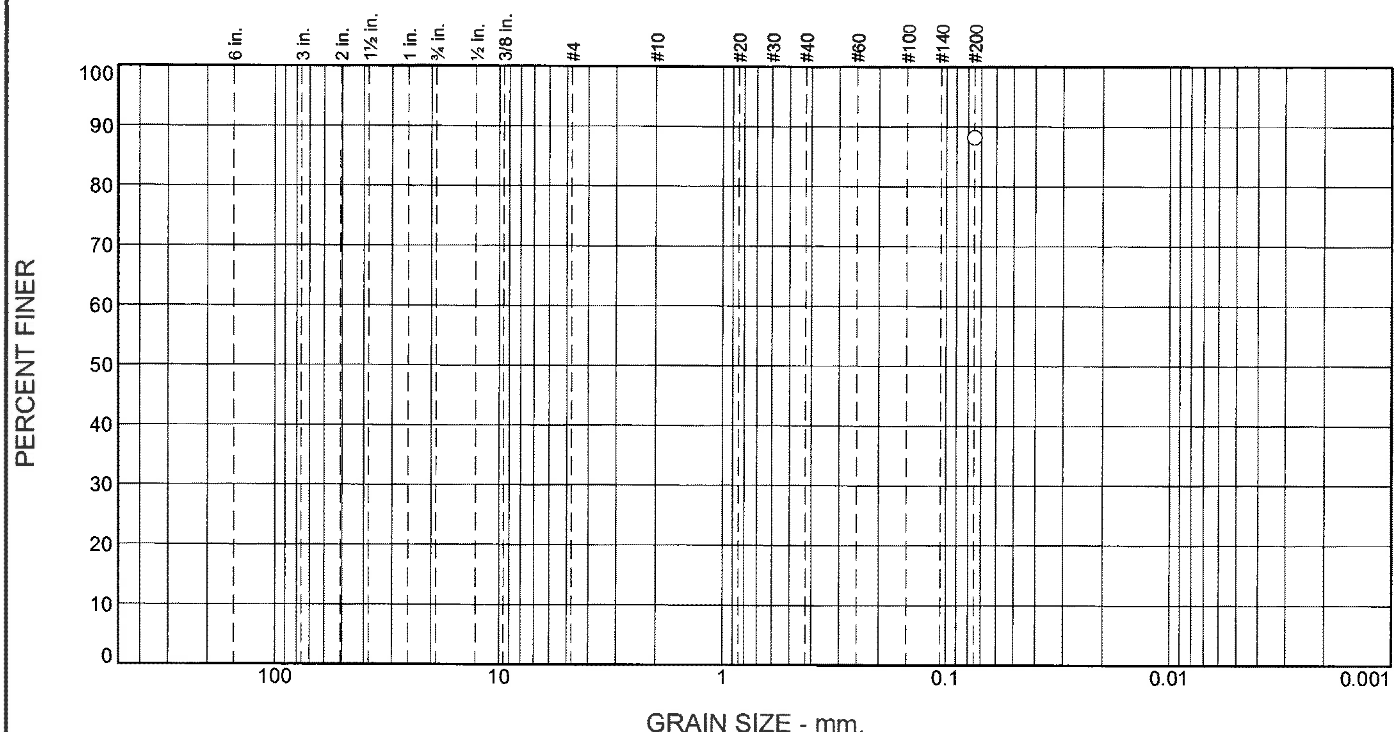
Location: B-2 Sample 2-2
Sample Number: 19L132 **Depth:** 5'-6.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						88.2

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	88.2		

* (no specification provided)

Material Description

Brown sandy silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L133
Sample Date:3-11-19
Moisture Content = 37.0%

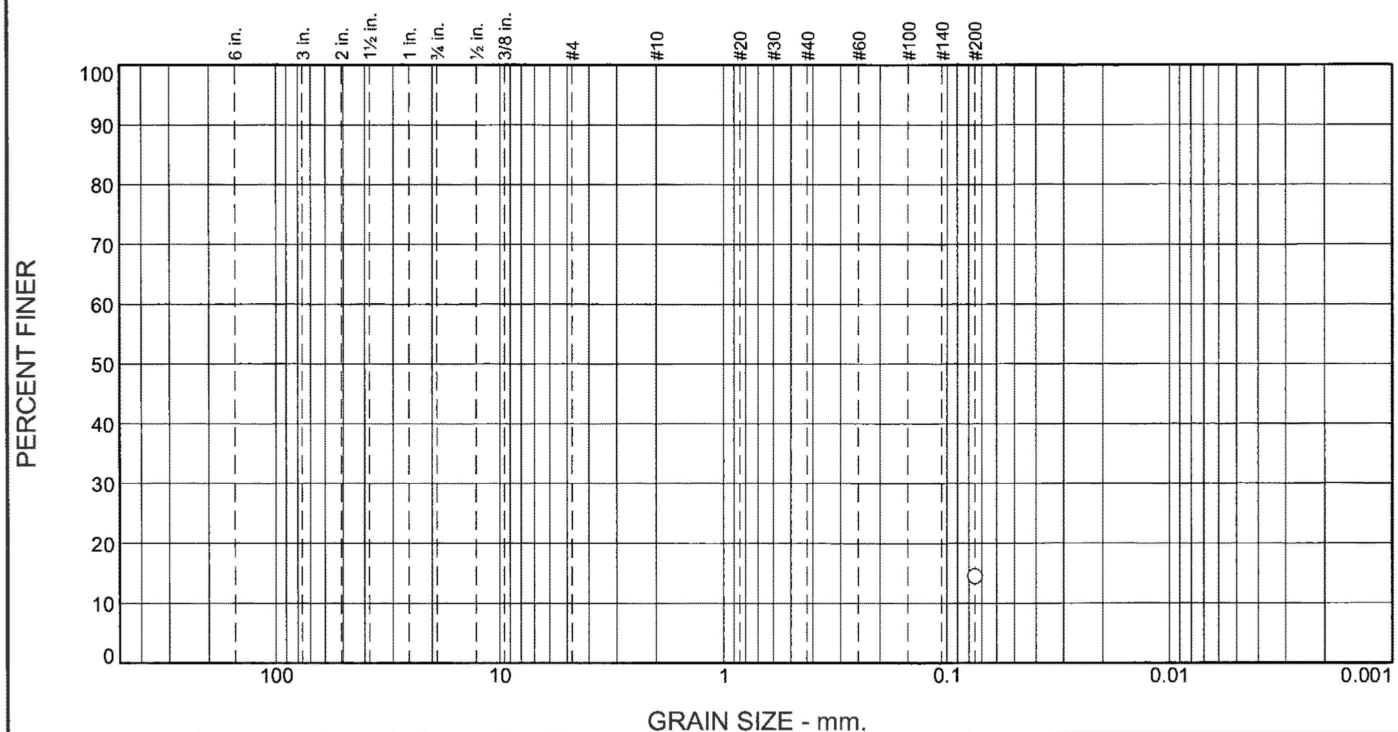
Date Received: 3-15-19 **Date Tested:** 3-22-19
Tested By: M.Thomas
Checked By: M.Thomas
Title: Materials Laboratory Manager

Location: B-2 Sample 2-3
Sample Number: 19L133 **Depth:** 7.5'-9' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing
Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						14.5

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	14.5		

* (no specification provided)

Material Description

Dark Grey/Black silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L134
sample Date:3-11-19
Moisture Content = 25.0 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-4
Sample Number: 19L134 **Depth:** 10'-11.5' **Date Sampled:** 3-11-19

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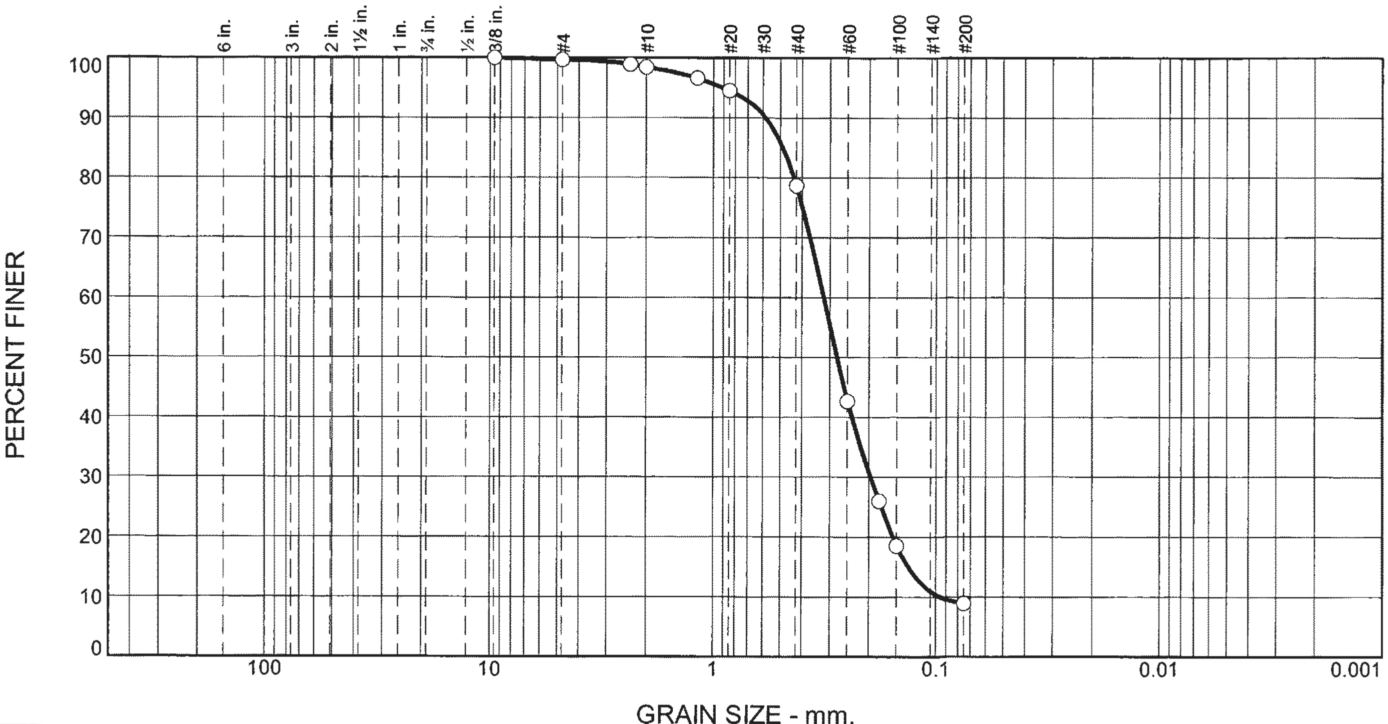
Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.3	1.2	19.8	69.8	8.9

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.7		
#8	98.9		
#10	98.5		
#16	96.6		
#20	94.5		
#40	78.7		
#60	42.7		
#80	26.0		
#100	18.5		
#200	8.9		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.5827 D_{85}= 0.4892 D_{60}= 0.3205
D_{50}= 0.2792 D_{30}= 0.1966 D_{15}= 0.1334
D_{10}= 0.0956 C_u= 3.35 C_c= 1.26

Remarks

Sample ID:19L121
Sample Date:3-11-19
Moisture Content = 22.6 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials laboratory Manager

Location: B-2 Sample 2-5
Sample Number: 19L121 **Depth:** 15'-16.5'

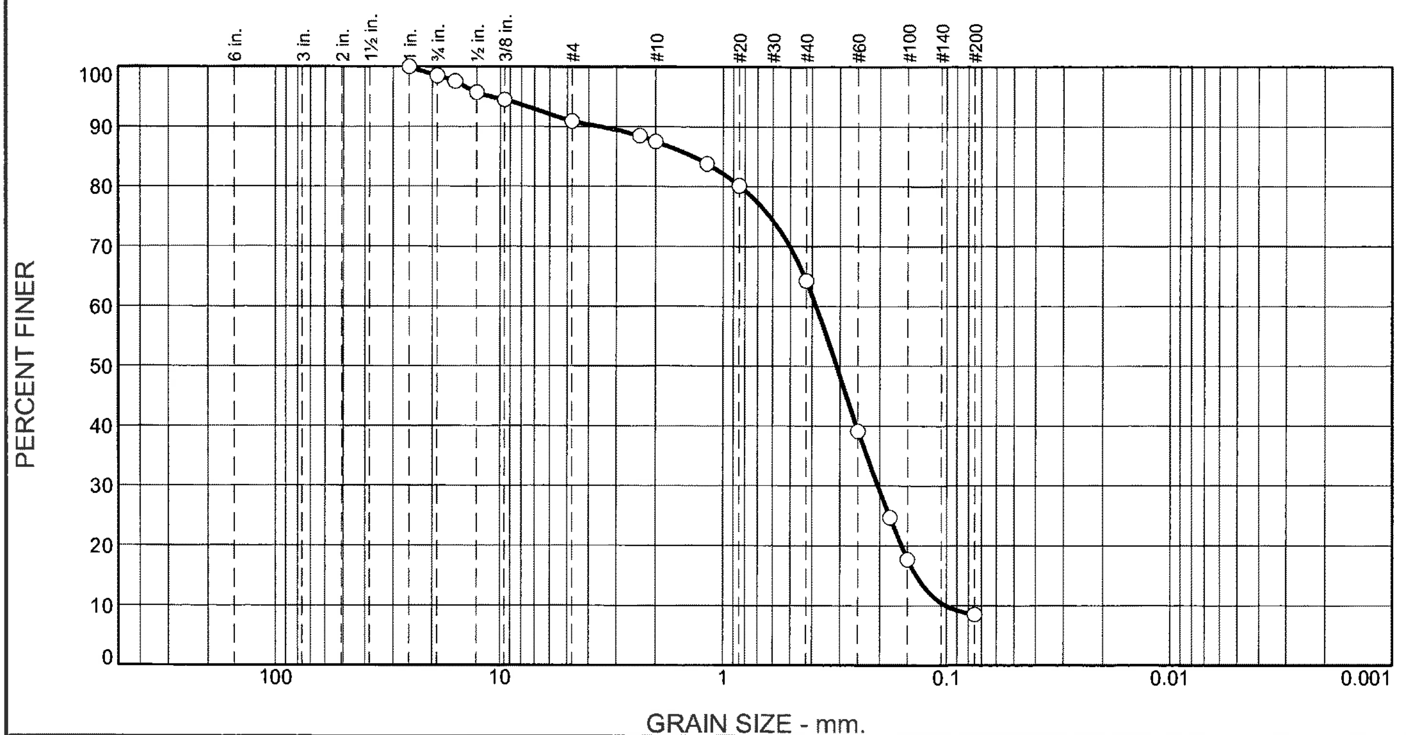
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	1.4	7.6	3.5	23.3	55.7	8.5

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	98.6		
.625	97.6		
.5	95.7		
.375	94.5		
#4	91.0		
#8	88.5		
#10	87.5		
#16	83.8		
#20	80.2		
#40	64.2		
#60	39.1		
#80	24.7		
#100	17.7		
#200	8.5		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 3.5671 D_{85}= 1.3567 D_{60}= 0.3839
D_{50}= 0.3115 D_{30}= 0.2039 D_{15}= 0.1371
D_{10}= 0.1011 C_u= 3.80 C_c= 1.07

Remarks

Sample ID:19L122
Sample Date:3-11-19
Moisture Content = 18.8 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-8
Sample Number: 19L122 **Depth:** 30'-31.5'
Date Sampled: 3-11-19

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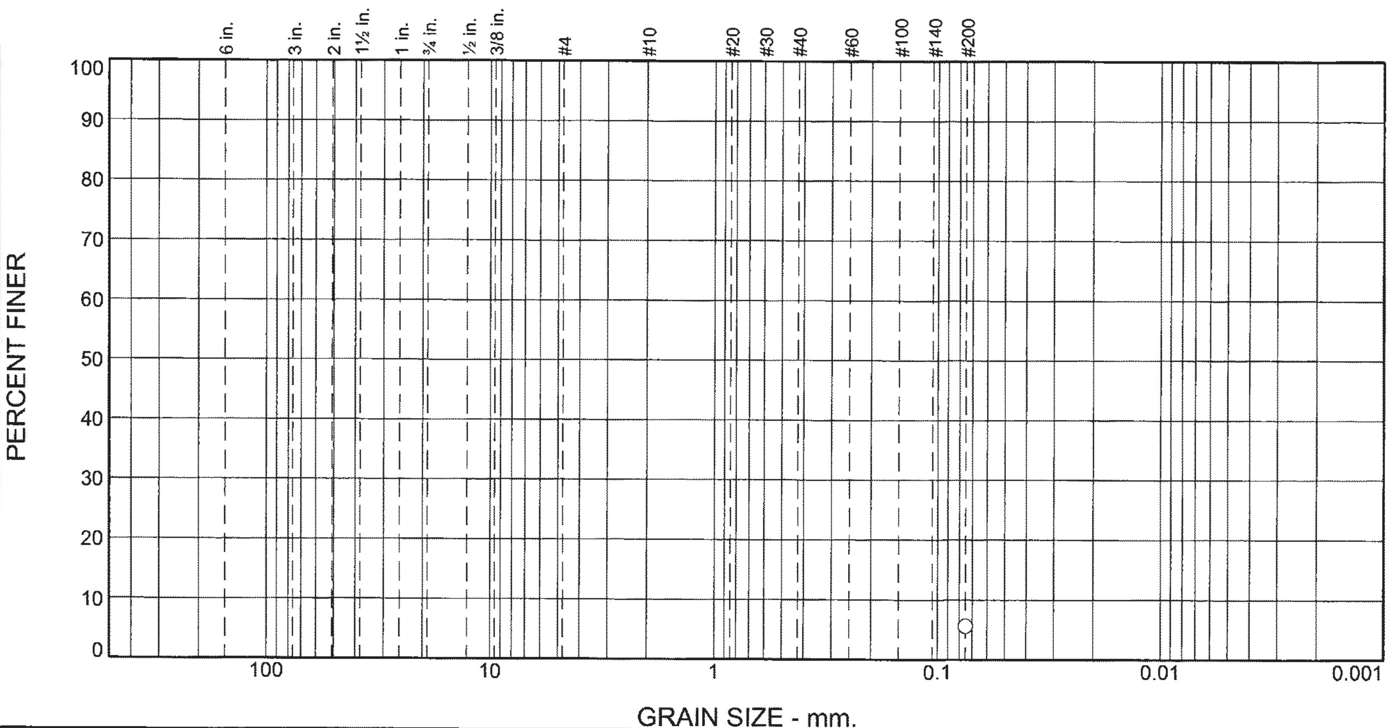
Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing
Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						5.6

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	5.6		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L135
Sample Date:3-11-19
Moisture Content = 18.9 %

Date Received: 3-15-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

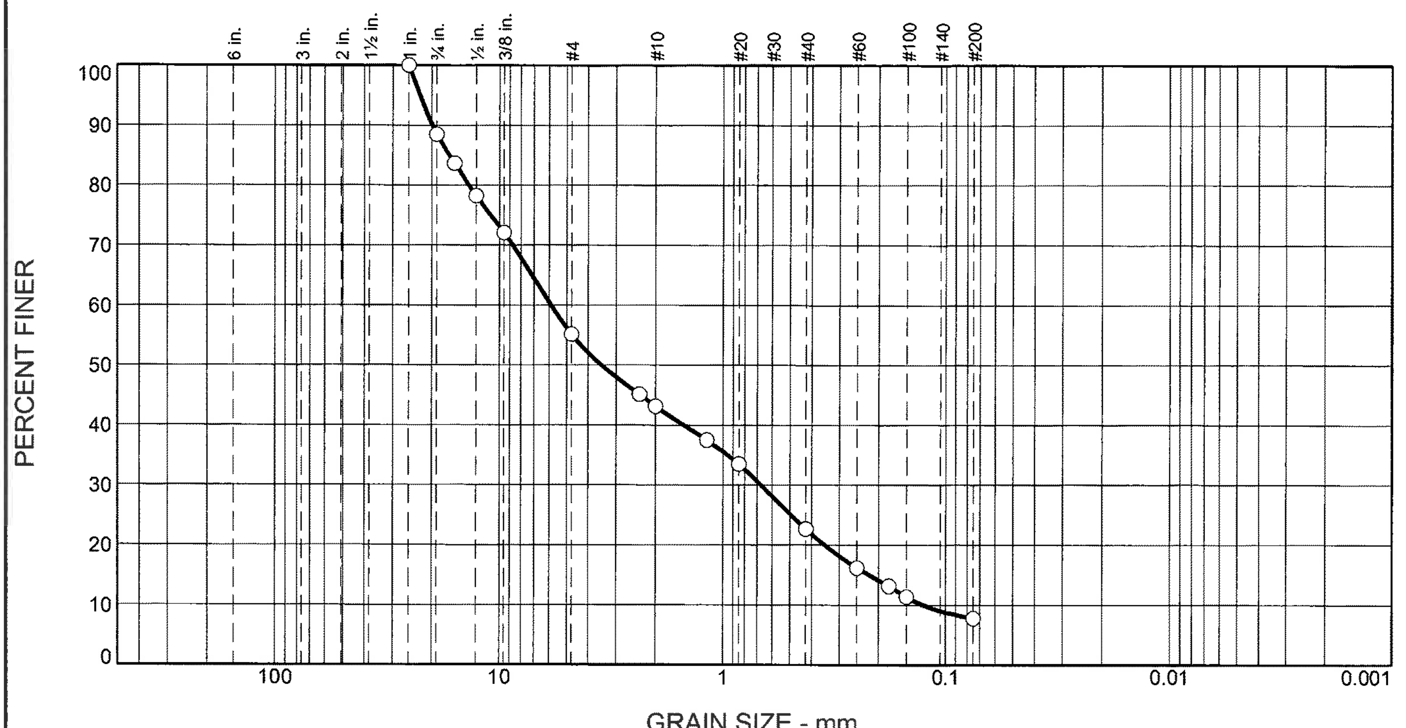
Location: B-2 Sample 2-9
Sample Number: 19L135 **Depth:** 35'-36.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	11.5	33.3	12.0	20.5	14.9	7.8

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	88.5		
.625	83.7		
.5	78.3		
.375	72.1		
#4	55.2		
#8	45.1		
#10	43.2		
#16	37.5		
#20	33.5		
#40	22.7		
#60	16.2		
#80	13.2		
#100	11.4		
#200	7.8		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt and gravel.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 19.9452 D_{85}= 16.7747 D_{60}= 5.8717
D_{50}= 3.4968 D_{30}= 0.6741 D_{15}= 0.2194
D_{10}= 0.1253 C_u= 46.85 C_c= 0.62

Remarks

Sample ID:19L123
Sample Date:3-11-19
Moisture Content = 9.4 %

Date Received: 3-11-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-10
Sample Number: 19L123 **Depth:** 37'-38.5' **Date Sampled:** 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, **the recommendations in the report have precedence**.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and Civil Engineer are the Owner's representatives. If the contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density of not less than 95 percent of maximum dry density as determined by ASTM Test Method D1557 as specified in the technical portion of the Geotechnical Engineering Report. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Geotechnical Engineer.

SOIL AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the contractor for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including Court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

General site clearing should include removal of any organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas.

SUBGRADE PREPARATION: Subgrade should be prepared as described in our site preparation section of this report.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Geotechnical Engineer. All materials utilized for constructing site fills shall be free from vegetable or other deleterious matter as determined by the Geotechnical Engineer.

PLACEMENT, SPREADING, AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer.

Both cut and fill shall be surface compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. **DEFINITIONS** – The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

2. **SCOPE OF WORK** – This portion of the work shall include all labor, materials, tools, and equipment necessary for and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. **PREPARATION OF THE SUBGRADE** – Subgrade should be prepared as described in our site preparation and pavement design sections of this report.

4. **AGGREGATE BASE** – The aggregate base shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base should conform to WSDOT Standard Specification for Crushed Surfacing Base Course or Top Course (Item 9-03.9(3)). The base material shall be compacted to a minimum compaction of 95% as determined by ASTM D1557. Each layer of subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. **ASPHALTIC CONCRETE SURFACING** – Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The drying, proportioning, and mixing of the materials shall conform to WSDOT Specifications.

The prime coat, spreading and compaction equipment, as well as the process of spreading and compacting the mixture, shall conform to WSDOT Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with combination steel-wheel and pneumatic rollers, as described in WSDOT Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

6. **TACK COAT** – The tack (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of WSDOT Specifications.

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

July 31, 2020

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide our opinion regarding the nearby steep slopes. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019.

Based on our communication with you, it is our understanding that the City of Puyallup has requested to provide our opinion on the hazards and risks to the site due to the site being within 300 feet of steep slopes.

We have reviewed Washington State Department of Natural Resources (DNR), City of Puyallup, and Pierce County published landslide hazard maps and web data. We have also reviewed the Landslide Inventory, Susceptibility, and Exposure Analysis of Pierce County, Washington (DNR), prepared by Katherine A. Mickelson et al., and dated July 2017.

Based on our review, we understand that steep slopes are located roughly 300 feet to the south and east from the site. These nearby slopes are mapped moderate to high for shallow landslide susceptibility, and moderate for deep susceptibility. However, there are no historic landslides or debris mapped at the nearby slopes. The closest landslide mapped is located roughly 1 mile southeast of the site.

There is an existing developed property between the nearby southern slope and the southern boundary of the site. There is a partially developed property between the nearby eastern slope and the eastern boundary of the site. In our opinion, these properties to the south and east create a buffer between the nearby slopes and the site. Based on our review of available published documents and maps, it is our opinion that there is minimum to no risk to the planned development from the nearby slopes.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

07/31/20

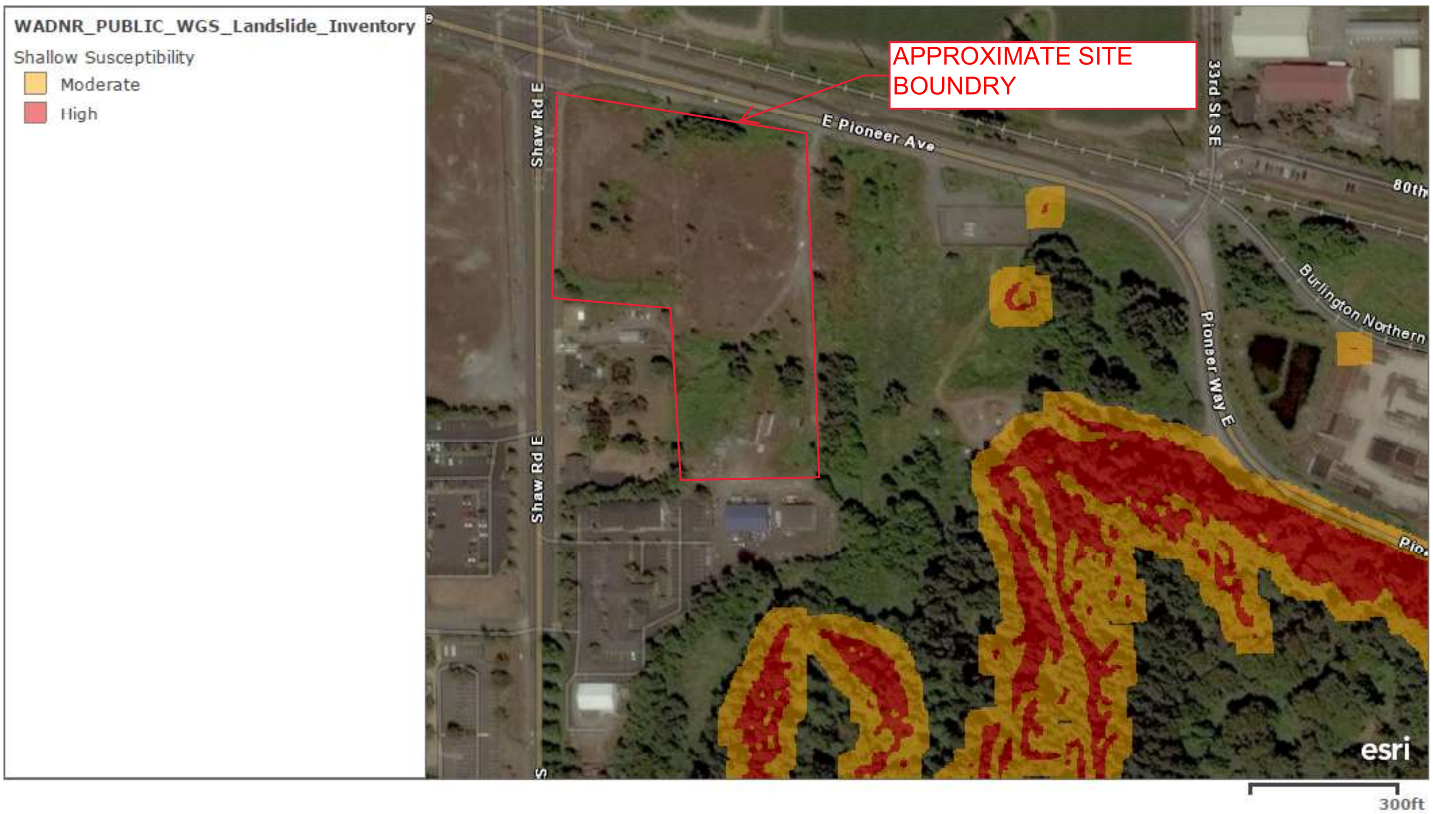
VIJAY CHAUDHARY
STATE OF WASHINGTON
51061
REGISTERED
PROFESSIONAL ENGINEER

Theresa Nunan

Vijay Chaudhary, P.E.
Project Engineer

Theresa R. Nunan
Project Manager

Attachments: WA DNR Landslide Inventory Maps (Figures A, B, and C)



USDA FSA, GeoEye, Maxar | Esri Community Maps Contributors, King County, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan

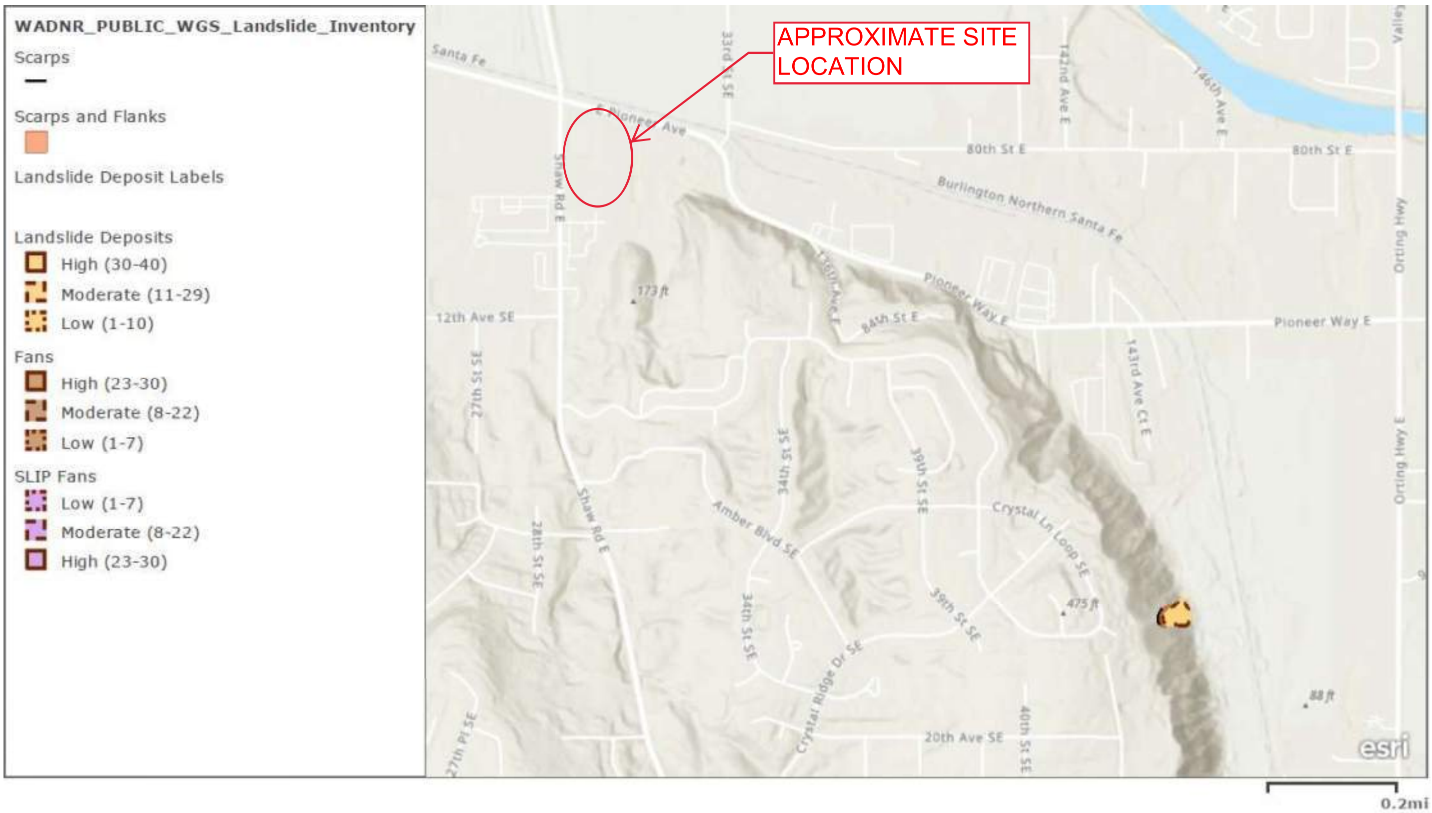
East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: A	Not to scale

USDA FSA, GeoEye, Maxar | Esri Community Maps Contributors, King County, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan

East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: B	Not to scale



Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, King County, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

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Krazan

East Town Crossing

Date: July 2020	Project Number: 062-19007

Drawn By: VC	Figure: C	Not to scale

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

March 19, 2021

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide the results of two (2) Large-Scale Pilot Infiltration Tests (PITs) we conducted at the above-referenced site. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019, as well as an addendum letter dated July 31, 2020 that addressed the nearby steep slopes.

Large-Scale PITs

Two (2) test pits, designated P-1 and P-2, were excavated near Monitoring Wells MW-1 and MW-2, respectively, on March 4, 2021 at the approximate locations indicated on the Site Plan, Figure 1, in order to conduct large-scale infiltration tests in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The infiltration test locations were selected in the field by the client and excavated using a client provided excavator and operator. The bottom of each pit was excavated 10-feet wide by 10-feet long, which met the minimum required horizontal surface area of 100 square feet (sf). Each test pit was initially excavated to a depth of 2 feet below the existing ground surface (bgs), which exposed silty sand (SM) soils at the pit bottom. Water was observed seeping from the sides of pit P-1 during excavation, and was observed ponded at the ground surface at several locations in the vicinity of pit P-1. Test pits P-1 and P-2 encountered undocumented fill to a depth of 1.8 feet and 0.5 feet bgs, respectively, followed by native brown silty sand (SM) with trace gravel and occasional sandy silt and sandy clay seams and layers to the bottom of the test pits. The soils exposed at the PIT test depth were similar to those encountered in the geotechnical borings conducted during our original exploration of the site.

The infiltration test procedure includes a pre-soak period, followed by steady-state and then falling head infiltration rate testing. Each pit was filled with water to a depth of 12 inches above the bottom of the pit for the pre-soak period. After two (2) hours of pre-soak, the water hose was turned off as even just a slight trickle caused the water level in the pit to continue to rise. Water level readings were obtained for an additional 4 hours in pit P-2 with no change in the water level, while the water level in pit P-1 increased ¾-inches which we attributed to seepage from the sides of this pit which were observed during its excavation. Since the water in pits P-1 and P-2 was not infiltrating, we left the pits open overnight, and returned to the site to record the water level. Since it had commenced to rain just prior to our leaving the site, a 5-gallon bucket was left at the location of pit P-2 to obtain an estimate of the amount of rain that fell overnight. We recorded 0.6 inches of rain in the bucket the following morning. On the morning of March 5, 2021, the water level in pit P-1 had risen another 1.2 inches, while the water level in pit P-2 rose about 0.3 inches. Figure 2 includes photos of pits P-1 and P-2 taken on March 5, 2021. The pits were not over-excavated due to the presence of water. The contractor had excavated three test pits within the northwestern corner of the site on March 4, 2021. We observed about 8 to 10 inches of water in the bottom of two of the test pits on March 5, 2021.

Evaluation of Infiltration Feasibility: One of the Site Suitability Criteria (SSC) presented in Section 3.3.7, Volume III, 2014 SWMMWW, **SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer**, states that the base of all infiltration basins or trench systems shall be greater than or equal to 5 feet above the seasonal high-water mark, bedrock (or hardpan), or other low permeability layer. Based on the results of our field exploration and large-scale PITs, the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Based on the results of our general site assessment and field testing, the low permeability soils encountered at the site do not meet the requirements of Site Suitability Criteria SSC-5 and it is therefore our opinion that onsite infiltration of stormwater using basin or trench system is not considered feasible for the proposed development. **However,** consideration may be given to the use of permeable pavement and other Best Management Practices (BMPs), depending on the final site grading plan.

Limitations

This letter has been prepared for the exclusive use of the Abbey Road Group and their assigns, for the specific application to the site. The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

This letter does not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands or other biological conditions. The information presented herein is based upon professional interpretation using standard industry practices and engineering conservatism that we consider proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

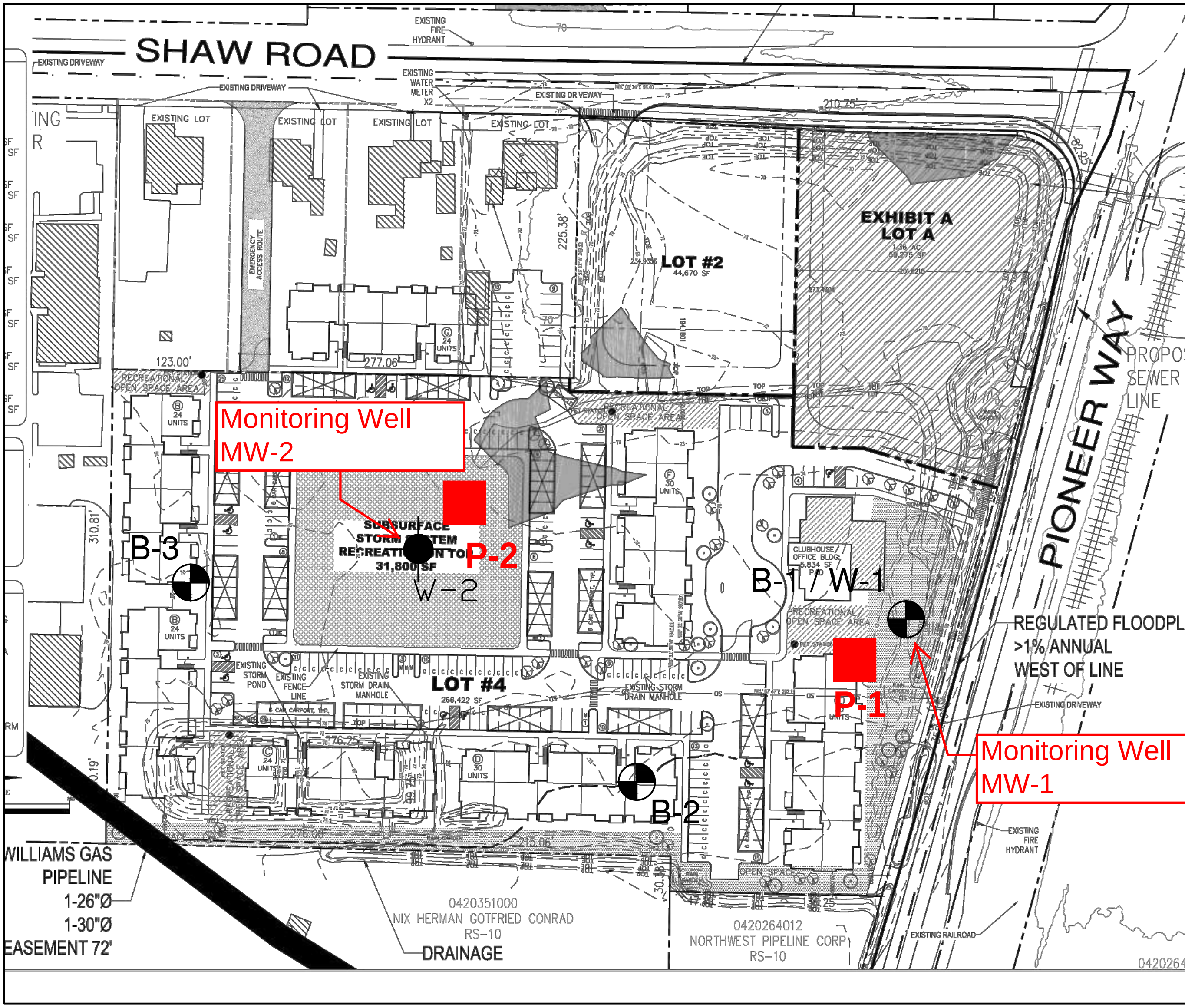
3/19/21

VIJAY CHAUDHARY
STATE OF WASHINGTON
51061
REGISTERED
PROFESSIONAL ENGINEER

Theresa R. Nunan
Project Manager

Vijay Chaudhary, P.E.
Assistant Regional Engineering Manager

Attachments: Figure 1 – Site Plan
Figure 2 – Photos



LEGEND

	B-1	Number and Approximate Location of Borings
	W-1	Approximate Location of Monitoring Well
	P-1	Approximate Location of Pilot Infiltration Test

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: March 2021
Krazan & ASSOCIATES, INC.	Not to Scale

Water in Pit P-1 on March 5, 2021.

Water in Pit P-2 on March 5, 2021.

Water in Test Pit on March 5, 2021. Test pit was excavated in NE portion of site on March 4, 2021.

Figure 2 - Photos (March 5, 2021)

Figure A7 - Geo-technical Glass Proctor Report

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

December 10, 2021 KA Project No. 062-21033

Abbey Road Group, LLC
P.O. Box 11489
Olympia, WA 98508

Attn: Mr. Gil Hulsmann
Tel: 253-435-3699 x1510
Email: gil.hulsmann@abbeyroadgroup.com

Reference: Laboratory Testing – Recycled Glass
East Town Crossing Project
SE Corner of E Shaw Road & E Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

The gradation and proctor test results for the two recycled glass samples, one designated "clean" and the other designated "with fines", supplied by Dan Lloyd Construction are attached to this letter. The gradation tests were conducted on the samples 'as received' and again after completing the Proctor compaction tests. As can be seen in the summary of test results, Table 1 attached to this letter, the glass pierces broke down significantly due to the compaction efforts.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

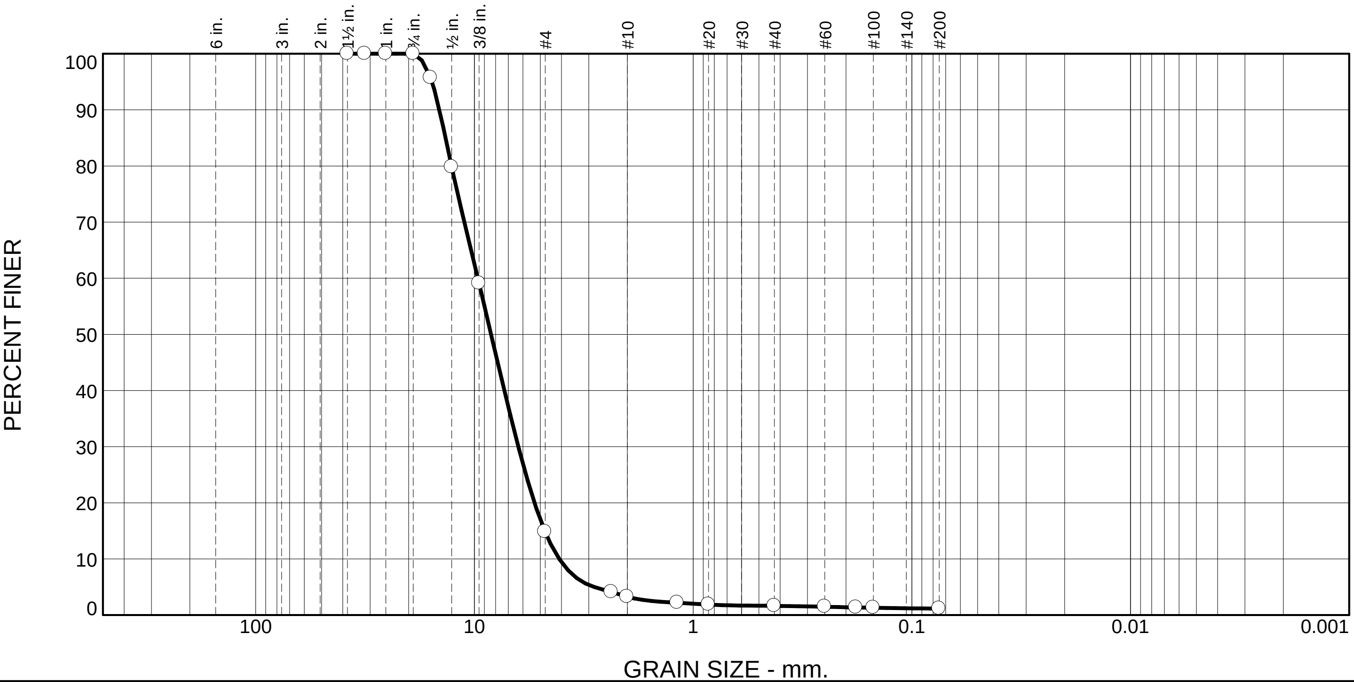
KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan

Theresa R. Nunan
Project Manager

Attachments: Recycled Glass Gradation and Proctor Test Results – "Clean" Sample
Recycled Glass Gradation and Proctor Test Results – "With Fines" Sample
Table 1 – Summary of Recycled Glass Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	85	12	1	1	1	

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	96		
.5	80		
.375	59		
#4	15		
#8	4		
#10	3		
#16	2		
#20	2		
#40	2		
#60	1		
#80	1		
#100	1		
#200	1.2		

* (no specification provided)

Material Description

Recycled Glass Clean - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 14.4630 D_{85}= 13.5519 D_{60}= 9.6467
D_{50}= 8.3902 D_{30}= 6.2995 D_{15}= 4.7699
D_{10}= 4.0959 C_u= 2.36 C_c= 1.00

Remarks

Sample ID:21L892
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

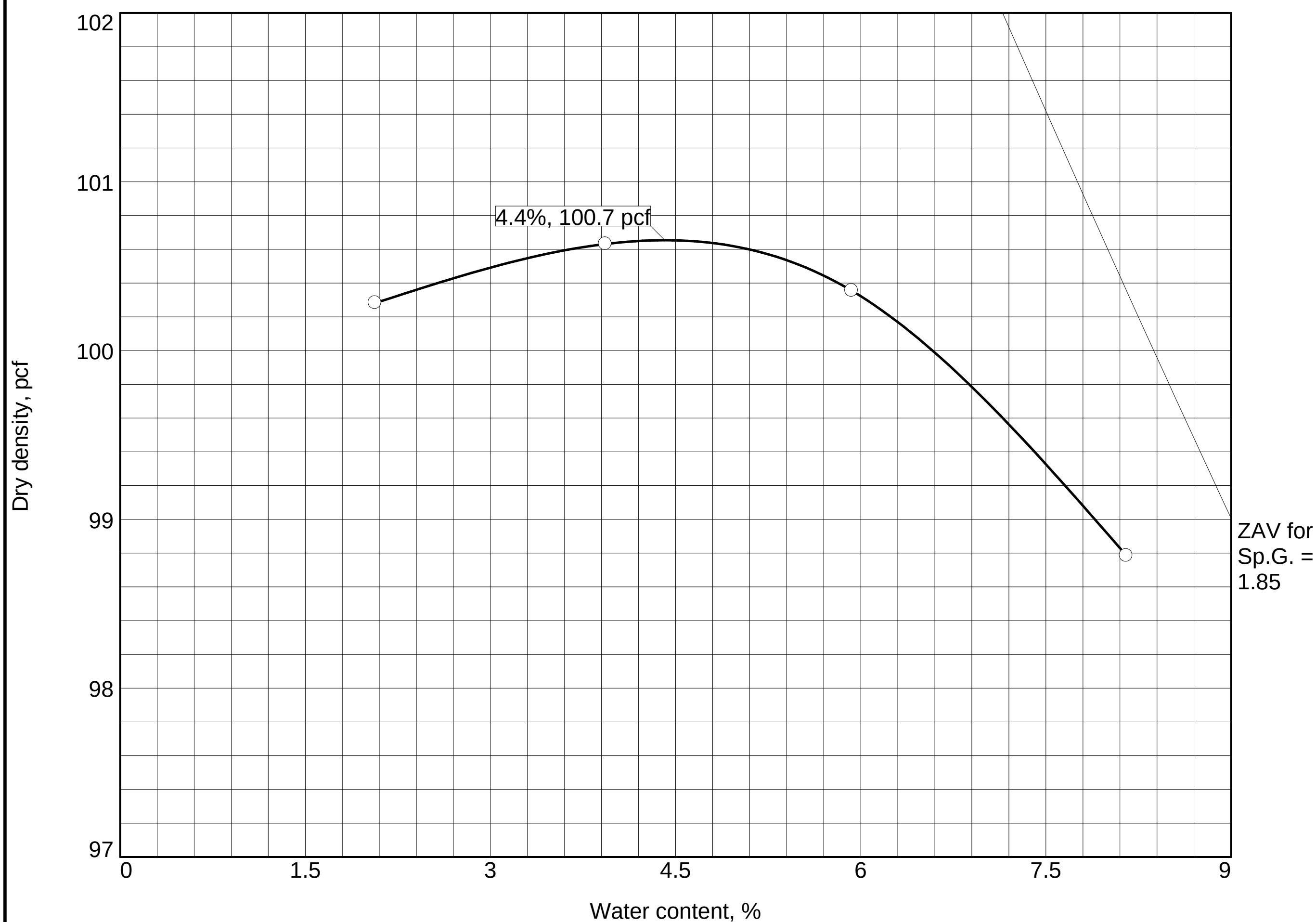
Source of Sample: Dan Lloyd Construction
Sample Number: 21L892
Date Sampled: 11-29-21

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GP	A-1-a		1.85	NV	NP	0	1.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 100.7 pcf Optimum moisture = 4.4 %	Recycled Glass Clean. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services
Project: East Town Crossing Lab Testing - Recycled Glass

Source of Sample: Dan Lloyd Construction **Sample Number:** 21L892

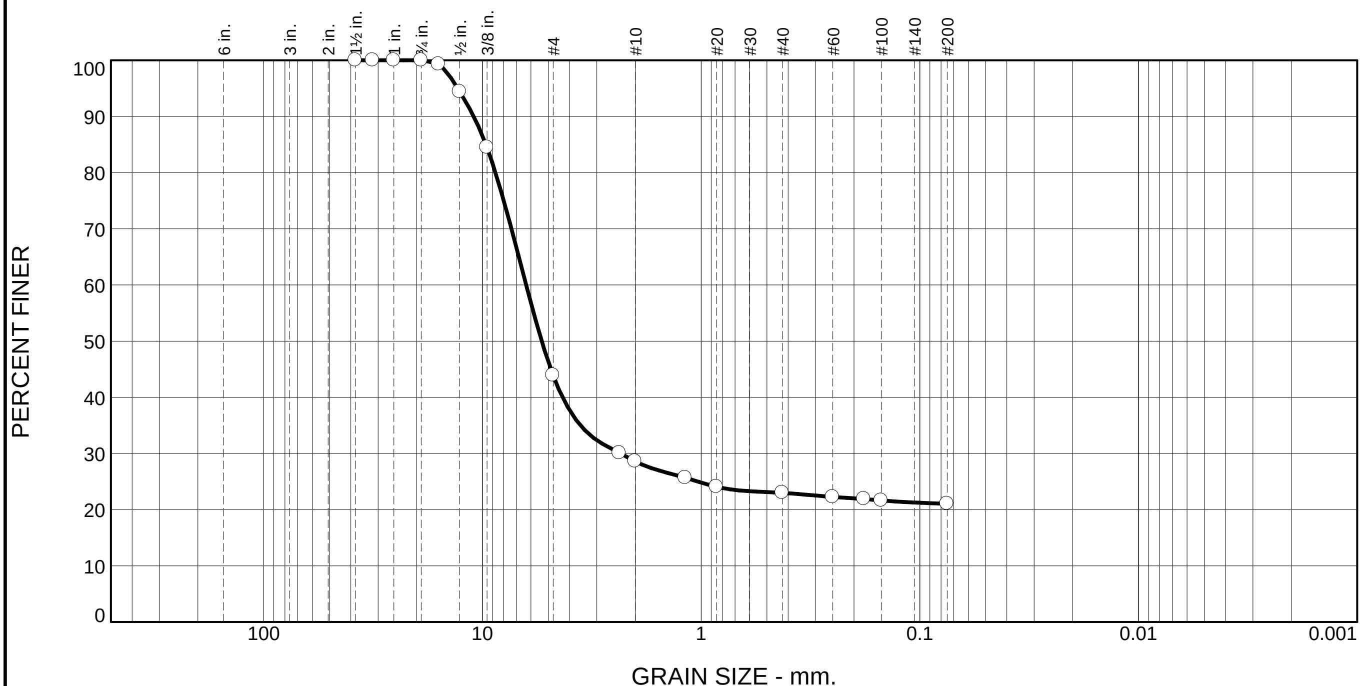
Krazan

Remarks:
Sample ID:21L892
Sample Date:11-29-21
Void Ratio:0.14
Porosity:12%

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	56	15	6	2	21	

Test Results (C-136 & C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	99		
.5	94		
.375	84		
#4	44		
#8	30		
#10	29		
#16	26		
#20	24		
#40	23		
#60	22		
#80	22		
#100	22		
#200	21		

* (no specification provided)

Material Description

Recycled Glass Clean - After Compaction
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 10.9683 D_{85}= 9.6367 D_{60}= 6.3112
D_{50}= 5.3536 D_{30}= 2.3352 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:21L893
Sample Date: 11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: I.Teriong
Title: Project Manager

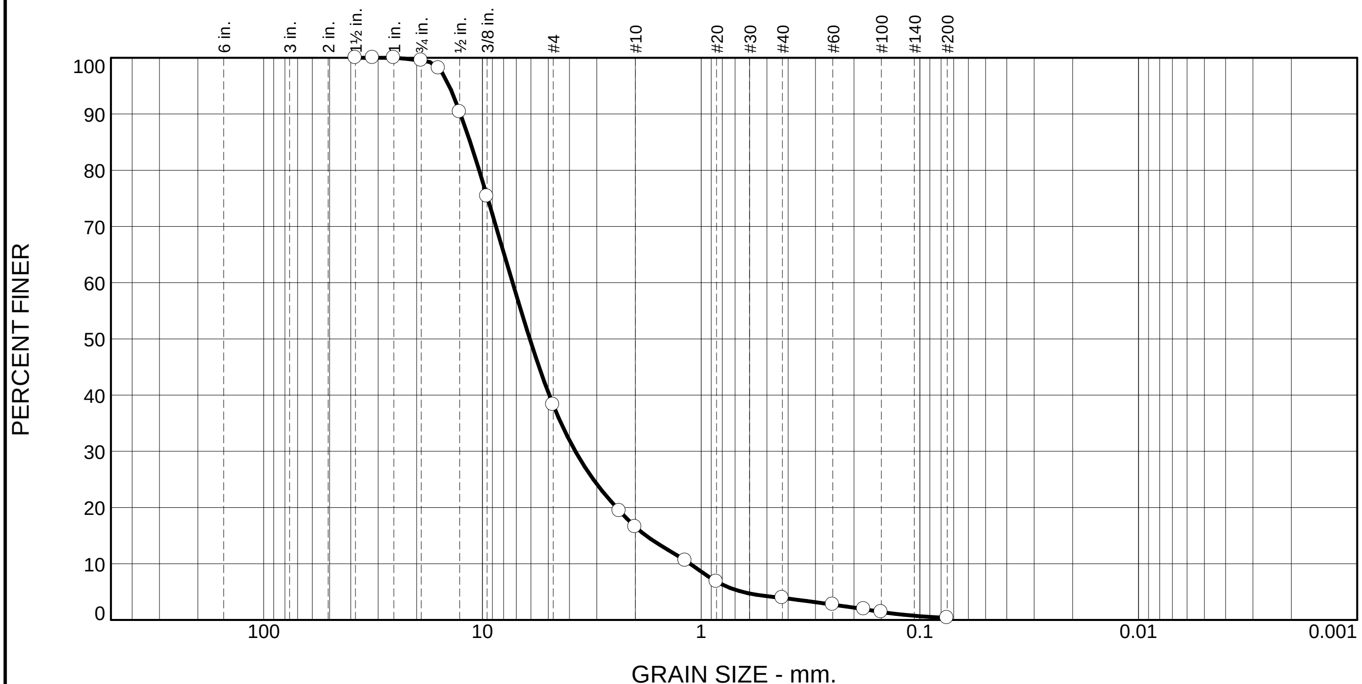
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L892

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	62	21	13	4	0	

Test Results (C-136 & c-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	98		
.5	90		
.375	75		
#4	38		
#8	19		
#10	17		
#16	11		
#20	7		
#40	4		
#60	3		
#80	2		
#100	1		
#200	0.4		

* (no specification provided)

Material Description

Recycled Glass With Fines - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 12.6020 D_{85}= 11.3802 D_{60}= 7.2823
D_{50}= 6.0733 D_{30}= 3.7592 D_{15}= 1.7859
D_{10}= 1.1229 C_u= 6.49 C_c= 1.73

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

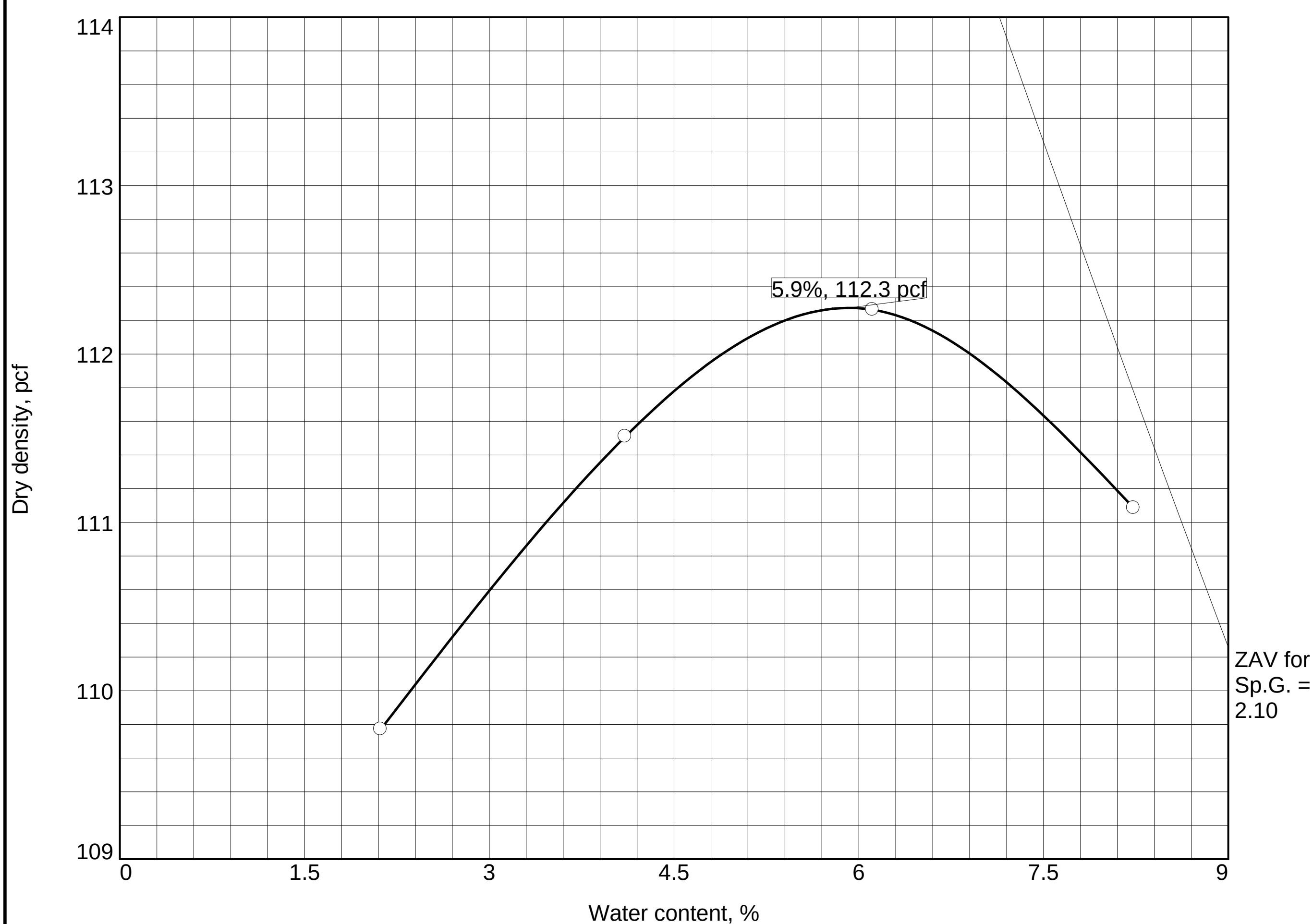
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L893

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GW	A-1-a		2.1	NV	NP	0	0.4

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.3 pcf Optimum moisture = 5.9 %	Recycled Glass With Fines. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services

Project: East Town Crossing Lab Testing - Recycled Glass

○**Source of Sample:** Dan Lloyd Construction **Sample Number:** 21L893

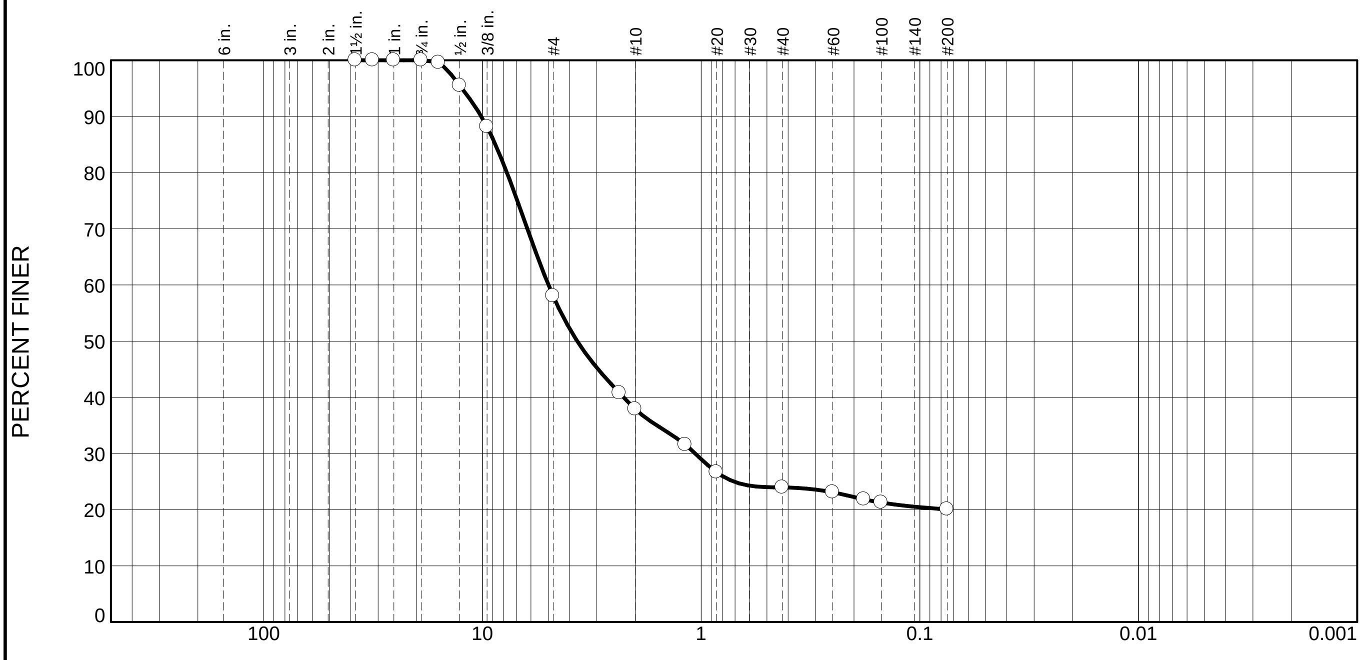
Krazan

Remarks:
Sample ID:21L893
Sample Date:11-29-21
Void Ratio:0.16
Porosity:14%

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	42	20	14	4	20	

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	100		
.5	95		
.375	88		
#4	58		
#8	41		
#10	38		
#16	32		
#20	27		
#40	24		
#60	23		
#80	22		
#100	21		
#200	20		

* (no specification provided)

Material Description

Recycled Glass With Fines - After Compaction.
Sampled by the Supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

$D_{90}=$ 10.1195 $D_{85}=$ 8.7171 $D_{60}=$ 4.9887
$D_{50}=$ 3.6862 $D_{30}=$ 1.0651 $D_{15}=$
$D_{10}=$ $C_u=$ $C_c=$

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

Source of Sample: Dan Lloyd Construction
Sample Number: 21L893
Date Sampled: 11-29-21

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass
Project No: 062-21033 **Figure**

March 19, 2021

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide the results of two (2) Large-Scale Pilot Infiltration Tests (PITs) we conducted at the above-referenced site. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019, as well as an addendum letter dated July 31, 2020 that addressed the nearby steep slopes.

Large-Scale PITs

Two (2) test pits, designated P-1 and P-2, were excavated near Monitoring Wells MW-1 and MW-2, respectively, on March 4, 2021 at the approximate locations indicated on the Site Plan, Figure 1, in order to conduct large-scale infiltration tests in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The infiltration test locations were selected in the field by the client and excavated using a client provided excavator and operator. The bottom of each pit was excavated 10-feet wide by 10-feet long, which met the minimum required horizontal surface area of 100 square feet (sf). Each test pit was initially excavated to a depth of 2 feet below the existing ground surface (bgs), which exposed silty sand (SM) soils at the pit bottom. Water was observed seeping from the sides of pit P-1 during excavation, and was observed ponded at the ground surface at several locations in the vicinity of pit P-1. Test pits P-1 and P-2 encountered undocumented fill to a depth of 1.8 feet and 0.5 feet bgs, respectively, followed by native brown silty sand (SM) with trace gravel and occasional sandy silt and sandy clay seams and layers to the bottom of the test pits. The soils exposed at the PIT test depth were similar to those encountered in the geotechnical borings conducted during our original exploration of the site.

The infiltration test procedure includes a pre-soak period, followed by steady-state and then falling head infiltration rate testing. Each pit was filled with water to a depth of 12 inches above the bottom of the pit for the pre-soak period. After two (2) hours of pre-soak, the water hose was turned off as even just a slight trickle caused the water level in the pit to continue to rise. Water level readings were obtained for an additional 4 hours in pit P-2 with no change in the water level, while the water level in pit P-1 increased ¾-inches which we attributed to seepage from the sides of this pit which were observed during its excavation. Since the water in pits P-1 and P-2 was not infiltrating, we left the pits open overnight, and returned to the site to record the water level. Since it had commenced to rain just prior to our leaving the site, a 5-gallon bucket was left at the location of pit P-2 to obtain an estimate of the amount of rain that fell overnight. We recorded 0.6 inches of rain in the bucket the following morning. On the morning of March 5, 2021, the water level in pit P-1 had risen another 1.2 inches, while the water level in pit P-2 rose about 0.3 inches. Figure 2 includes photos of pits P-1 and P-2 taken on March 5, 2021. The pits were not over-excavated due to the presence of water. The contractor had excavated three test pits within the northwestern corner of the site on March 4, 2021. We observed about 8 to 10 inches of water in the bottom of two of the test pits on March 5, 2021.

Evaluation of Infiltration Feasibility: One of the Site Suitability Criteria (SSC) presented in Section 3.3.7, Volume III, 2014 SWMMWW, **SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer**, states that the base of all infiltration basins or trench systems shall be greater than or equal to 5 feet above the seasonal high-water mark, bedrock (or hardpan), or other low permeability layer. Based on the results of our field exploration and large-scale PITs, the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Based on the results of our general site assessment and field testing, the low permeability soils encountered at the site do not meet the requirements of Site Suitability Criteria SSC-5 and it is therefore our opinion that onsite infiltration of stormwater using basin or trench system is not considered feasible for the proposed development. **However,** consideration may be given to the use of permeable pavement and other Best Management Practices (BMPs), depending on the final site grading plan.

Limitations

This letter has been prepared for the exclusive use of the Abbey Road Group and their assigns, for the specific application to the site. The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

This letter does not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands or other biological conditions. The information presented herein is based upon professional interpretation using standard industry practices and engineering conservatism that we consider proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

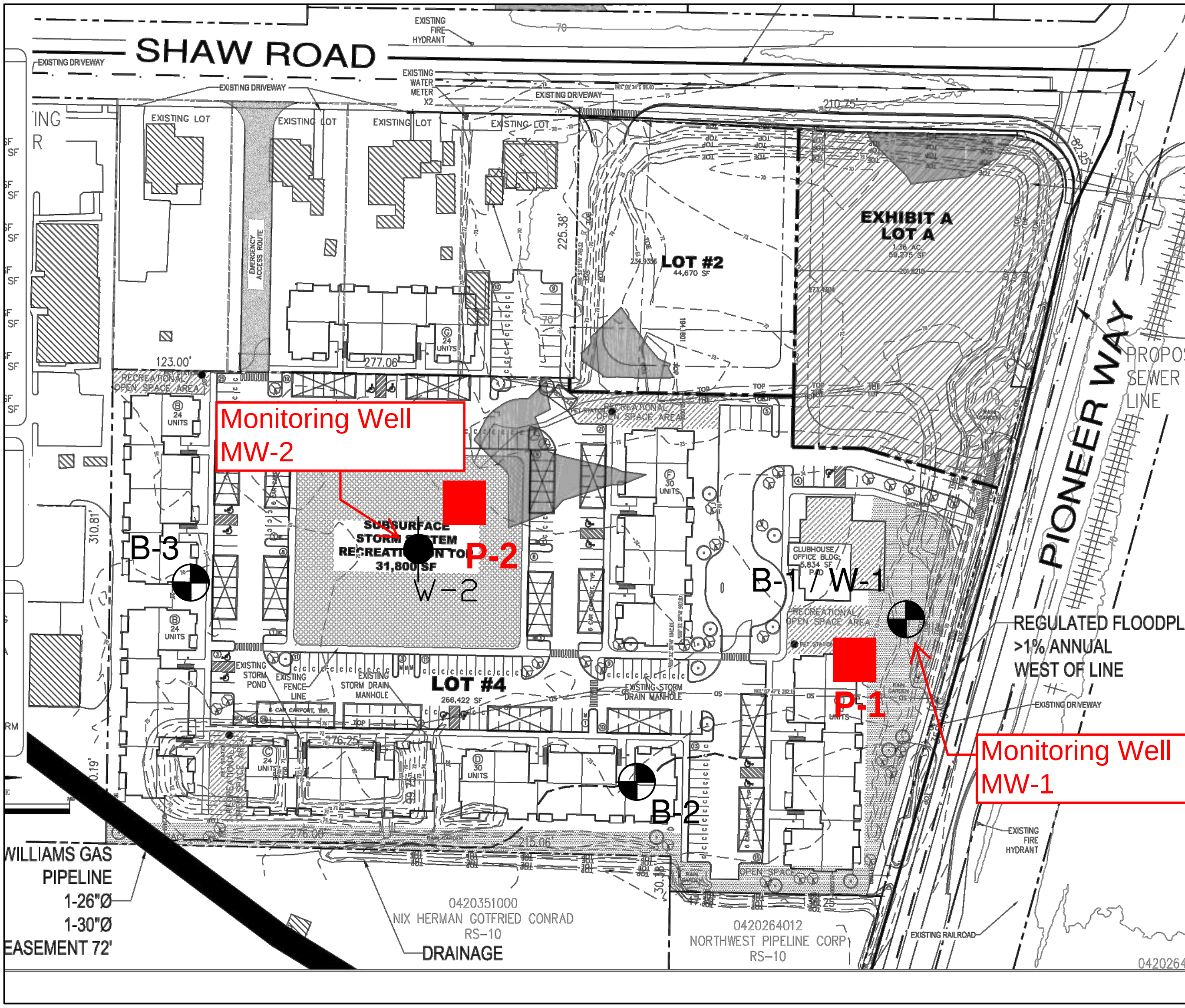
KRAZAN & ASSOCIATES, INC.

3/19/21

Theresa R. Nunan
Project Manager

Vijay Chaudhary, P.E.
Assistant Regional Engineering Manager

Attachments: Figure 1 – Site Plan
Figure 2 – Photos



LEGEND

B-1 Number and Approximate Location of Borings

W-1 Approximate Location of Monitoring Well

P-1 Approximate Location of Pilot Infiltration Test

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: March 2021
Krazan & ASSOCIATES, INC.	Not to Scale

Water in Pit P-1 on March 5, 2021.

Water in Pit P-2 on March 5, 2021.

Water in Test Pit on March 5, 2021. Test pit was excavated in NE portion of site on March 4, 2021.

Figure 2 - Photos (March 5, 2021)

APPENDIX B-3

Service Disabled Veteran Owned Small Business

Job #: 06-171

Project Name: East Town Crossing

As Of Date: 1/17/2023

Subject: Water Monitoring Information for the East Town Crossing Site

Special Notes:

On Site Average Elevation: 70 Elevation

Max Boring Depth for the Shaw / Pioneer Crossing: 51.75 IE sloping to 60.60 IE

Shaw / Pioneer Intersection Elevation: 69.9 Top Surface

East Town Crossing Monitoring Well Information:

Well # 1 (B-1/W-1): 72.84, Rim IE

Well # 2 (W-2) 74.13 Rim IE

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
3/18/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
3/26/2019	East Town Crossing	B-1/W-1	64.94	7.90	Krazans Report	Water Monitoring Well Testing
4/2/2019	East Town Crossing	B-1/W-1	64.84	8.00	Krazans Report	Water Monitoring Well Testing
4/10/2019	East Town Crossing	B-1/W-1	64.54	8.30	Krazans Report	Water Monitoring Well Testing
4/19/2019	East Town Crossing	B-1/W-1	64.54	8.30	Krazans Report	Water Monitoring Well Testing
4/24/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
4/28/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
12/27/2019	East Town Crossing	B-1/W-1	69.14	3.70	Krazans Report	Water Monitoring Well Testing
1/31/2020	East Town Crossing	B-1/W-1	69.84	3.00	Krazans Report	Water Monitoring Well Testing
2/17/2020	East Town Crossing	B-1/W-1	66.44	6.40	Krazans Report	Water Monitoring Well Testing
3/16/2020	East Town Crossing	B-1/W-1	65.54	7.30	Krazans Report	Water Monitoring Well Testing
8/21/2020	East Town Crossing	B-1/W-1	63.94	8.90	Abbey Road Group	Water Monitoring Well Testing
8/28/2020	East Town Crossing	B-1/W-1	63.99	8.85	Abbey Road Group	Water Monitoring Well Testing
9/4/2020	East Town Crossing	B-1/W-1	63.84	9.00	Abbey Road Group	Water Monitoring Well Testing
9/11/2020	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
9/21/2020	East Town Crossing	B-1/W-1	63.72	9.12	Abbey Road Group	Water Monitoring Well Testing
9/25/2020	East Town Crossing	B-1/W-1	64.36	8.48	Abbey Road Group	Water Monitoring Well Testing
10/2/2020	East Town Crossing	B-1/W-1	64.27	8.57	Abbey Road Group	Water Monitoring Well Testing
10/9/2020	East Town Crossing	B-1/W-1	64.25	8.59	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
10/16/2020	East Town Crossing	B-1/W-1	64.82	8.02	Abbey Road Group	Water Monitoring Well Testing
10/23/2020	East Town Crossing	B-1/W-1	64.81	8.03	Abbey Road Group	Water Monitoring Well Testing
11/6/2020	East Town Crossing	B-1/W-1	65.59	7.25	Abbey Road Group	Water Monitoring Well Testing
11/13/2020	East Town Crossing	B-1/W-1	65.49	7.35	Abbey Road Group	Water Monitoring Well Testing
11/19/2020	East Town Crossing	B-1/W-1	65.89	6.95	Abbey Road Group	Water Monitoring Well Testing
12/4/2020	East Town Crossing	B-1/W-1	65.67	7.17	Abbey Road Group	Water Monitoring Well Testing
12/11/2020	East Town Crossing	B-1/W-1	66.64	6.20	Abbey Road Group	Water Monitoring Well Testing
12/21/2020	East Town Crossing	B-1/W-1	67.28	5.56	Abbey Road Group	Water Monitoring Well Testing
12/28/2020	East Town Crossing	B-1/W-1	67.09	5.75	Abbey Road Group	Water Monitoring Well Testing
1/4/2021	East Town Crossing	B-1/W-1	68.44	4.40	Abbey Road Group	Water Monitoring Well Testing
1/11/2021	East Town Crossing	B-1/W-1	67.84	5.00	Abbey Road Group	Water Monitoring Well Testing
1/18/2021	East Town Crossing	B-1/W-1	67.89	4.95	Abbey Road Group	Water Monitoring Well Testing
2/1/2021	East Town Crossing	B-1/W-1	67.24	5.60	Abbey Road Group	Water Monitoring Well Testing
2/8/2021	East Town Crossing	B-1/W-1	66.96	5.88	Abbey Road Group	Water Monitoring Well Testing
2/16/2021	East Town Crossing	B-1/W-1	67.79	5.05	Abbey Road Group	Water Monitoring Well Testing
2/22/2021	East Town Crossing	B-1/W-1	68.09	4.75	Abbey Road Group	Water Monitoring Well Testing
3/1/2021	East Town Crossing	B-1/W-1	67.43	5.41	Abbey Road Group	Water Monitoring Well Testing
3/5/2021	East Town Crossing	B-1/W-1	67.11	5.73	Abbey Road Group	Water Monitoring Well Testing
3/15/2021	East Town Crossing	B-1/W-1	66.54	6.30	Abbey Road Group	Water Monitoring Well Testing
3/22/2021	East Town Crossing	B-1/W-1	66.36	6.48	Abbey Road Group	Water Monitoring Well Testing
4/5/2021	East Town Crossing	B-1/W-1	66.28	6.56	Abbey Road Group	Water Monitoring Well Testing
4/13/2021	East Town Crossing	B-1/W-1	66.01	6.83	Abbey Road Group	Water Monitoring Well Testing
4/19/2021	East Town Crossing	B-1/W-1	65.82	7.02	Abbey Road Group	Water Monitoring Well Testing
4/22/2021	East Town Crossing	B-1/W-1	65.73	7.11	Abbey Road Group	Water Monitoring Well Testing
4/30/2021	East Town Crossing	B-1/W-1	65.77	7.07	Abbey Road Group	Water Monitoring Well Testing
5/072021	East Town Crossing	B-1/W-1	65.66	7.18	Abbey Road Group	Water Monitoring Well Testing
5/172021	East Town Crossing	B-1/W-1	65.39	7.45	Abbey Road Group	Water Monitoring Well Testing
5/24/2021	East Town Crossing	B-1/W-1	65.39	7.45	Abbey Road Group	Water Monitoring Well Testing
5/28/2021	East Town Crossing	B-1/W-1	65.34	7.50	Abbey Road Group	Water Monitoring Well Testing
6/4/2021	East Town Crossing	B-1/W-1	65.19	7.65	Abbey Road Group	Water Monitoring Well Testing
6/14/2021	East Town Crossing	B-1/W-1	65.49	7.35	Abbey Road Group	Water Monitoring Well Testing
6/22/2021	East Town Crossing	B-1/W-1	65.29	7.55	Abbey Road Group	Water Monitoring Well Testing
6/29/2021	East Town Crossing	B-1/W-1	65.03	7.81	Abbey Road Group	Water Monitoring Well Testing
7/8/2021	East Town Crossing	B-1/W-1	64.79	8.05	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	B-1/W-1	64.64	8.20	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
7/20/2021	East Town Crossing	B-1/W-1	64.42	8.42	Abbey Road Group	Water Monitoring Well Testing
7/27/2021	East Town Crossing	B-1/W-1	64.21	8.63	Abbey Road Group	Water Monitoring Well Testing
8/2/2021	East Town Crossing	B-1/W-1	64.05	8.79	Abbey Road Group	Water Monitoring Well Testing
8/10/2021	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
8/16/2021	East Town Crossing	B-1/W-1	63.82	9.02	Abbey Road Group	Water Monitoring Well Testing
8/23/2021	East Town Crossing	B-1/W-1	63.73	9.11	Abbey Road Group	Water Monitoring Well Testing
8/30/2021	East Town Crossing	B-1/W-1	63.69	9.15	Abbey Road Group	Water Monitoring Well Testing
9/9/2021	East Town Crossing	B-1/W-1	63.59	9.25	Abbey Road Group	Water Monitoring Well Testing
9/13/2021	East Town Crossing	B-1/W-1	63.54	9.30	Abbey Road Group	Water Monitoring Well Testing
9/20/2021	East Town Crossing	B-1/W-1	63.73	9.11	Abbey Road Group	Water Monitoring Well Testing
9/27/2021	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
10/4/2021	East Town Crossing	B-1/W-1	64.20	8.64	Abbey Road Group	Water Monitoring Well Testing
10/18/2021	East Town Crossing	B-1/W-1	64.20	8.64	Abbey Road Group	Water Monitoring Well Testing
10/25/2021	East Town Crossing	B-1/W-1	64.44	8.40	Abbey Road Group	Water Monitoring Well Testing
11/1/2021	East Town Crossing	B-1/W-1	65.34	7.50	Abbey Road Group	Water Monitoring Well Testing
11/8/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/17/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/22/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/29/2021	East Town Crossing	B-1/W-1	66.52	6.32	Abbey Road Group	Water Monitoring Well Testing
12/6/2021	East Town Crossing	B-1/W-1	66.33	6.51	Abbey Road Group	Water Monitoring Well Testing
12/13/2021	East Town Crossing	B-1/W-1	67.49	5.35	Abbey Road Group	Water Monitoring Well Testing
1/3/2022	East Town Crossing	B-1/W-1	67.44	5.40	Abbey Road Group	Water Monitoring Well Testing
1/25/2022	East Town Crossing	B-1/W-1	63.80	9.04	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering
1/28/2022	East Town Crossing	B-1/W-1	63.08	9.76	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering (2 Pumps Running)
2/4/2022	East Town Crossing	B-1/W-1	65.01	7.83	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering ended 2/03/2022
2/8/2022	East Town Crossing	B-1/W-1	65.54	7.30	Abbey Road Group	Water Monitoring Well Testing
2/16/2022	East Town Crossing	B-1/W-1	65.55	7.29	Abbey Road Group	Water Monitoring Well Testing
3/9/2022	East Town Crossing	B-1/W-1	66.94	5.90	Abbey Road Group	Water Monitoring Well Testing
3/22/2022	East Town Crossing	B-1/W-1	67.09	5.75	Abbey Road Group	Water Monitoring Well Testing
3/31/2022	East Town Crossing	B-1/W-1	66.33	6.51	Abbey Road Group	Water Monitoring Well Testing
4/12/2022	East Town Crossing	B-1/W-1	66.16	6.68	Abbey Road Group	Water Monitoring Well Testing
4/19/2022	East Town Crossing	B-1/W-1	66.06	6.78	Abbey Road Group	Water Monitoring Well Testing
4/25/2022	East Town Crossing	B-1/W-1	65.94	6.90	Abbey Road Group	Water Monitoring Well Testing
5/3/2022	East Town Crossing	B-1/W-1	66.08	6.76	Abbey Road Group	Water Monitoring Well Testing
5/10/2022	East Town Crossing	B-1/W-1	66.27	6.57	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
5/18/2022	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
5/25/2022	East Town Crossing	B-1/W-1	66.84	6.00	Abbey Road Group	Water Monitoring Well Testing
6/1/2022	East Town Crossing	B-1/W-1	65.94	6.90	Abbey Road Group	Water Monitoring Well Testing
6/6/2022	East Town Crossing	B-1/W-1	66.14	6.70	Abbey Road Group	Water Monitoring Well Testing
6/16/2022	East Town Crossing	B-1/W-1	66.46	6.38	Abbey Road Group	Water Monitoring Well Testing
6/20/2022	East Town Crossing	B-1/W-1	66.14	6.70	Abbey Road Group	Water Monitoring Well Testing
6/30/2022	East Town Crossing	B-1/W-1	65.54	7.30	Abbey Road Group	Water Monitoring Well Testing
7/6/2022	East Town Crossing	B-1/W-1	65.44	7.40	Abbey Road Group	Water Monitoring Well Testing
7/11/2022	East Town Crossing	B-1/W-1	65.14	7.70	Abbey Road Group	Water Monitoring Well Testing
7/19/2022	East Town Crossing	B-1/W-1	64.84	8.00	Abbey Road Group	Water Monitoring Well Testing
7/28/2022	East Town Crossing	B-1/W-1	64.59	8.25	Abbey Road Group	Water Monitoring Well Testing
8/1/2022	East Town Crossing	B-1/W-1	64.49	8.35	Abbey Road Group	Water Monitoring Well Testing
8/10/2022	East Town Crossing	B-1/W-1	64.24	8.60	Abbey Road Group	Water Monitoring Well Testing
8/15/2022	East Town Crossing	B-1/W-1	64.19	8.65	Abbey Road Group	Water Monitoring Well Testing
8/25/2022	East Town Crossing	B-1/W-1	64.04	8.80	Abbey Road Group	Water Monitoring Well Testing
8/30/2022	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
9/6/2022	East Town Crossing	B-1/W-1	63.86	8.98	Abbey Road Group	Water Monitoring Well Testing
9/12/2022	East Town Crossing	B-1/W-1	63.69	9.15	Abbey Road Group	Water Monitoring Well Testing
9/19/2022	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
9/28/2022	East Town Crossing	B-1/W-1	63.64	9.20	Abbey Road Group	Water Monitoring Well Testing
10/7/2022	East Town Crossing	B-1/W-1	63.61	9.23	Abbey Road Group	Water Monitoring Well Testing
10/12/2022	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
10/17/2022	East Town Crossing	B-1/W-1	63.62	9.22	Abbey Road Group	Water Monitoring Well Testing
10/24/2022	East Town Crossing	B-1/W-1	63.84	9.00	Abbey Road Group	Water Monitoring Well Testing
10/31/2022	East Town Crossing	B-1/W-1	64.16	8.68	Abbey Road Group	Water Monitoring Well Testing
11/7/2022	East Town Crossing	B-1/W-1	65.04	7.80	Abbey Road Group	Water Monitoring Well Testing
11/14/2022	East Town Crossing	B-1/W-1	64.80	8.04	Abbey Road Group	Water Monitoring Well Testing
11/29/2022	East Town Crossing	B-1/W-1	65.12	7.72	Abbey Road Group	Water Monitoring Well Testing
12/5/2022	East Town Crossing	B-1/W-1	65.71	7.13	Abbey Road Group	Water Monitoring Well Testing
12/16/2022	East Town Crossing	B-1/W-1	65.73	7.11	Abbey Road Group	Water Monitoring Well Testing
12/20/2022	East Town Crossing	B-1/W-1	65.75	7.09	Abbey Road Group	Water Monitoring Well Testing
12/27/2022	East Town Crossing	B-1/W-1	67.19	5.65	Abbey Road Group	Water Monitoring Well Testing
1/3/2023	East Town Crossing	B-1/W-1	66.60	6.24	Abbey Road Group	Water Monitoring Well Testing
1/9/2023	East Town Crossing	B-1/W-1	66.61	6.23	Abbey Road Group	Water Monitoring Well Testing
1/17/2023	East Town Crossing	B-1/W-1	66.68	6.16	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Job #: 06-171

Project Name: East Town Crossing

As Of Date: 1/17/2023

Subject: Water Monitoring Information for the East Town Crossing Site

Special Notes:

On Site Average Elevation: 70 Elevation

Max Boring Depth for the Shaw / Pioneer Crossing: 51.75 IE sloping to 60.60 IE

Shaw / Pioneer Intersection Elevation: 69.9 Top Surface

East Town Crossing Monitoring Well Information:

Well # 1 (B-1/W-1):	72.84, Rim IE
Well # 2 (W-2)	74.13 Rim IE

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
3/18/2019	East Town Crossing	W-2	66.63	7.50	Krazans Report	Water Monitoring Well Testing
3/26/2020	East Town Crossing	W-2	66.83	7.30	Krazans Report	Water Monitoring Well Testing
4/2/2019	East Town Crossing	W-2	66.83	7.30	Krazans Report	Water Monitoring Well Testing
4/10/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/19/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/24/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/28/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
12/27/2019	East Town Crossing	W-2	70.03	4.10	Krazans Report	Water Monitoring Well Testing
1/31/2020	East Town Crossing	W-2	70.63	3.50	Krazans Report	Water Monitoring Well Testing
2/17/2020	East Town Crossing	W-2	68.33	5.80	Krazans Report	Water Monitoring Well Testing
3/16/2020	East Town Crossing	W-2	67.33	6.80	Krazans Report	Water Monitoring Well Testing
8/21/2020	East Town Crossing	W-2	66.08	8.05	Abbey Road Group	Water Monitoring Well Testing
8/28/2020	East Town Crossing	W-2	65.98	8.15	Abbey Road Group	Water Monitoring Well Testing
9/4/2020	East Town Crossing	W-2	65.81	8.32	Abbey Road Group	Water Monitoring Well Testing
9/11/2020	East Town Crossing	W-2	65.68	8.45	Abbey Road Group	Water Monitoring Well Testing
9/21/2020	East Town Crossing	W-2	65.58	8.55	Abbey Road Group	Water Monitoring Well Testing
9/25/2020	East Town Crossing	W-2	65.79	8.34	Abbey Road Group	Water Monitoring Well Testing
10/2/2020	East Town Crossing	W-2	65.82	8.31	Abbey Road Group	Water Monitoring Well Testing
10/9/2020	East Town Crossing	W-2	65.82	8.31	Abbey Road Group	Water Monitoring Well Testing
10/16/2020	East Town Crossing	W-2	66.27	7.86	Abbey Road Group	Water Monitoring Well Testing
10/23/2020	East Town Crossing	W-2	66.27	7.86	Abbey Road Group	Water Monitoring Well Testing
11/6/2020	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
11/13/2020	East Town Crossing	W-2	66.68	7.45	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
11/19/2020	East Town Crossing	W-2	67.08	7.05	Abbey Road Group	Water Monitoring Well Testing
12/4/2020	East Town Crossing	W-2	67.18	6.95	Abbey Road Group	Water Monitoring Well Testing
12/11/2020	East Town Crossing	W-2	68.10	6.03	Abbey Road Group	Water Monitoring Well Testing
12/21/2020	East Town Crossing	W-2	68.56	5.57	Abbey Road Group	Water Monitoring Well Testing
12/28/2020	East Town Crossing	W-2	68.73	5.40	Abbey Road Group	Water Monitoring Well Testing
1/4/2021	East Town Crossing	W-2	69.98	4.15	Abbey Road Group	Water Monitoring Well Testing
1/11/2021	East Town Crossing	W-2	69.73	4.40	Abbey Road Group	Water Monitoring Well Testing
1/18/2021	East Town Crossing	W-2	70.13	4.00	Abbey Road Group	Water Monitoring Well Testing
2/1/2021	East Town Crossing	W-2	69.31	4.82	Abbey Road Group	Water Monitoring Well Testing
2/8/2021	East Town Crossing	W-2	69.10	5.03	Abbey Road Group	Water Monitoring Well Testing
2/16/2021	East Town Crossing	W-2	69.48	4.65	Abbey Road Group	Water Monitoring Well Testing
2/22/2021	East Town Crossing	W-2	69.73	4.40	Abbey Road Group	Water Monitoring Well Testing
3/1/2021	East Town Crossing	W-2	69.52	4.61	Abbey Road Group	Water Monitoring Well Testing
3/5/2021	East Town Crossing	W-2	69.13	5.00	Abbey Road Group	Water Monitoring Well Testing
3/15/2021	East Town Crossing	W-2	68.60	5.53	Abbey Road Group	Water Monitoring Well Testing
3/22/2021	East Town Crossing	W-2	68.32	5.81	Abbey Road Group	Water Monitoring Well Testing
4/5/2021	East Town Crossing	W-2	68.15	5.98	Abbey Road Group	Water Monitoring Well Testing
4/13/2021	East Town Crossing	W-2	67.91	6.22	Abbey Road Group	Water Monitoring Well Testing
4/19/2021	East Town Crossing	W-2	67.75	6.38	Abbey Road Group	Water Monitoring Well Testing
4/22/2021	East Town Crossing	W-2	67.62	6.51	Abbey Road Group	Water Monitoring Well Testing
4/30/2021	East Town Crossing	W-2	67.67	6.46	Abbey Road Group	Water Monitoring Well Testing
5/7/2021	East Town Crossing	W-2	67.63	6.50	Abbey Road Group	Water Monitoring Well Testing
5/17/2021	East Town Crossing	W-2	67.48	6.65	Abbey Road Group	Water Monitoring Well Testing
5/24/2021	East Town Crossing	W-2	67.51	6.62	Abbey Road Group	Water Monitoring Well Testing
5/28/2021	East Town Crossing	W-2	67.49	6.64	Abbey Road Group	Water Monitoring Well Testing
6/4/2021	East Town Crossing	W-2	67.17	6.96	Abbey Road Group	Water Monitoring Well Testing
6/14/2021	East Town Crossing	W-2	67.51	6.62	Abbey Road Group	Water Monitoring Well Testing
6/22/2021	East Town Crossing	W-2	67.50	6.63	Abbey Road Group	Water Monitoring Well Testing
6/29/2021	East Town Crossing	W-2	67.18	6.95	Abbey Road Group	Water Monitoring Well Testing
7/8/2021	East Town Crossing	W-2	67.08	7.05	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.95	7.18	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.73	7.40	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.45	7.68	Abbey Road Group	Water Monitoring Well Testing
8/2/2021	East Town Crossing	W-2	66.39	7.74	Abbey Road Group	Water Monitoring Well Testing
8/10/2021	East Town Crossing	W-2	66.18	7.95	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
8/16/2021	East Town Crossing	W-2	66.02	8.11	Abbey Road Group	Water Monitoring Well Testing
8/23/2021	East Town Crossing	W-2	65.87	8.26	Abbey Road Group	Water Monitoring Well Testing
8/30/2021	East Town Crossing	W-2	65.72	8.41	Abbey Road Group	Water Monitoring Well Testing
9/9/2021	East Town Crossing	W-2	65.58	8.55	Abbey Road Group	Water Monitoring Well Testing
9/13/2021	East Town Crossing	W-2	65.55	8.58	Abbey Road Group	Water Monitoring Well Testing
9/20/2021	East Town Crossing	W-2	65.66	8.47	Abbey Road Group	Water Monitoring Well Testing
9/27/2021	East Town Crossing	W-2	65.63	8.50	Abbey Road Group	Water Monitoring Well Testing
10/4/2021	East Town Crossing	W-2	65.70	8.43	Abbey Road Group	Water Monitoring Well Testing
10/18/2021	East Town Crossing	W-2	65.81	8.32	Abbey Road Group	Water Monitoring Well Testing
10/25/2021	East Town Crossing	W-2	65.98	8.15	Abbey Road Group	Water Monitoring Well Testing
11/1/2021	East Town Crossing	W-2	66.53	7.60	Abbey Road Group	Water Monitoring Well Testing
11/8/2021	East Town Crossing	W-2	67.23	6.90	Abbey Road Group	Water Monitoring Well Testing
11/17/2021	East Town Crossing	W-2	68.93	5.20	Abbey Road Group	Water Monitoring Well Testing
11/22/2021	East Town Crossing	W-2	68.98	5.15	Abbey Road Group	Water Monitoring Well Testing
11/29/2021	East Town Crossing	W-2	69.17	4.96	Abbey Road Group	Water Monitoring Well Testing
12/6/2021	East Town Crossing	W-2	68.92	5.21	Abbey Road Group	Water Monitoring Well Testing
12/13/2021	East Town Crossing	W-2	69.35	4.78	Abbey Road Group	Water Monitoring Well Testing
1/3/2022	East Town Crossing	W-2	69.30	4.83	Abbey Road Group	Water Monitoring Well Testing
1/25/2022	East Town Crossing	W-2	65.88	8.25	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering
1/28/2022	East Town Crossing	W-2	65.05	9.08	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering (2 Pumps Running)
2/4/2022	East Town Crossing	W-2	64.98	9.15	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering ended 2/03/2022
2/8/2022	East Town Crossing	W-2	66.23	7.90	Abbey Road Group	Water Monitoring Well Testing
2/16/2022	East Town Crossing	W-2	67.13	7.00	Abbey Road Group	Water Monitoring Well Testing
3/9/2022	East Town Crossing	W-2	68.53	5.60	Abbey Road Group	Water Monitoring Well Testing
3/22/2022	East Town Crossing	W-2	68.43	5.70	Abbey Road Group	Water Monitoring Well Testing
3/31/2022	East Town Crossing	W-2	68.05	6.08	Abbey Road Group	Water Monitoring Well Testing
4/12/2022	East Town Crossing	W-2	67.97	6.16	Abbey Road Group	Water Monitoring Well Testing
4/19/2022	East Town Crossing	W-2	67.97	6.16	Abbey Road Group	Water Monitoring Well Testing
4/25/2022	East Town Crossing	W-2	67.73	6.40	Abbey Road Group	Water Monitoring Well Testing
5/3/2022	East Town Crossing	W-2	67.68	6.45	Abbey Road Group	Water Monitoring Well Testing
5/10/2022	East Town Crossing	W-2	67.83	6.30	Abbey Road Group	Water Monitoring Well Testing
5/18/2022	East Town Crossing	W-2	68.10	6.03	Abbey Road Group	Water Monitoring Well Testing
5/25/2022	East Town Crossing	W-2	68.43	5.70	Abbey Road Group	Water Monitoring Well Testing
6/1/2022	East Town Crossing	W-2	67.63	6.50	Abbey Road Group	Water Monitoring Well Testing
6/6/2022	East Town Crossing	W-2	67.85	6.28	Abbey Road Group	Water Monitoring Well Testing
6/16/2022	East Town Crossing	W-2	68.13	6.00	Abbey Road Group	Water Monitoring Well Testing
6/20/2022	East Town Crossing	W-2	68.03	6.10	Abbey Road Group	Water Monitoring Well Testing
6/30/2022	East Town Crossing	W-2	67.43	6.70	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
7/6/2022	East Town Crossing	W-2	67.33	6.80	Abbey Road Group	Water Monitoring Well Testing
7/11/2022	East Town Crossing	W-2	67.03	7.10	Abbey Road Group	Water Monitoring Well Testing
7/19/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
7/28/2022	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
8/1/2022	East Town Crossing	W-2	66.68	7.45	Abbey Road Group	Water Monitoring Well Testing
8/10/2022	East Town Crossing	W-2	66.48	7.65	Abbey Road Group	Water Monitoring Well Testing
8/15/2022	East Town Crossing	W-2	66.38	7.75	Abbey Road Group	Water Monitoring Well Testing
8/25/2022	East Town Crossing	W-2	66.28	7.85	Abbey Road Group	Water Monitoring Well Testing
8/30/2022	East Town Crossing	W-2	66.18	7.95	Abbey Road Group	Water Monitoring Well Testing
9/6/2022	East Town Crossing	W-2	66.15	7.98	Abbey Road Group	Water Monitoring Well Testing
9/12/2022	East Town Crossing	W-2	65.88	8.25	Abbey Road Group	Water Monitoring Well Testing
9/19/2022	East Town Crossing	W-2	65.86	8.27	Abbey Road Group	Water Monitoring Well Testing
9/28/2022	East Town Crossing	W-2	65.85	8.28	Abbey Road Group	Water Monitoring Well Testing
10/7/2022	East Town Crossing	W-2	65.76	8.37	Abbey Road Group	Water Monitoring Well Testing
10/12/2022	East Town Crossing	W-2	65.66	8.47	Abbey Road Group	Water Monitoring Well Testing
10/17/2022	East Town Crossing	W-2	65.49	8.64	Abbey Road Group	Water Monitoring Well Testing
10/24/2022	East Town Crossing	W-2	65.70	8.43	Abbey Road Group	Water Monitoring Well Testing
10/31/2022	East Town Crossing	W-2	65.97	8.16	Abbey Road Group	Water Monitoring Well Testing
11/7/2022	East Town Crossing	W-2	66.83	7.30	Abbey Road Group	Water Monitoring Well Testing
11/14/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
11/29/2022	East Town Crossing	W-2	66.46	7.67	Abbey Road Group	Water Monitoring Well Testing
12/5/2022	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
12/16/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
12/20/2022	East Town Crossing	W-2	66.61	7.52	Abbey Road Group	Water Monitoring Well Testing
12/27/2022	East Town Crossing	W-2	68.00	6.13	Abbey Road Group	Water Monitoring Well Testing
1/3/2023	East Town Crossing	W-2	68.26	5.87	Abbey Road Group	Water Monitoring Well Testing
1/9/2023	East Town Crossing	W-2	68.23	5.90	Abbey Road Group	Water Monitoring Well Testing
1/17/2023	East Town Crossing	W-2	67.44	6.69	Abbey Road Group	Water Monitoring Well Testing

Appendix C

Maintenance Report

Okay to leave this Appendix C empty at this time, since a formal O&M manual will be required at Closeout.
[Storm Report; Pg 195 of 448]

Noted

Prior to Occupancy, submit a DRAFT version of the City's Stormwater Management Facilities Agreement with an O&M manual using the maintenance activities described in the City's Stormwater Site Management Plan. The agreement shall be recorded with the Pierce County Auditors Office.
[Storm Report; Pg 195 of 448]

Noted

At the time of submitting the Stormwater Management Facilities Agreement include the R-Tank and BioPod O&M information.
[Storm Report; Pg 195 of 448]

Noted

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Mis-alignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.13: Maintenance Standards - Sand Filters (Above Ground/Open) (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

Table V-A.14: Maintenance Standards - Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

Table V-A.15: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the

Table V-A.15: Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Vault			compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Table V-A.16: Maintenance Standards - Baffle Oil/Water Separators (API Type)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with out thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1-inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local rules and regulations.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	See Table V-A.5: Maintenance Standards - Catch Basins Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	vegetation management			protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-A.22: Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface

Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods:
				• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves)
				• Vacuum/sweep permeable paving installation using:
				  ◦ Walk-behind vacuum (sidewalks)
				  ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)
				  ◦ ShopVac or brush brooms (small areas)
				• Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.

	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods:

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				◦ Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. ◦ Hand held pressure washer or power washer with rotating brushes ◦ Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials
Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◦ Walk-behind vacuum (sidewalks) ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◦ ShopVac or brush brooms (small areas) Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). • Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Vacuum sweep or stiff broom/power brush for cleaning moss from pavement surface
	A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations
	A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections
	A		Settlement of surface	May require resetting
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of aggregate material in paving grid	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue)
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Rehabilitate per manufacturer's recommendations.
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2" top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				
Inlet/outlet pipe	A		Pipe is damaged	Repair/replace
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from under-drain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

a Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

b Inspection should occur during storm event.

Table V-A.23: Maintenance Standards - Vegetated Roofs

Activity	Objective	Schedule	Notes
Structural and Drainage Components			
Clear inlet pipes: Remove soil substrate, vegetation or other debris.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect drain pipe: Check for cracks settling and proper alignment, and correct and re-compact soils or fill material surrounding pipe, if necessary.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect fire ventilation points for proper operation	Fire and safety.	Twice annually.	
Maintain egress and ingress: Clear routes of obstructions and maintained to design standards.	Fire and safety.	Twice annually.	
Insects: (see note)			Roof garden design should provide drainage rates that do not allow pooling of water for periods that promote insect larvae development. If standing water is present for extended periods correct drainage problem. Chemical sprays should not be used.
Prevent release of contaminants: Identify activities (mechanical systems maintenance, pet access, etc.) that can potentially release pollutants to the roof garden and establish agreements to prevent release.	Water quality protection.	During construction of roof and then as determined by inspection.	Any cause of pollutant release should be corrected as soon as identified and the pollutant removed.
Vegetation and Growth Medium			
Invasive or nuisance plants: Remove manually and without herbicide applications.	Promote selected plant growth and survival, maintain aesthetics.	Twice annually.	At a minimum, schedule weeding with inspections to coincide with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).

Appendix D

Drainage Calculations

PROVIDE-buoyancy calculations or buoyancy certification letter for the RTank system considering groundwater monitoring results conducted by Abbey Road Group. [Storm Report; Pg 208 of 448]

Added

Project Description

File Name .... 20231116 Conveyance Calc.SPF
Description ....
Q:\2023\2230752\10_CIV\CAD_2230752-W-SD.dwg

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... Santa Barbara UH
Time of Concentration (TOC) Method .... User-Defined
Link Routing Method .... Hydrodynamic
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods .... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins...	63
Nodes...	116
Junctions	112
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	3
Links...	115
Channels	0
Pipes	113
Pumps	0
Orifices	0
Weirs	0
Outlets	2
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	25-year	Intensity	inches	Washington	Pierce	25.00	3.50	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Impervious Area (%)	Impervious Area Curve Number	Pervious Area Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	BLDG A_NORTH	0.05	100.00	98.00	76.00	3.46	3.24	0.15	0.04	0 00:06:00
2	BLDG A_SOUTH	0.05	100.00	98.00	76.00	3.46	3.24	0.15	0.04	0 00:06:00
3	BLDG B_NE	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
4	BLDG B_NW	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
5	BLDG B_SE	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
6	BLDG B_SW	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
7	BLDG C_NE	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
8	BLDG C_NW	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
9	BLDG C_SE	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
10	BLDG C_SW	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
11	BLDG CLUB_EAST	0.03	100.00	98.00	76.00	3.46	3.24	0.09	0.02	0 00:06:00
12	BLDG CLUB_WEST	0.03	100.00	98.00	76.00	3.46	3.24	0.09	0.02	0 00:06:00
13	BLDG D_NE	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
14	BLDG D_NW	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
15	BLDG D_SOUTH	0.12	100.00	98.00	76.00	3.46	3.24	0.38	0.10	0 00:06:00
16	BLDG E_EAST	0.08	100.00	98.00	76.00	3.46	3.24	0.26	0.07	0 00:06:00
17	BLDG E_WEST	0.16	100.00	98.00	76.00	3.46	3.24	0.52	0.13	0 00:06:00
18	BLDG F_EAST	0.10	100.00	98.00	76.00	3.46	3.24	0.33	0.08	0 00:06:00
19	BLDG F_WEST	0.10	100.00	98.00	76.00	3.46	3.24	0.33	0.08	0 00:06:00
20	BLDG G_EAST	0.08	100.00	98.00	76.00	3.46	3.24	0.26	0.07	0 00:06:00
21	BLDG G_WEST	0.10	100.00	98.00	76.00	3.46	3.24	0.32	0.08	0 00:06:00
22	BLDG H_EAST	0.10	100.00	98.00	76.00	3.46	3.24	0.31	0.08	0 00:06:00
23	BLDG H_WEST	0.08	100.00	98.00	76.00	3.46	3.24	0.26	0.07	0 00:06:00
24	BLDG T.I. EAST	0.05	100.00	98.00	76.00	3.46	3.24	0.15	0.04	0 00:06:00
25	BLDG T.I. NE	0.02	100.00	98.00	76.00	3.46	3.24	0.07	0.02	0 00:06:00
26	BLDG T.I. NW	0.04	100.00	98.00	76.00	3.46	3.24	0.14	0.03	0 00:06:00
27	BLDG T.I. SE	0.03	100.00	98.00	76.00	3.46	3.24	0.09	0.02	0 00:06:00
28	BLDG T.I. SW	0.04	100.00	98.00	76.00	3.46	3.24	0.14	0.04	0 00:06:00
29	BLDG T.I. WEST	0.06	100.00	98.00	76.00	3.46	3.24	0.19	0.05	0 00:06:00
30	SDCB 02	0.22	98.00	98.00	76.00	3.46	3.20	0.70	0.18	0 00:06:00
31	SDCB 03	0.13	100.00	98.00	76.00	3.46	3.24	0.42	0.11	0 00:06:00
32	SDCB 04	0.06	73.00	98.00	76.00	3.46	2.73	0.17	0.04	0 00:06:00
33	SDCB 05	0.24	90.00	98.00	76.00	3.46	3.05	0.73	0.18	0 00:06:00
34	SDCB 06	0.16	65.00	98.00	76.00	3.46	2.57	0.40	0.10	0 00:06:00
35	SDCB 07	0.09	64.00	98.00	76.00	3.46	2.56	0.24	0.06	0 00:06:00
36	SDCB 08	0.05	100.00	98.00	76.00	3.46	3.24	0.15	0.04	0 00:06:00
37	SDCB 09	0.25	82.00	98.00	76.00	3.46	2.90	0.73	0.18	0 00:06:00
38	SDCB 11	0.10	91.00	98.00	76.00	3.46	3.07	0.30	0.08	0 00:06:00
39	SDCB 12	0.10	99.00	98.00	76.00	3.46	3.22	0.33	0.08	0 00:06:00
40	SDCB 13	0.13	94.00	98.00	76.00	3.46	3.12	0.41	0.10	0 00:06:00
41	SDCB 14	0.22	68.00	98.00	76.00	3.46	2.63	0.57	0.14	0 00:06:00
42	SDCB 15	0.13	88.00	98.00	76.00	3.46	3.01	0.38	0.09	0 00:06:00
43	SDCB 16	0.14	65.00	98.00	76.00	3.46	2.57	0.36	0.09	0 00:06:00
44	SDCB 17	0.10	92.00	98.00	76.00	3.46	3.08	0.32	0.08	0 00:06:00
45	SDCB 19	0.46	78.00	98.00	76.00	3.46	2.82	1.29	0.32	0 00:06:00
46	SDCB 20	0.11	79.00	98.00	76.00	3.46	2.84	0.32	0.08	0 00:06:00
47	SDCB 21	0.09	93.00	98.00	76.00	3.46	3.10	0.27	0.07	0 00:06:00
48	SDCB 22	0.20	82.00	98.00	76.00	3.46	2.90	0.58	0.14	0 00:06:00
49	SDCB 23	0.20	86.00	98.00	76.00	3.46	2.97	0.59	0.15	0 00:06:00
50	SDCB 24	0.02	85.00	98.00	76.00	3.46	2.95	0.06	0.02	0 00:06:00
51	SDCB 25	0.03	65.00	98.00	76.00	3.46	2.57	0.06	0.02	0 00:06:00
52	SDCB 27	0.49	76.00	98.00	76.00	3.46	2.78	1.35	0.33	0 00:06:00
53	SDCB 28	0.20	73.00	98.00	76.00	3.46	2.73	0.54	0.13	0 00:06:00
54	SDCB 29	0.20	79.00	98.00	76.00	3.46	2.84	0.57	0.14	0 00:06:00
55	SDCB 30	0.43	77.00	98.00	76.00	3.46	2.80	1.20	0.30	0 00:06:00
56	SDCB 31	0.52	26.00	98.00	76.00	3.46	1.84	0.96	0.22	0 00:06:00
57	SDCB 32	0.19	73.00	98.00	76.00	3.46	2.73	0.51	0.13	0 00:06:00
58	SDCB 33	0.23	83.00	98.00	76.00	3.46	2.91	0.67	0.17	0 00:06:00
59	SDCB 34	0.14	76.00	98.00	76.00	3.46	2.78	0.38	0.10	0 00:06:00
60	SDCB 36	0.36	79.00	98.00	76.00	3.46	2.84	1.01	0.25	0 00:06:00
61	SDCB 37	0.07	96.00	98.00	76.00	3.46	3.16	0.23	0.06	0 00:06:00
62	SDCB 38	0.25	72.00	98.00	76.00	3.46	2.71	0.67	0.17	0 00:06:00
63	SDCB 40	0.11	0.00	98.00	76.00	3.46	1.34	0.15	0.03	0 00:06:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	SDCB#01	Junction	66.90	74.84	67.40	0.00	0.00	0.18	68.38	0.00	6.46	0 00:00	0.00	0.00
2	SDCB#02	Junction	69.50	72.40	0.00	0.00	0.00	0.44	70.20	0.00	2.20	0 00:00	0.00	0.00
3	SDCB#03	Junction	70.19	72.19	0.00	0.00	0.00	0.26	70.46	0.00	1.73	0 00:00	0.00	0.00
4	SDCB#04	Junction	70.47	72.64	0.00	0.00	0.00	0.08	70.61	0.00	2.03	0 00:00	0.00	0.00
5	SDCB#05	Junction	69.29	72.11	0.00	0.00	0.00	0.66	69.77	0.00	2.34	0 00:00	0.00	0.00
6	SDCB#06	Junction	69.06	73.03	0.00	0.00	0.00	0.23	69.31	0.00	3.72	0 00:00	0.00	0.00
7	SDCB#07	Junction	69.42	71.79	0.00	0.00	0.00	0.13	69.61	0.00	2.18	0 00:00	0.00	0.00
8	SDCB#08	Junction	69.67	72.45	0.00	0.00	0.00	0.07	69.81	0.00	2.64	0 00:00	0.00	0.00
9	SDCB#09	Junction	68.51	72.35	0.00	0.00	0.00	1.05	69.04	0.00	3.31	0 00:00	0.00	0.00
10	SDCB#10	Junction	67.90	76.96	68.40	0.00	0.00	0.07	70.47	0.00	6.49	0 00:00	0.00	0.00
11	SDCB#11	Junction	73.48	76.58	0.00	0.00	0.00	0.26	73.63	0.00	2.95	0 00:00	0.00	0.00
12	SDCB#12	Junction	73.83	76.54	0.00	0.00	0.00	0.08	73.97	0.00	2.57	0 00:00	0.00	0.00
13	SDCB#13	Junction	73.87	76.58	0.00	0.00	0.00	0.10	74.03	0.00	2.55	0 00:00	0.00	0.00
14	SDCB#14	Junction	71.89	76.31	0.00	0.00	0.00	0.53	72.24	0.00	4.07	0 00:00	0.00	0.00
15	SDCB#15	Junction	71.68	76.25	0.00	0.00	0.00	0.68	72.12	0.00	4.13	0 00:00	0.00	0.00
16	SDCB#16	Junction	72.23	76.36	0.00	0.00	0.00	0.31	72.47	0.00	3.89	0 00:00	0.00	0.00
17	SDCB#17	Junction	72.75	76.55	0.00	0.00	0.00	0.14	72.95	0.00	3.60	0 00:00	0.00	0.00
18	SDCB#18	Junction	68.40	76.69	0.00	0.00	0.00	1.97	70.47	0.00	6.22	0 00:00	0.00	0.00
19	SDCB#19	Junction	70.35	75.25	0.00	0.00	0.00	1.21	70.73	0.00	4.52	0 00:00	0.00	0.00
20	SDCB#20	Junction	70.98	75.25	0.00	0.00	0.00	0.90	71.42	0.00	3.83	0 00:00	0.00	0.00
21	SDCB#21	Junction	71.81	75.25	0.00	0.00	0.00	0.07	71.92	0.00	3.33	0 00:00	0.00	0.00
22	SDCB#22	Junction	71.36	75.25	0.00	0.00	0.00	0.75	71.76	0.00	3.49	0 00:00	0.00	0.00
23	SDCB#23	Junction	71.93	75.25	0.00	0.00	0.00	0.44	72.21	0.00	3.04	0 00:00	0.00	0.00
24	SDCB#24	Junction	72.61	75.25	0.00	0.00	0.00	0.03	72.70	0.00	2.55	0 00:00	0.00	0.00
25	SDCB#25	Junction	72.79	75.25	0.00	0.00	0.00	0.02	72.85	0.00	2.40	0 00:00	0.00	0.00
26	SDCB#26	Junction	68.40	76.79	0.00	0.00	0.00	1.20	70.47	0.00	6.32	0 00:00	0.00	0.00
27	SDCB#27	Junction	71.20	75.25	0.00	0.00	0.00	1.21	71.74	0.00	3.51	0 00:00	0.00	0.00
28	SDCB#28	Junction	72.15	75.25	0.00	0.00	0.00	0.23	72.39	0.00	2.86	0 00:00	0.00	0.00
29	SDCB#29	Junction	71.72	75.40	0.00	0.00	0.00	0.62	72.04	0.00	3.36	0 00:00	0.00	0.00
30	SDCB#30	Junction	72.69	75.40	0.00	0.00	0.00	0.30	72.97	0.00	2.43	0 00:00	0.00	0.00
31	SDCB#31	Junction	70.25	77.16	0.00	0.00	0.00	0.56	70.64	0.00	6.52	0 00:00	0.00	0.00
32	SDCB#32	Junction	72.60	75.25	0.00	0.00	0.00	0.20	72.83	0.00	2.42	0 00:00	0.00	0.00
33	SDCB#33	Junction	70.81	75.25	0.00	0.00	0.00	0.26	71.03	0.00	4.22	0 00:00	0.00	0.00
34	SDCB#34	Junction	71.52	75.25	0.00	0.00	0.00	0.09	71.67	0.00	3.58	0 00:00	0.00	0.00
35	SDCB#35	Junction	68.40	77.00	0.00	0.00	0.00	0.55	70.47	0.00	6.53	0 00:00	0.00	0.00
36	SDCB#36	Junction	70.59	75.26	0.00	0.00	0.00	0.47	70.81	0.00	4.45	0 00:00	0.00	0.00
37	SDCB#37	Junction	71.52	75.67	0.00	0.00	0.00	0.22	71.76	0.00	3.91	0 00:00	0.00	0.00
38	SDCB#38	Junction	71.88	75.26	0.00	0.00	0.00	0.16	72.08	0.00	3.18	0 00:00	0.00	0.00
39	SDCB#40	Junction	73.22	76.27	0.00	0.00	0.00	0.03	73.27	0.00	3.00	0 00:00	0.00	0.00
40	SDCO#A1	Junction	72.71	76.38	0.00	0.00	0.00	0.07	72.85	0.00	3.53	0 00:00	0.00	0.00
41	SDCO#A2	Junction	73.21	76.54	0.00	0.00	0.00	0.04	73.30	0.00	3.24	0 00:00	0.00	0.00
42	SDCO#A3	Junction	74.00	75.03	0.00	0.00	0.00	0.04	74.09	0.00	0.94	0 00:00	0.00	0.00
43	SDCO#A4	Junction	73.96	75.89	0.00	0.00	0.00	0.04	74.05	0.00	1.84	0 00:00	0.00	0.00
44	SDCO#A5	Junction	73.23	76.82	0.00	0.00	0.00	0.04	73.32	0.00	3.50	0 00:00	0.00	0.00
45	SDCO#B1	Junction	74.33	78.08	0.00	0.00	0.00	0.10	74.41	0.00	3.67	0 00:00	0.00	0.00
46	SDCO#B2	Junction	75.11	77.80	0.00	0.00	0.00	0.05	75.21	0.00	2.59	0 00:00	0.00	0.00
47	SDCO#B3	Junction	75.28	77.92	0.00	0.00	0.00	0.05	75.39	0.00	2.53	0 00:00	0.00	0.00
48	SDCO#B4	Junction	75.41	77.95	0.00	0.00	0.00	0.05	75.51	0.00	2.44	0 00:00	0.00	0.00
49	SDCO#B5	Junction	71.99	78.08	0.00	0.00	0.00	0.10	72.18	0.00	5.90	0 00:00	0.00	0.00
50	SDCO#B6	Junction	72.81	78.02	0.00	0.00	0.00	0.05	72.91	0.00	5.11	0 00:00	0.00	0.00
51	SDCO#B7	Junction	72.87	77.95	0.00	0.00	0.00	0.05	72.98	0.00	4.97	0 00:00	0.00	0.00
52	SDCO#B8	Junction	72.81	78.02	0.00	0.00	0.00	0.05	72.91	0.00	5.11	0 00:00	0.00	0.00
53	SDCO#C1	Junction	72.21	76.85	0.00	0.00	0.00	0.10	73.15	0.00	3.70	0 00:00	0.00	0.00
54	SDCO#C10	Junction	72.74	76.81	0.00	0.00	0.00	0.05	72.98	0.00	3.83	0 00:00	0.00	0.00
55	SDCO#C2	Junction	74.28	76.87	0.00	0.00	0.00	0.05	74.35	0.00	2.52	0 00:00	0.00	0.00
56	SDCO#C3	Junction	74.37	76.91	0.00	0.00	0.00	0.05	74.48	0.00	2.43	0 00:00	0.00	0.00
57	SDCO#C4	Junction	74.29	76.83	0.00	0.00	0.00	0.05	74.39	0.00	2.44	0 00:00	0.00	0.00
58	SDCO#C5	Junction	71.44	76.97	0.00	0.00	0.00	0.10	71.61	0.00	5.36	0 00:00	0.00	0.00
59	SDCO#C6	Junction	72.54	77.11	0.00	0.00	0.00	0.05	72.64	0.00	4.47	0 00:00	0.00	0.00
60	SDCO#C7	Junction	72.66	76.99	0.00	0.00	0.00	0.05	72.77	0.00	4.22	0 00:00	0.00	0.00
61	SDCO#C8	Junction	72.19	76.97	0.00	0.00	0.00	0.05	72.29	0.00	4.68	0 00:00	0.00	0.00
62	SDCO#C9	Junction	72.19	76.88	0.00	0.00	0.00	0.05	72.44	0.00	4.44	0 00:00	0.00	0.00
63	SDCO#CLUB1	Junction	72.38	76.33	0.00	0.00	0.00	0.05	72.46	0.00	3.87	0 00:00	0.00	0.00
64	SDCO#CLUB2	Junction	72.72	76.59	0.00	0.00	0.00	0.02	72.79	0.00	3.80	0 00:00	0.00	0.00
65	SDCO#CLUB3	Junction	73.13	76.45	0.00	0.00	0.00	0.02	73.20	0.00	3.25	0 00:00	0.00	0.00
66	SDCO#CLUB4	Junction	72.72	76.62	0.00	0.00	0.00	0.02	72.79	0.00	3.83	0 00:00	0.00	0.00
67	SDCO#CLUB5	Junction	73.15	76.43	0.00	0.00	0.00	0.02	73.22	0.00	3.21	0 00:00	0.00	0.00
68	SDCO#COM01	Junction	70.38	73.56	0.00	0.00	0.00	0.08	70.53	0.00	3.03	0 00:00	0.00	0.00

MIN FREEBOARD ATTAINED IS GREATER THAN 0.5' FOR ALL STRUCTURES

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
69	SDCO#COM02	Junction	71.03	73.51	0.00	0.00	0.00	0.05	71.13	0.00	2.38	0 00:00	0.00	0.00
70	SDCO#COM03	Junction	71.46	73.53	0.00	0.00	0.00	0.05	71.75	0.00	1.78	0 00:00	0.00	0.00
71	SDCO#COM04	Junction	71.11	73.59	0.00	0.00	0.00	0.04	71.20	0.00	2.39	0 00:00	0.00	0.00
72	SDCO#COM05	Junction	71.34	73.62	0.00	0.00	0.00	0.04	71.43	0.00	2.19	0 00:00	0.00	0.00
73	SDCO#COM06	Junction	71.98	73.47	0.00	0.00	0.00	0.04	72.07	0.00	1.40	0 00:00	0.00	0.00
74	SDCO#COM07	Junction	70.58	73.18	0.00	0.00	0.00	0.03	70.67	0.00	2.51	0 00:00	0.00	0.00
75	SDCO#COM08	Junction	71.11	73.55	0.00	0.00	0.00	0.03	71.20	0.00	2.35	0 00:00	0.00	0.00
76	SDCO#COM09	Junction	70.17	73.63	0.00	0.00	0.00	0.04	70.24	0.00	3.39	0 00:00	0.00	0.00
77	SDCO#COM10	Junction	71.09	73.63	0.00	0.00	0.00	0.02	71.14	0.00	2.49	0 00:00	0.00	0.00
78	SDCO#COM11	Junction	71.09	73.63	0.00	0.00	0.00	0.02	71.16	0.00	2.47	0 00:00	0.00	0.00
79	SDCO#COM12	Junction	70.17	72.88	0.00	0.00	0.00	0.04	70.23	0.00	2.65	0 00:00	0.00	0.00
80	SDCO#COM13	Junction	70.87	73.41	0.00	0.00	0.00	0.04	70.95	0.00	2.46	0 00:00	0.00	0.00
81	SDCO#D1	Junction	72.84	77.30	0.00	0.00	0.00	0.10	72.96	0.00	4.34	0 00:00	0.00	0.00
82	SDCO#D2	Junction	74.65	77.29	0.00	0.00	0.00	0.10	74.79	0.00	2.50	0 00:00	0.00	0.00
83	SDCO#D3	Junction	74.71	77.29	0.00	0.00	0.00	0.10	74.88	0.00	2.41	0 00:00	0.00	0.00
84	SDCO#D4	Junction	73.53	77.46	0.00	0.00	0.00	0.10	73.63	0.00	3.83	0 00:00	0.00	0.00
85	SDCO#D5	Junction	74.47	77.03	0.00	0.00	0.00	0.05	74.55	0.00	2.48	0 00:00	0.00	0.00
86	SDCO#D6	Junction	74.79	77.33	0.00	0.00	0.00	0.05	74.87	0.00	2.46	0 00:00	0.00	0.00
87	SDCO#D7	Junction	74.72	77.28	0.00	0.00	0.00	0.05	74.82	0.00	2.46	0 00:00	0.00	0.00
88	SDCO#E1	Junction	72.07	76.54	0.00	0.00	0.00	0.13	72.25	0.00	4.29	0 00:00	0.00	0.00
89	SDCO#E2	Junction	72.43	76.80	0.00	0.00	0.00	0.13	72.60	0.00	4.20	0 00:00	0.00	0.00
90	SDCO#E3	Junction	73.14	76.57	0.00	0.00	0.00	0.13	73.31	0.00	3.26	0 00:00	0.00	0.00
91	SDCO#E4	Junction	72.64	76.50	0.00	0.00	0.00	0.07	72.76	0.00	3.74	0 00:00	0.00	0.00
92	SDCO#E5	Junction	72.96	76.75	0.00	0.00	0.00	0.07	73.08	0.00	3.67	0 00:00	0.00	0.00
93	SDCO#E6	Junction	73.56	76.50	0.00	0.00	0.00	0.07	73.68	0.00	2.82	0 00:00	0.00	0.00
94	SDCO#E7	Junction	74.24	76.76	0.00	0.00	0.00	0.13	74.41	0.00	2.35	0 00:00	0.00	0.00
95	SDCO#F1	Junction	71.77	77.26	0.00	0.00	0.00	0.08	71.90	0.00	5.36	0 00:00	0.00	0.00
96	SDCO#F2	Junction	72.50	76.98	0.00	0.00	0.00	0.08	72.57	0.00	4.41	0 00:00	0.00	0.00
97	SDCO#F3	Junction	73.46	77.21	0.00	0.00	0.00	0.08	73.60	0.00	3.61	0 00:00	0.00	0.00
98	SDCO#G1	Junction	73.29	77.07	0.00	0.00	0.00	0.08	73.40	0.00	3.67	0 00:00	0.00	0.00
99	SDCO#G2	Junction	74.47	77.01	0.00	0.00	0.00	0.08	74.60	0.00	2.41	0 00:00	0.00	0.00
100	SDCO#G3	Junction	72.89	77.15	0.00	0.00	0.00	0.06	73.03	0.00	4.12	0 00:00	0.00	0.00
101	SDCO#G4	Junction	74.22	76.76	0.00	0.00	0.00	0.06	74.34	0.00	2.42	0 00:00	0.00	0.00
102	SDCO#H1	Junction	72.76	77.10	0.00	0.00	0.00	0.08	72.84	0.00	4.26	0 00:00	0.00	0.00
103	SDCO#H2	Junction	73.13	77.02	0.00	0.00	0.00	0.08	73.27	0.00	3.75	0 00:00	0.00	0.00
104	SDCO#H3	Junction	74.20	76.74	0.00	0.00	0.00	0.08	74.33	0.00	2.41	0 00:00	0.00	0.00
105	SDCO#H4	Junction	72.79	77.00	0.00	0.00	0.00	0.07	72.89	0.00	4.11	0 00:00	0.00	0.00
106	SDCO#H5	Junction	72.94	75.70	0.00	0.00	0.00	0.07	73.07	0.00	2.63	0 00:00	0.00	0.00
107	SDCO#H6	Junction	74.06	76.59	0.00	0.00	0.00	0.07	74.18	0.00	2.41	0 00:00	0.00	0.00
108	WQ#1	Junction	67.90	73.16	0.00	0.00	0.00	1.05	68.46	0.00	4.70	0 00:00	0.00	0.00
109	WQ#2	Junction	70.66	76.71	0.00	0.00	0.00	0.26	70.74	0.00	5.97	0 00:00	0.00	0.00
110	WQ#3	Junction	69.48	76.48	0.00	0.00	0.00	0.68	70.47	0.00	6.01	0 00:00	0.00	0.00
111	WQ#4	Junction	69.60	76.07	0.00	0.00	0.00	1.21	70.47	0.00	5.60	0 00:00	0.00	0.00
112	WQ#5	Junction	70.30	76.23	0.00	0.00	0.00	1.20	70.68	0.00	5.55	0 00:00	0.00	0.00
113	TRENCH INLET	Outfall	67.32					0.18	67.32					
114	R-TANK 1	Storage Node	66.90	70.88	67.40		0.00	1.11	68.38				0.00	0.00
115	R-TANK 2	Storage Node	67.90	73.32	68.40		0.00	2.87	70.47				0.00	0.00
116	R-TANK 3	Storage Node	67.90	75.23	68.40		0.00	1.80	70.47				0.00	0.00

MIN FREEBOARD ATTAINED IS GREATER THAN 0.5' FOR ALL STRUCTURES

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	{SD - Phase 1}.PIPE 02	Pipe	SDCB#02	SDCB#05	108.10	69.83	69.29	0.5000	8.000	0.0150	0.44	0.74	0.59	1.86	0.42	0.64	0.00	Calculated
2	{SD - Phase 1}.PIPE 03	Pipe	SDCB#03	SDCB#02	71.71	70.19	69.83	0.5000	8.000	0.0150	0.26	0.74	0.35	1.58	0.32	0.48	0.00	Calculated
3	{SD - Phase 1}.PIPE 04	Pipe	SDCB#04	SDCB#03	55.25	70.47	70.19	0.5100	8.004	0.0150	0.08	0.75	0.10	0.81	0.21	0.31	0.00	Calculated
4	{SD - Phase 1}.PIPE 05	Pipe	SDCB#05	SDCB#09	89.22	69.29	68.84	0.5000	8.004	0.0130	0.65	0.86	0.76	2.73	0.43	0.65	0.00	Calculated
5	{SD - Phase 1}.PIPE 06	Pipe	SDCB#06	SDCB#09	42.41	69.06	68.84	0.5200	8.004	0.0130	0.23	0.87	0.26	2.05	0.23	0.35	0.00	Calculated
6	{SD - Phase 1}.PIPE 07	Pipe	SDCB#07	SDCB#06	72.15	69.42	69.06	0.5000	8.000	0.0150	0.13	0.74	0.18	1.29	0.22	0.33	0.00	Calculated
7	{SD - Phase 1}.PIPE 08	Pipe	SDCB#08	SDCB#07	49.14	69.67	69.42	0.5100	8.004	0.0150	0.07	0.75	0.10	1.09	0.17	0.25	0.00	Calculated
8	{SD - Phase 1}.PIPE 09	Pipe	SDCB#09	WQ#1	21.39	68.51	68.40	0.5100	12.000	0.0130	1.05	2.55	0.41	2.81	0.48	0.48	0.00	Calculated
9	{SD - Phase 1}.PIPE 11	Pipe	SDCB#11	WQ#2	5.71	73.48	72.83	11.3800	8.000	0.0130	0.26	4.08	0.06	5.41	0.13	0.19	0.00	Calculated
10	{SD - Phase 1}.PIPE 12	Pipe	SDCB#12	SDCB#11	64.20	73.83	73.48	0.5500	8.004	0.0130	0.08	0.89	0.09	1.51	0.14	0.21	0.00	Calculated
11	{SD - Phase 1}.PIPE 13	Pipe	SDCB#13	SDCB#11	78.00	73.87	73.48	0.5000	8.004	0.0130	0.10	0.86	0.12	1.67	0.15	0.23	0.00	Calculated
12	{SD - Phase 1}.PIPE 14	Pipe	SDCB#14	SDCB#15	42.96	71.89	71.68	0.4900	12.000	0.0130	0.53	2.49	0.21	1.82	0.39	0.39	0.00	Calculated
13	{SD - Phase 1}.PIPE 15	Pipe	SDCB#15	WQ#3	6.67	71.68	71.65	0.4500	12.000	0.0130	0.68	2.39	0.29	2.39	0.39	0.39	0.00	Calculated
14	{SD - Phase 1}.PIPE 16	Pipe	SDCB#16	SDCB#14	67.53	72.23	71.89	0.5000	12.000	0.0130	0.31	2.53	0.12	1.62	0.29	0.29	0.00	Calculated
15	{SD - Phase 1}.PIPE 17	Pipe	SDCB#17	SDCB#16	36.65	72.75	72.57	0.4900	8.004	0.0130	0.14	0.85	0.17	1.79	0.19	0.28	0.00	Calculated
16	{SD - Phase 1}.PIPE 18	Pipe	SDCB#18	R-TANK 2	54.55	68.40	68.40	0.0000	24.000	0.0130	1.94	0.97	2.01	1.11	2.00	1.00	153.00	SURCHARGED
17	{SD - Phase 1}.PIPE 20	Pipe	SDCB#20	SDCB#19	126.79	70.98	70.35	0.5000	12.000	0.0130	0.90	2.51	0.36	2.95	0.41	0.41	0.00	Calculated
18	{SD - Phase 1}.PIPE 21	Pipe	SDCB#21	SDCB#20	57.67	71.81	71.31	0.8700	8.004	0.0130	0.07	1.13	0.06	1.74	0.11	0.17	0.00	Calculated
19	{SD - Phase 1}.PIPE 22	Pipe	SDCB#22	SDCB#20	75.77	71.36	70.98	0.5000	12.000	0.0130	0.75	2.52	0.30	2.39	0.42	0.42	0.00	Calculated
20	{SD - Phase 1}.PIPE 23	Pipe	SDCB#23	SDCB#22	113.35	71.93	71.36	0.5000	12.000	0.0130	0.44	2.53	0.17	1.84	0.34	0.34	0.00	Calculated
21	{SD - Phase 1}.PIPE 24	Pipe	SDCB#24	SDCB#23	69.19	72.61	72.26	0.5100	8.004	0.0130	0.03	0.86	0.04	1.20	0.09	0.13	0.00	Calculated
22	{SD - Phase 1}.PIPE 25	Pipe	SDCB#25	SDCB#24	34.45	72.79	72.61	0.5200	8.004	0.0130	0.02	0.87	0.02	0.70	0.08	0.11	0.00	Calculated
23	{SD - Phase 1}.PIPE 26	Pipe	SDCB#26	SDCB#18	104.96	68.40	68.40	0.0000	24.000	0.0130	0.78	0.70	1.11	0.41	2.00	1.00	153.00	SURCHARGED
24	{SD - Phase 1}.PIPE 27	Pipe	SDCB#27	WQ#5	80.37	71.20	70.80	0.5000	12.000	0.0130	1.20	2.51	0.48	3.06	0.50	0.50	0.00	Calculated
25	{SD - Phase 1}.PIPE 28	Pipe	SDCB#28	SDCB#27	122.98	72.15	71.54	0.5000	8.004	0.0130	0.22	0.85	0.26	2.08	0.23	0.35	0.00	Calculated
26	{SD - Phase 1}.PIPE 29	Pipe	SDCB#29	SDCB#27	82.06	71.72	71.20	0.6300	12.000	0.0130	0.62	2.84	0.22	1.94	0.43	0.43	0.00	Calculated
27	{SD - Phase 1}.PIPE 30	Pipe	SDCB#30	SDCB#29	128.14	72.69	72.05	0.5000	8.004	0.0130	0.29	0.86	0.34	2.24	0.27	0.40	0.00	Calculated
28	{SD - Phase 1}.PIPE 31	Pipe	SDCB#31	R-TANK 3	5.26	70.25	70.22	0.5700	12.000	0.0130	0.55	2.69	0.21	2.28	0.35	0.35	0.00	Calculated
29	{SD - Phase 1}.PIPE 40	Pipe	SDCB#40	SDCB#27	52.18	73.22	71.20	3.8700	12.000	0.0130	0.03	7.01	0.00	0.17	0.29	0.29	0.00	Calculated
30	{SD - Phase 1}.PIPE B1	Pipe	SDCO#B1	SDCB#18	50.72	74.33	69.73	9.0700	8.004	0.0130	0.10	3.64	0.03	4.41	0.35	0.52	0.00	Calculated
31	{SD - Phase 1}.PIPE B2	Pipe	SDCO#B2	SDCO#B1	60.72	75.11	74.50	1.0000	6.000	0.0130	0.05	0.56	0.08	1.72	0.10	0.20	0.00	Calculated
32	{SD - Phase 1}.PIPE B3	Pipe	SDCO#B3	SDCO#B2	16.77	75.28	75.11	1.0100	6.000	0.0130	0.05	0.56	0.09	1.65	0.10	0.21	0.00	Calculated
33	{SD - Phase 1}.PIPE B4	Pipe	SDCO#B4	SDCO#B1	85.66	75.41	74.50	1.0600	6.000	0.0130	0.05	0.58	0.08	1.76	0.10	0.20	0.00	Calculated
34	{SD - Phase 1}.PIPE B5	Pipe	SDCO#B5	R-TANK 3	8.62	71.99	71.95	0.4600	6.000	0.0130	0.09	0.38	0.25	1.59	0.17	0.34	0.00	Calculated
35	{SD - Phase 1}.PIPE B6	Pipe	SDCO#B6	SDCO#B5	81.80	72.81	71.99	1.0000	6.000	0.0130	0.05	0.56	0.09	1.02	0.14	0.29	0.00	Calculated
36	{SD - Phase 1}.PIPE B7	Pipe	SDCO#B7	SDCO#B6	6.36	72.87	72.81	0.9400	6.000	0.0130	0.05	0.54	0.09	1.58	0.11	0.21	0.00	Calculated
37	{SD - Phase 1}.PIPE B8	Pipe	SDCO#B8	SDCO#B5	81.80	72.81	71.99	1.0000	6.000	0.0130	0.05	0.56	0.09	1.02	0.14	0.29	0.00	Calculated
38	{SD - Phase 1}.PIPE C1	Pipe	SDCO#C1	SDCB#29	45.29	73.04	72.05	2.1900	8.004	0.0130	0.10	1.79	0.05	2.66	0.11	0.16	0.00	Calculated
39	{SD - Phase 1}.PIPE C10	Pipe	SDCO#C10	SDCO#C9	54.90	72.88	72.33	1.0000	6.000	0.0130	0.05	0.56	0.09	1.64	0.10	0.21	0.00	Calculated
40	{SD - Phase 1}.PIPE C2	Pipe	SDCO#C2	SDCO#C1	22.10	74.28	73.21	4.8400	6.000	0.0130	0.05	1.23	0.04	2.96	0.07	0.14	0.00	Calculated
41	{SD - Phase 1}.PIPE C3	Pipe	SDCO#C3	SDCO#C2	9.24	74.37	74.28	0.9700	6.000	0.0130	0.05	0.55	0.09	2.00	0.09	0.18	0.00	Calculated
42	{SD - Phase 1}.PIPE C4	Pipe	SDCO#C4	SDCO#C1	108.05	74.29	73.21	1.0000	6.000	0.0130	0.05	0.56	0.08	1.73	0.10	0.20	0.00	Calculated
43	{SD - Phase 1}.PIPE C5	Pipe	SDCO#C5	R-TANK 3	7.93	71.44	71.40	0.5000	8.004	0.0130	0.10	0.86	0.11	1.54	0.16	0.23	0.00	Calculated
44	{SD - Phase 1}.PIPE C6	Pipe	SDCO#C6	SDCO#C5	109.73	72.54	71.44	1.0000	6.000	0.0130	0.05	0.56	0.09	1.12	0.13	0.27	0.00	Calculated
45	{SD - Phase 1}.PIPE C7	Pipe	SDCO#C7	SDCO#C6	12.01	72.66	72.54	1.0000	6.000	0.0130	0.05	0.56	0.09	1.64	0.10	0.21	0.00	Calculated
46	{SD - Phase 1}.PIPE C8	Pipe	SDCO#C8	SDCO#C5	45.14	72.19	71.74	1.0000	6.000	0.0130	0.05	0.56	0.09	1.71	0.10	0.20	0.00	Calculated
47	{SD - Phase 1}.PIPE C9	Pipe	SDCO#C9	SDCO#C8	13.55	72.33	72.19	1.0300	6.000	0.0130	0.05	0.57	0.08	1.63	0.10	0.21	0.00	Calculated
48	{SD - Phase 1}.PIPE COM01	Pipe	SDCO#COM01	SDCB#03	37.51	70.38	70.19	0.5100	8.004	0.0150	0.08	0.75	0.11	0.88	0.21	0.32	0.00	Calculated
49	{SD - Phase 1}.PIPE COM02	Pipe	SDCO#COM02	SDCO#COM01	49.39	71.03	70.54	0.9900	6.000	0.0130	0.05	0.56	0.08	1.70	0.10	0.20	0.00	Calculated

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
50	{SD - Phase 1}.PIPE COM03	Pipe	SDCO#COM03	SDCO#COM02	60.72	71.64	71.03	1.0000	6.000	0.0150	0.05	0.49	0.10	1.59	0.10	0.21	0.00	Calculated
51	{SD - Phase 1}.PIPE COM04	Pipe	SDCO#COM04	SDCO#COM01	56.60	71.11	70.54	1.0100	6.000	0.0130	0.04	0.56	0.07	1.59	0.09	0.18	0.00	Calculated
52	{SD - Phase 1}.PIPE COM05	Pipe	SDCO#COM05	SDCO#COM04	22.78	71.34	71.11	1.0100	6.000	0.0130	0.04	0.56	0.07	1.56	0.09	0.18	0.00	Calculated
53	{SD - Phase 1}.PIPE COM06	Pipe	SDCO#COM06	SDCO#COM05	59.24	71.93	71.34	1.0000	6.000	0.0150	0.04	0.51	0.07	1.50	0.09	0.18	0.00	Calculated
54	{SD - Phase 1}.PIPE COM07	Pipe	SDCO#COM07	SDCB#04	21.49	70.58	70.47	0.5100	8.000	0.0130	0.03	0.86	0.04	0.83	0.12	0.18	0.00	Calculated
55	{SD - Phase 1}.PIPE COM08	Pipe	SDCO#COM08	SDCO#COM07	36.57	71.11	70.74	1.0100	6.000	0.0130	0.03	0.56	0.06	1.55	0.08	0.17	0.00	Calculated
56	{SD - Phase 1}.PIPE COM09	Pipe	SDCO#COM09	SDCB#05	34.88	70.17	69.29	2.5200	8.004	0.0130	0.04	1.92	0.02	0.30	0.27	0.41	0.00	Calculated
57	{SD - Phase 1}.PIPE COM10	Pipe	SDCO#COM10	SDCO#COM09	48.42	71.09	70.34	1.5500	6.000	0.0130	0.02	0.70	0.02	1.44	0.06	0.11	0.00	Calculated
58	{SD - Phase 1}.PIPE COM11	Pipe	SDCO#COM11	SDCO#COM09	74.62	71.09	70.34	1.0100	6.000	0.0130	0.02	0.56	0.04	1.40	0.07	0.14	0.00	Calculated
59	{SD - Phase 1}.PIPE COM12	Pipe	SDCO#COM12	SDCB#08	16.26	70.17	69.67	3.0800	8.000	0.0130	0.04	2.12	0.02	1.07	0.10	0.15	0.00	Calculated
60	{SD - Phase 1}.PIPE COM13	Pipe	SDCO#COM13	SDCO#COM12	45.72	70.87	70.34	1.1600	6.000	0.0130	0.04	0.60	0.06	1.65	0.08	0.17	0.00	Calculated
61	{SD - Phase 1}.PIPE D1	Pipe	SDCO#D1	SDCB#28	47.80	72.84	72.15	1.4400	8.004	0.0130	0.09	1.45	0.07	1.25	0.18	0.27	0.00	Calculated
62	{SD - Phase 1}.PIPE D2	Pipe	SDCO#D2	SDCO#D1	163.60	74.65	73.01	1.0000	6.000	0.0130	0.10	0.56	0.17	2.11	0.14	0.28	0.00	Calculated
63	{SD - Phase 1}.PIPE D3	Pipe	SDCO#D3	SDCO#D2	6.36	74.71	74.65	0.9400	6.000	0.0130	0.10	0.54	0.18	1.88	0.15	0.31	0.00	Calculated
64	{SD - Phase 1}.PIPE D4	Pipe	SDCO#D4	SDCB#29	54.62	73.36	72.05	2.4000	8.004	0.0130	0.10	1.99	0.05	2.88	0.10	0.15	0.00	Calculated
65	{SD - Phase 1}.PIPE D5	Pipe	SDCO#D5	SDCO#D4	32.05	74.47	73.53	2.9300	6.000	0.0130	0.05	0.96	0.05	2.03	0.09	0.18	0.00	Calculated
66	{SD - Phase 1}.PIPE D6	Pipe	SDCO#D6	SDCO#D5	10.82	74.79	74.47	2.9600	6.000	0.0130	0.05	0.96	0.05	2.41	0.08	0.16	0.00	Calculated
67	{SD - Phase 1}.PIPE D7	Pipe	SDCO#D7	SDCO#D4	119.28	74.72	73.53	1.0000	6.000	0.0130	0.05	0.56	0.09	1.70	0.10	0.20	0.00	Calculated
68	{SD - Phase 1}.PIPE E1	Pipe	SDCO#E1	SDCB#22	42.30	71.90	71.69	0.5000	6.000	0.0130	0.13	0.53	0.25	2.16	0.17	0.35	0.00	Calculated
69	{SD - Phase 1}.PIPE E4	Pipe	SDCO#E4	SDCB#23	42.52	72.48	72.26	0.5200	6.000	0.0130	0.07	0.53	0.12	1.79	0.12	0.24	0.00	Calculated
70	{SD - Phase 1}.PIPE G1	Pipe	SDCO#G1	SDCB#16	23.14	73.29	72.73	2.4200	6.000	0.0130	0.08	0.87	0.09	2.66	0.11	0.21	0.00	Calculated
71	{SD - Phase 1}.PIPE G2	Pipe	SDCO#G2	SDCO#G1	118.43	74.47	73.29	1.0000	6.000	0.0130	0.08	0.56	0.14	2.19	0.12	0.24	0.00	Calculated
72	{SD - Phase 1}.PIPE G3	Pipe	SDCO#G3	SDCB#17	29.24	72.89	72.75	0.4800	6.000	0.0130	0.06	0.39	0.16	1.10	0.17	0.34	0.00	Calculated
73	{SD - Phase 1}.PIPE G4	Pipe	SDCO#G4	SDCO#G3	116.18	74.22	73.06	1.0000	6.000	0.0130	0.06	0.56	0.11	1.88	0.11	0.23	0.00	Calculated
74	{SD - Phase 1}.PIPE H1	Pipe	SDCO#H1	SDCB#14	9.90	72.76	72.22	5.4500	8.004	0.0130	0.08	2.83	0.03	3.30	0.08	0.12	0.00	Calculated
75	{SD - Phase 1}.PIPE H2	Pipe	SDCO#H2	SDCO#H1	20.00	73.13	72.93	1.0000	6.000	0.0130	0.08	0.56	0.14	1.91	0.13	0.26	0.00	Calculated
76	{SD - Phase 1}.PIPE H3	Pipe	SDCO#H3	SDCO#H2	106.86	74.20	73.13	1.0000	6.000	0.0130	0.08	0.56	0.14	1.91	0.13	0.26	0.00	Calculated
77	{SD - Phase 1}.PIPE H4	Pipe	SDCO#H4	SDCB#15	24.70	72.79	72.18	2.4700	6.000	0.0130	0.07	0.88	0.07	2.54	0.09	0.19	0.00	Calculated
78	{SD - Phase 1}.PIPE H5	Pipe	SDCO#H5	SDCO#H4	14.98	72.94	72.79	1.0000	6.000	0.0130	0.07	0.56	0.12	2.01	0.11	0.22	0.00	Calculated
79	{SD - Phase 1}.PIPE H6	Pipe	SDCO#H6	SDCO#H5	112.34	74.06	72.94	1.0000	6.000	0.0130	0.07	0.56	0.12	1.80	0.12	0.24	0.00	Calculated
80	{SD - Phase 1}.PIPE RT-1	Pipe	R-TANK 1	SDCB#01	4.18	67.40	67.40	0.0000	24.000	0.0130	0.18	3.50	0.05	1.11	0.98	0.49	0.00	Calculated
81	{SD - Phase 1}.PIPE RT-2	Pipe	R-TANK 2	SDCB#10	5.00	68.40	68.40	0.0000	24.000	0.0130	0.07	3.20	0.02	0.86	2.00	1.00	153.00	SURCHARGED
82	{SD - Phase 1}.PIPE RT-3	Pipe	R-TANK 3	SDCB#26	128.16	68.40	68.40	0.0000	24.000	0.0130	0.52	0.63	0.82	0.64	2.00	1.00	153.00	SURCHARGED
83	{SD - Phase 1}.PIPE WQ#4	Pipe	WQ#4	SDCB#18	40.09	69.60	69.40	0.5000	12.000	0.0130	1.21	2.52	0.48	2.97	0.93	0.93	0.00	Calculated
84	{SD - Phase 2}.PIEP CLUB5	Pipe	SDCO#CLUB5	SDCO#CLUB4	42.78	73.15	72.72	1.0100	6.000	0.0130	0.02	0.56	0.04	1.41	0.07	0.14	0.00	Calculated
85	{SD - Phase 2}.PIPE 33	Pipe	SDCB#33	SDCB#31	113.81	70.81	70.25	0.4900	12.000	0.0130	0.26	2.50	0.10	1.29	0.30	0.30	0.00	Calculated
86	{SD - Phase 2}.PIPE 34	Pipe	SDCB#34	SDCB#33	74.43	71.52	71.14	0.5100	8.004	0.0130	0.09	0.86	0.11	1.64	0.15	0.22	0.00	Calculated
87	{SD - Phase 2}.PIPE 35	Pipe	SDCB#35	R-TANK 3	78.01	68.40	68.40	0.0000	24.000	0.0130	0.54	0.81	0.66	0.55	2.00	1.00	153.00	SURCHARGED
88	{SD - Phase 2}.PIPE 36	Pipe	SDCB#36	SDCB#35	68.05	70.59	69.40	1.7500	12.000	0.0130	0.47	4.71	0.10	3.68	0.54	0.54	0.00	Calculated
89	{SD - Phase 2}.PIPE 37	Pipe	SDCB#37	SDCB#36	118.86	71.52	70.93	0.5000	8.004	0.0130	0.22	0.85	0.26	2.07	0.23	0.34	0.00	Calculated
90	{SD - Phase 2}.PIPE 38	Pipe	SDCB#38	SDCB#37	72.17	71.88	71.52	0.5000	8.004	0.0130	0.16	0.85	0.19	1.64	0.22	0.33	0.00	Calculated
91	{SD - Phase 2}.PIPE A1	Pipe	SDCO#A1	SDCB#32	22.91	72.71	72.60	0.4800	8.000	0.0130	0.07	0.84	0.09	0.91	0.19	0.28	0.00	Calculated
92	{SD - Phase 2}.PIPE A2	Pipe	SDCO#A2	SDCO#A1	33.15	73.21	72.88	1.0000	6.000	0.0130	0.04	0.56	0.06	1.56	0.09	0.18	0.00	Calculated
93	{SD - Phase 2}.PIPE A3	Pipe	SDCO#A3	SDCO#A2	78.60	74.00	73.21	1.0100	6.000	0.0130	0.04	0.56	0.06	1.57	0.09	0.18	0.00	Calculated
94	{SD - Phase 2}.PIPE A4	Pipe	SDCO#A4	SDCO#A5	72.96	73.96	73.23	1.0000	6.000	0.0130	0.04	0.56	0.07	1.57	0.09	0.18	0.00	Calculated
95	{SD - Phase 2}.PIPE A5	Pipe	SDCO#A5	SDCO#A1	35.48	73.23	72.88	0.9900	6.000	0.0130	0.04	0.56	0.07	1.56	0.09	0.18	0.00	Calculated
96	{SD - Phase 2}.PIPE CLUB2	Pipe	SDCO#CLUB2	SDCO#CLUB1	33.61	72.72	72.38	1.0100	6.000	0.0130	0.02	0.56	0.04	1.29	0.07	0.15	0.00	Calculated
97	{SD - Phase 2}.PIPE CLUB3	Pipe	SDCO#CLUB3	SDCO#CLUB2	40.66	73.13	72.72	1.0100	6.000	0.0130	0.02	0.56	0.04	1.39	0.07	0.14	0.00	Calculated
98	{SD - Phase 2}.PIPE CLUB4	Pipe	SDCO#CLUB4	SDCO#CLUB1	32.02	72.72	72.38	1.0600	6.000	0.0130	0.02	0.58	0.04	1.30	0.07	0.15	0.00	Calculated

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
99	{SD - Phase 2}.PIPE E2	Pipe	SDCO#E2	SDCO#E1	35.98	72.43	72.07	1.0000	6.000	0.0130	0.13	0.56	0.23	2.12	0.18	0.35	0.00	Calculated
100	{SD - Phase 2}.PIPE E3	Pipe	SDCO#E3	SDCO#E2	71.44	73.14	72.43	0.9900	6.000	0.0130	0.13	0.56	0.23	2.20	0.17	0.34	0.00	Calculated
101	{SD - Phase 2}.PIPE E5	Pipe	SDCO#E5	SDCO#E4	31.53	72.96	72.64	1.0100	6.000	0.0130	0.07	0.57	0.12	1.78	0.12	0.24	0.00	Calculated
102	{SD - Phase 2}.PIPE E6	Pipe	SDCO#E6	SDCO#E5	59.72	73.56	72.96	1.0000	6.000	0.0130	0.07	0.56	0.12	1.84	0.12	0.24	0.00	Calculated
103	{SD - Phase 2}.PIPE E7	Pipe	SDCO#E7	SDCO#E3	109.59	74.24	73.14	1.0000	6.000	0.0130	0.13	0.56	0.23	2.27	0.17	0.34	0.00	Calculated
104	{SD - Phase 2}.PIPE F1	Pipe	SDCO#F1	SDCB#31	151.81	71.77	70.25	1.0000	6.000	0.0130	0.08	0.56	0.15	0.80	0.26	0.52	0.00	Calculated
105	{SD - Phase 2}.PIPE F2	Pipe	SDCO#F2	SDCB#35	17.47	72.50	69.90	14.8800	6.000	0.0130	0.08	2.16	0.04	5.11	0.26	0.52	0.00	Calculated
106	{SD - Phase 2}.PIPE F3	Pipe	SDCO#F3	SDCO#F2	96.17	73.46	72.50	1.0000	6.000	0.0130	0.08	0.56	0.15	2.66	0.11	0.21	0.00	Calculated
107	PIPE 32	Pipe	SDCB#32	SDCB#23	66.71	72.60	72.26	0.5100	8.000	0.0130	0.19	0.86	0.23	2.00	0.22	0.32	0.00	Calculated
108	PIPE CLUB1	Pipe	SDCO#CLUB1	SDCB#22	35.74	72.21	71.69	1.4500	8.000	0.0130	0.05	1.68	0.03	2.06	0.08	0.12	0.00	Calculated
109	PIPE WQ#1	Pipe	WQ#1	R-TANK 1	6.39	67.90	67.87	0.4700	12.000	0.0130	1.05	2.44	0.43	2.71	0.50	0.50	0.00	Calculated
110	PIPE WQ#2	Pipe	WQ#2	R-TANK 2	5.61	70.66	68.87	31.9100	12.000	0.0130	0.26	20.13	0.01	5.18	0.52	0.52	0.00	Calculated
111	PIPE WQ#3	Pipe	WQ#3	R-TANK 2	6.80	69.48	68.87	8.9700	12.000	0.0130	0.71	10.67	0.07	4.15	0.99	0.99	0.00	Calculated
112	PIPE WQ#4	Pipe	WQ#4	SDCB#19	40.09	69.60	69.40	0.5000	12.000	0.0130	1.21	4.87	0.25	3.31	0.49	0.49	0.00	Calculated
113	PIPE WQ#5	Pipe	WQ#5	SDCB#26	45.10	70.30	69.40	2.0000	12.000	0.0130	1.20	5.03	0.24	4.81	0.58	0.58	0.00	Calculated
114	{SD - Phase 1}.RT-1 OUTLET	Outlet	SDCB#01	TRENCH INLET		66.90	67.32				0.18							
115	{SD - Phase 1}.RT-2 OUTLET	Outlet	SDCB#10	R-TANK 1		67.90	66.90				0.07							

Subbasin Hydrology

Subbasin : BLDG A_NORTH

Input Data

Area (ac) 0.05
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

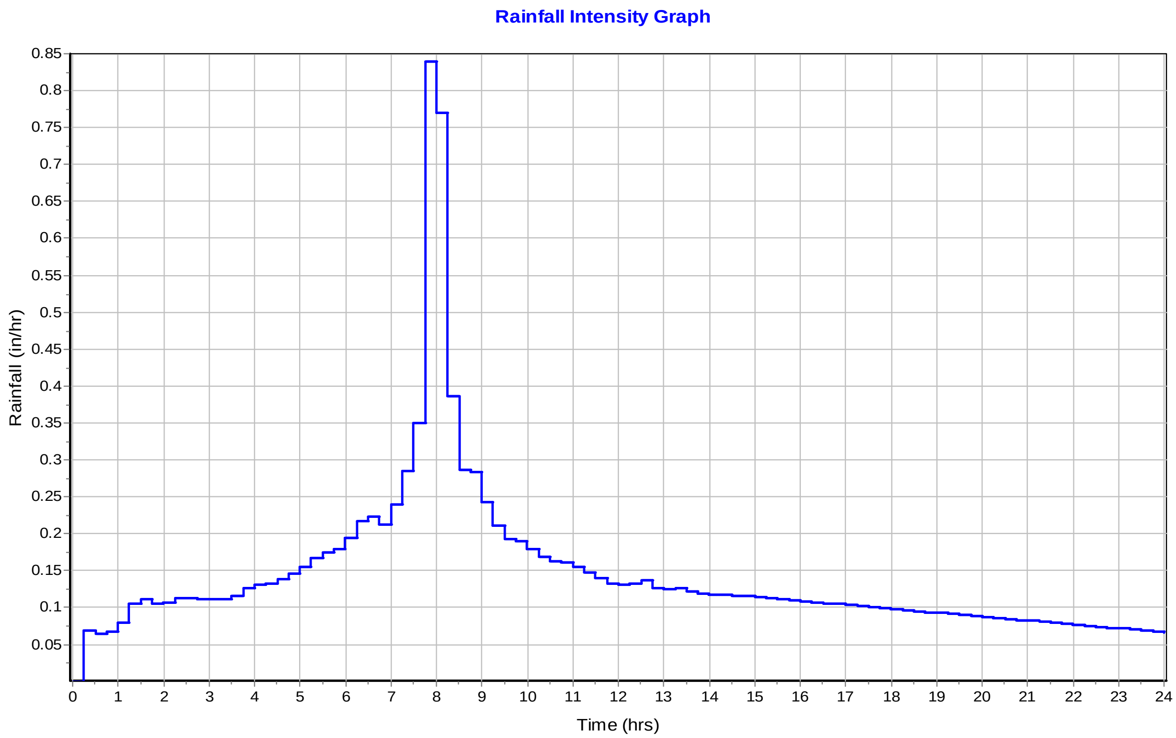
Composite Curve Number

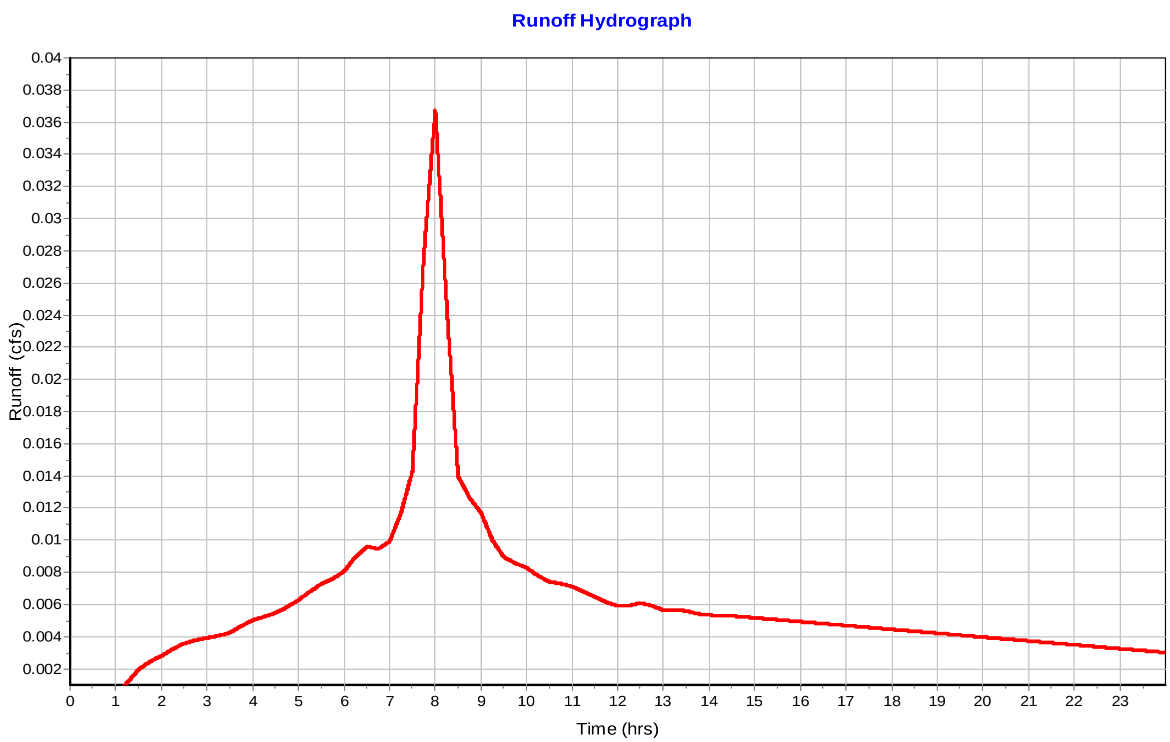
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.05		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.04
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG A_NORTH





Subbasin : BLDG A_SOUTH

Input Data

Area (ac) 0.05
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

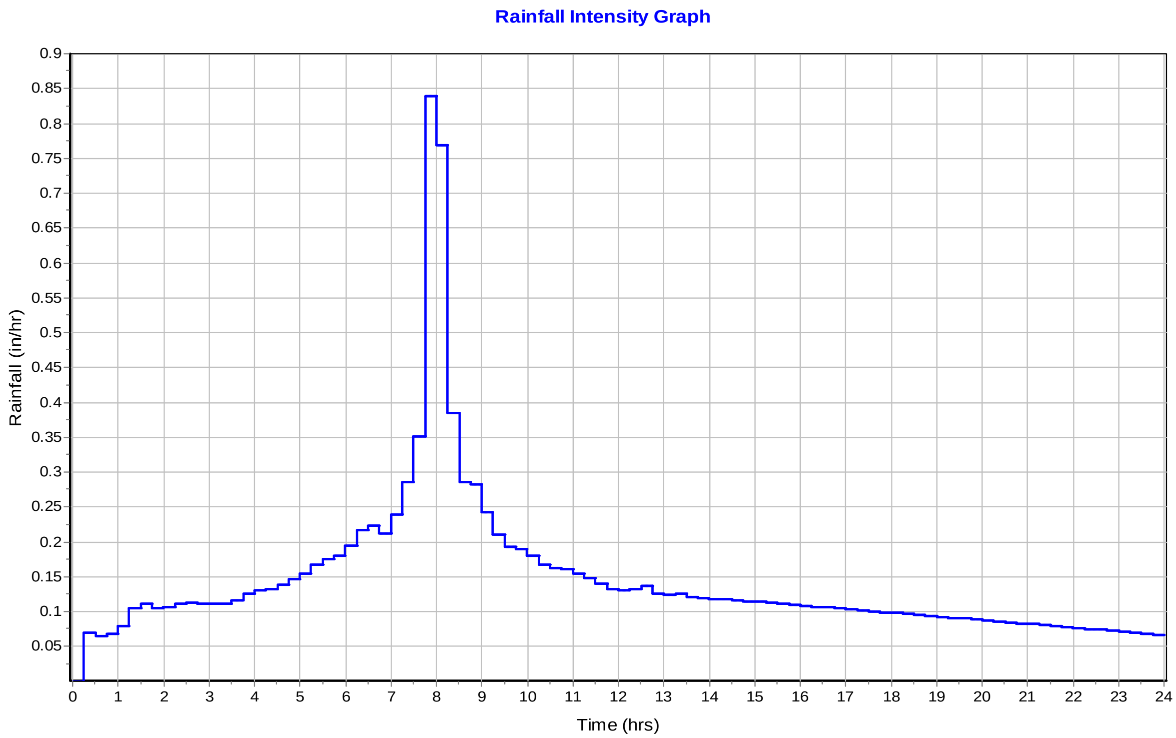
Composite Curve Number

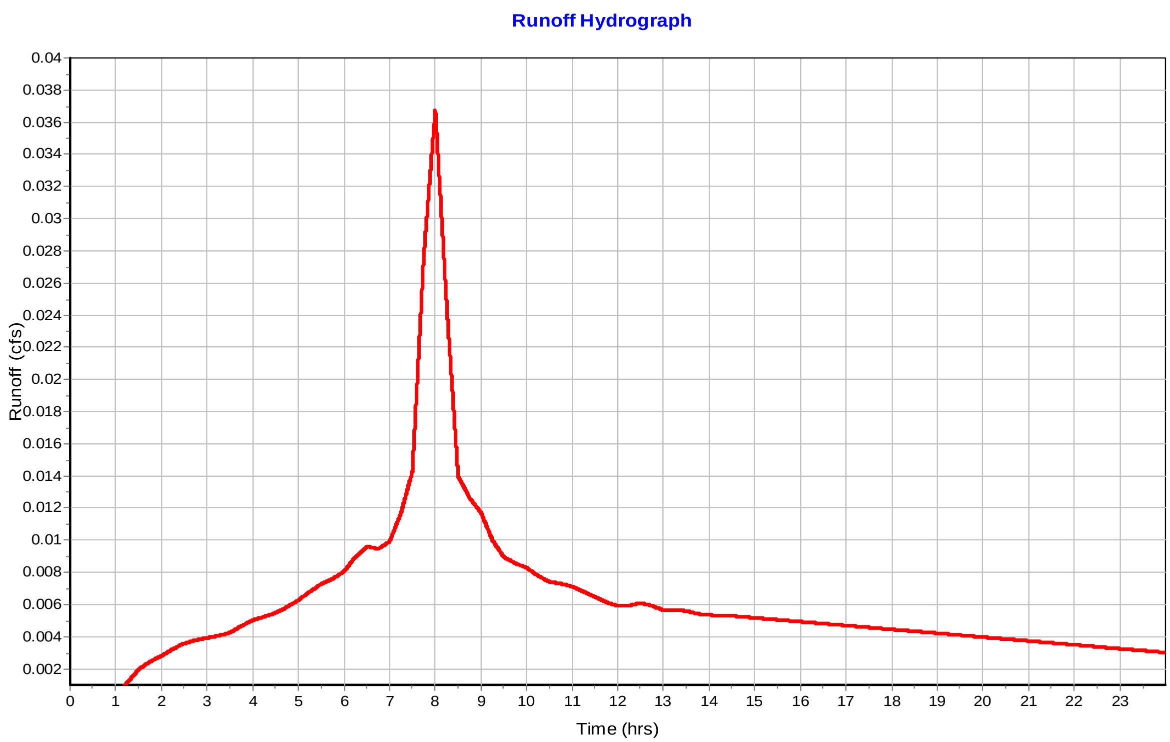
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.05		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.04
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG A_SOUTH





Subbasin : BLDG B_NE

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

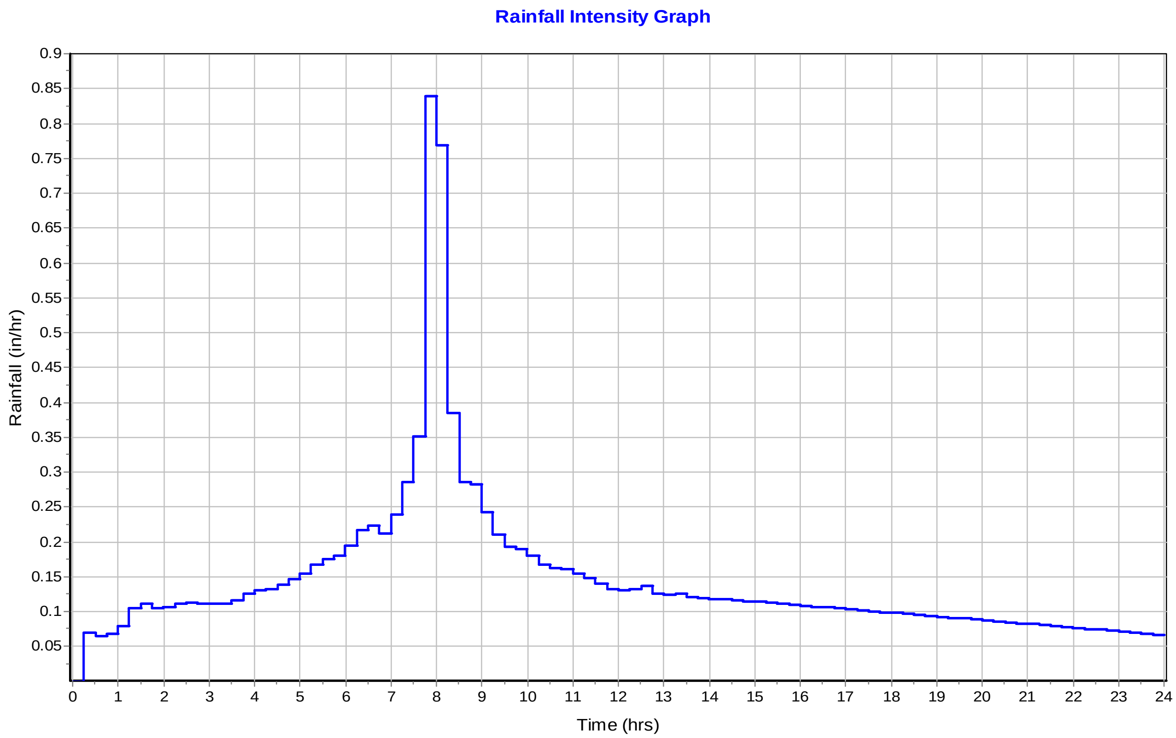
Composite Curve Number

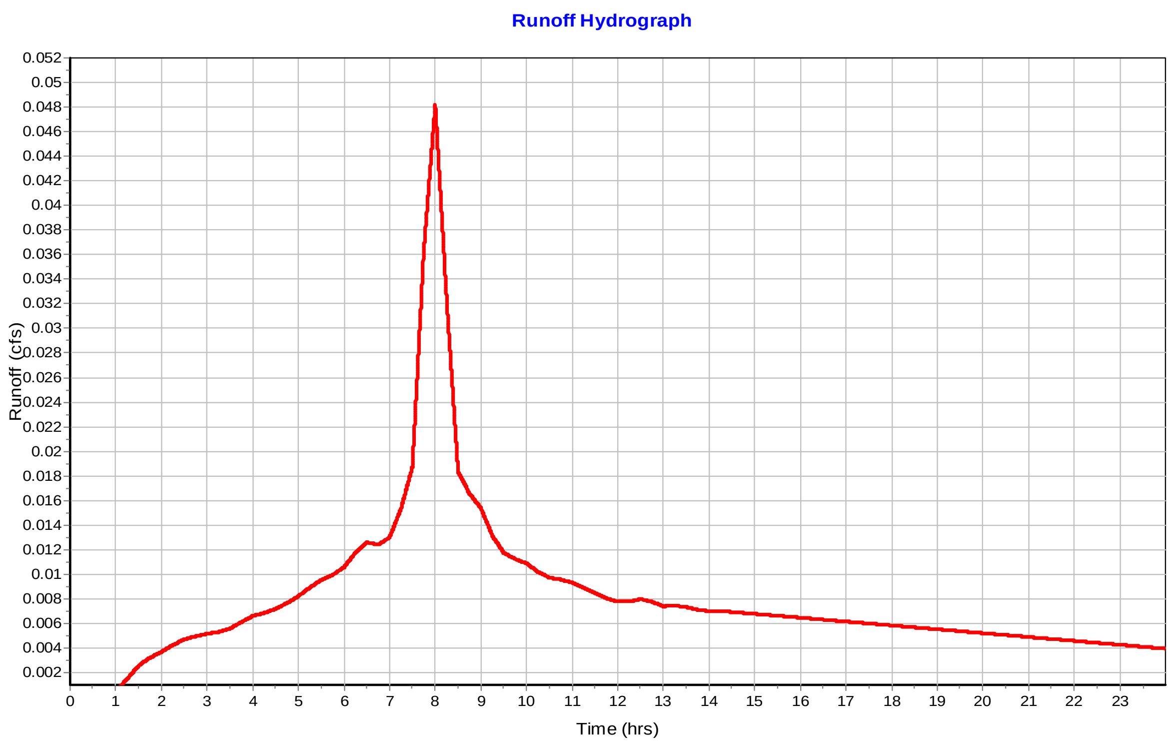
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG B_NE





Subbasin : BLDG B_NW

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

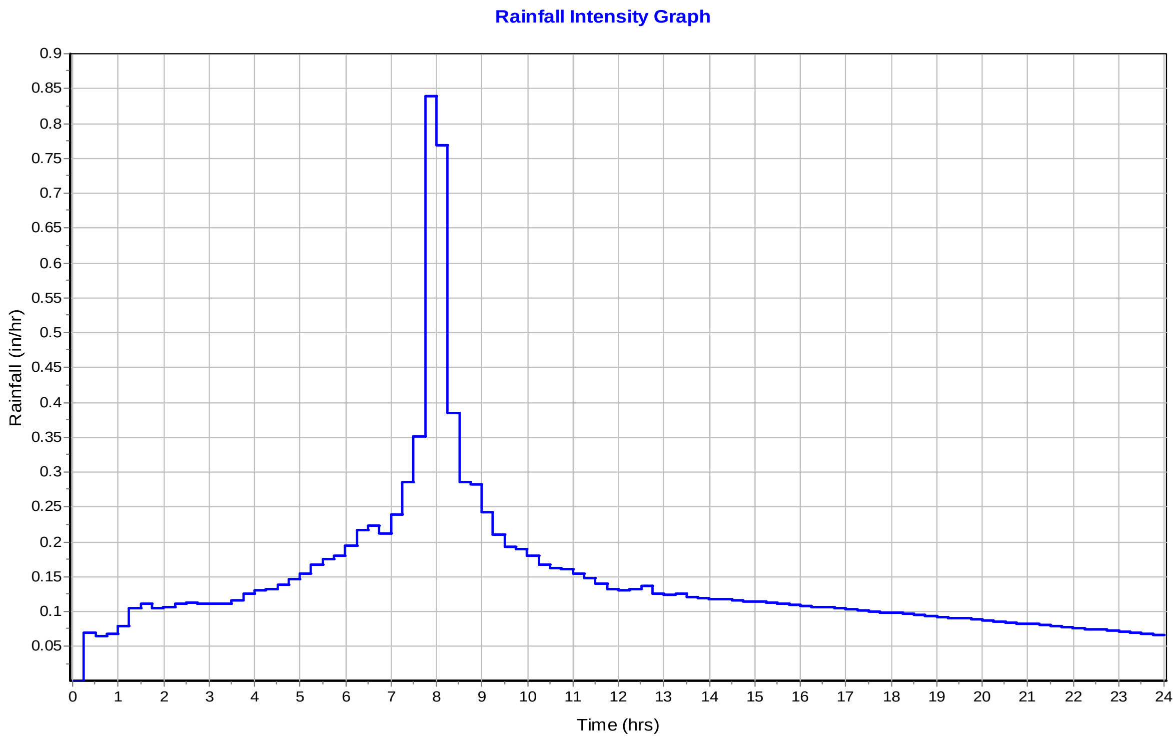
Composite Curve Number

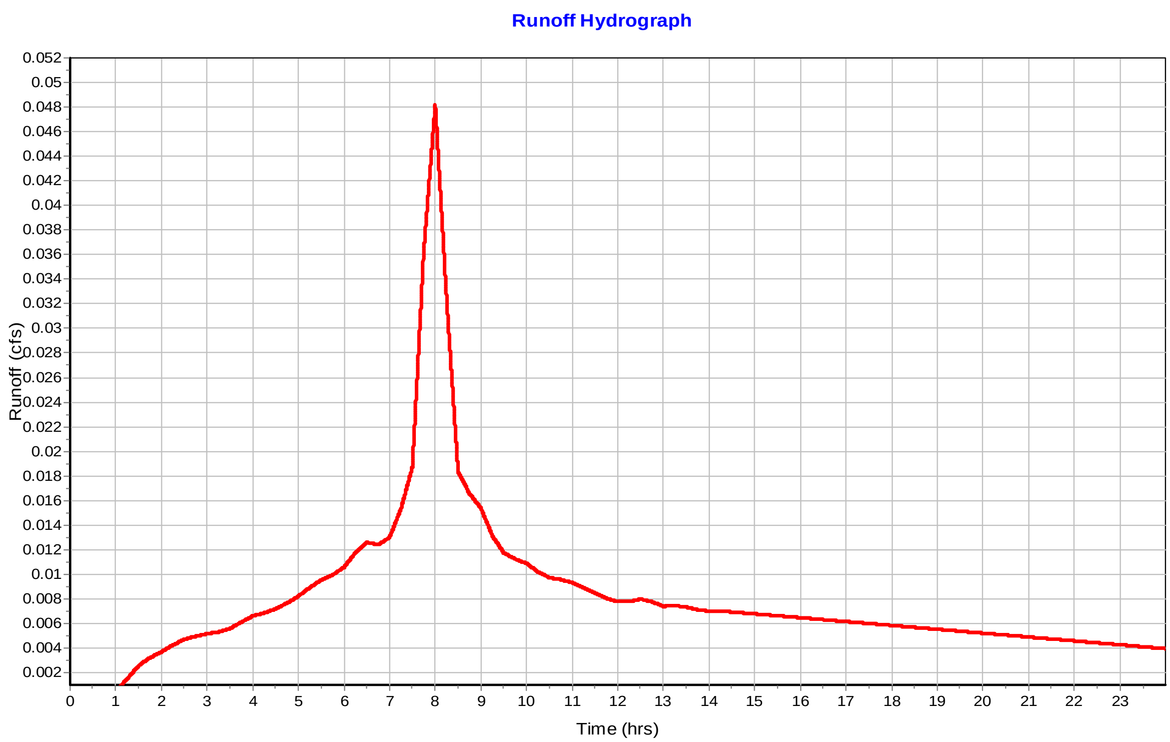
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG B_NW





Subbasin : BLDG B_SE

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

Composite Curve Number

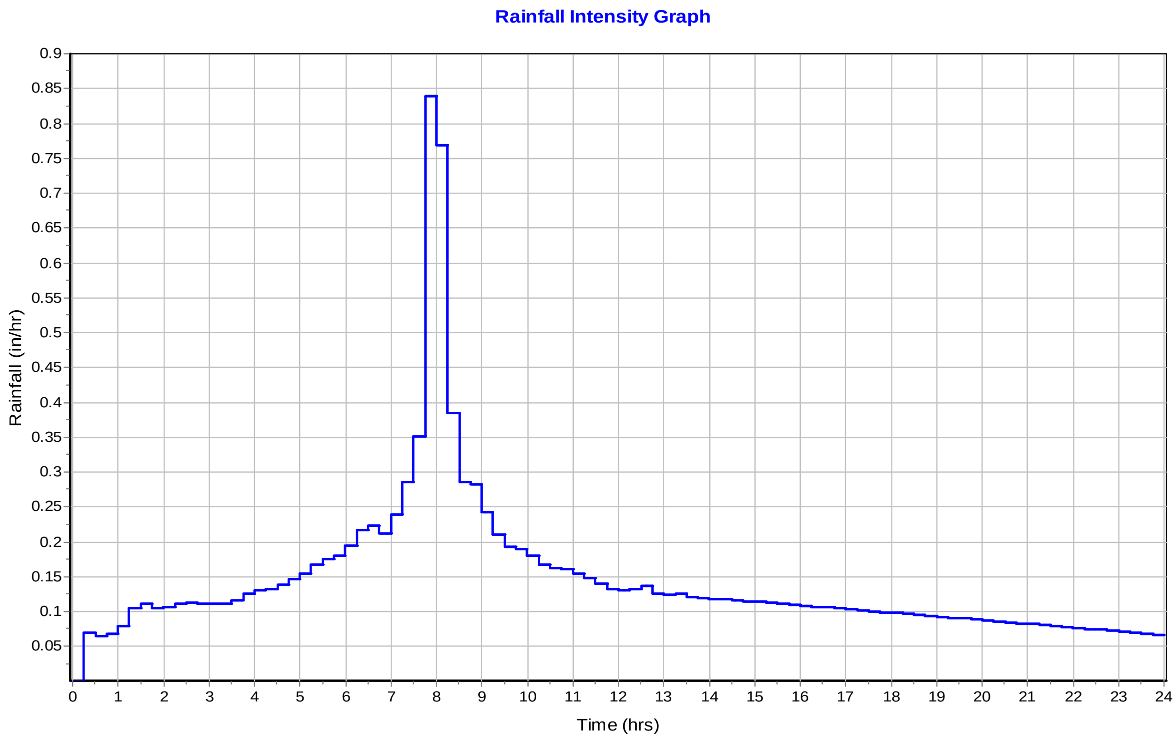
32

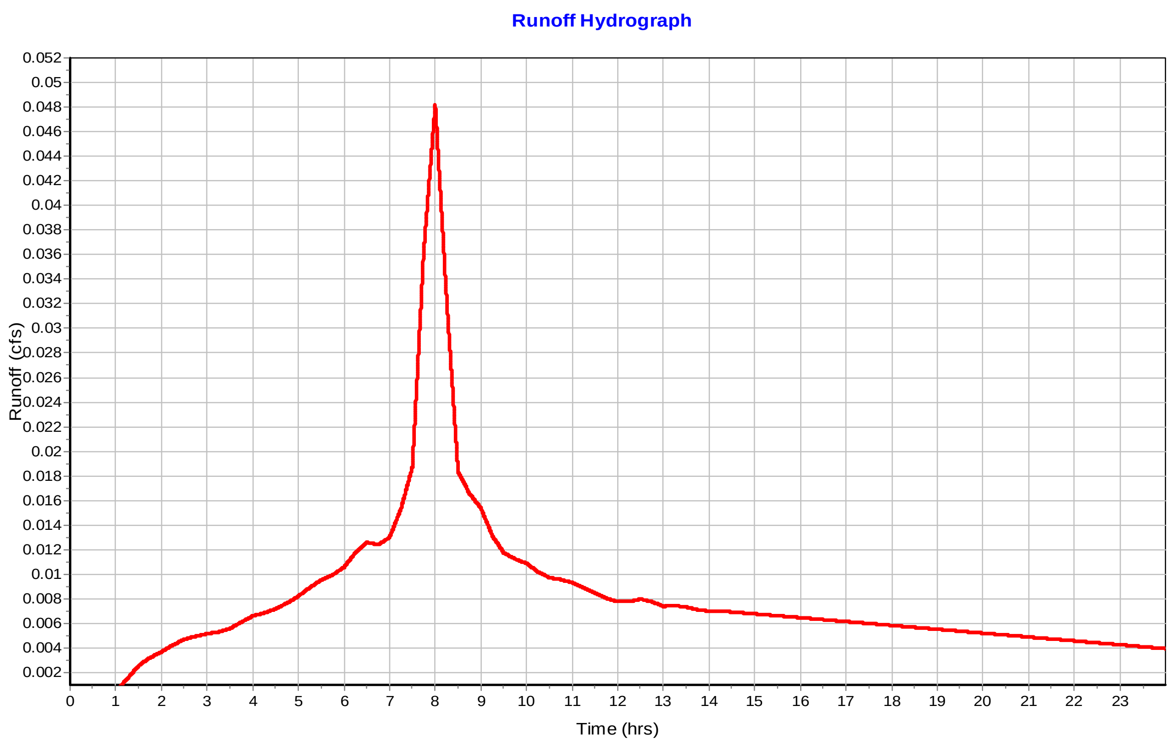
Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG B_SE





Subbasin : BLDG B_SW

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

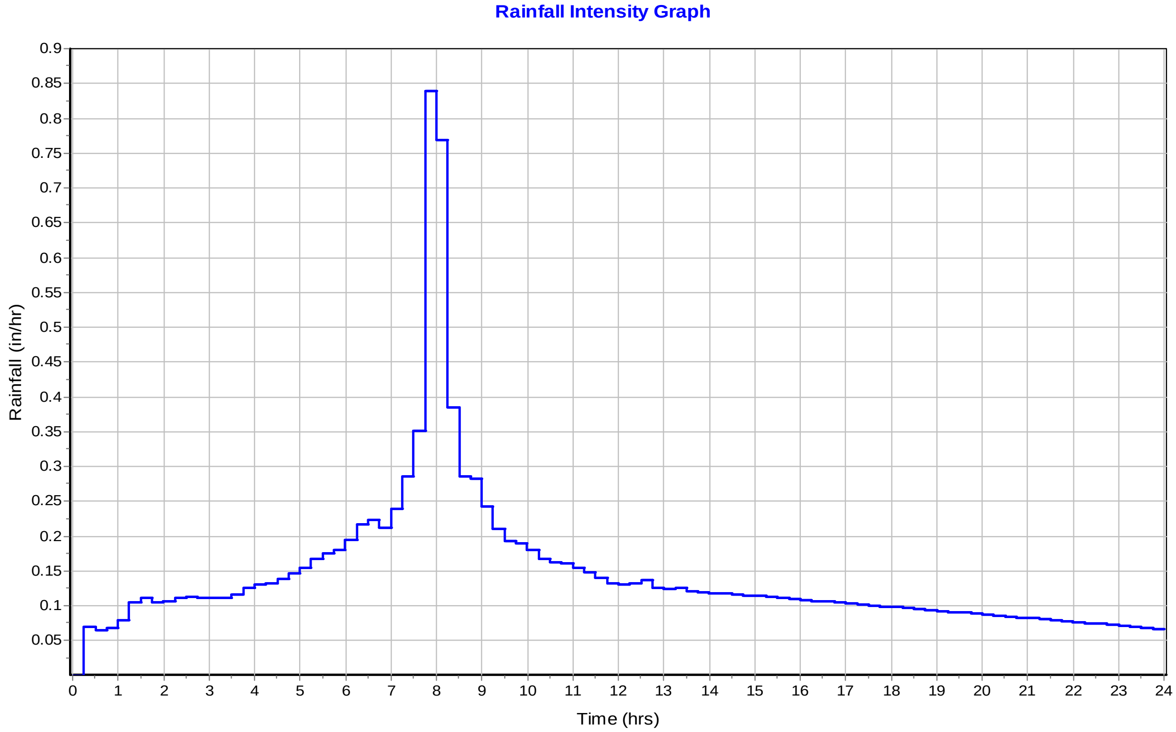
Composite Curve Number

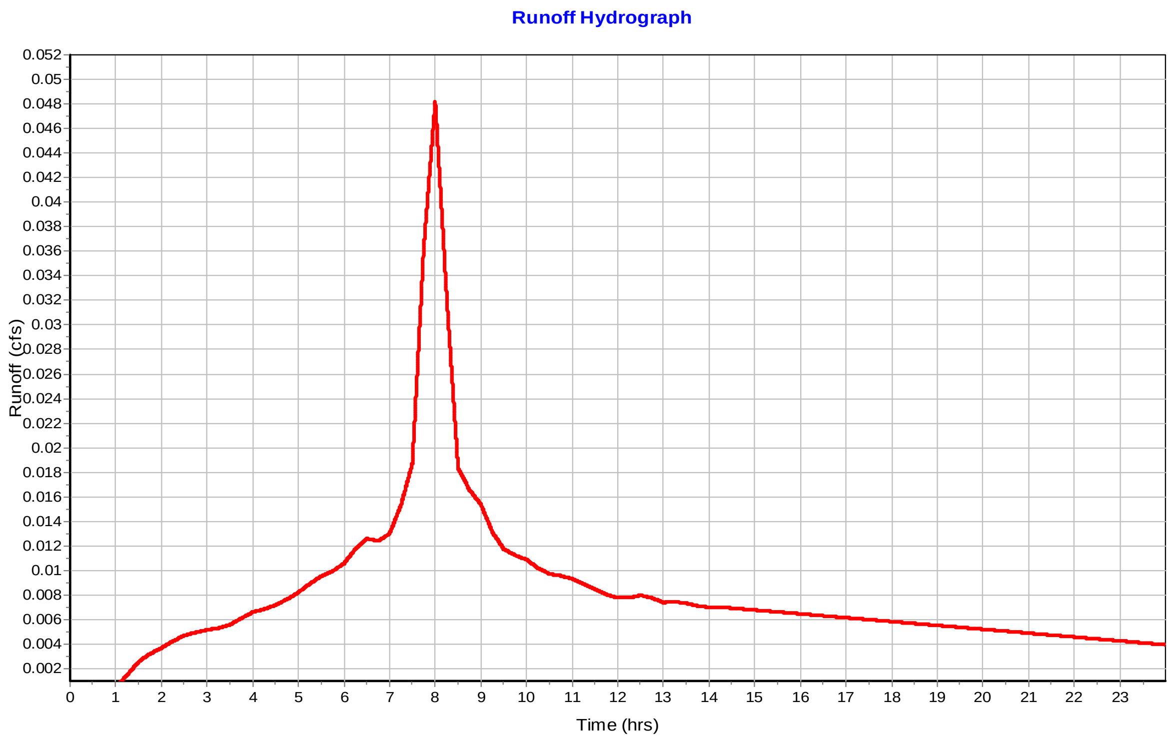
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG B_SW





Subbasin : BLDG C_NE

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

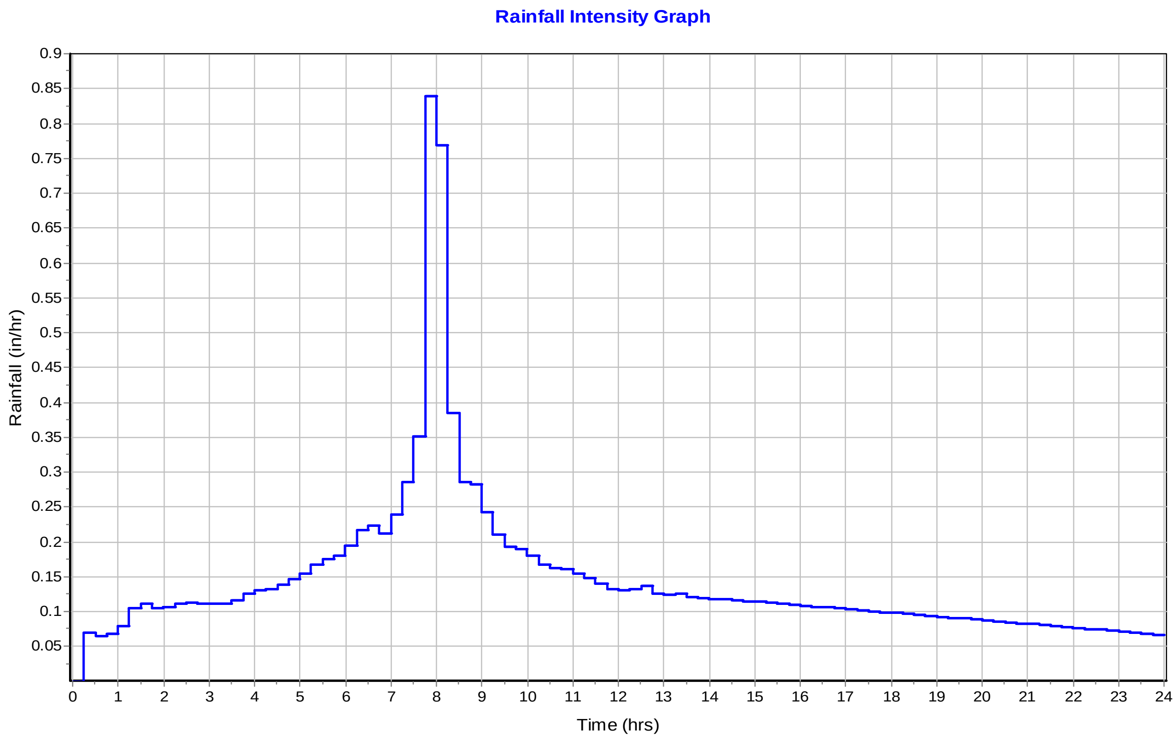
Composite Curve Number

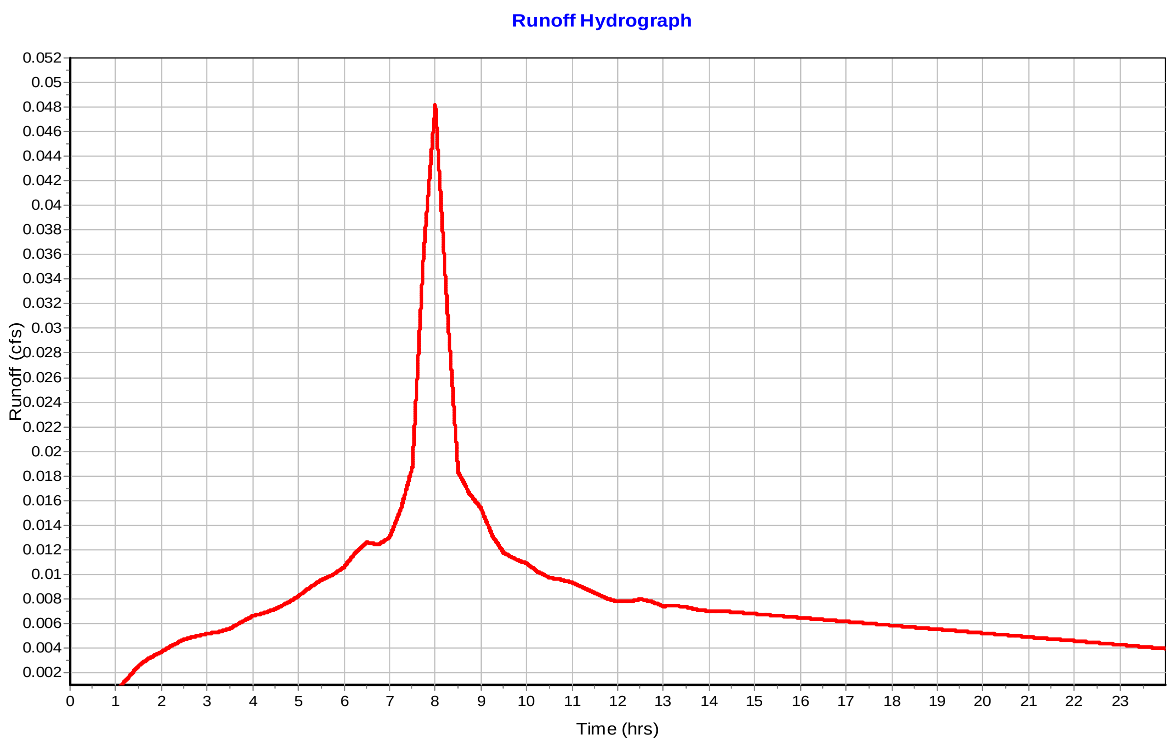
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG C_NE





Subbasin : BLDG C_NW

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

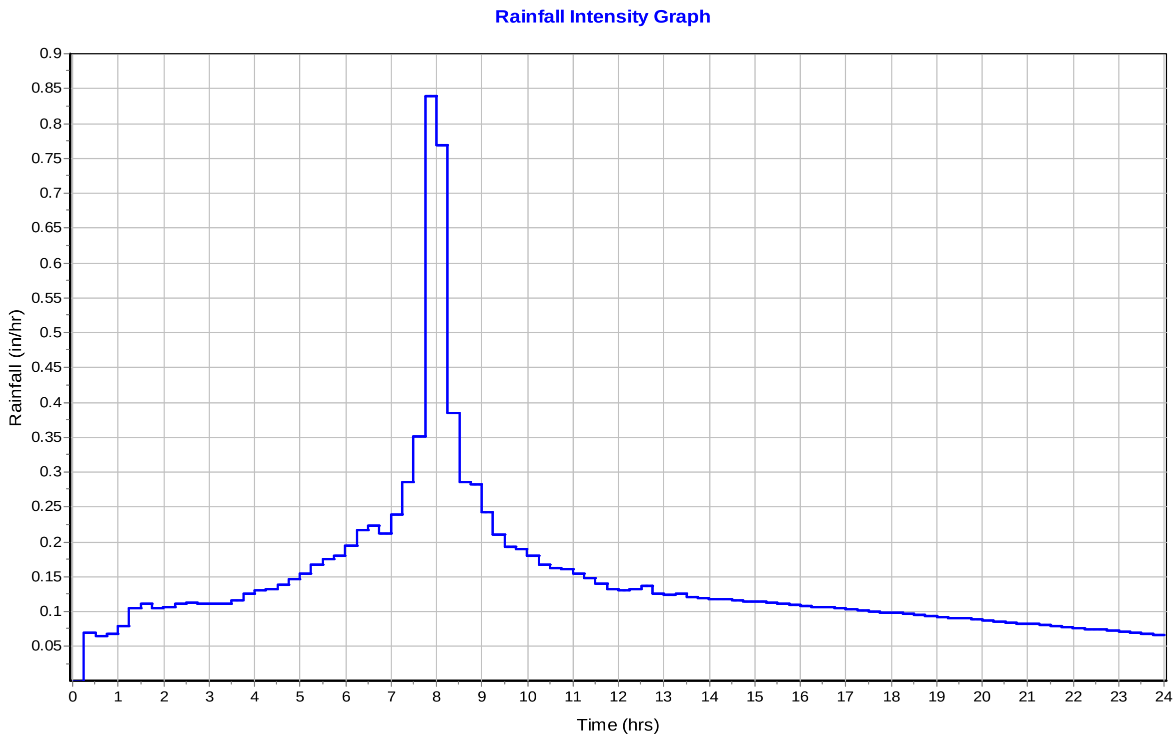
Composite Curve Number

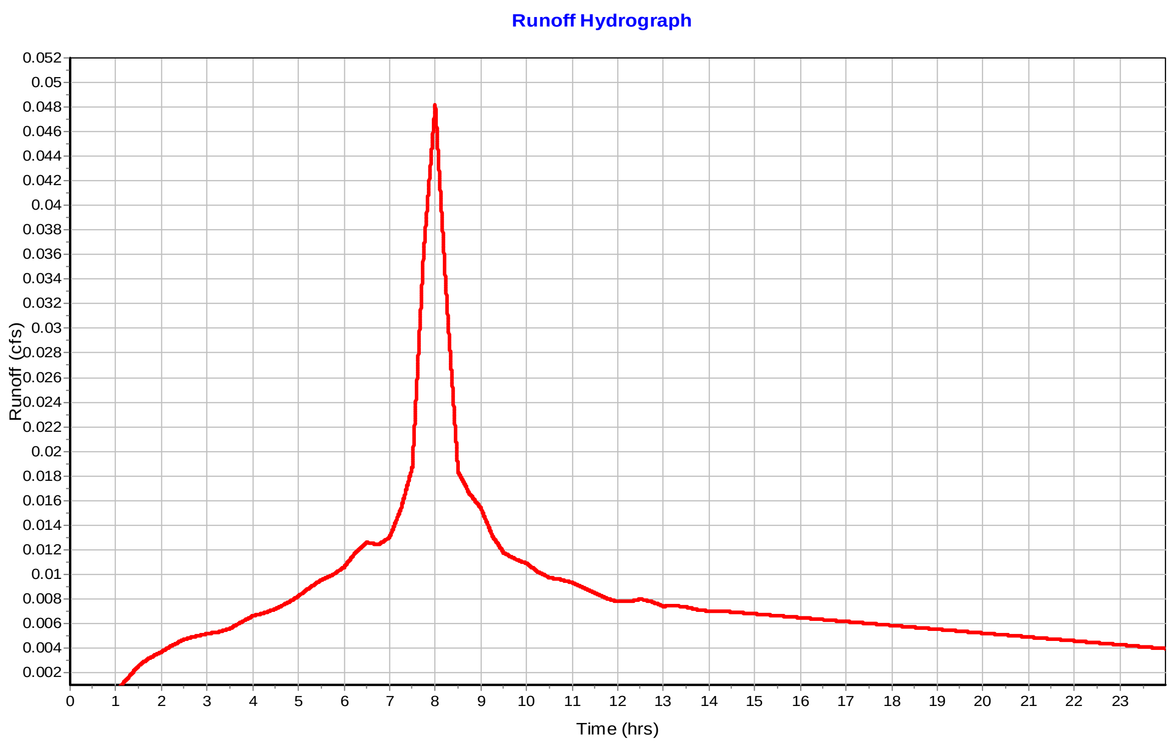
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG C_NW





Subbasin : BLDG C_SE

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

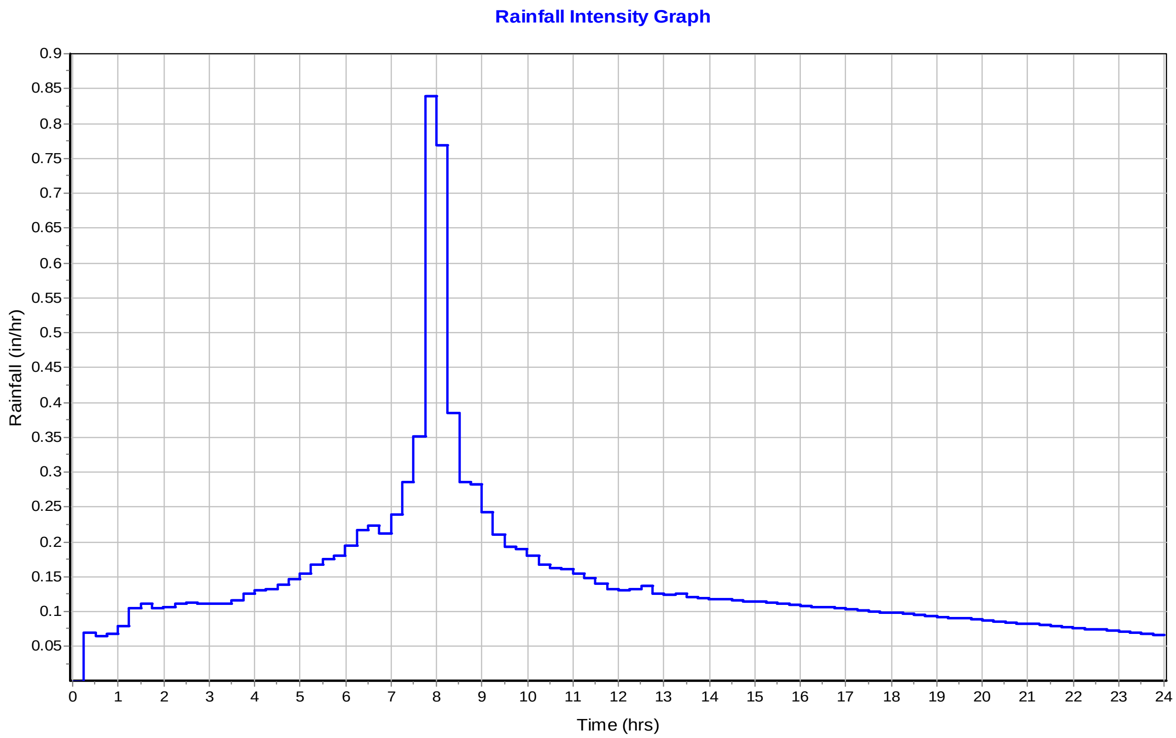
Composite Curve Number

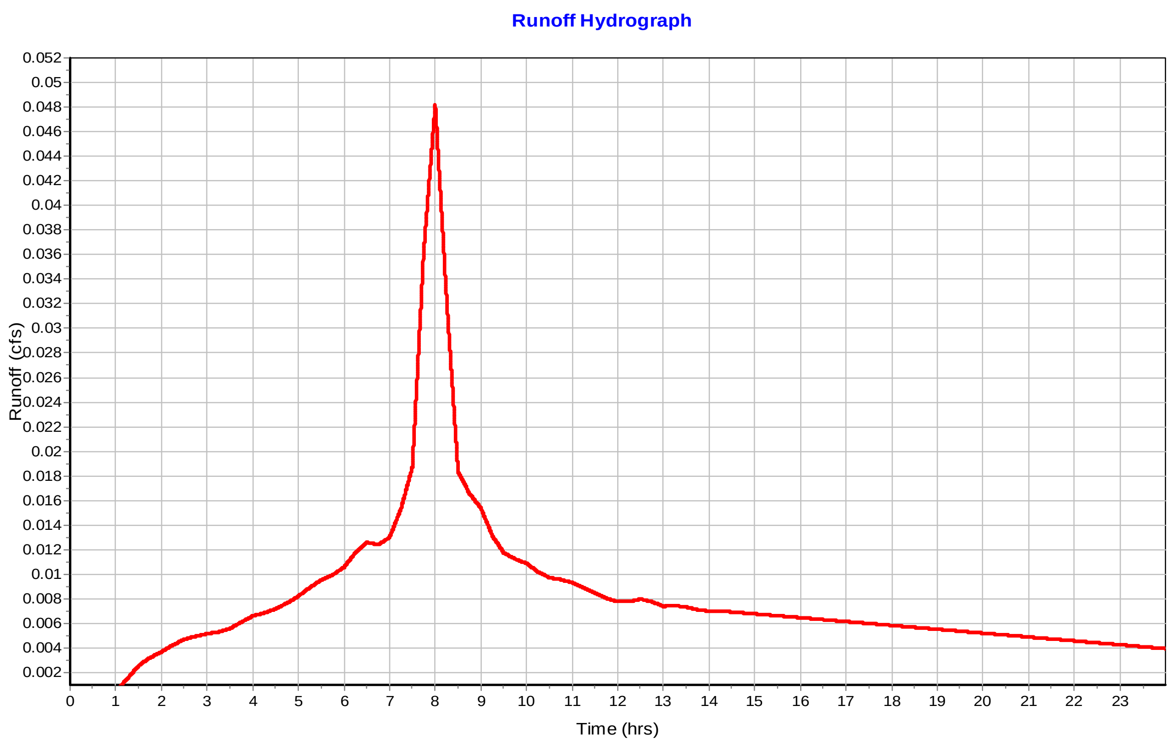
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG C_SE





Subbasin : BLDG C_SW

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

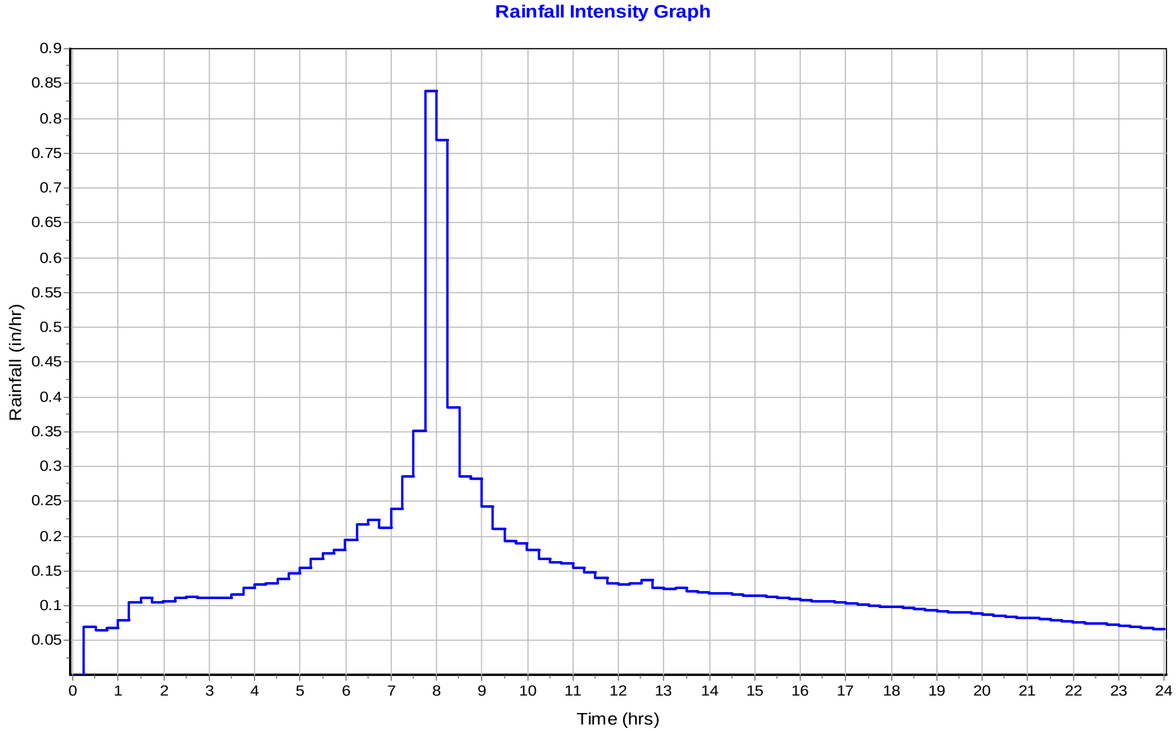
Composite Curve Number

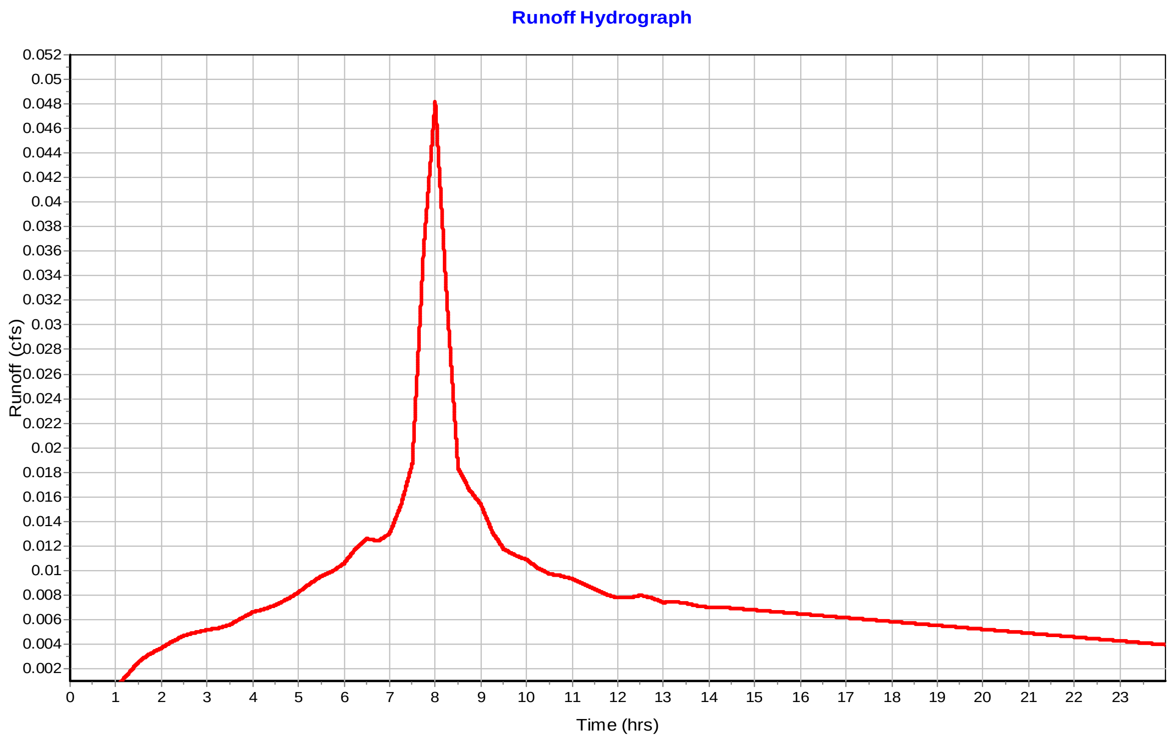
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG C_SW





Subbasin : BLDG CLUB_EAST

Input Data

Area (ac) 0.03
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

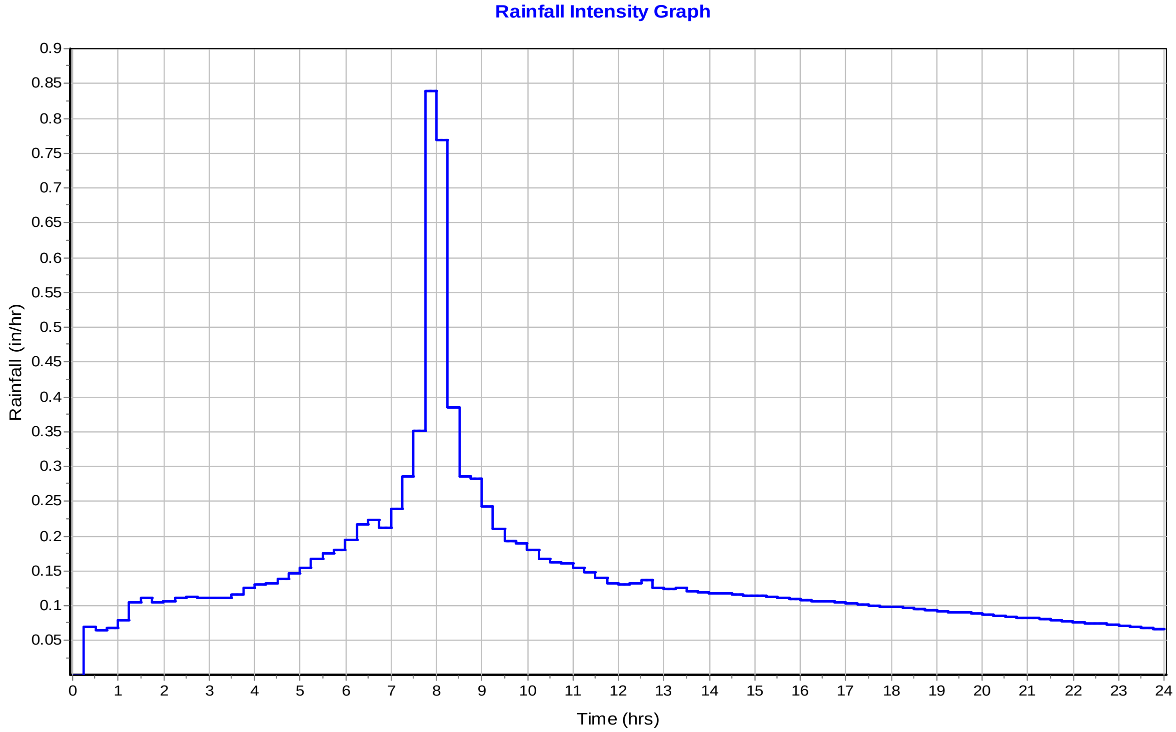
Composite Curve Number

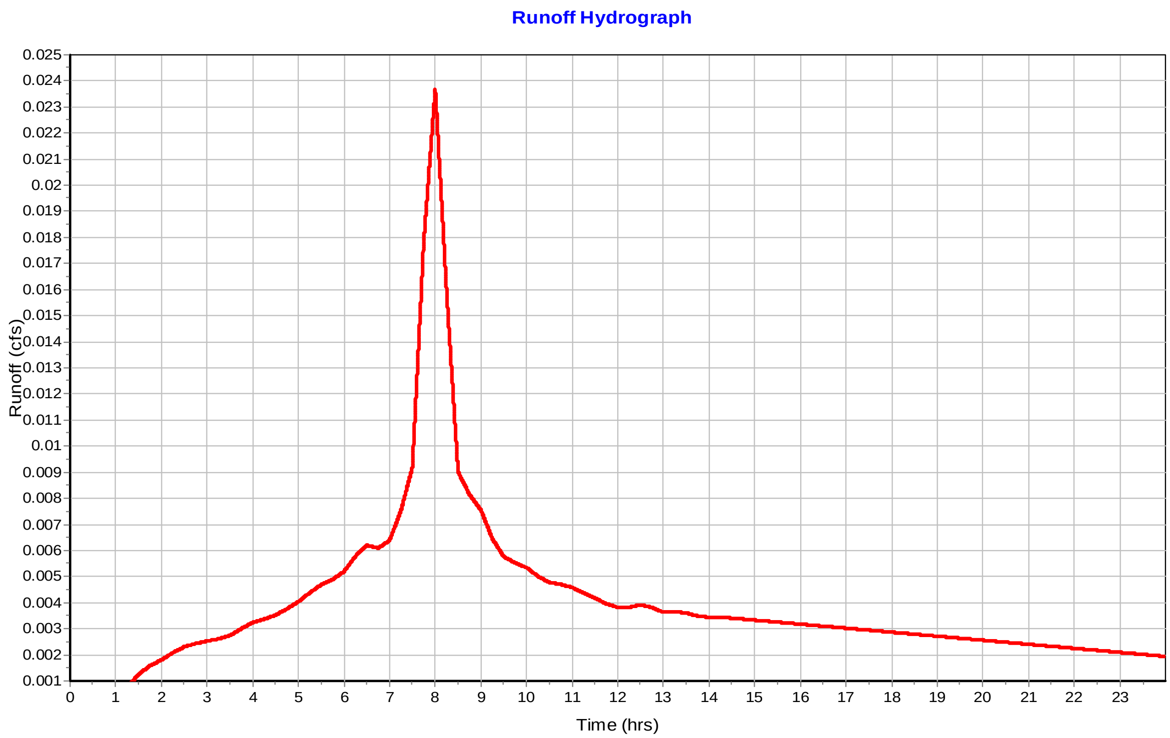
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.03		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.02
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG CLUB_EAST





Subbasin : BLDG CLUB_WEST

Input Data

Area (ac)	0.03
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

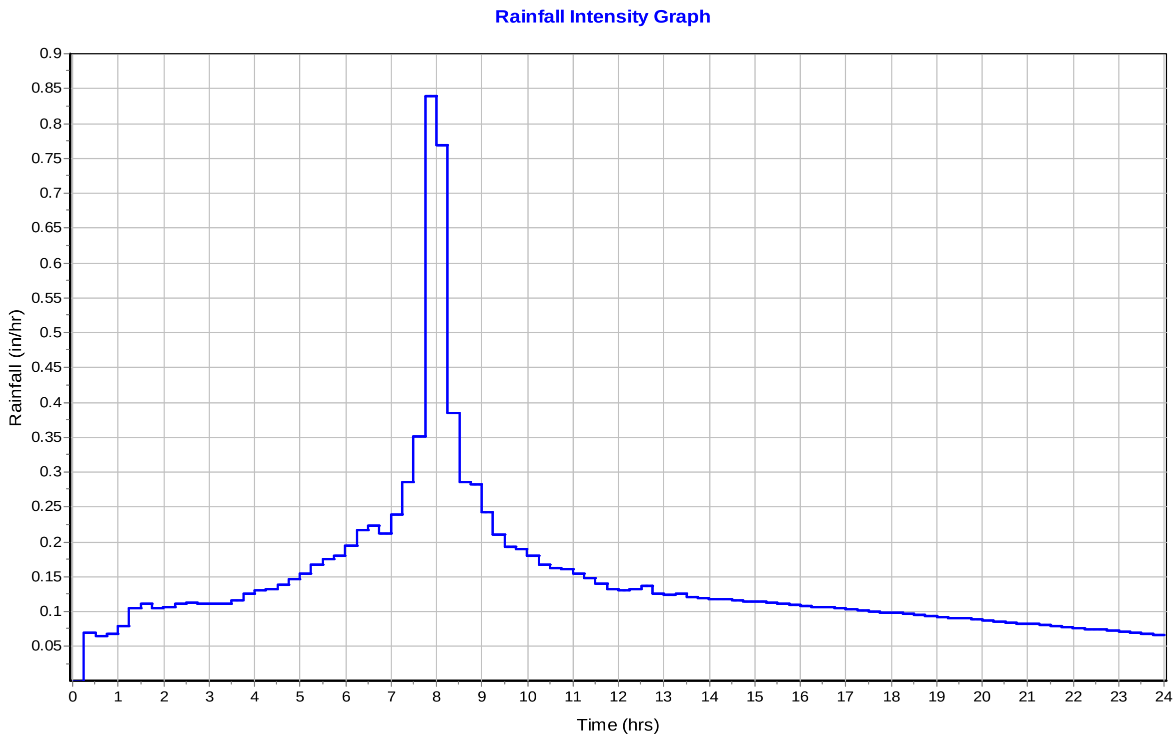
Composite Curve Number

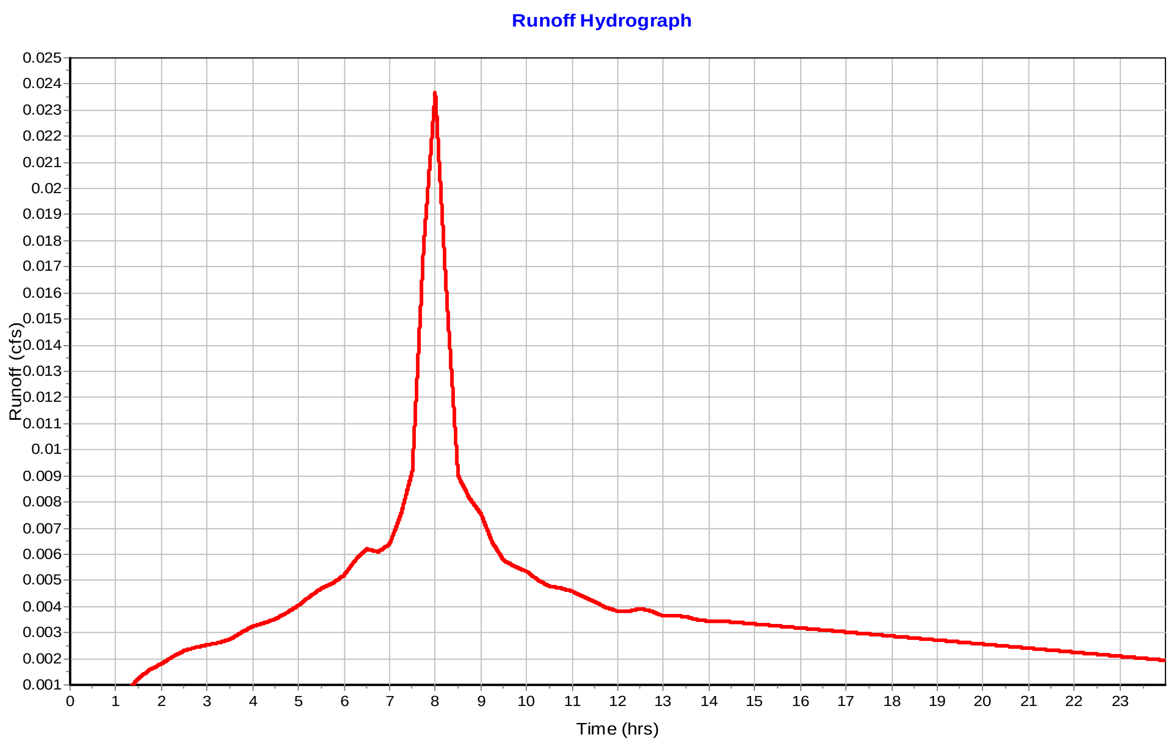
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.03		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.02
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG CLUB_WEST





Subbasin : BLDG D_NE

Input Data

Area (ac)	0.06
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

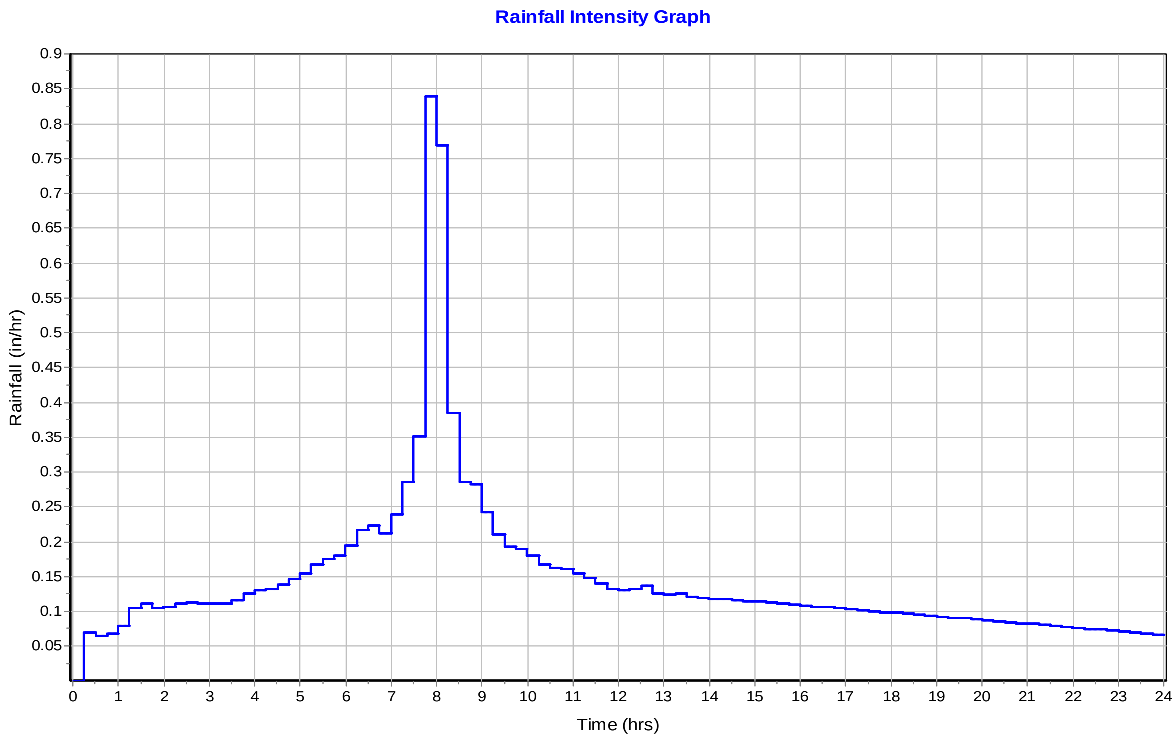
Composite Curve Number

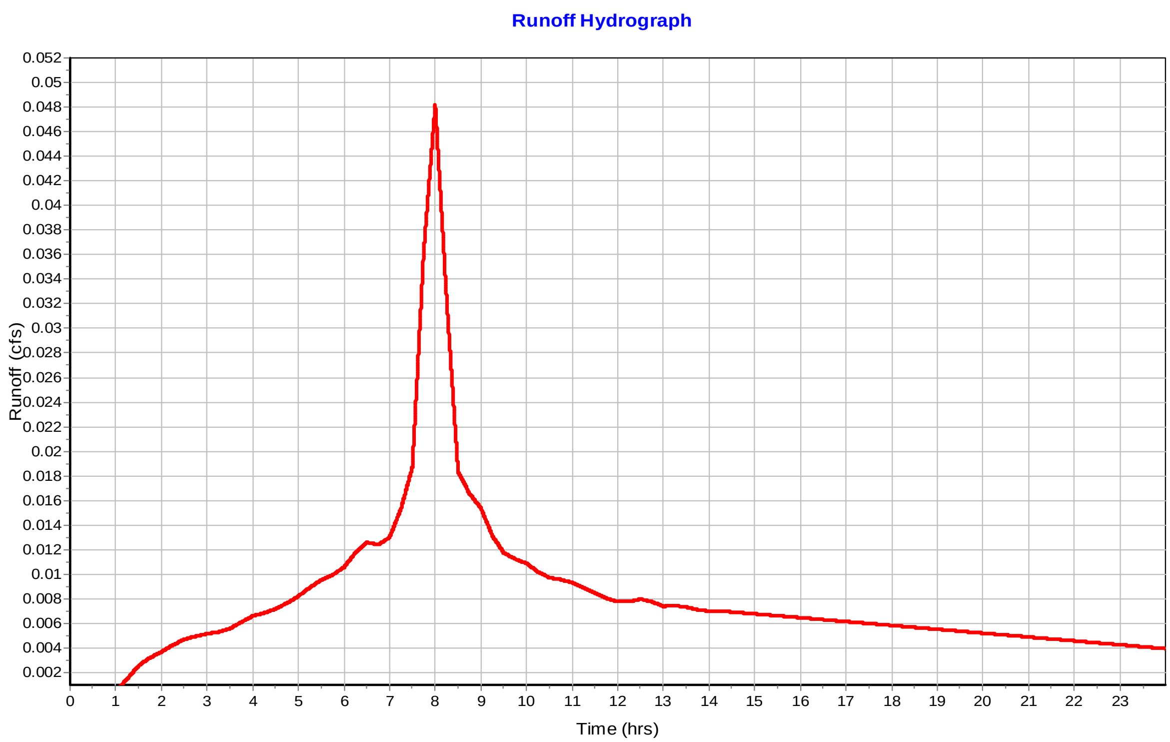
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.06		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.05
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG D_NE





Subbasin : BLDG D_NW

Input Data

Area (ac)	0.06
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

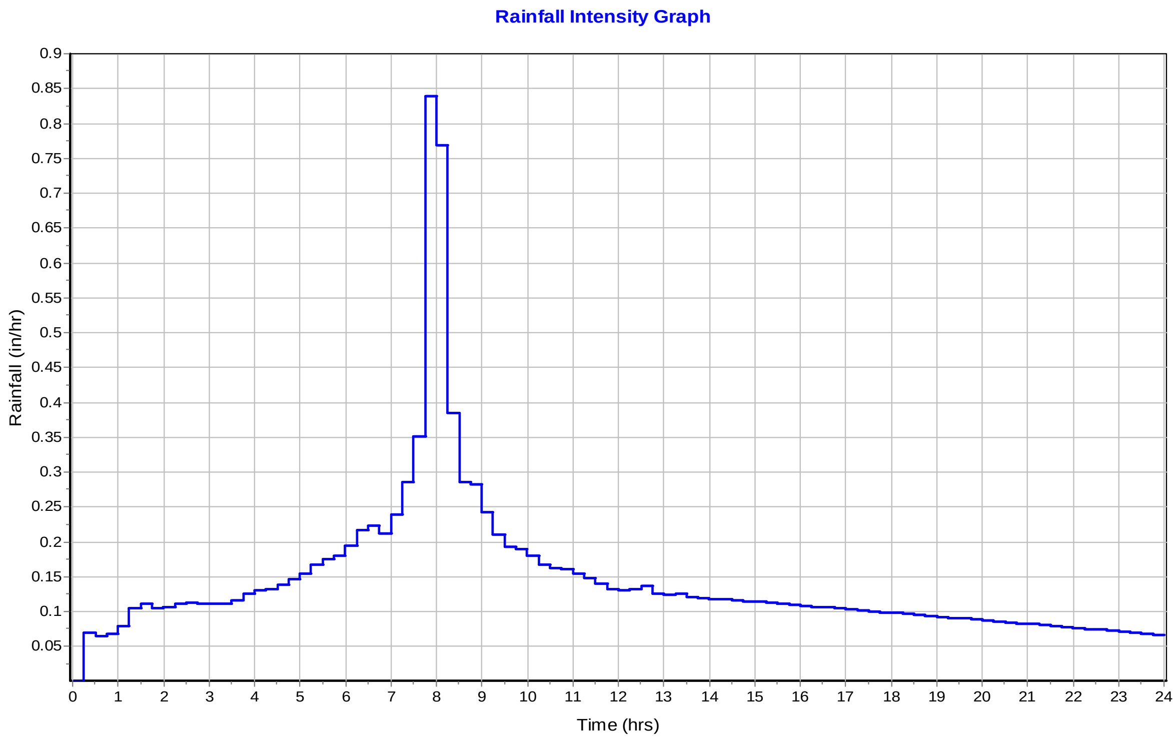
Composite Curve Number

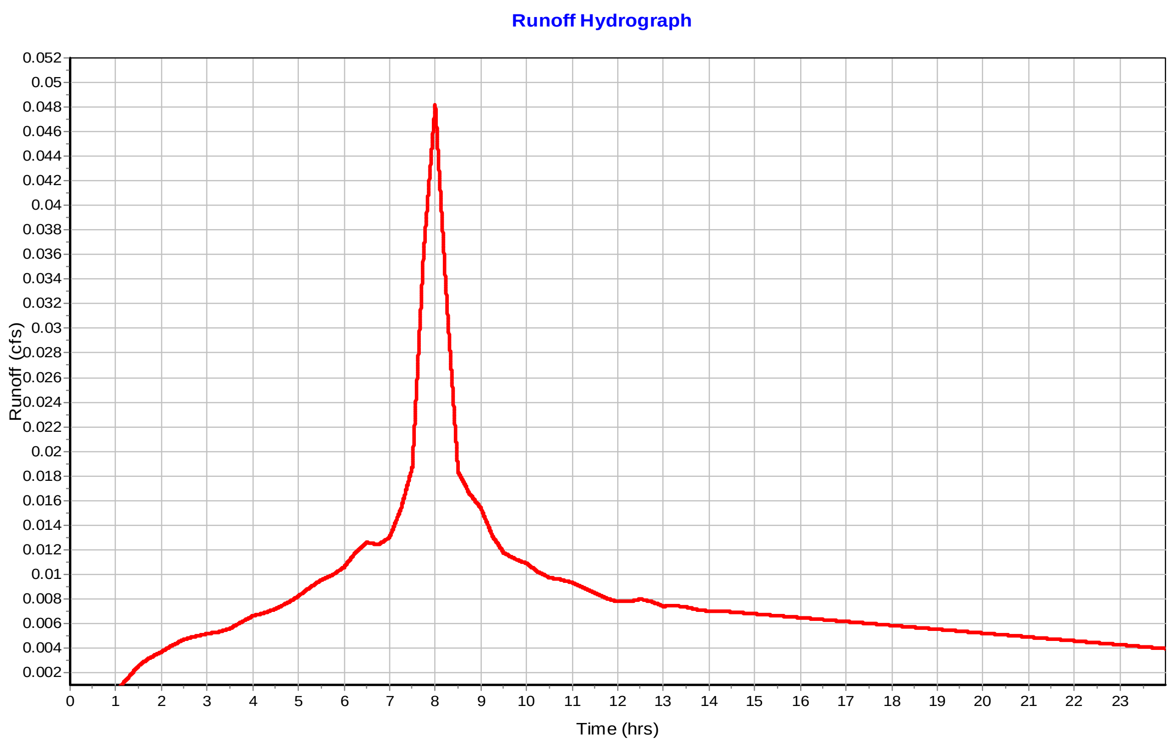
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.06		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.05
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG D_NW





Subbasin : BLDG D_SOUTH

Input Data

Area (ac)	0.12
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

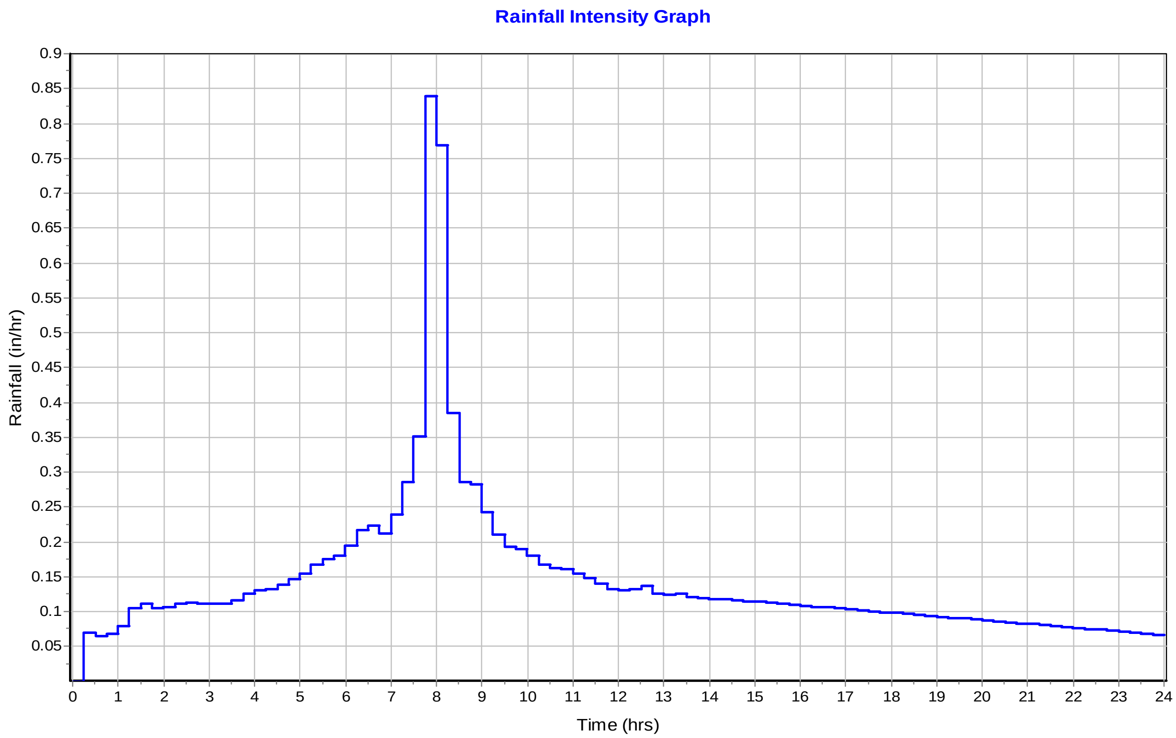
Composite Curve Number

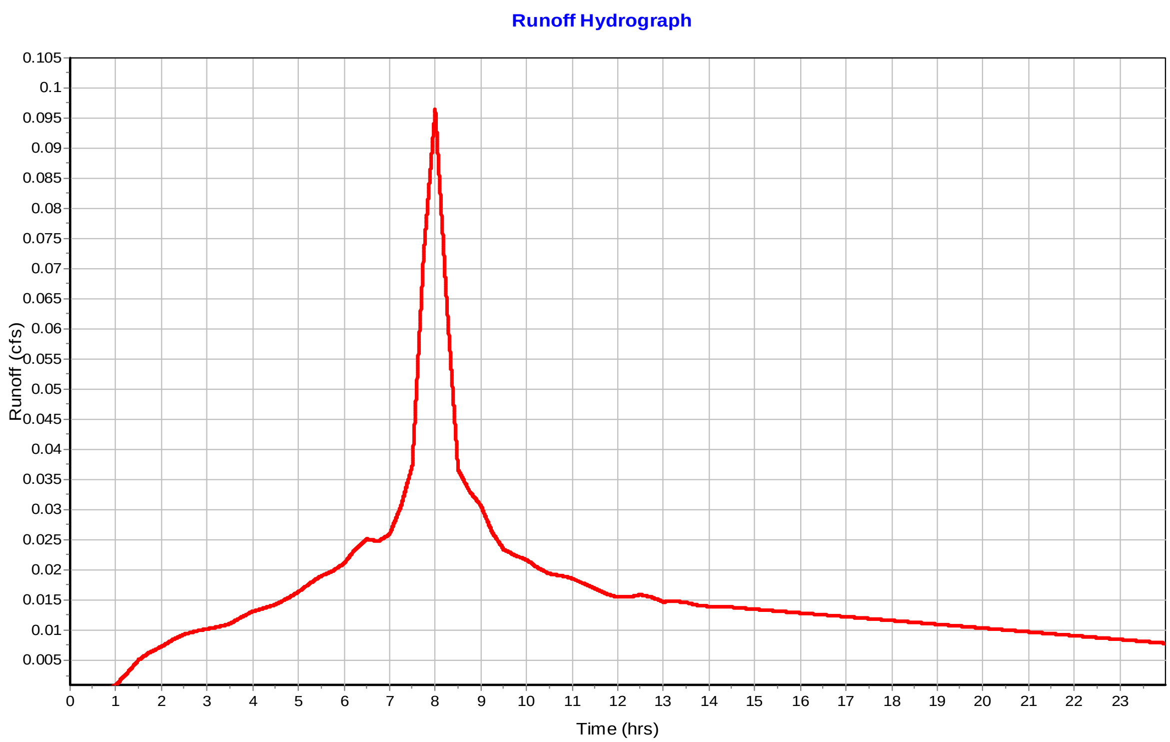
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.12		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.1
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG D_SOUTH





Subbasin : BLDG E_EAST

Input Data

Area (ac)	0.08
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

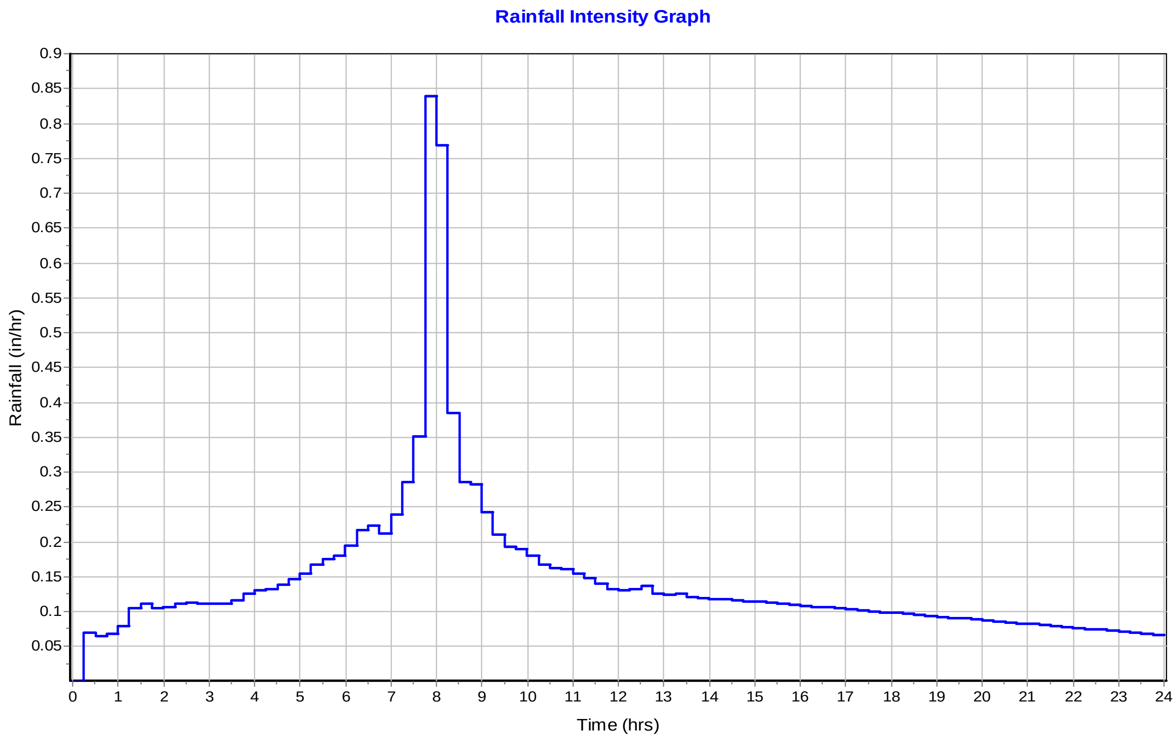
Composite Curve Number

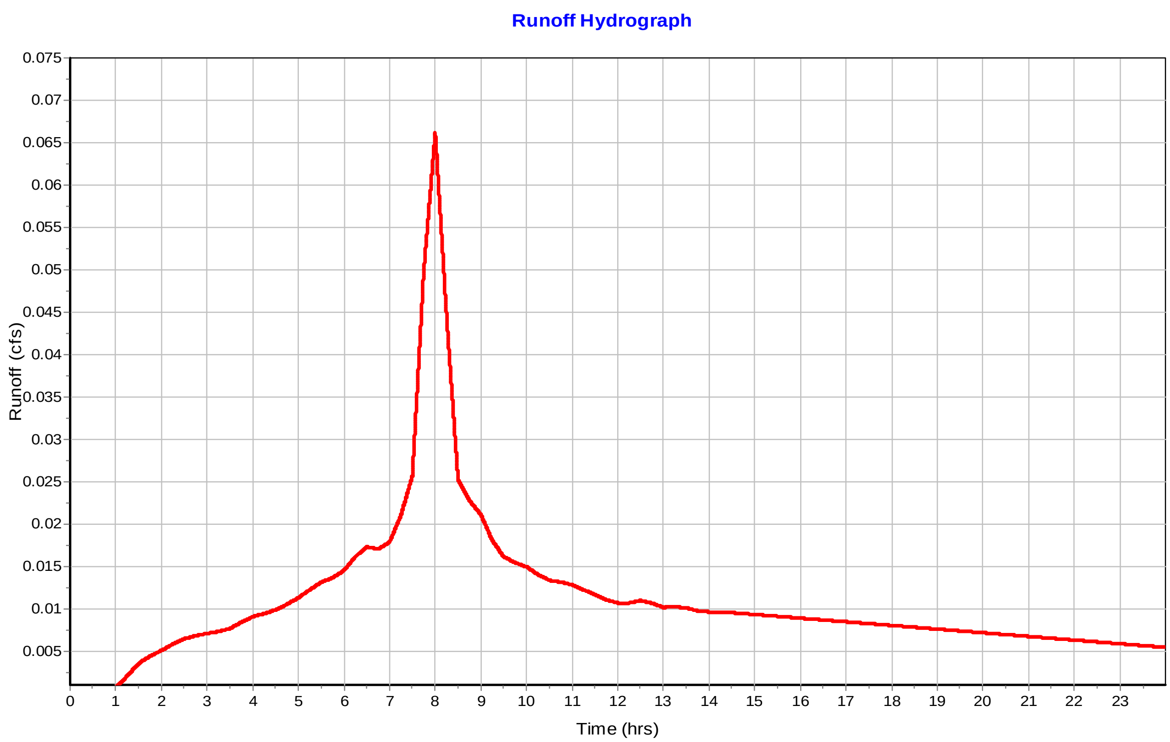
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.08		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.07
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG E_EAST





Subbasin : BLDG E_WEST

Input Data

Area (ac)	0.16
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

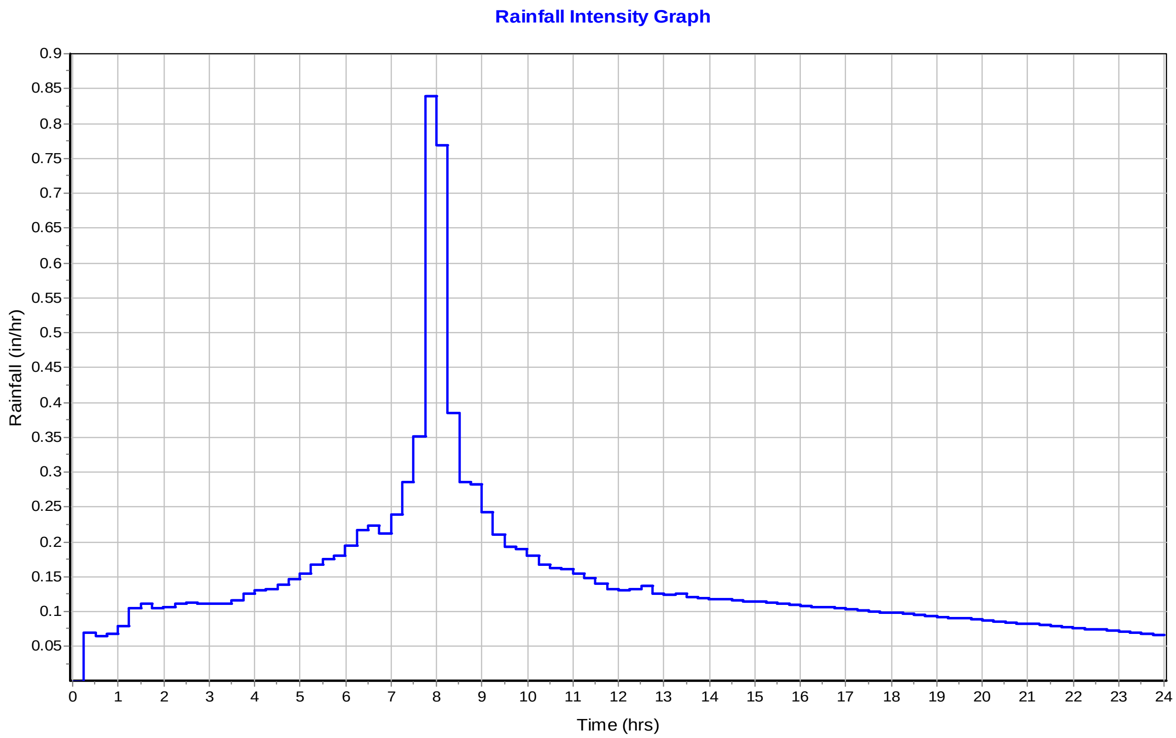
Composite Curve Number

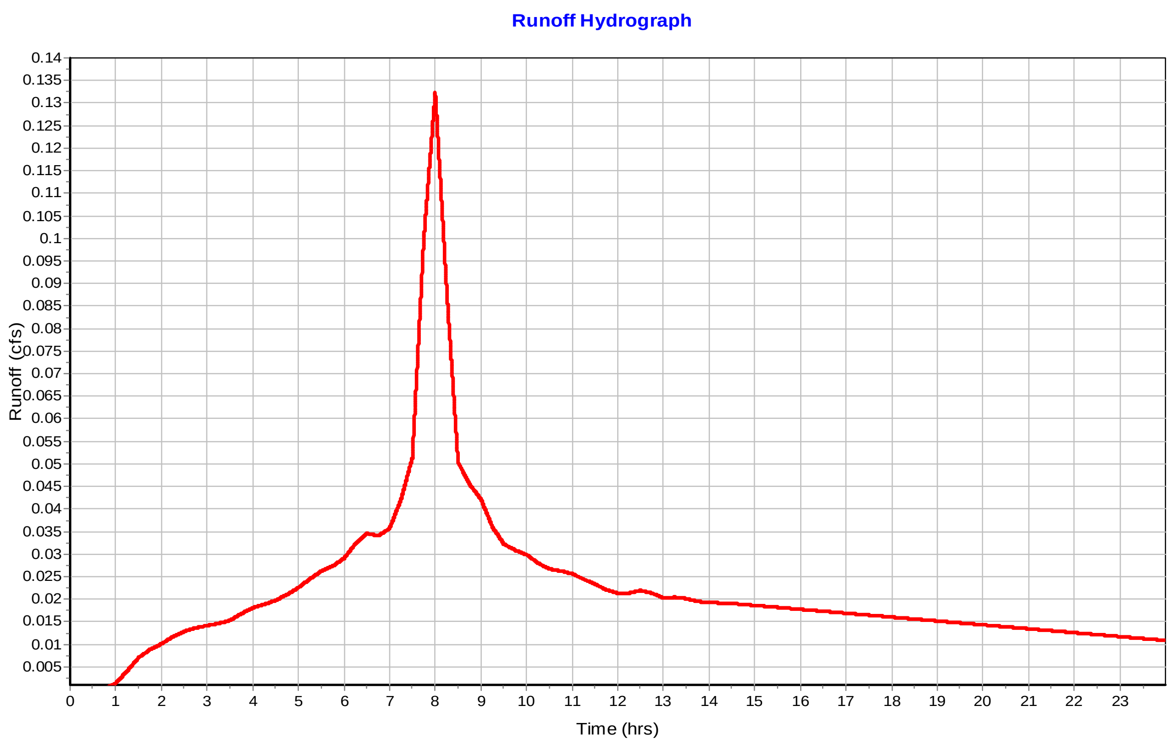
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.16		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.13
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG E_WEST





Subbasin : BLDG F_EAST

Input Data

Area (ac)	0.1
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

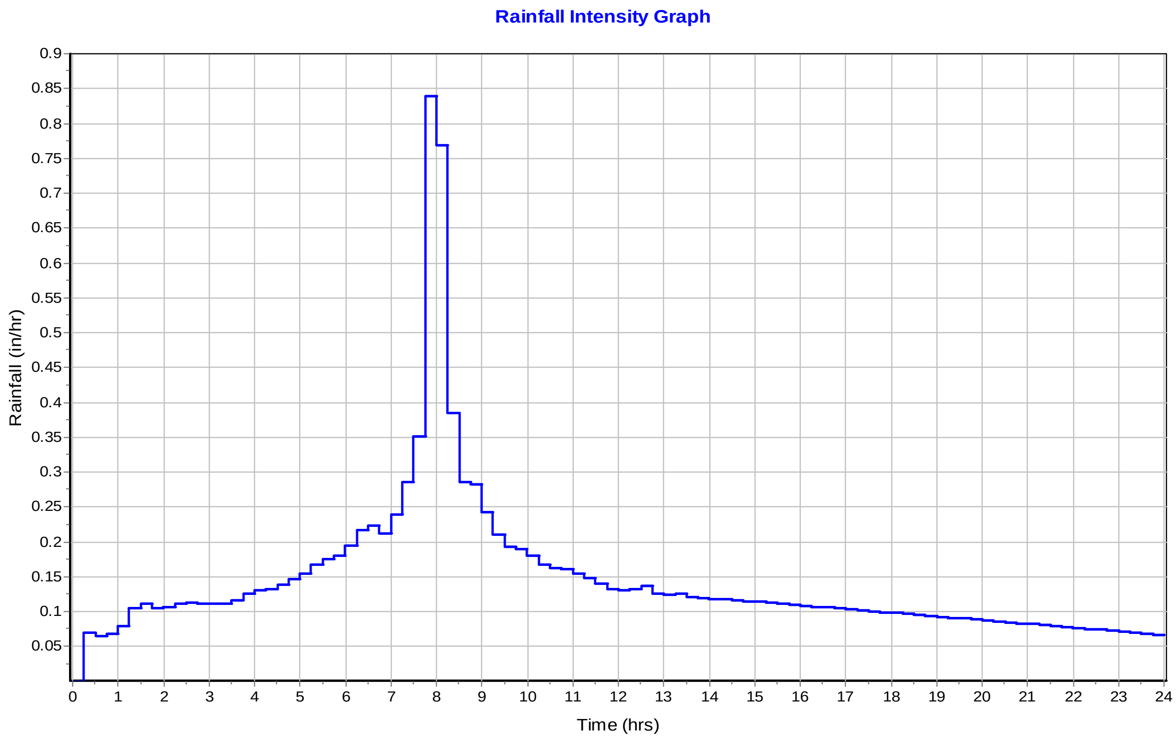
Composite Curve Number

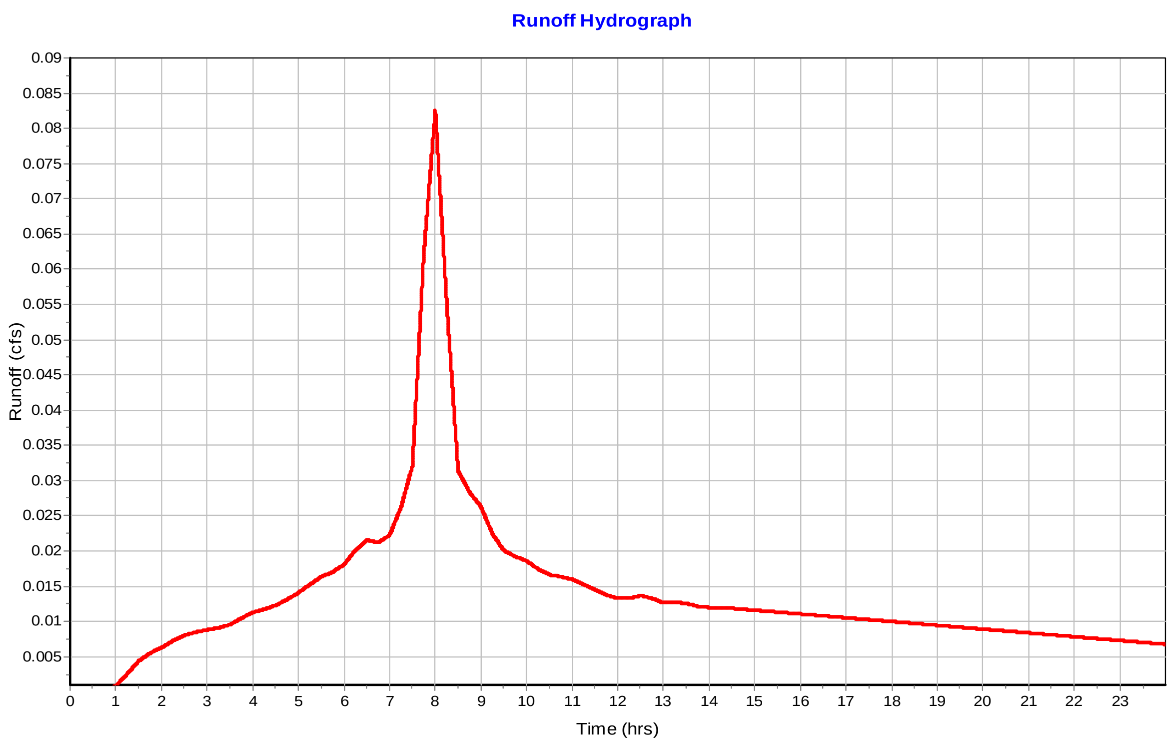
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.08
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG F_EAST





Subbasin : BLDG F_WEST

Input Data

Area (ac)	0.1
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

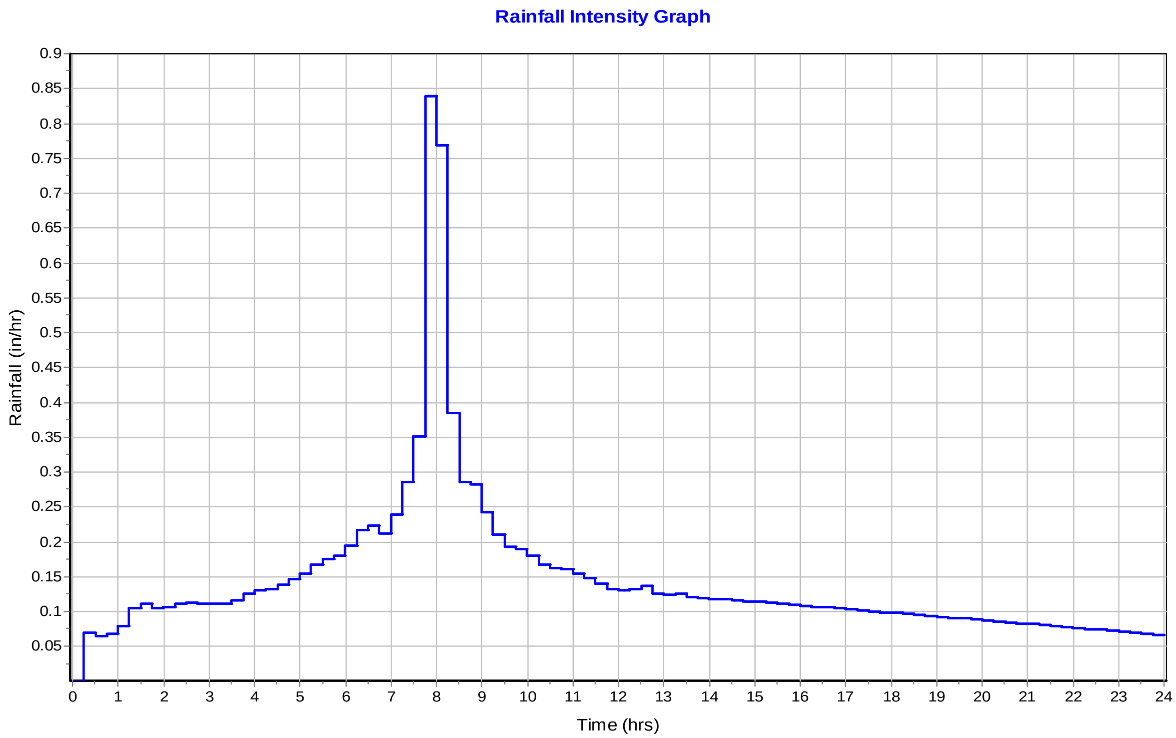
Composite Curve Number

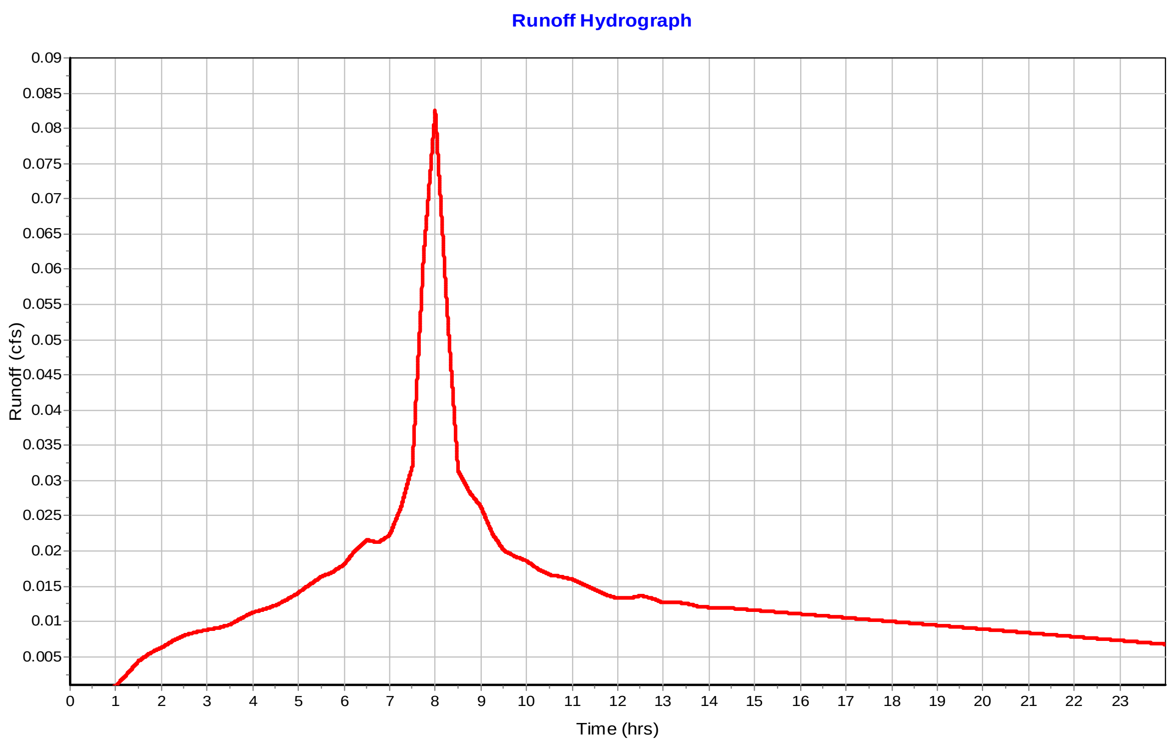
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.1		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.08
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG F_WEST





Subbasin : BLDG G_EAST

Input Data

Area (ac)	0.08
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

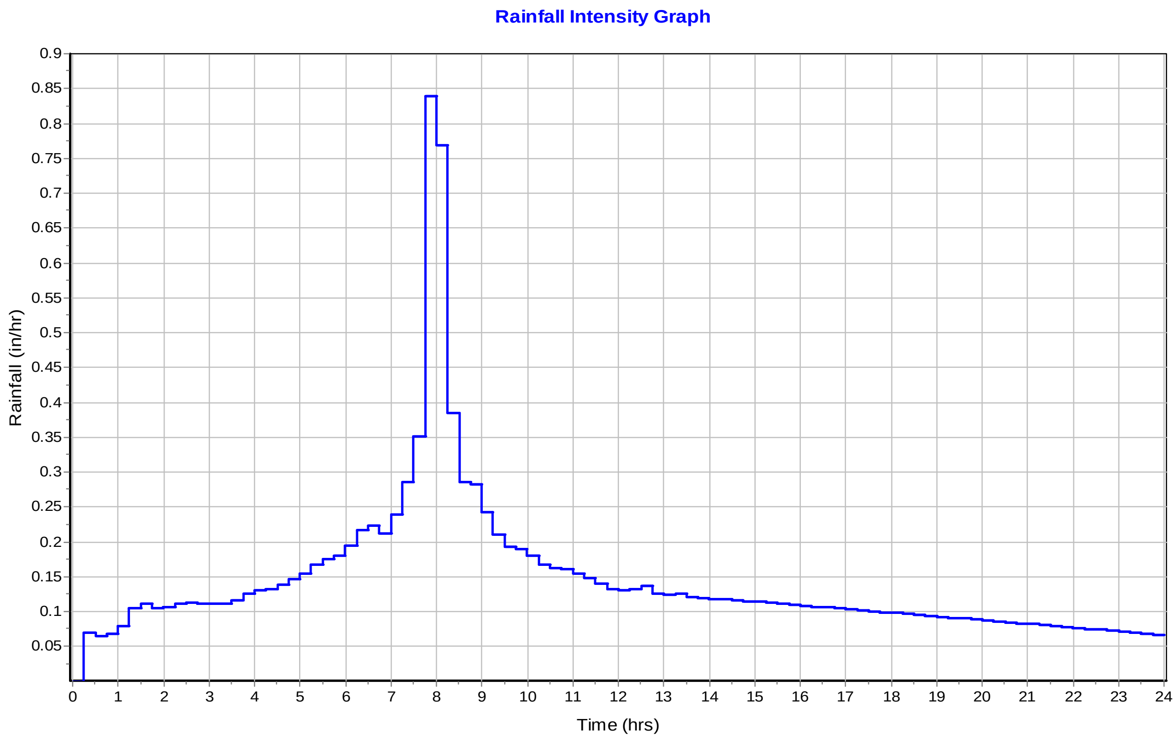
Composite Curve Number

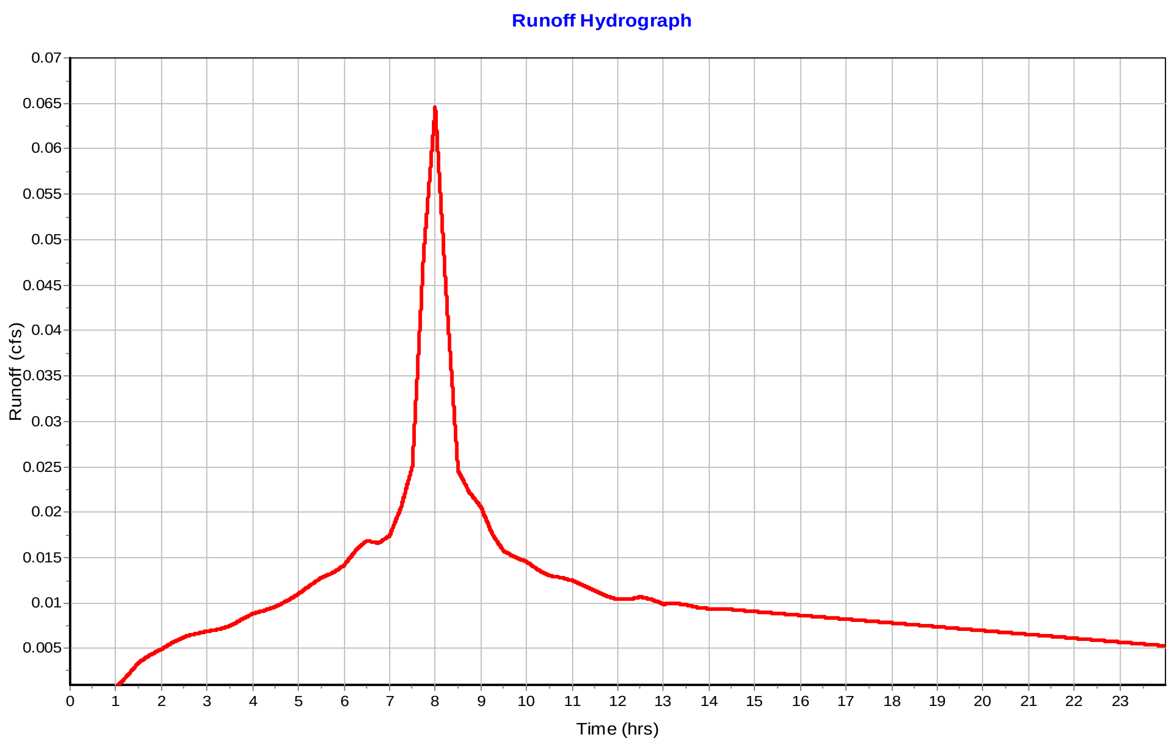
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.08		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.07
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG G_EAST





Subbasin : BLDG G_WEST

Input Data

Area (ac)	0.1
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

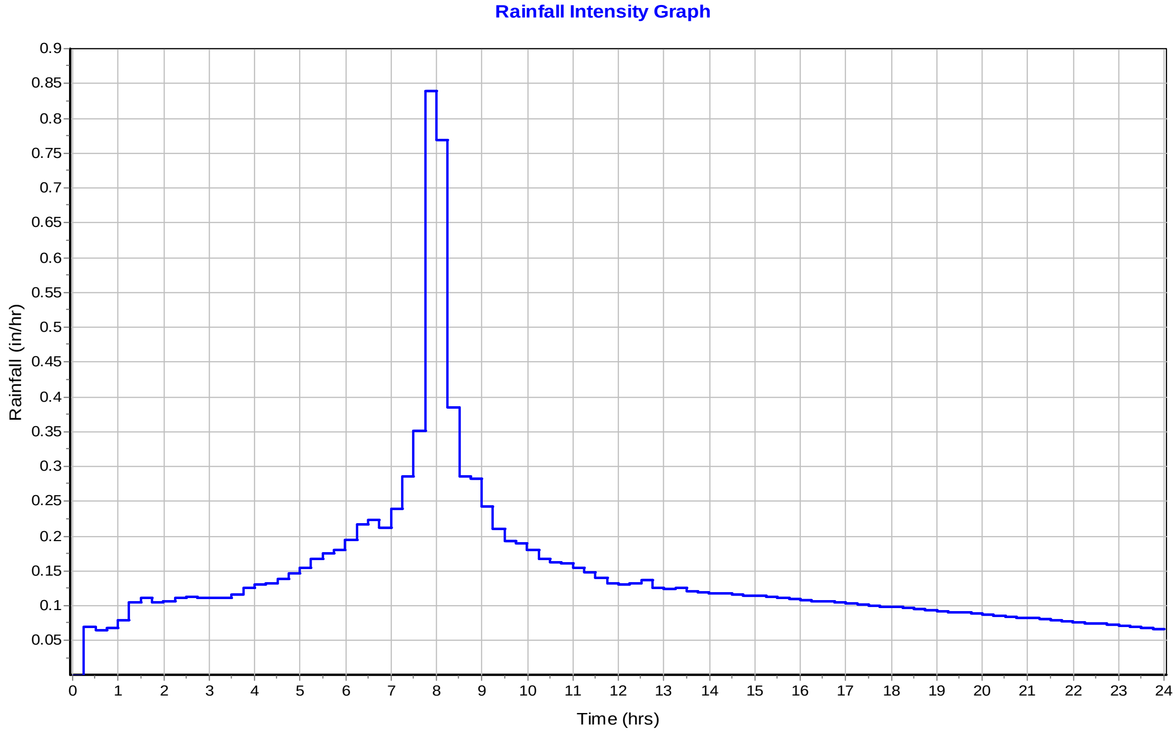
Composite Curve Number

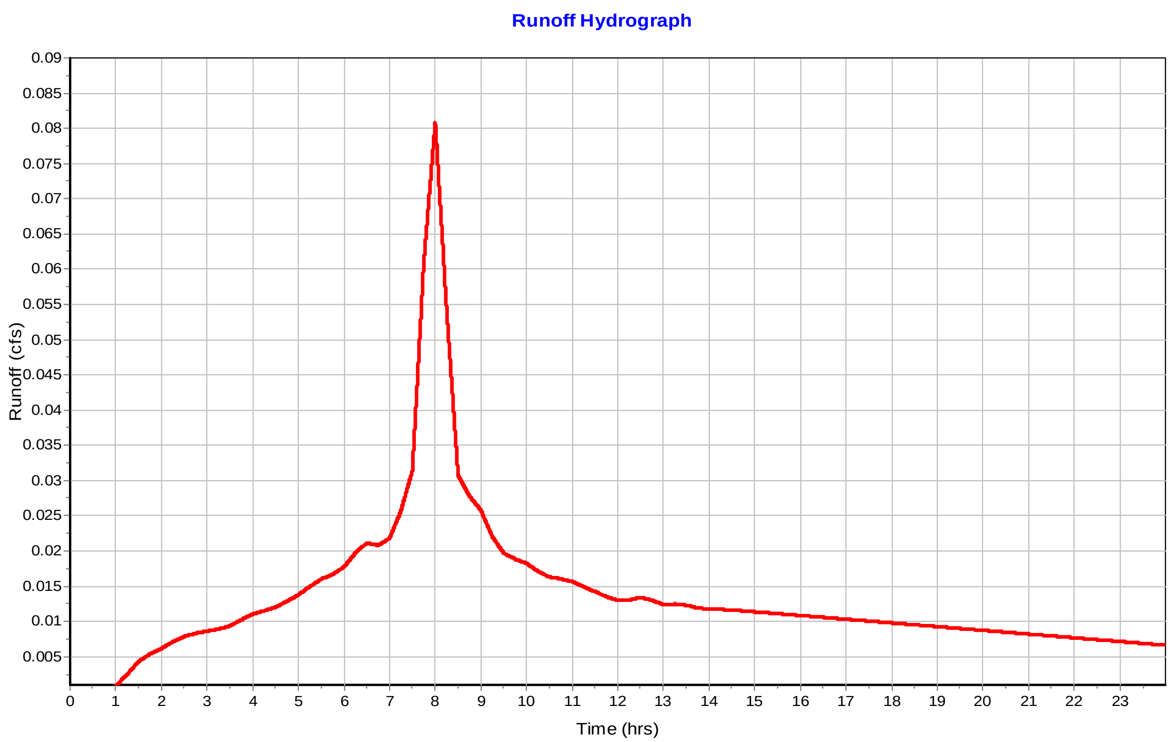
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.08
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG G_WEST





Subbasin : BLDG H_EAST

Input Data

Area (ac)	0.1
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

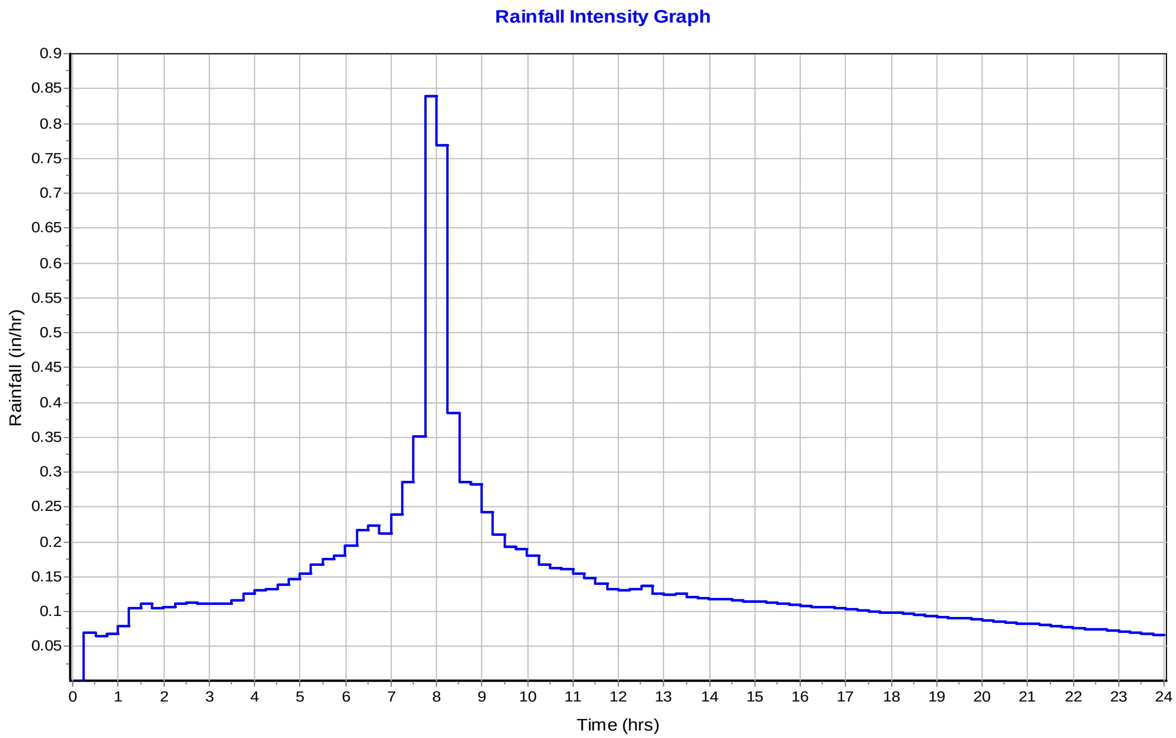
Composite Curve Number

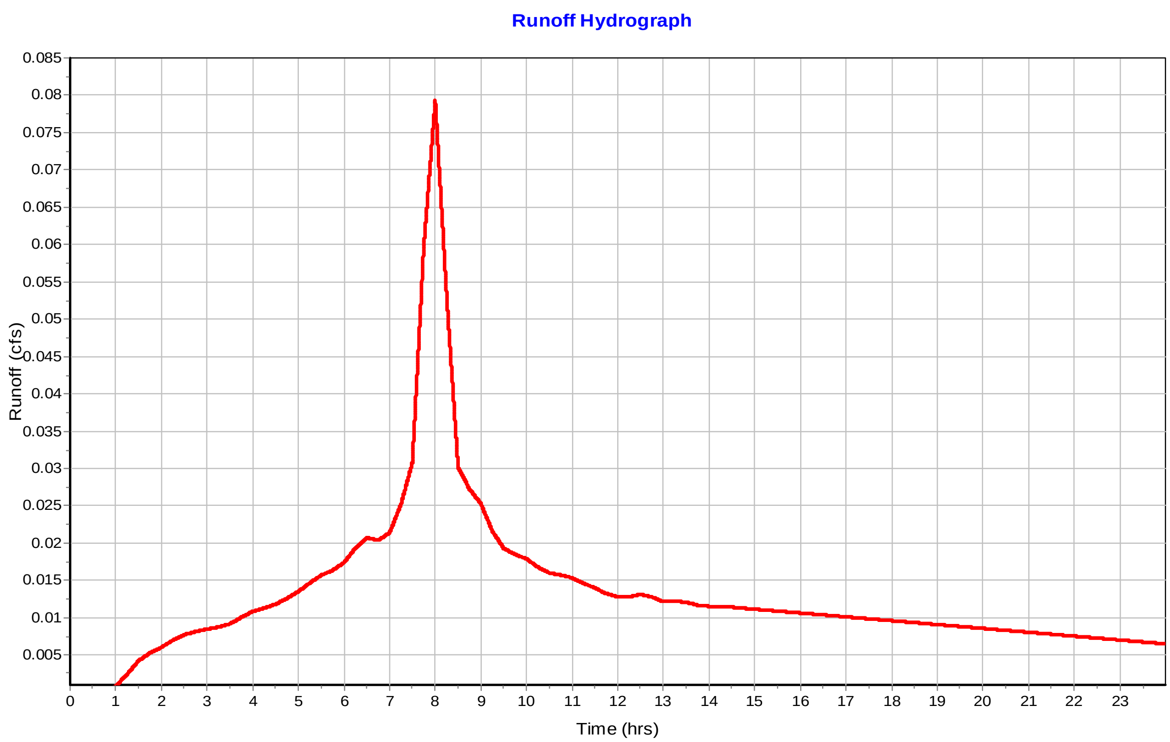
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.08
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG H_EAST





Subbasin : BLDG H_WEST

Input Data

Area (ac)	0.08
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

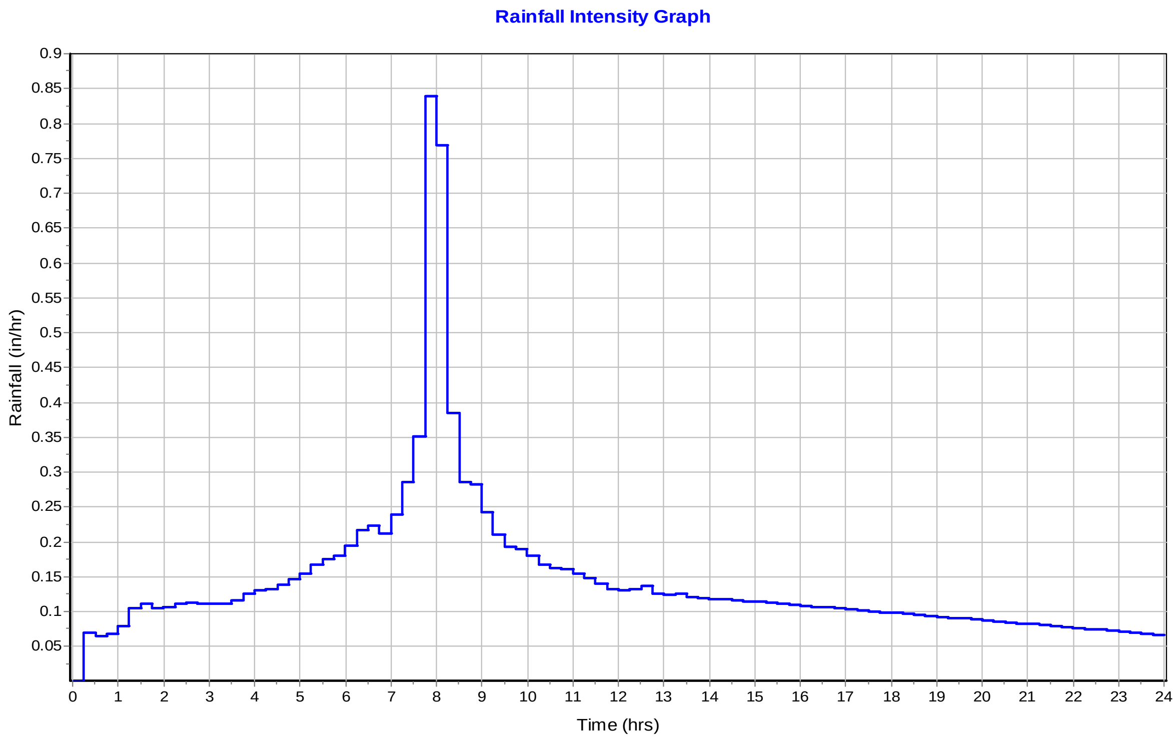
Composite Curve Number

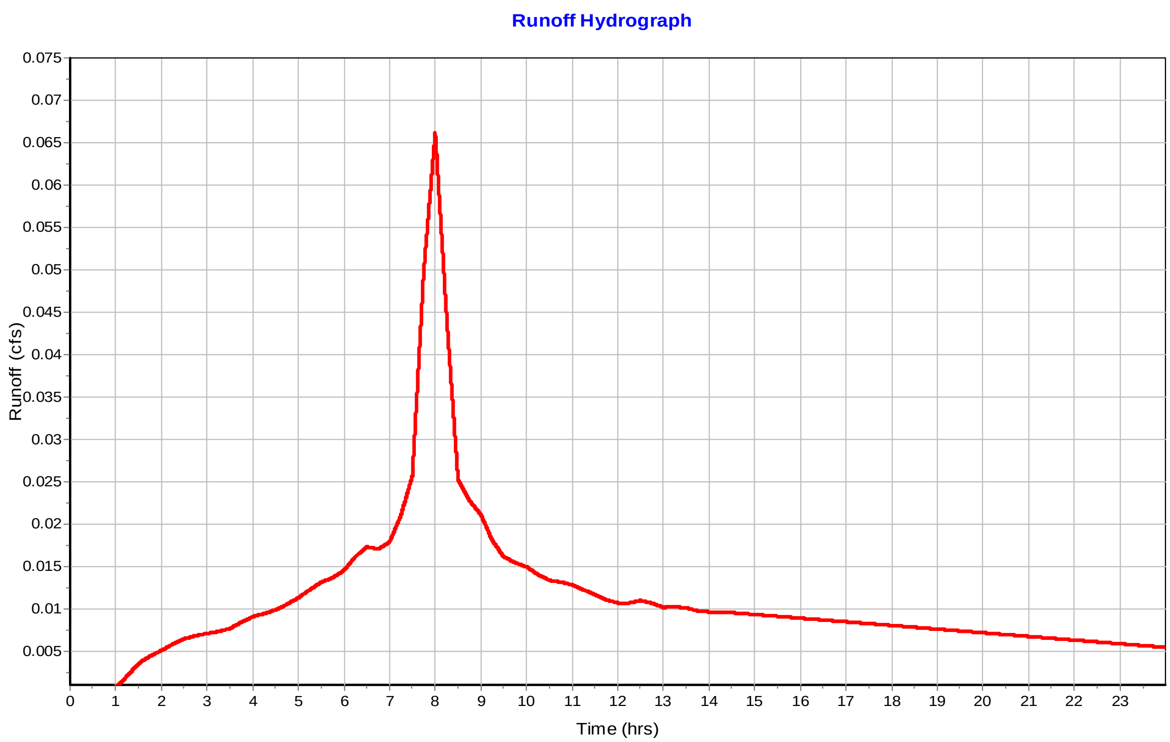
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.08		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.07
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG H_WEST





Subbasin : BLDG T.I. EAST

Input Data

Area (ac)	0.05
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

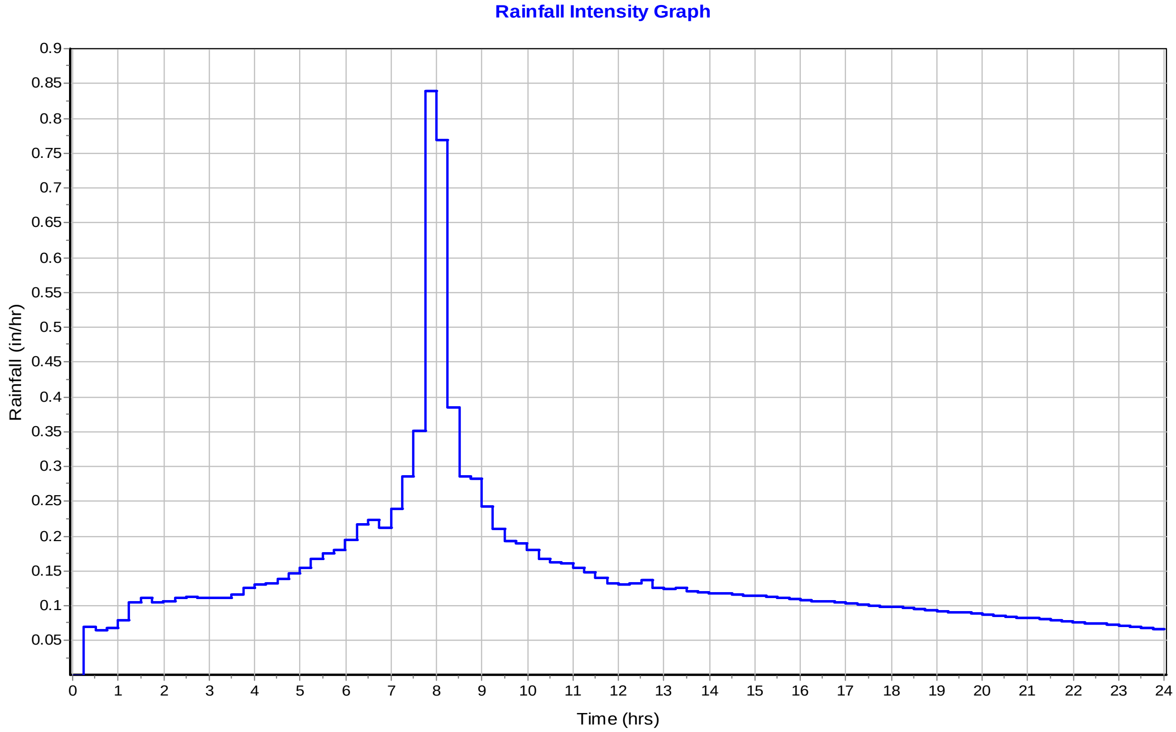
Composite Curve Number

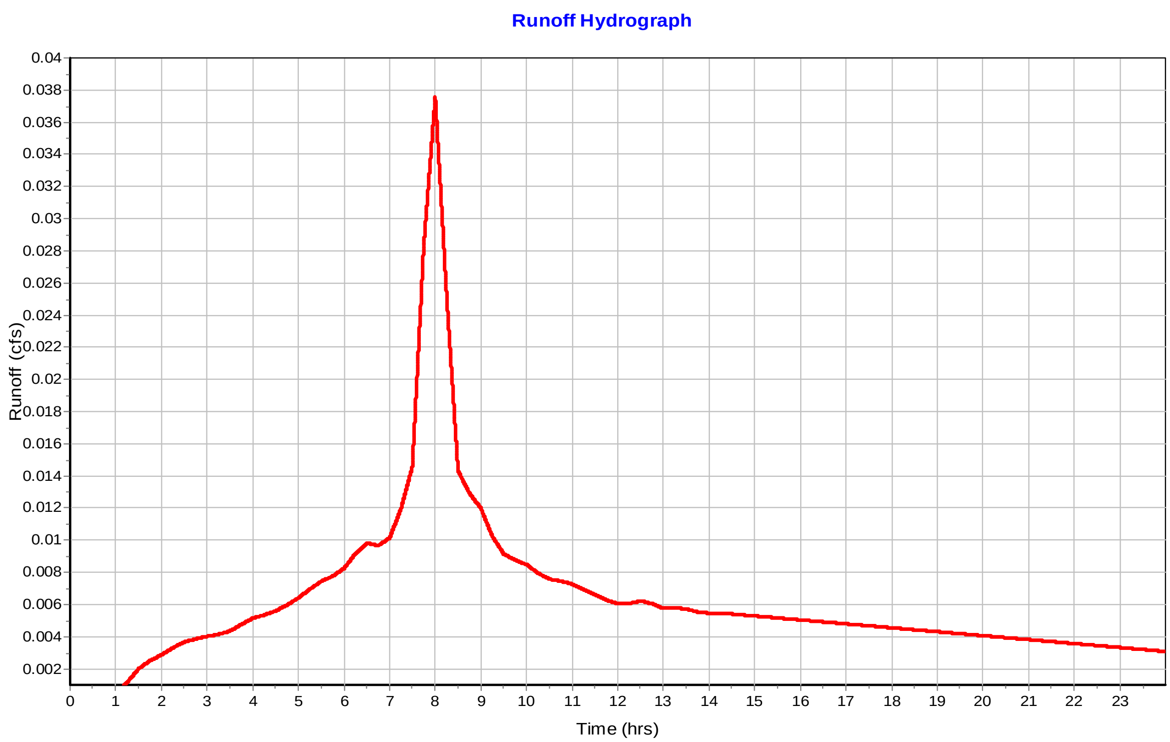
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.05		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.04
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG T.I. EAST





Subbasin : BLDG T.I. NE

Input Data

Area (ac)	0.02
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

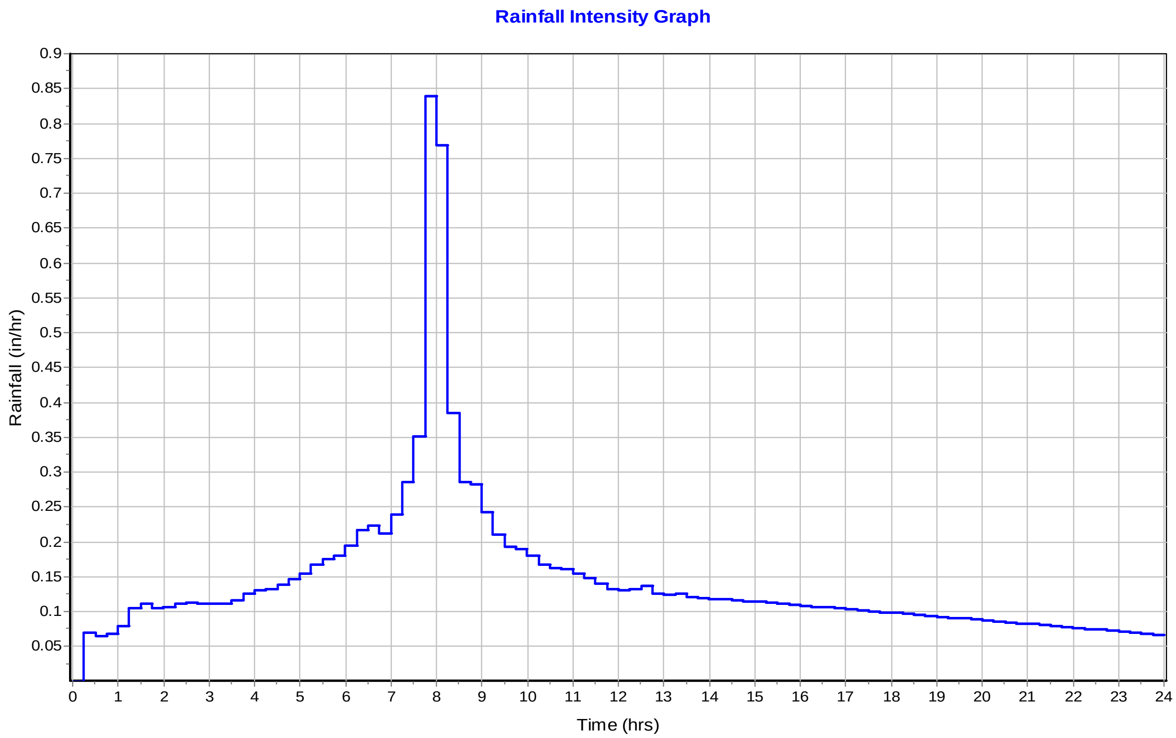
Composite Curve Number

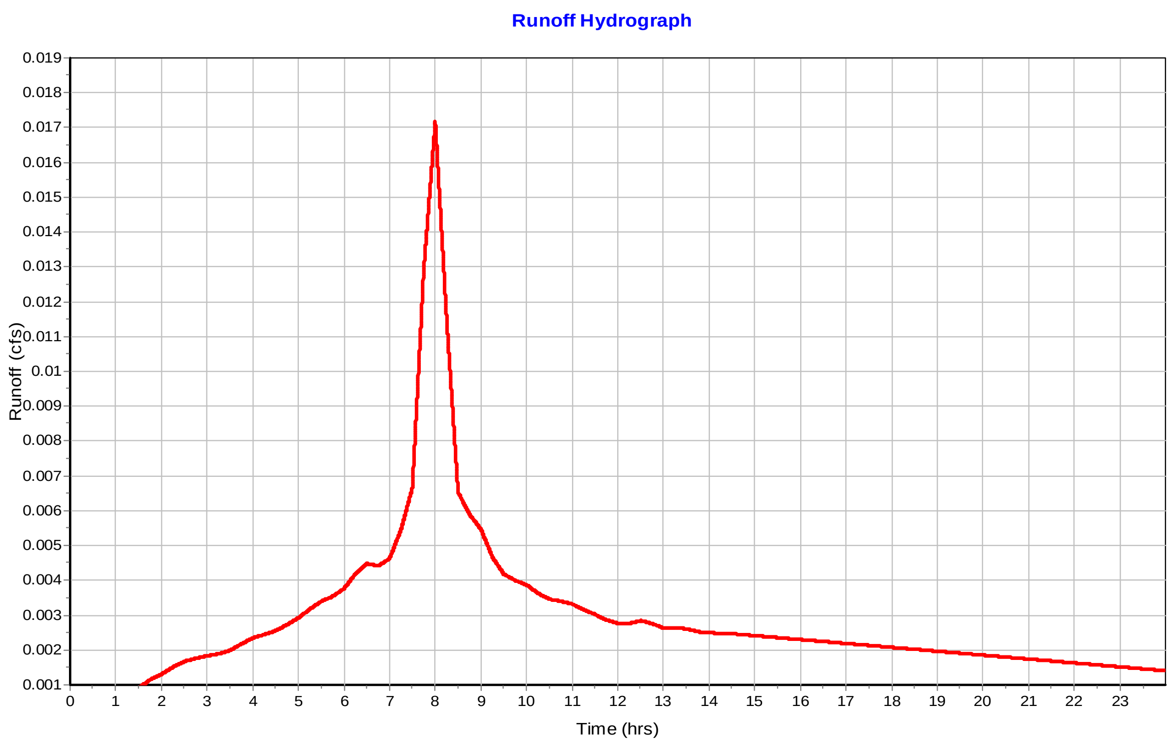
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.02		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.02
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG T.I. NE





Subbasin : BLDG T.I. NW

Input Data

Area (ac)	0.04
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

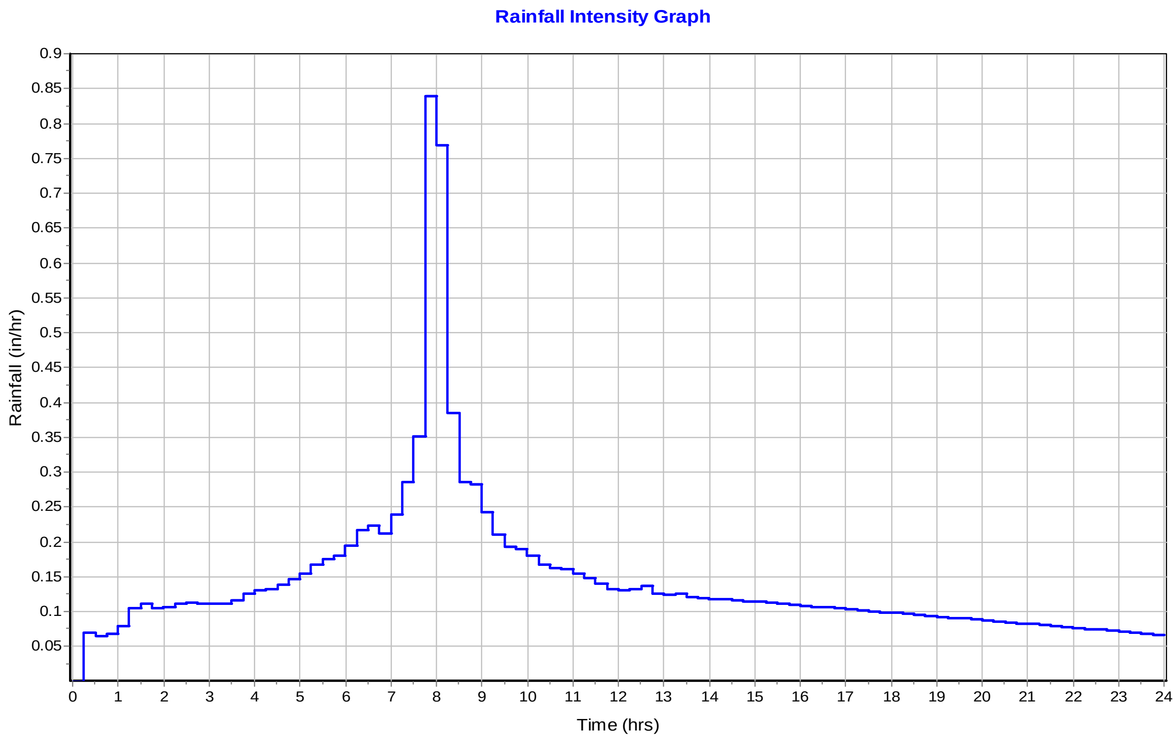
Composite Curve Number

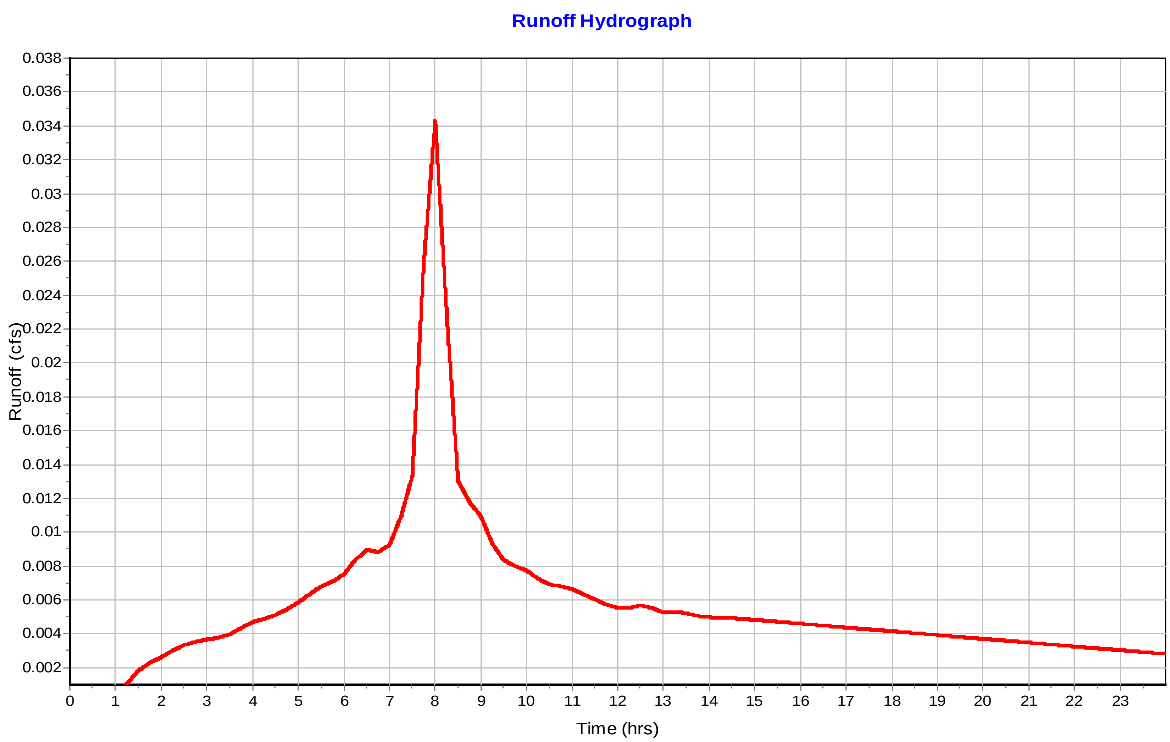
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.04		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.03
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG T.I. NW





Subbasin : BLDG T.I. SE

Input Data

Area (ac)	0.03
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

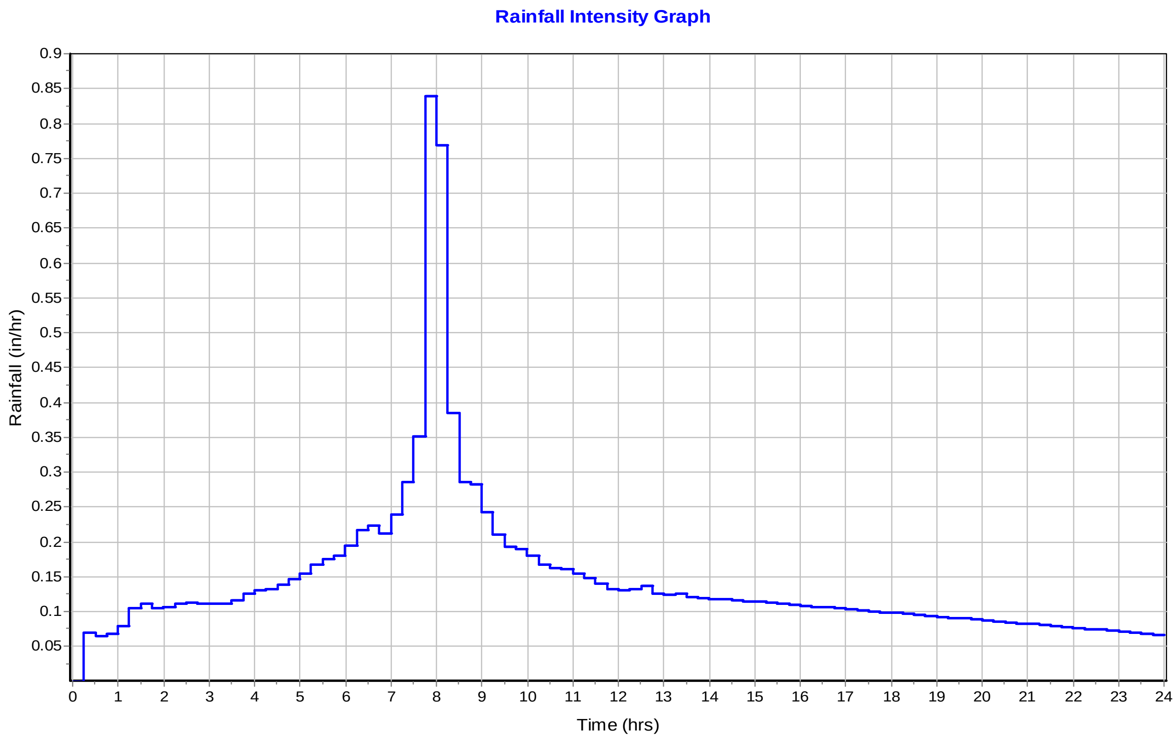
Composite Curve Number

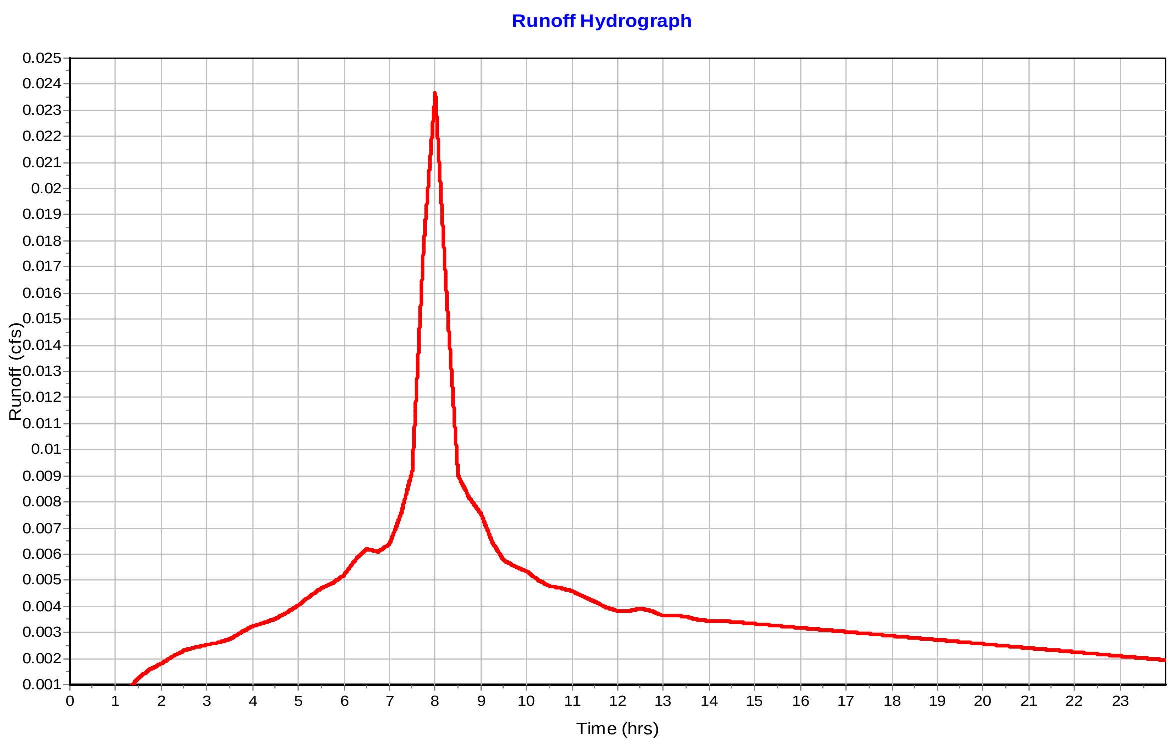
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.03		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.02
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG T.I. SE





Subbasin : BLDG T.I. SW

Input Data

Area (ac)	0.04
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

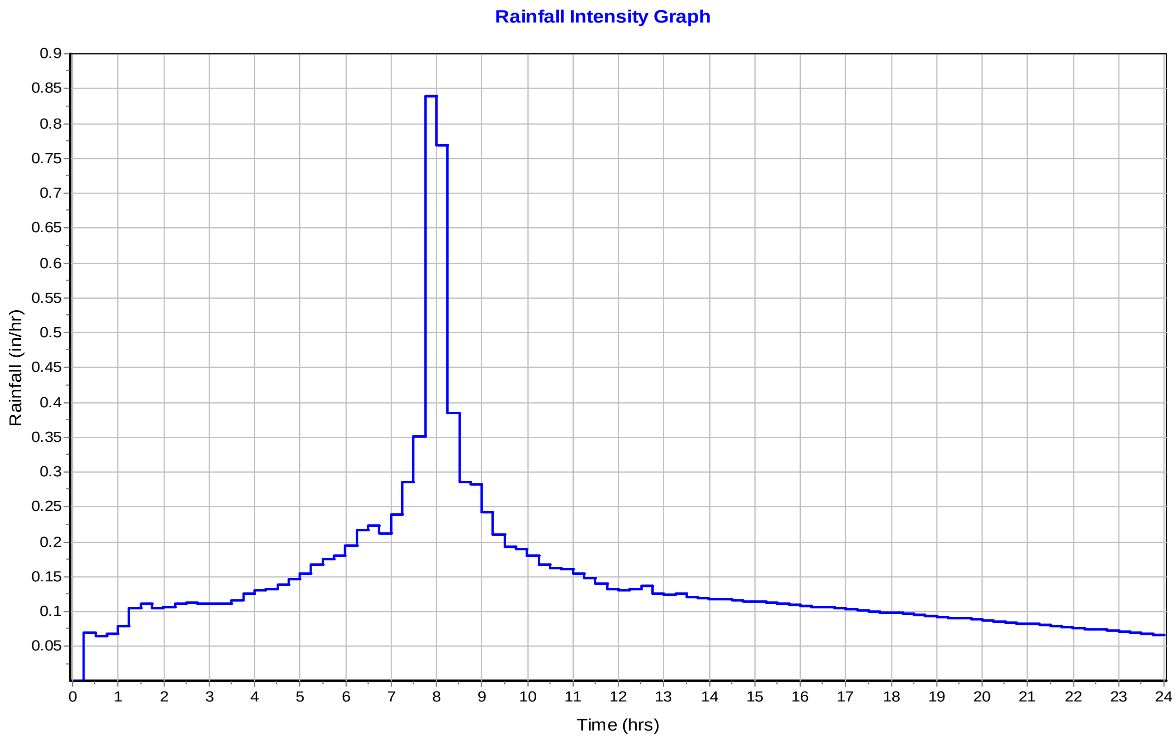
Composite Curve Number

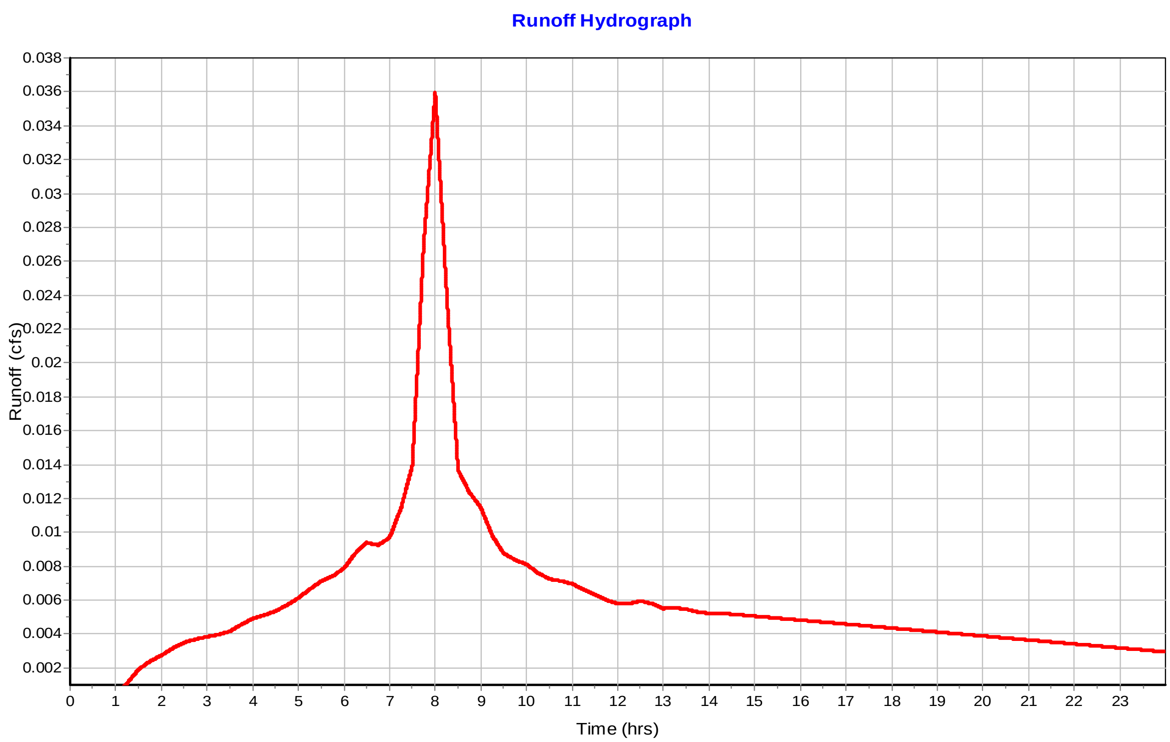
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.04		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.04
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : BLDG T.I. SW





Subbasin : BLDG T.I. WEST

Input Data

Area (ac) 0.06
Impervious Area (%) 100
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

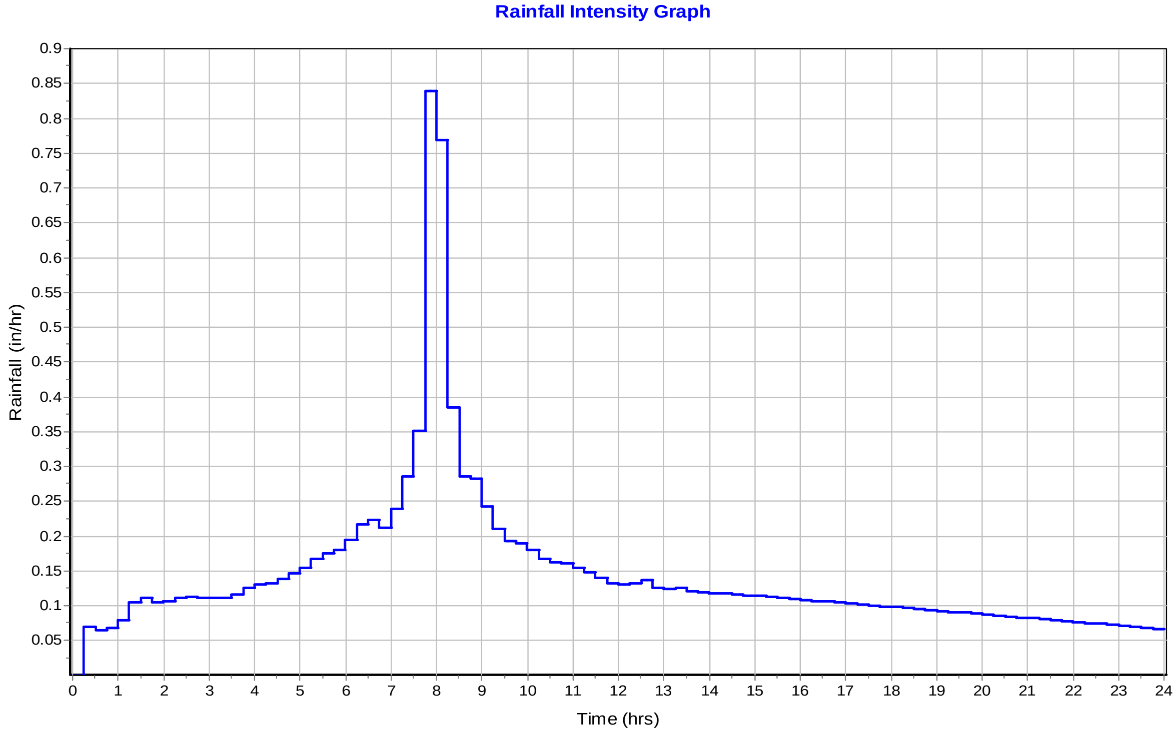
Composite Curve Number

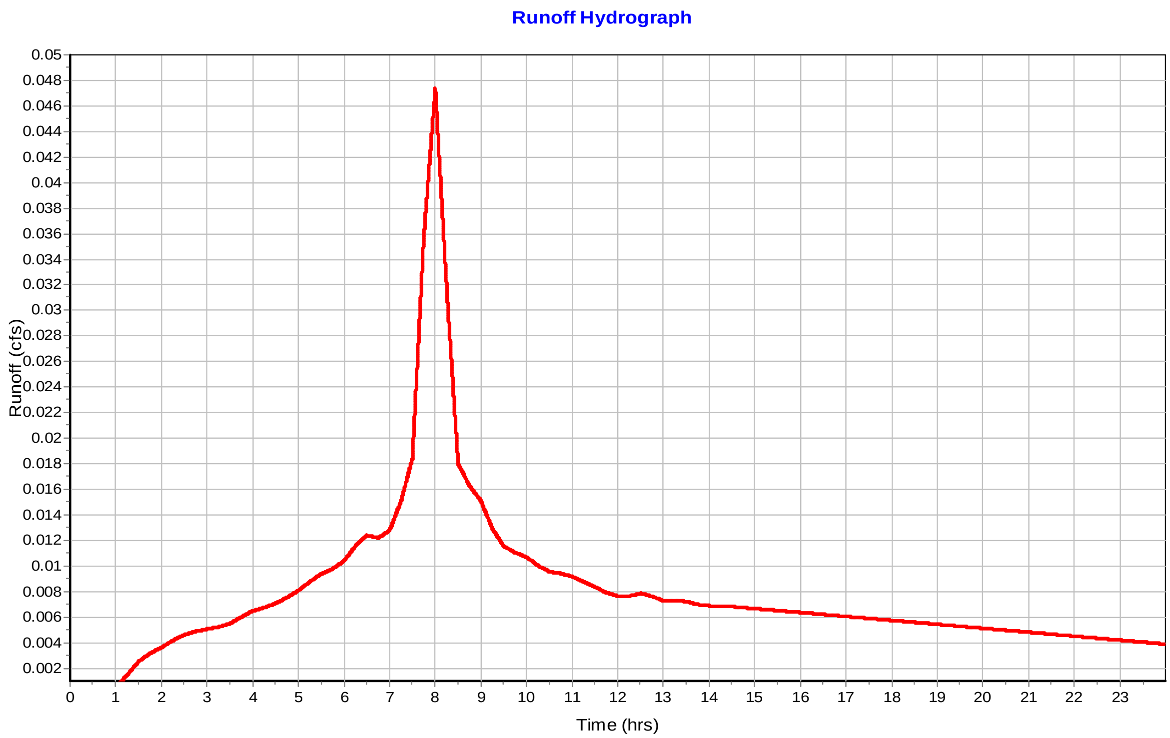
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.06		98

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.24
Peak Runoff (cfs) 0.05
Weighted Curve Number 98
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : BLDG T.I. WEST





Subbasin : SDCB 02

Input Data

Area (ac)	0.22
Impervious Area (%)	98
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

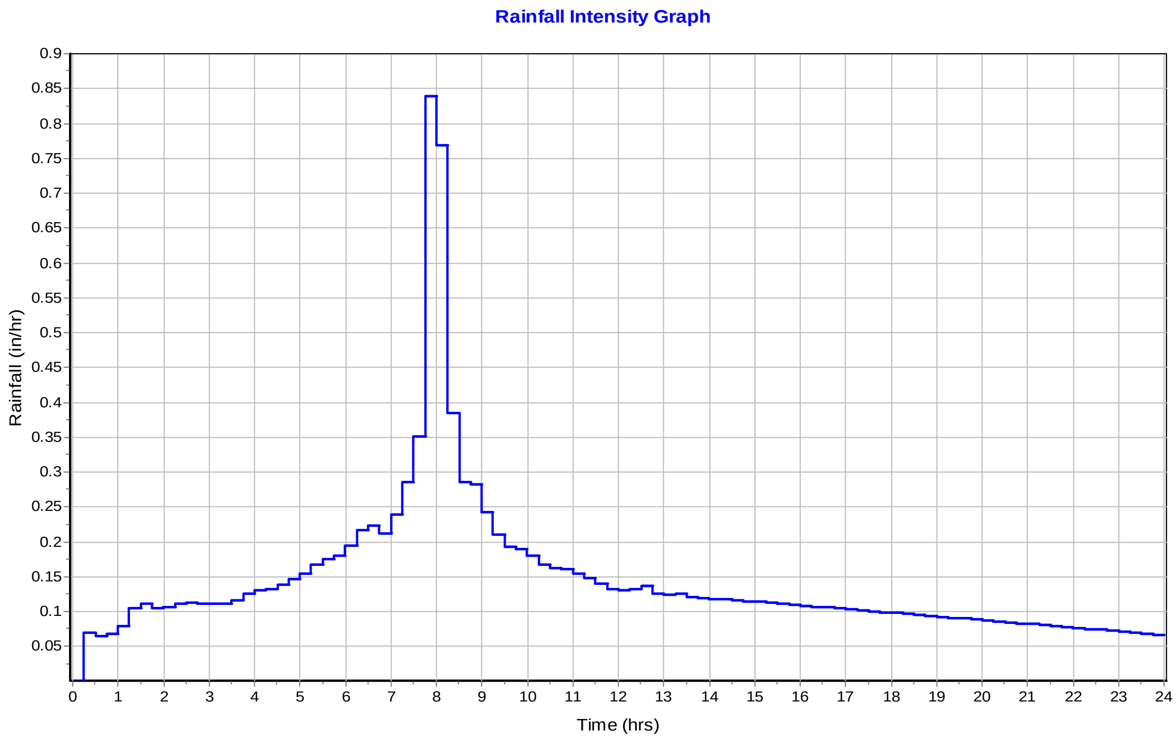
Composite Curve Number

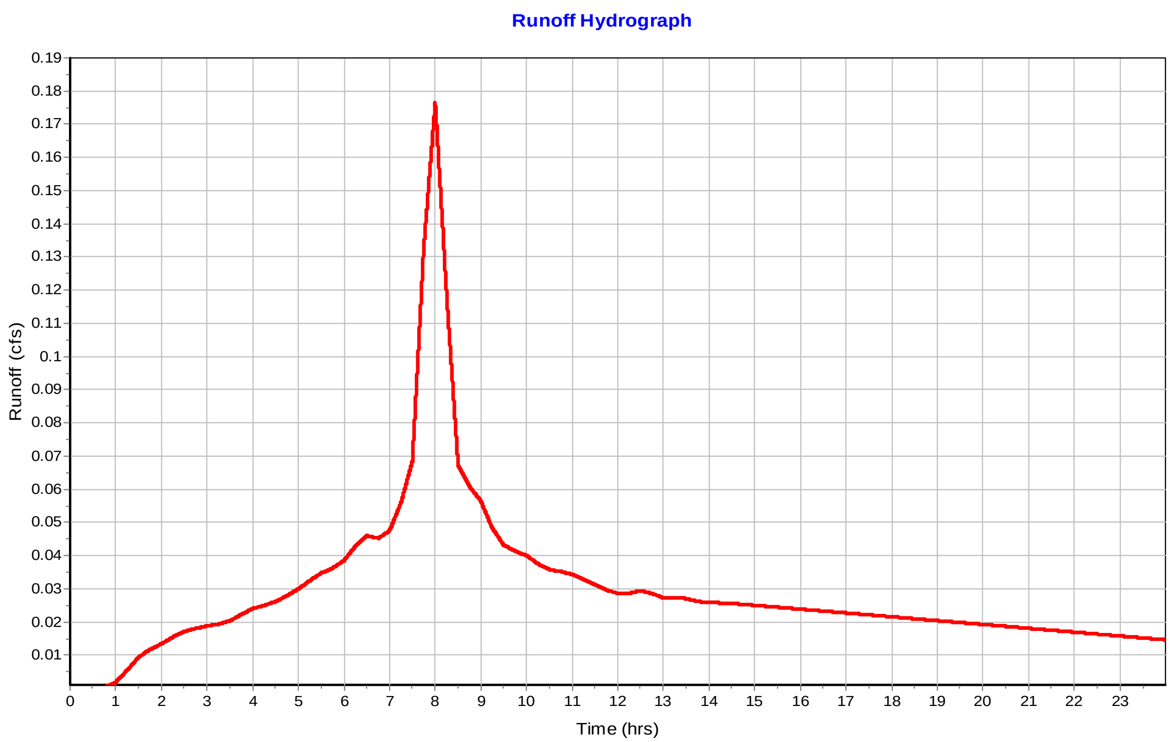
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.22		97.56

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.2
Peak Runoff (cfs)	0.18
Weighted Curve Number	97.56
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 02





Subbasin : SDCB 03

Input Data

Area (ac)	0.13
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

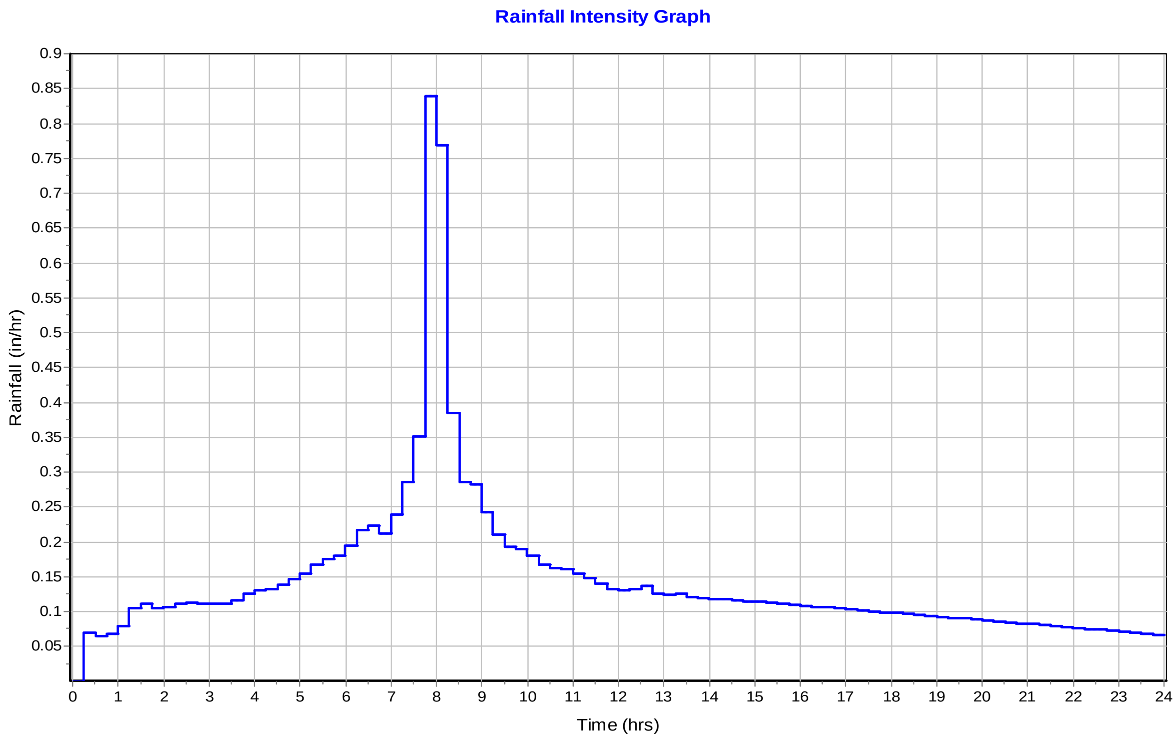
Composite Curve Number

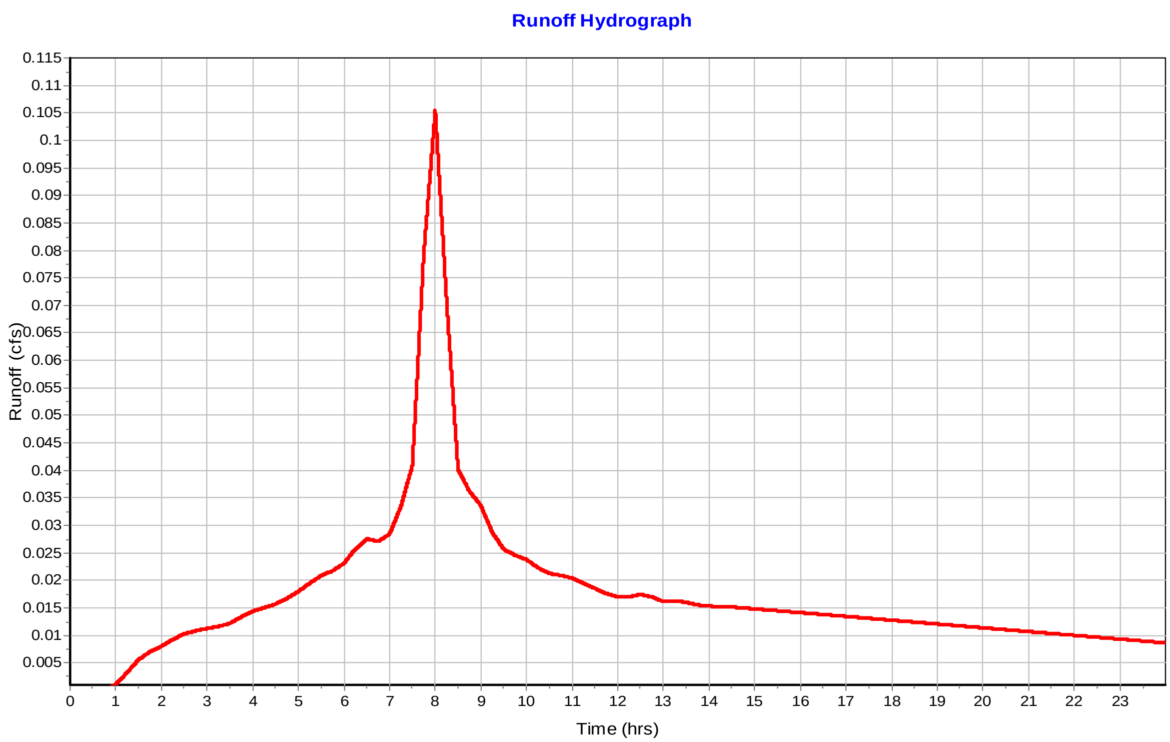
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.13		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.11
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 03





Subbasin : SDCB 04

Input Data

Area (ac)	0.06
Impervious Area (%)	73
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

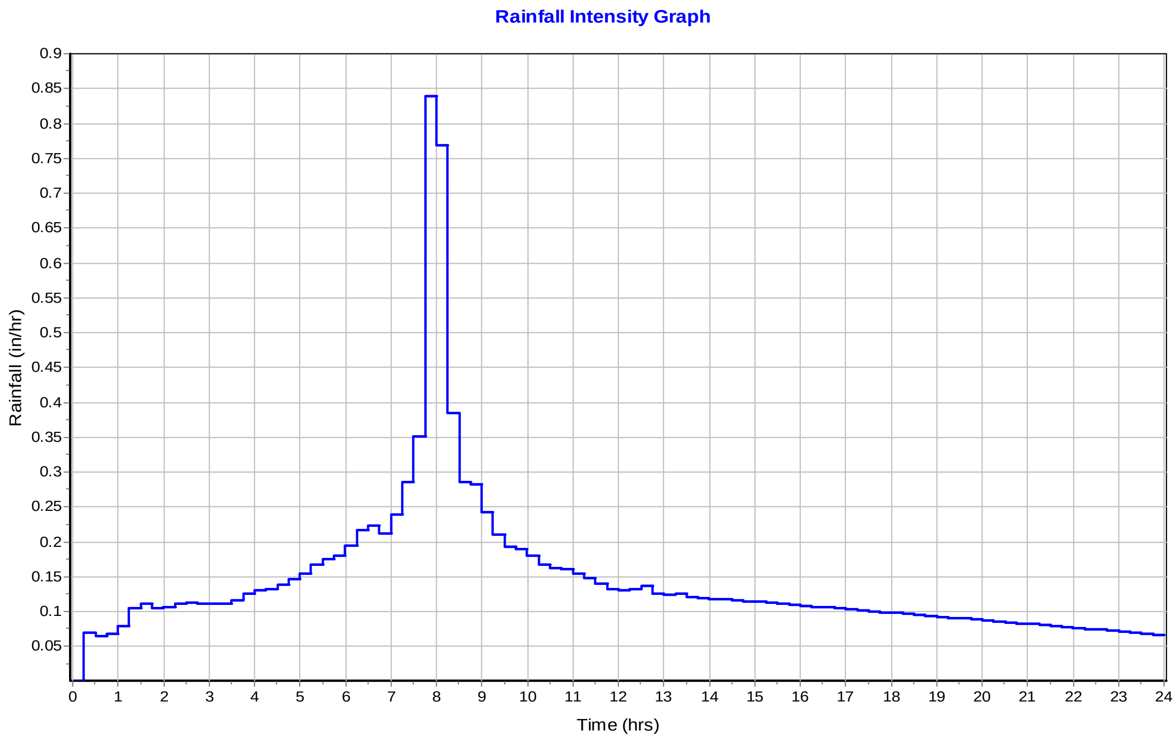
Composite Curve Number

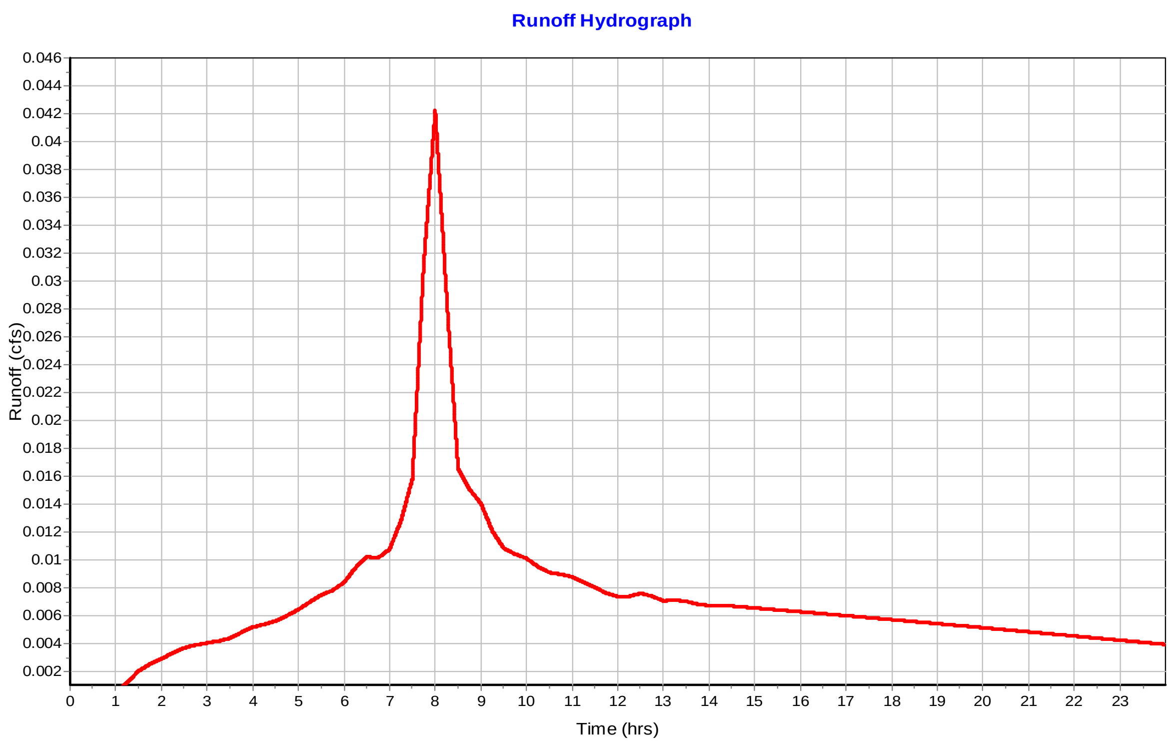
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.06		92.06

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.73
Peak Runoff (cfs)	0.04
Weighted Curve Number	92.06
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 04





Subbasin : SDCB 05

Input Data

Area (ac)	0.24
Impervious Area (%)	90
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

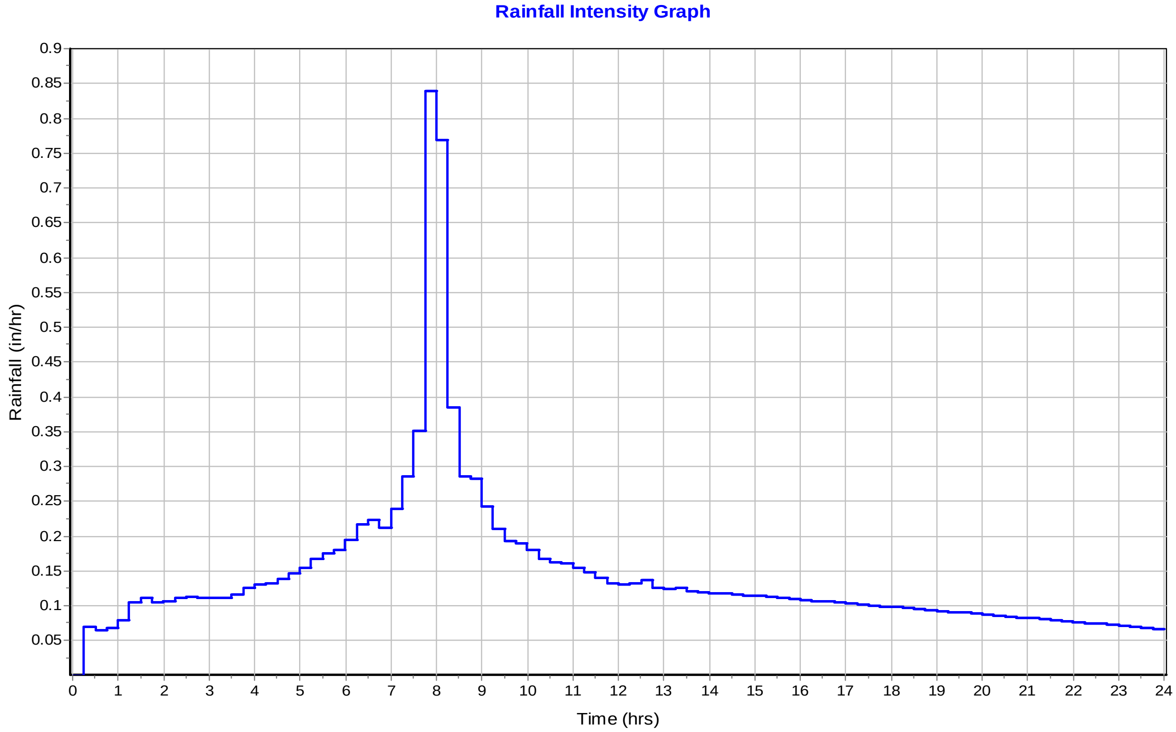
Composite Curve Number

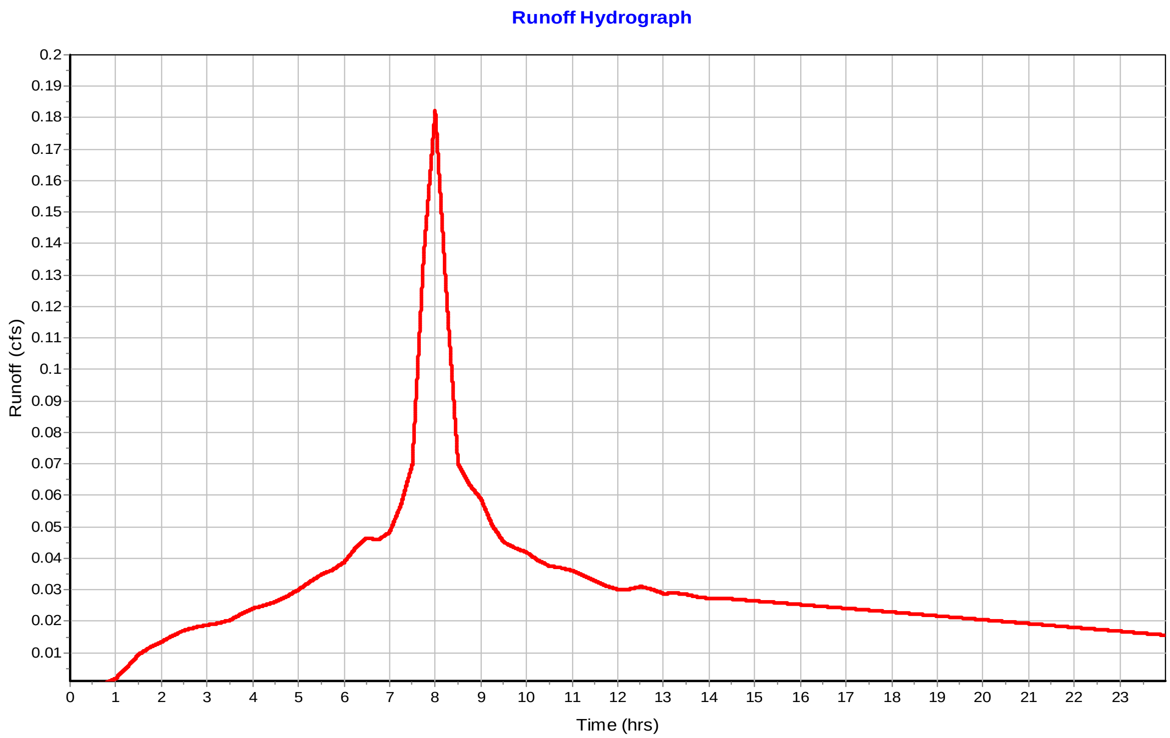
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.24		95.8

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.05
Peak Runoff (cfs)	0.18
Weighted Curve Number	95.8
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 05





Subbasin : SDCB 06

Input Data

Area (ac)	0.16
Impervious Area (%)	65
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

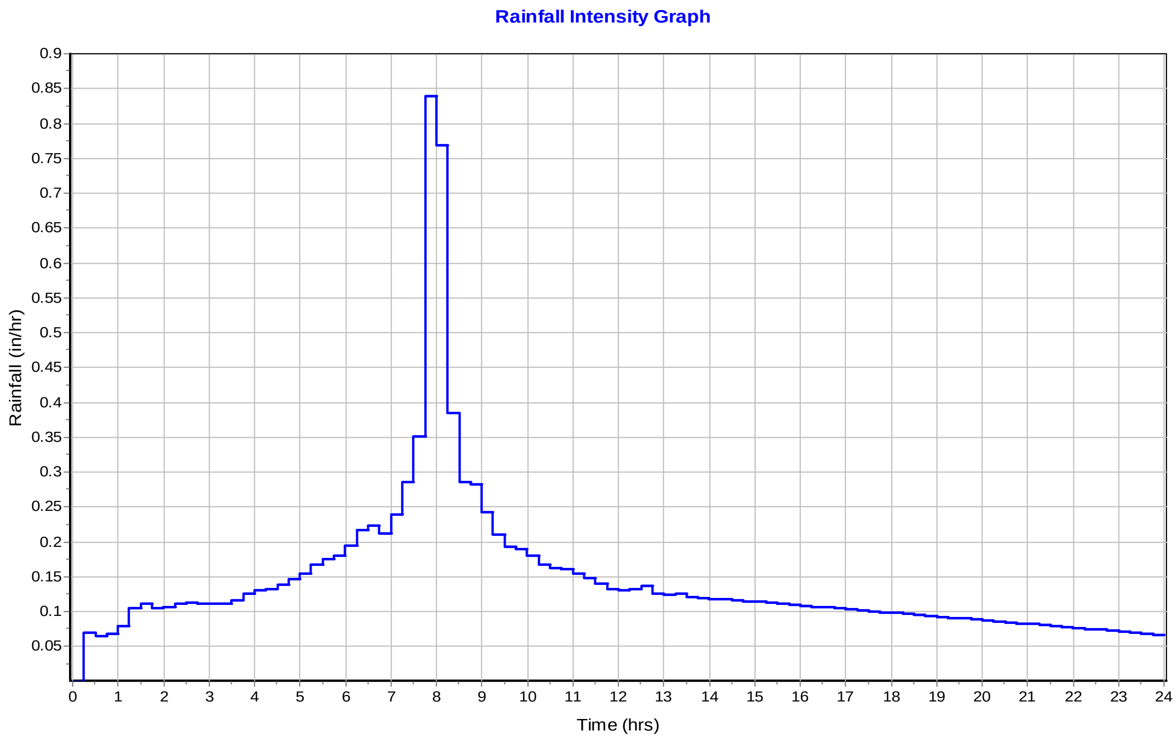
Composite Curve Number

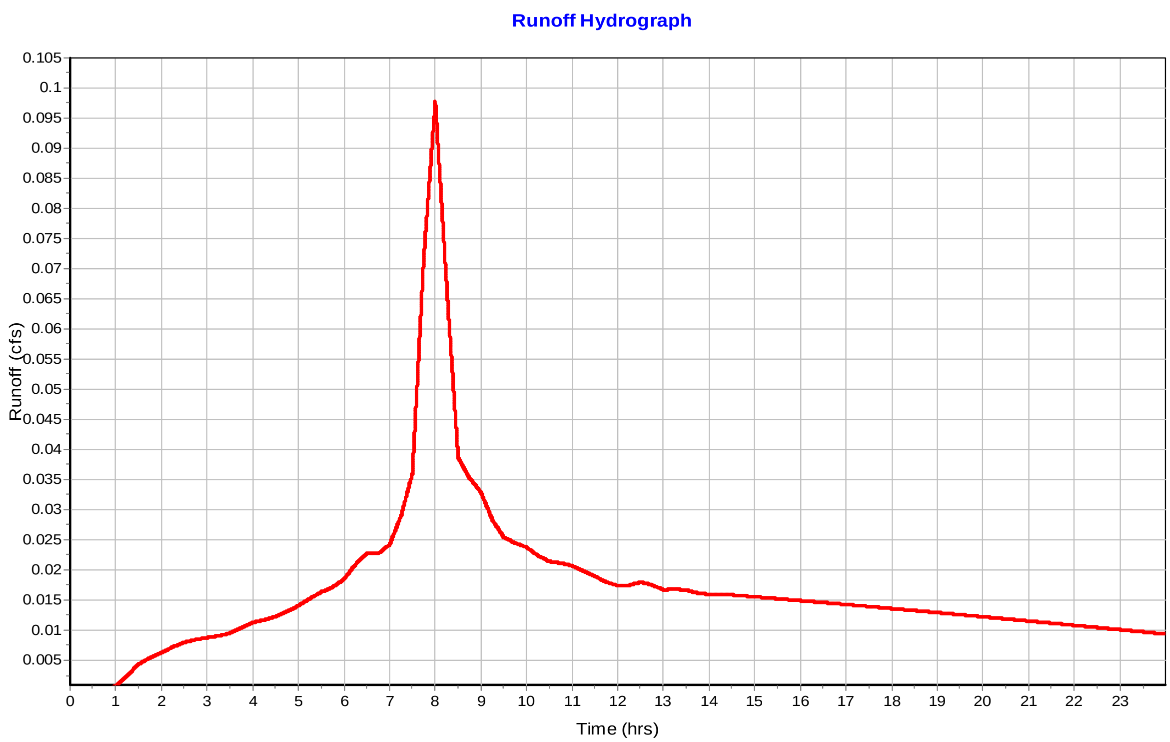
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.16		90.3

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.57
Peak Runoff (cfs)	0.1
Weighted Curve Number	90.3
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 06





Subbasin : SDCB 07

Input Data

Area (ac)	0.09
Impervious Area (%)	64
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

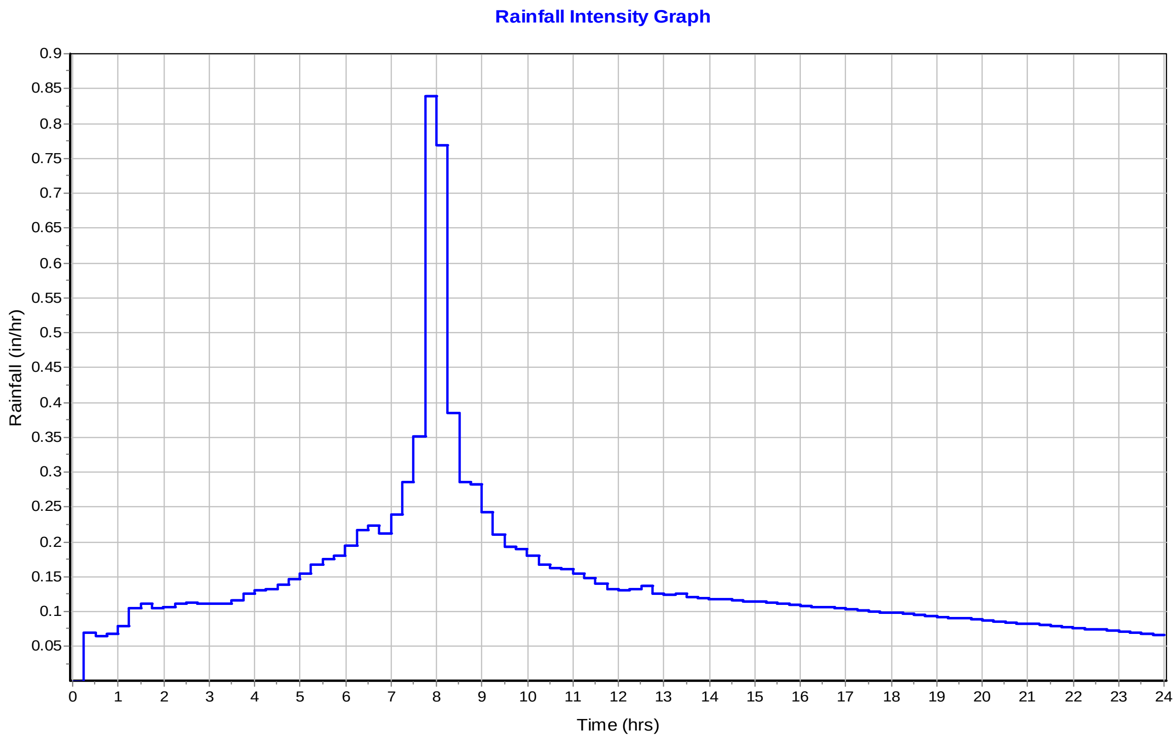
Composite Curve Number

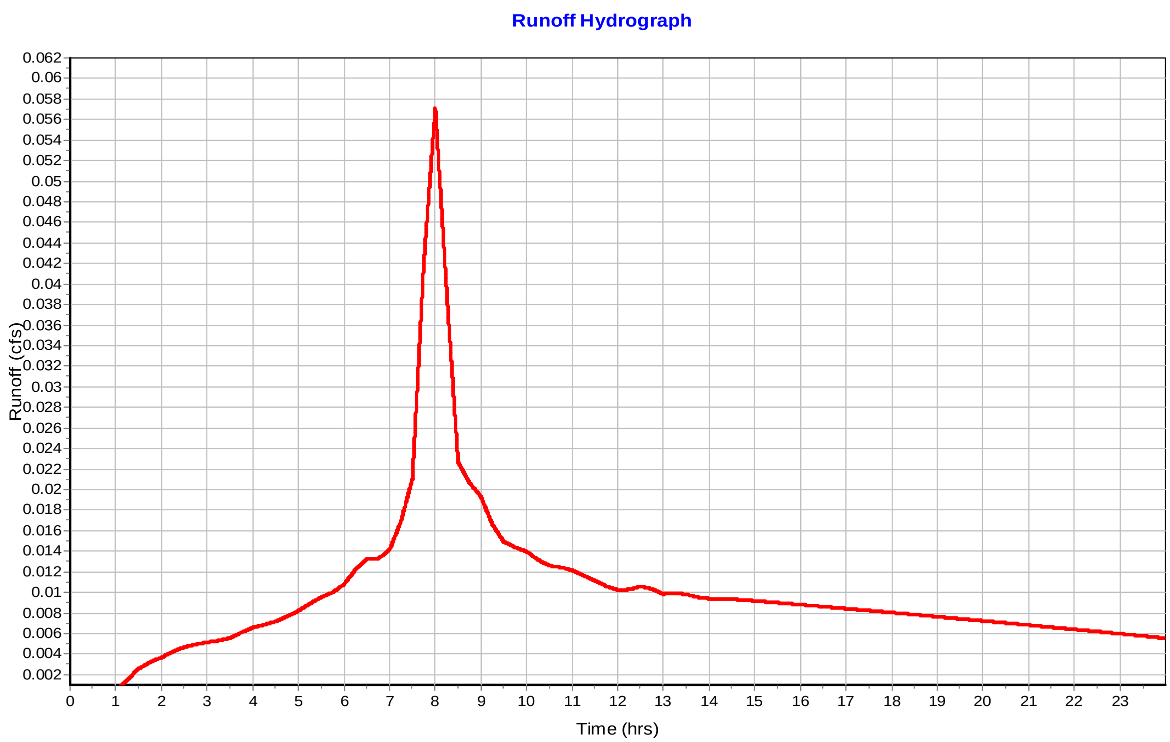
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.09		90.08

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.56
Peak Runoff (cfs)	0.06
Weighted Curve Number	90.08
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 07





Subbasin : SDCB 08

Input Data

Area (ac)	0.05
Impervious Area (%)	100
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

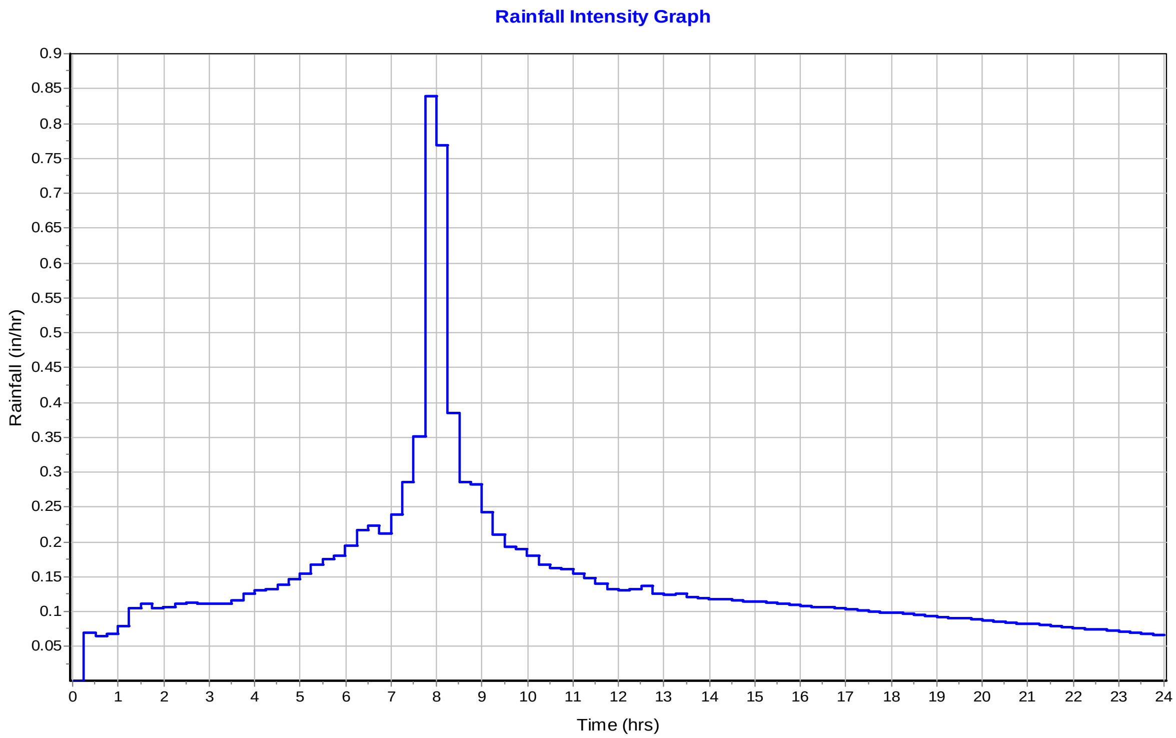
Composite Curve Number

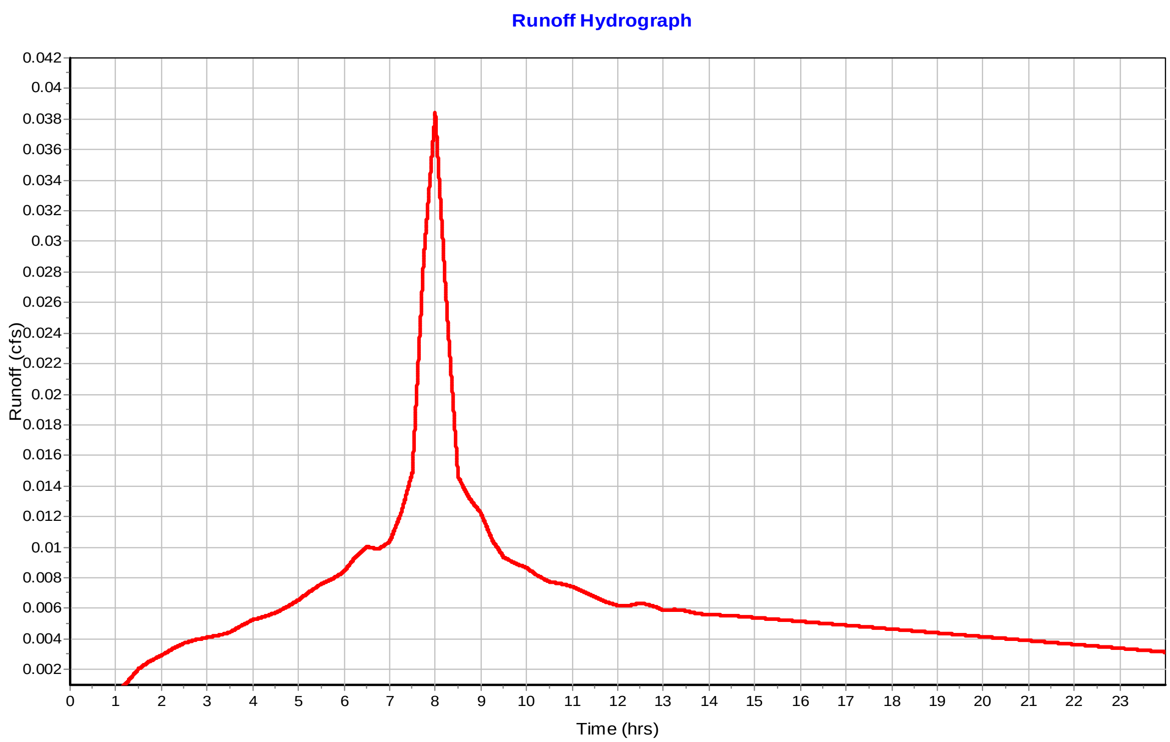
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.05		98

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.24
Peak Runoff (cfs)	0.04
Weighted Curve Number	98
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 08





Subbasin : SDCB 09

Input Data

Area (ac)	0.25
Impervious Area (%)	82
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

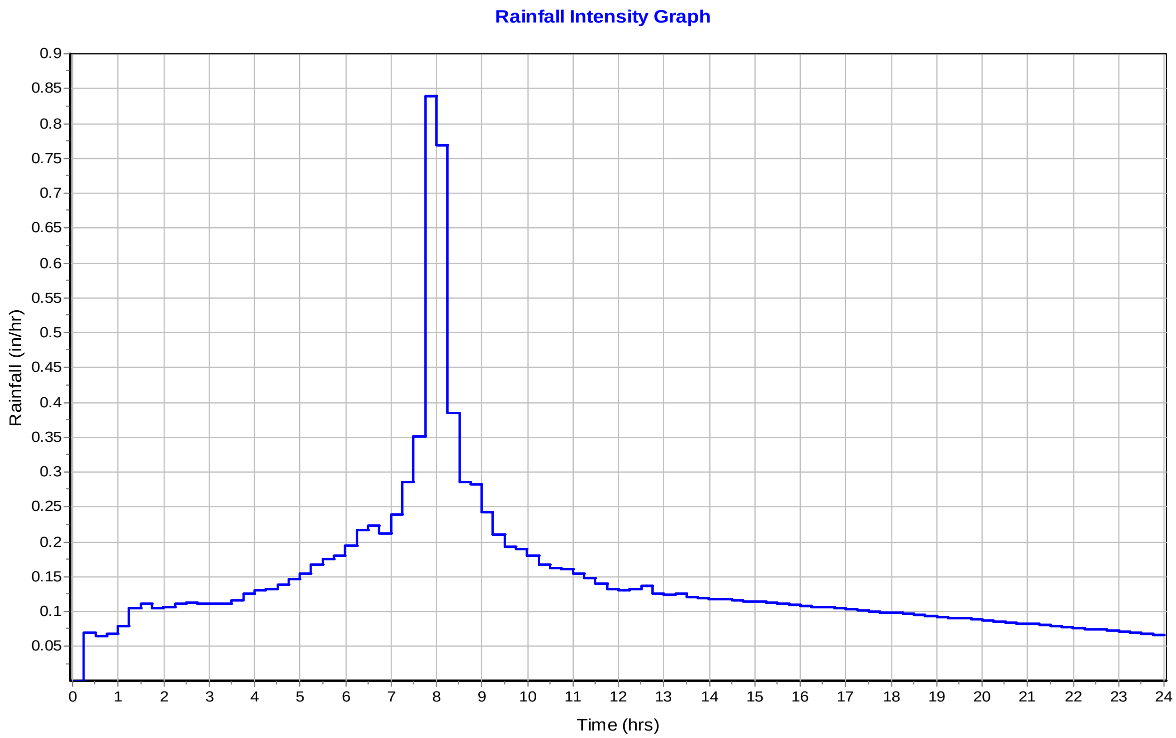
Composite Curve Number

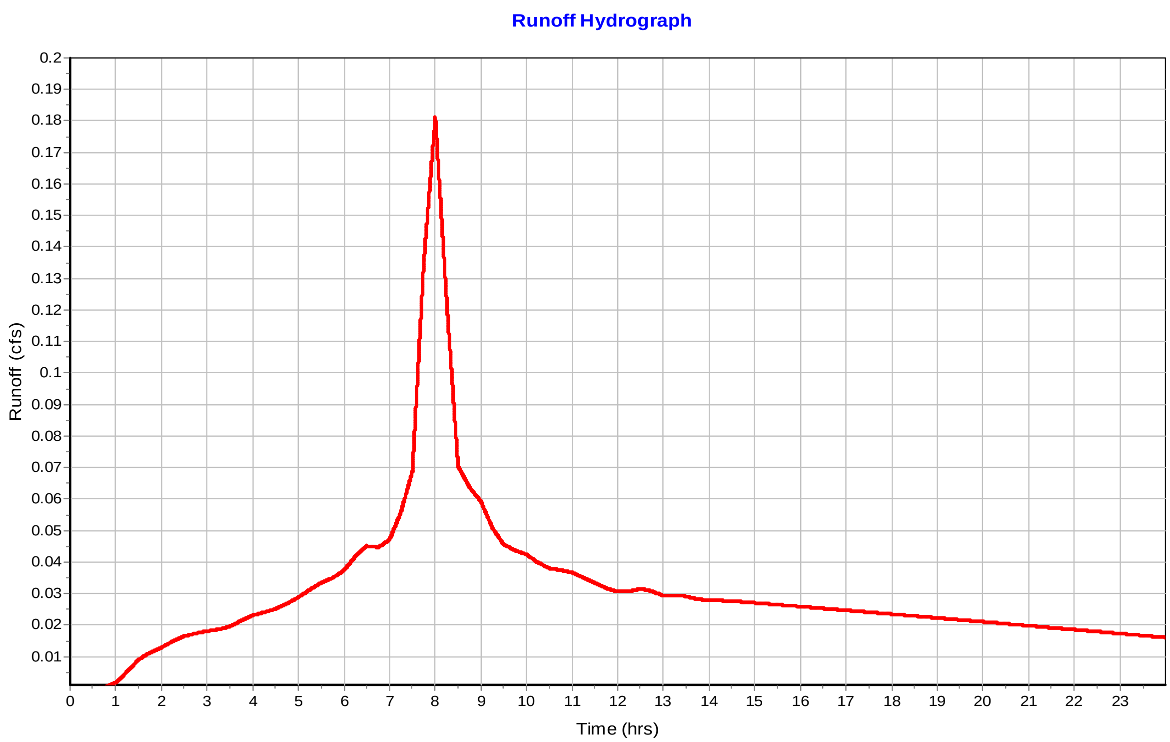
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.25		94.04

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.9
Peak Runoff (cfs)	0.18
Weighted Curve Number	94.04
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 09





Subbasin : SDCB 11

Input Data

Area (ac)	0.1
Impervious Area (%)	91
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

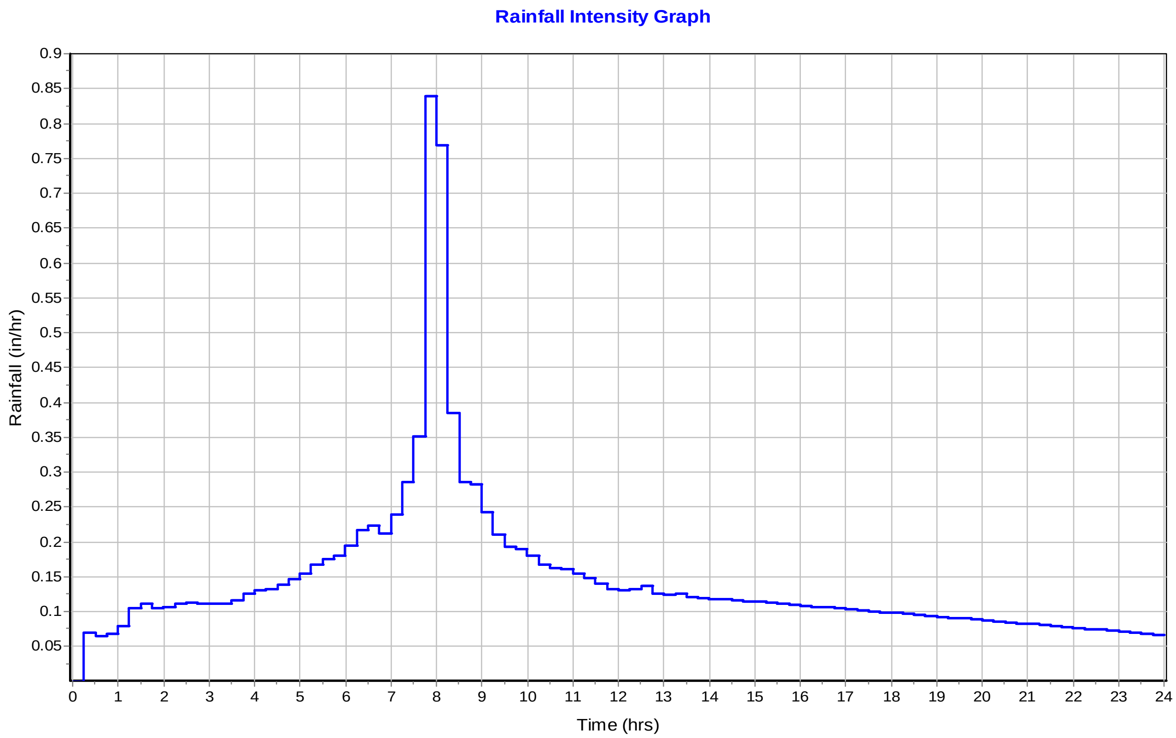
Composite Curve Number

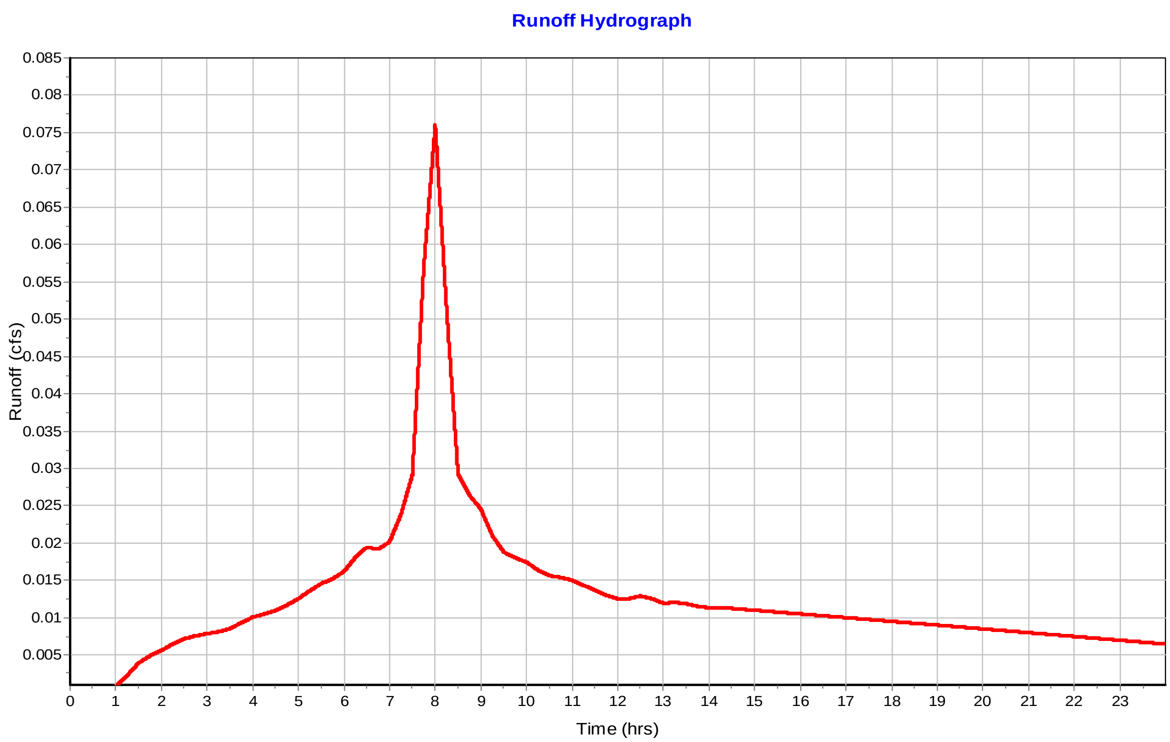
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		96.02

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.07
Peak Runoff (cfs)	0.08
Weighted Curve Number	96.02
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 11





Subbasin : SDCB 12

Input Data

Area (ac)	0.1
Impervious Area (%)	99
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

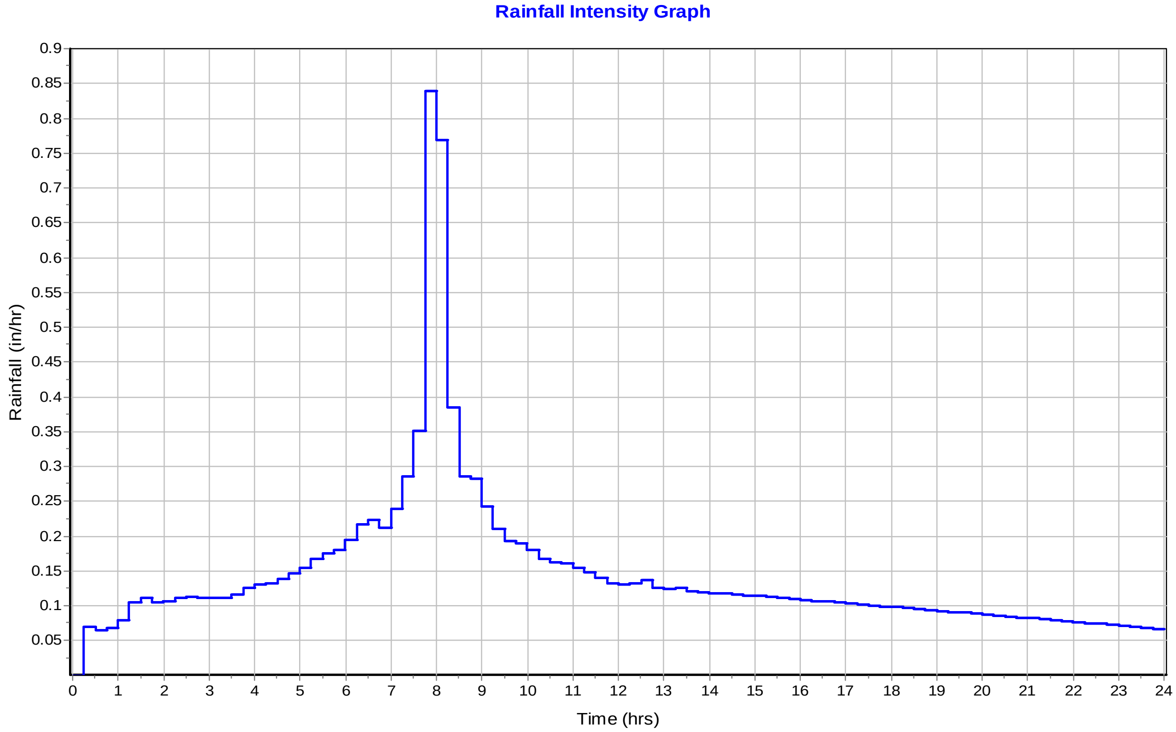
Composite Curve Number

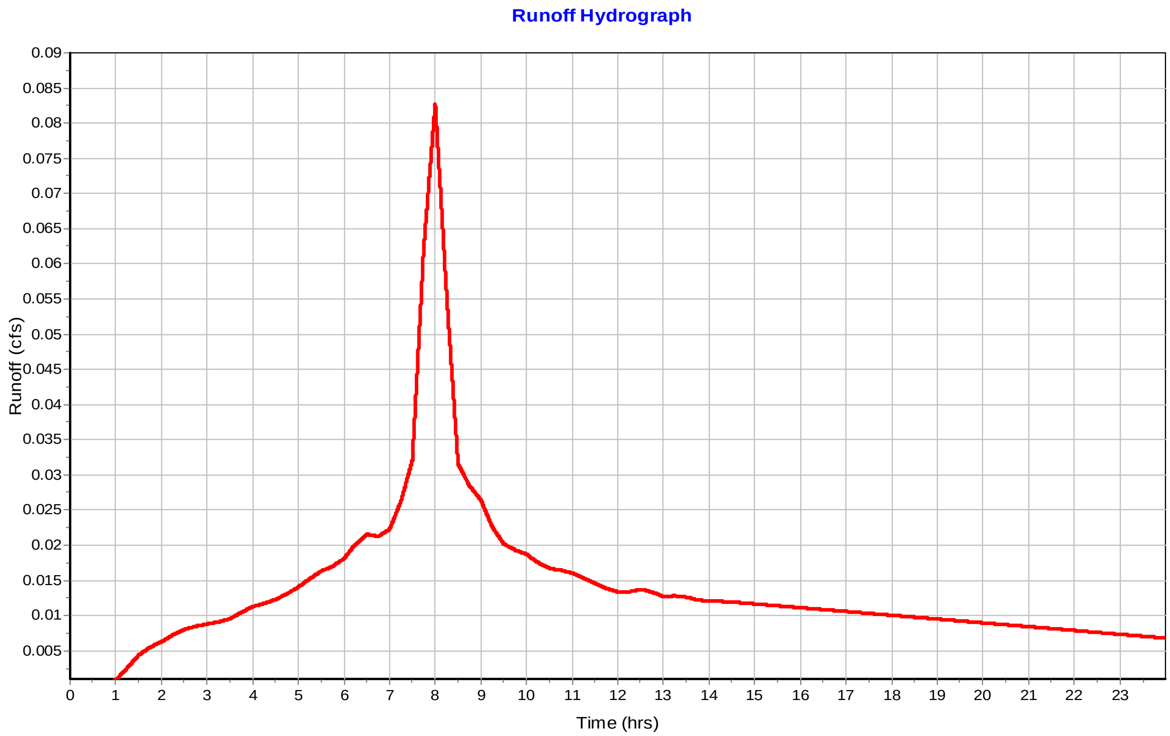
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		97.78

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.22
Peak Runoff (cfs)	0.08
Weighted Curve Number	97.78
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 12





Subbasin : SDCB 13

Input Data

Area (ac)	0.13
Impervious Area (%)	94
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

Composite Curve Number

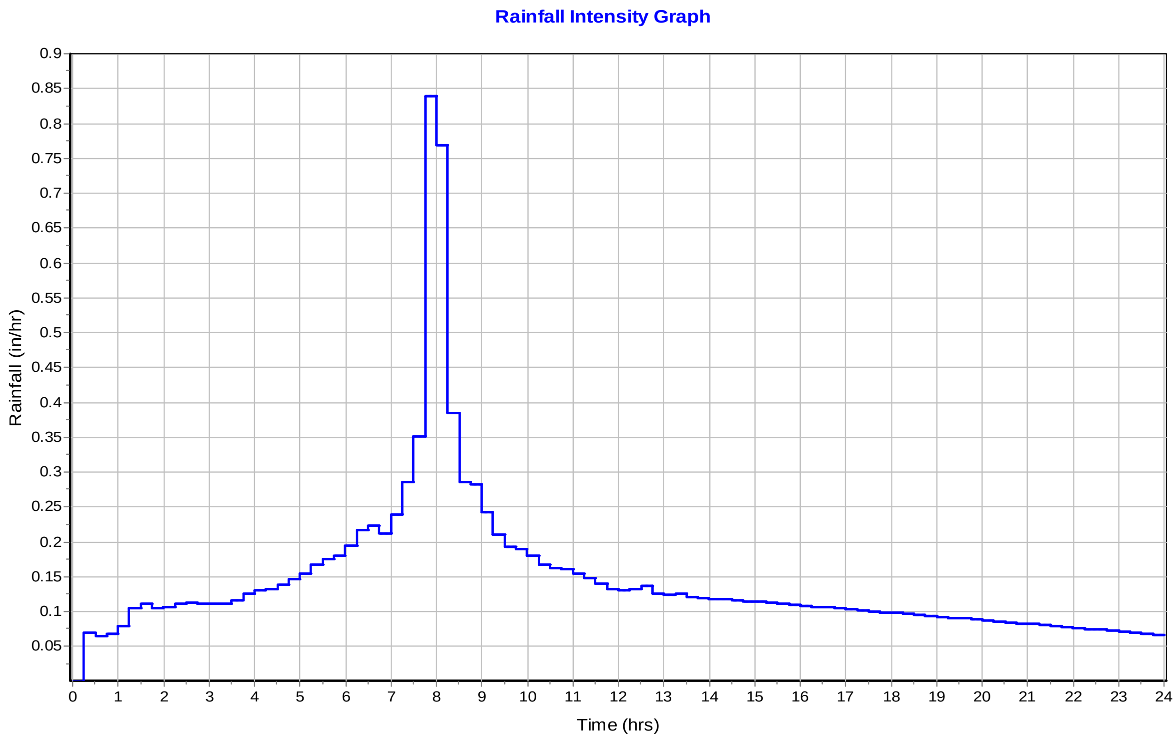
Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.13		96.68

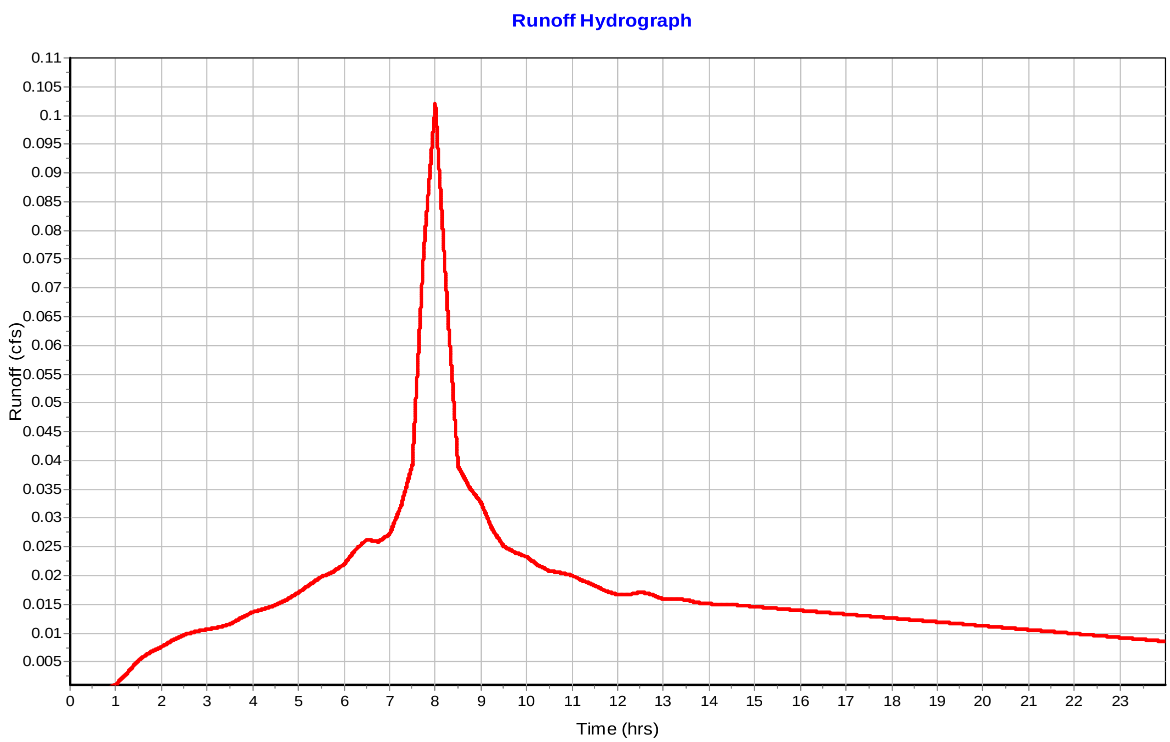
32

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.12
Peak Runoff (cfs)	0.1
Weighted Curve Number	96.68
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 13





Subbasin : SDCB 14

Input Data

Area (ac)	0.22
Impervious Area (%)	68
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

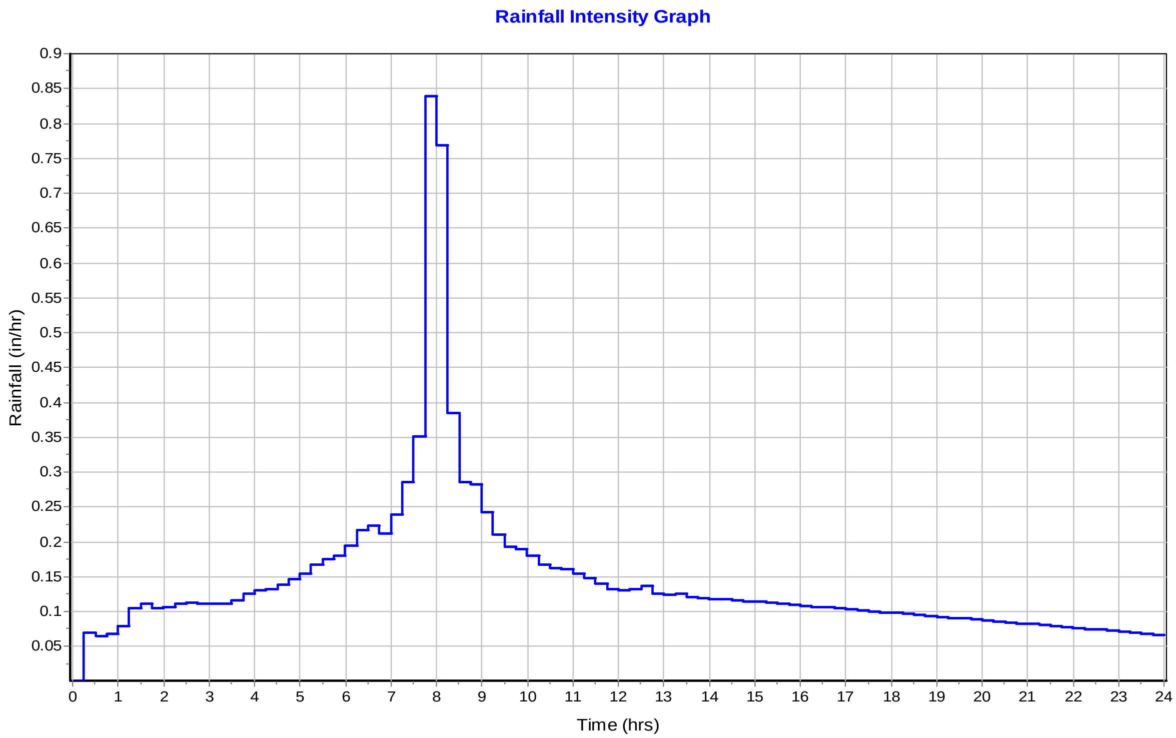
Composite Curve Number

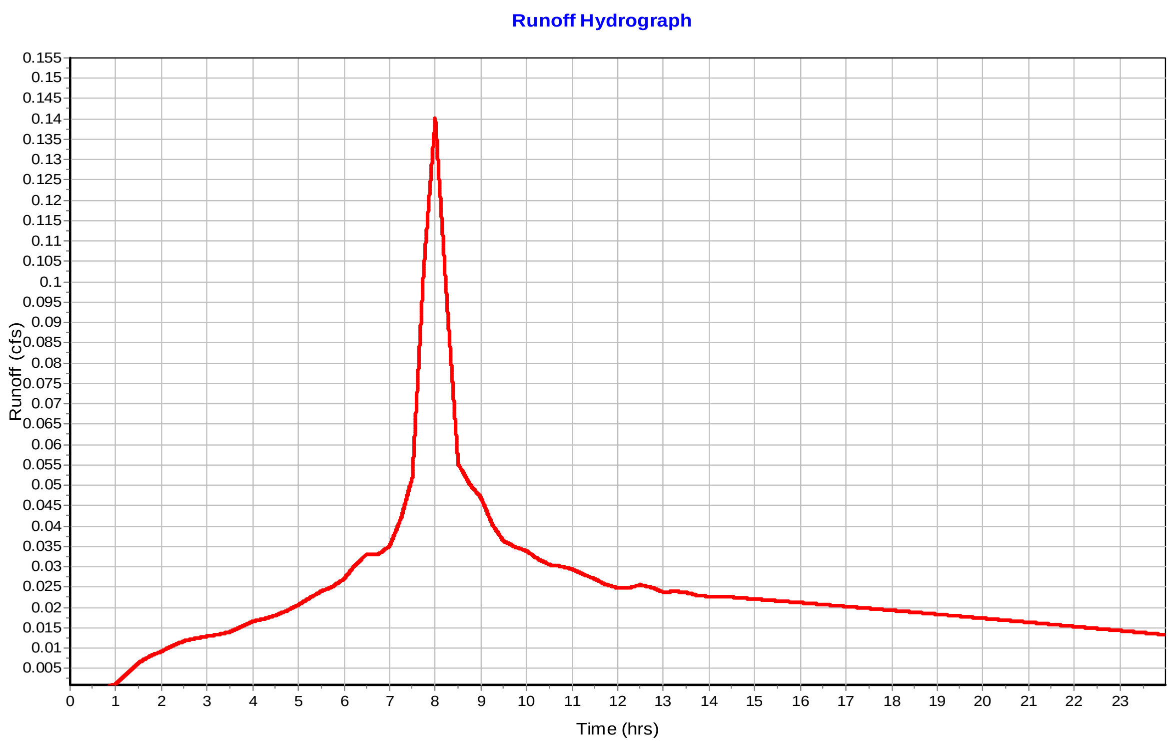
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.22		90.96

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.63
Peak Runoff (cfs)	0.14
Weighted Curve Number	90.96
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 14





Subbasin : SDCB 15

Input Data

Area (ac)	0.13
Impervious Area (%)	88
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

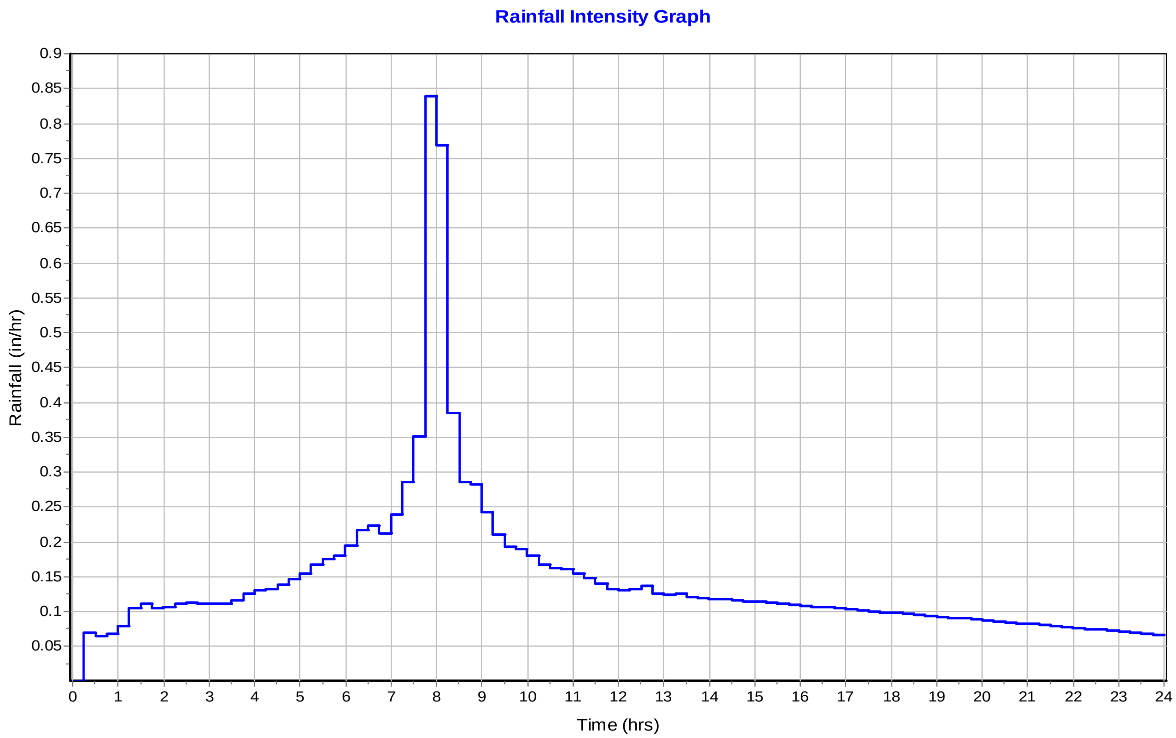
Composite Curve Number

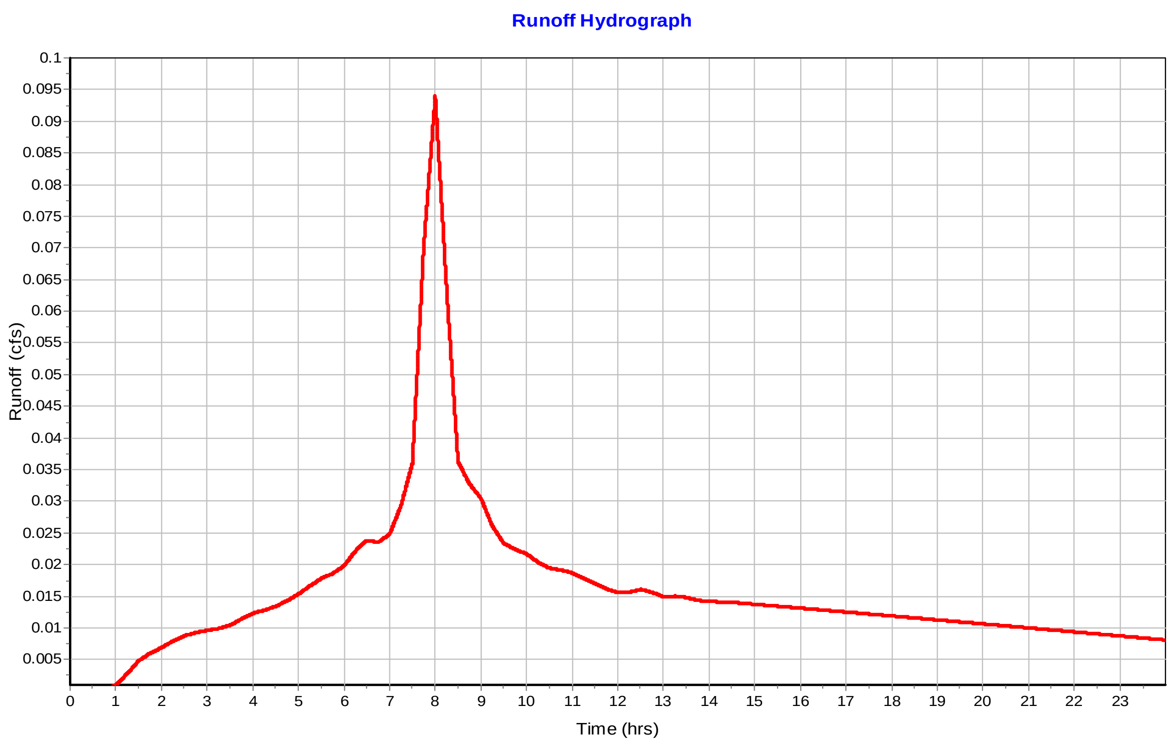
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.13		95.36

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.01
Peak Runoff (cfs)	0.09
Weighted Curve Number	95.36
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 15





Subbasin : SDCB 16

Input Data

Area (ac)	0.14
Impervious Area (%)	65
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

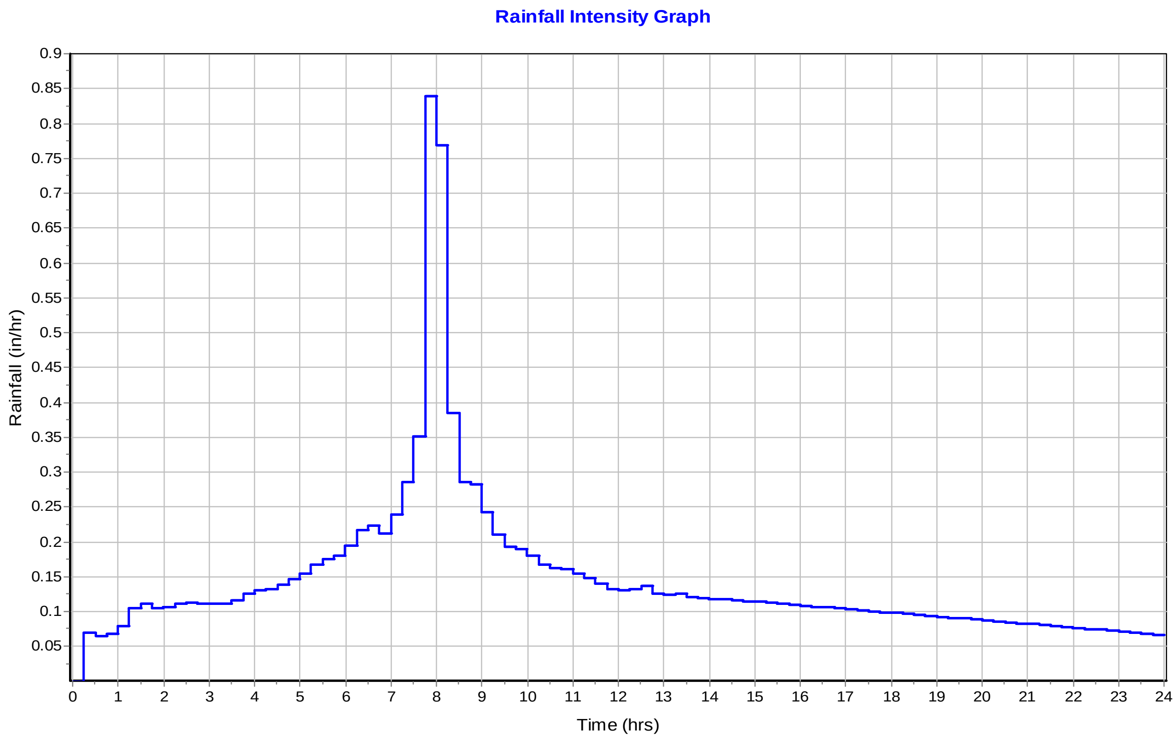
Composite Curve Number

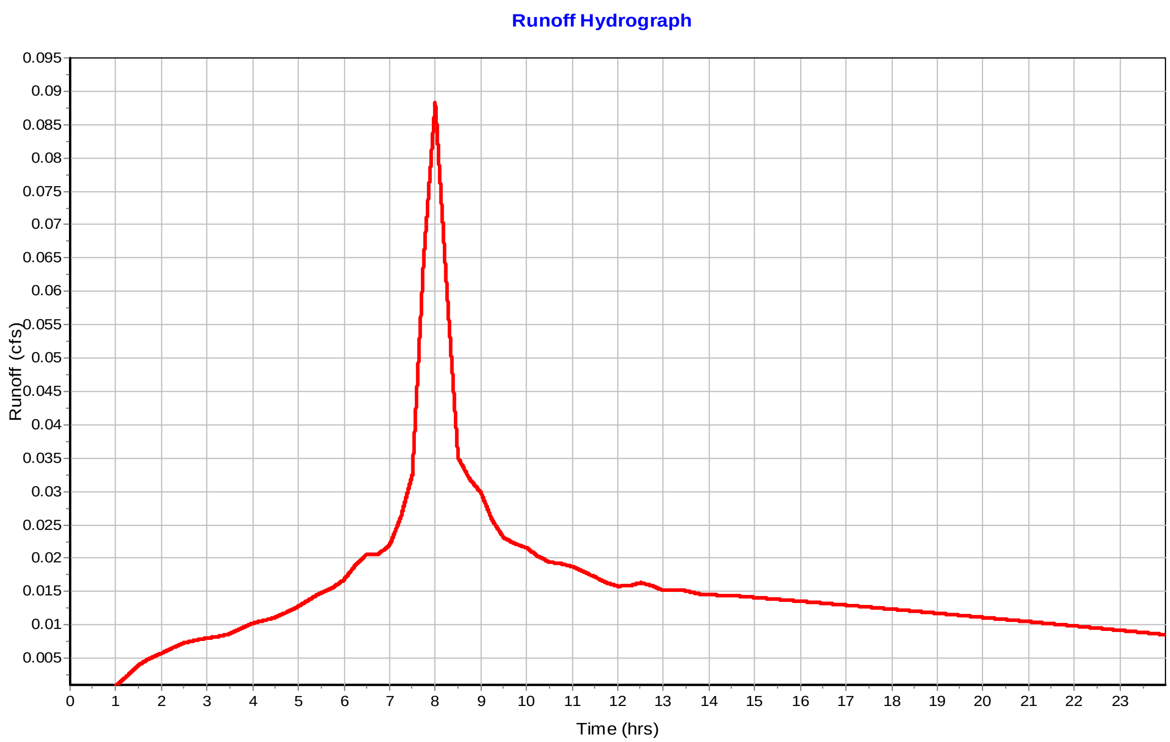
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.14		90.3

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.57
Peak Runoff (cfs)	0.09
Weighted Curve Number	90.3
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 16





Subbasin : SDCB 17

Input Data

Area (ac) 0.1
Impervious Area (%) 92
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

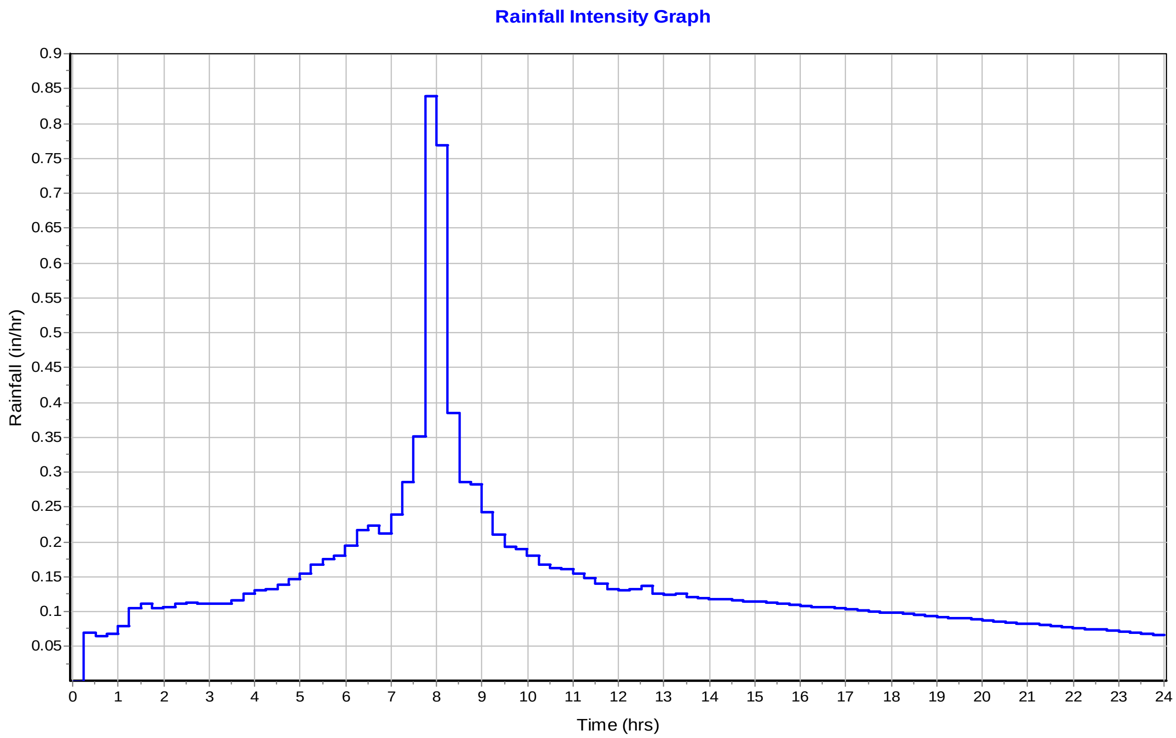
Composite Curve Number

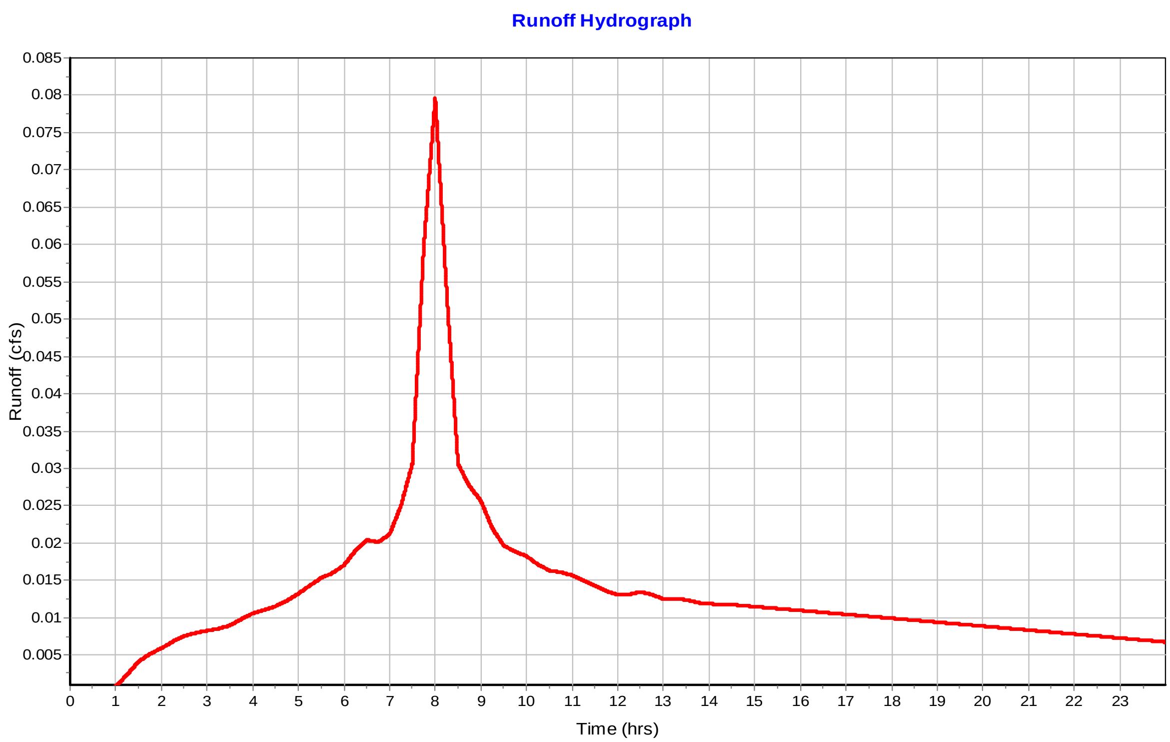
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.1		96.24

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 3.08
Peak Runoff (cfs) 0.08
Weighted Curve Number 96.24
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : SDCB 17





Subbasin : SDCB 19

Input Data

Area (ac)	0.46
Impervious Area (%)	78
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

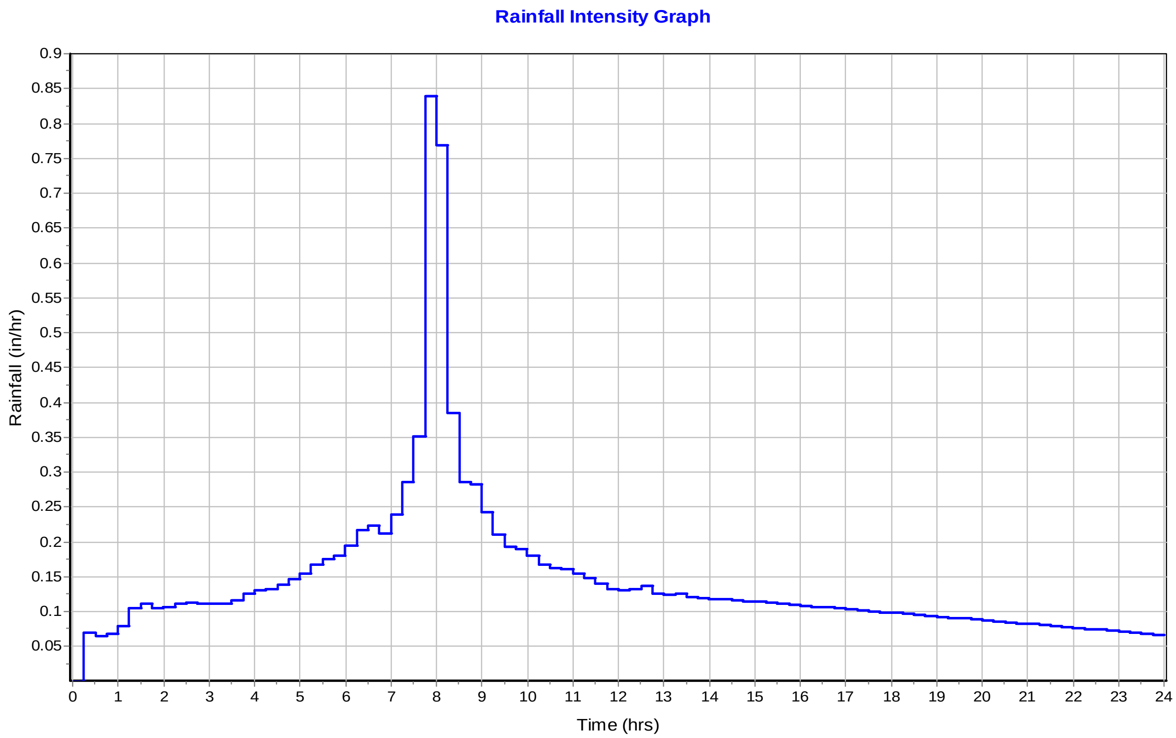
Composite Curve Number

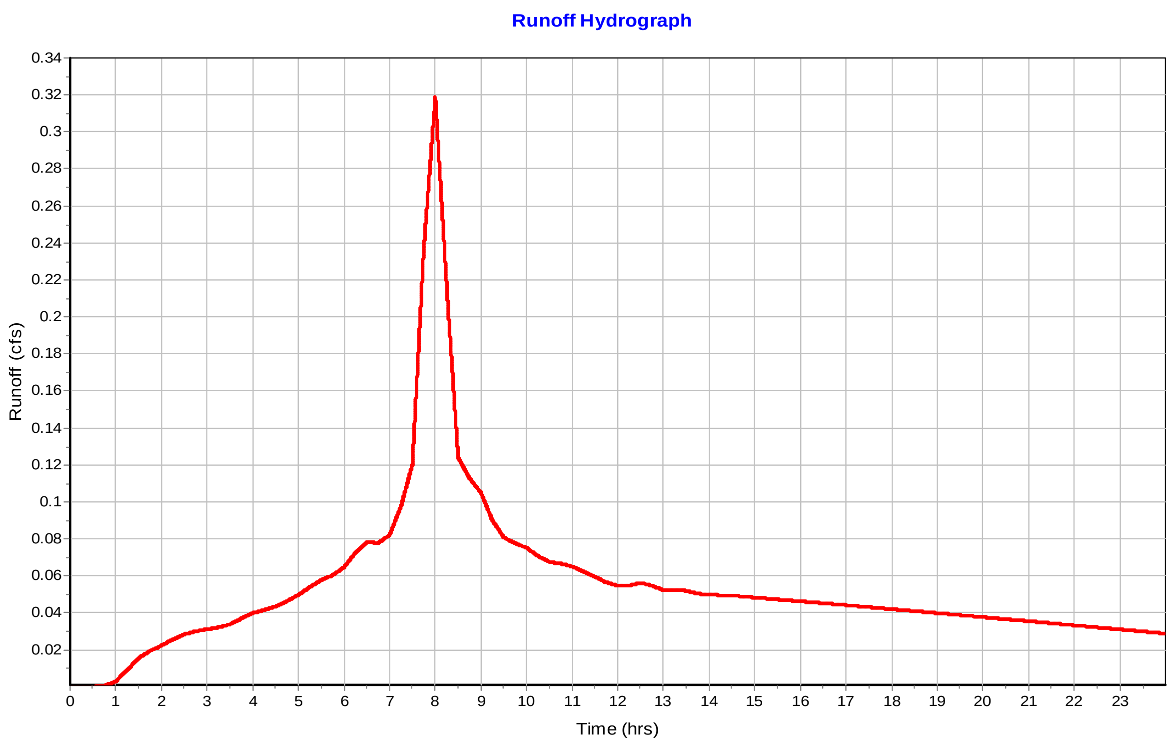
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.46		93.16

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.82
Peak Runoff (cfs)	0.32
Weighted Curve Number	93.16
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 19





Subbasin : SDCB 20

Input Data

Area (ac)	0.11
Impervious Area (%)	79
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

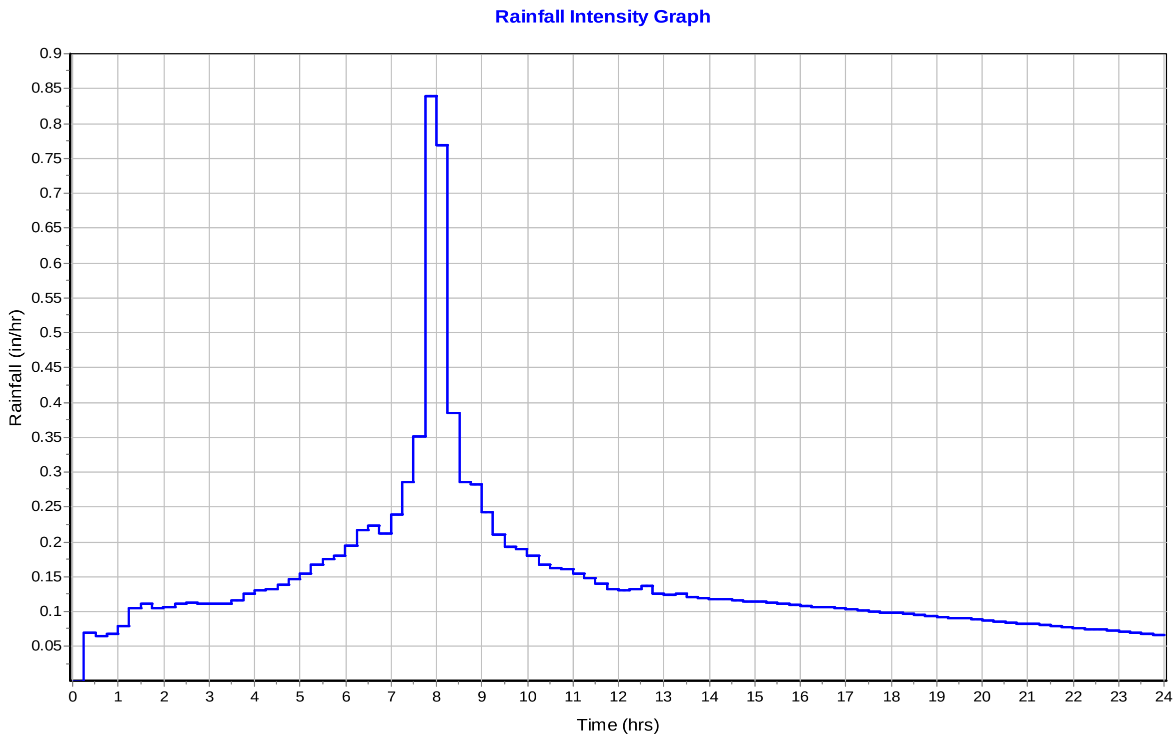
Composite Curve Number

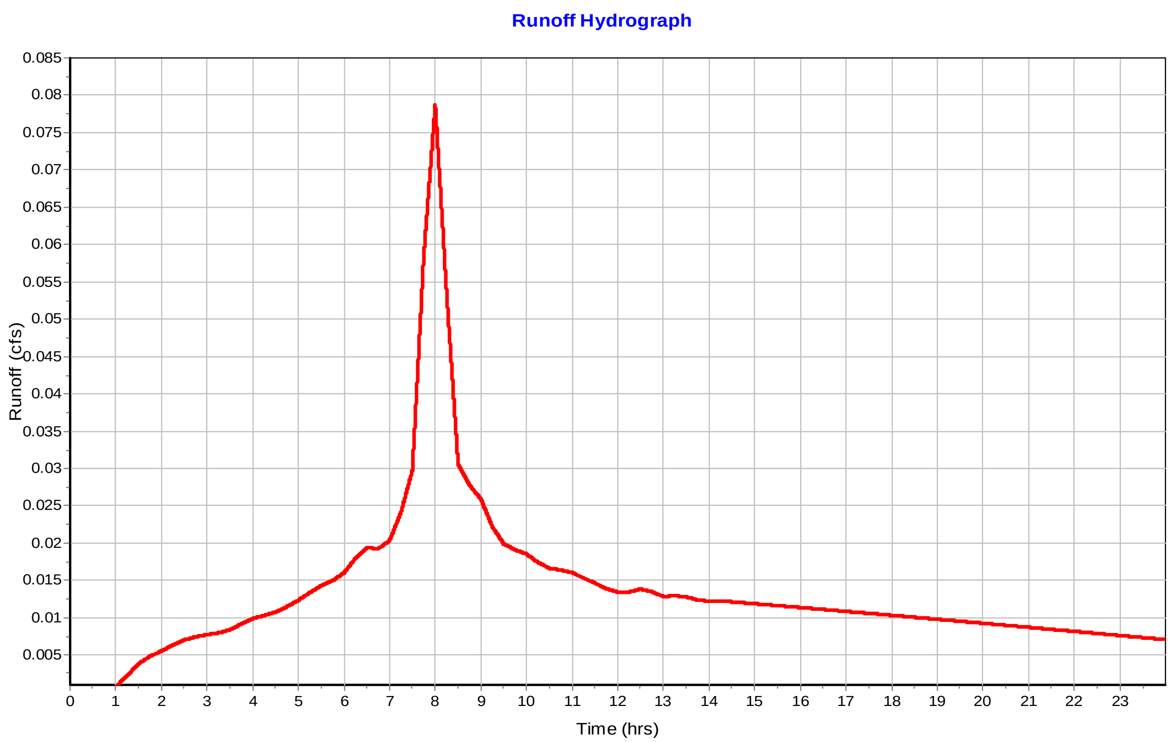
Soil/Surface Description 32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.11		93.38

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.84
Peak Runoff (cfs)	0.08
Weighted Curve Number	93.38
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 20





Subbasin : SDCB 21

Input Data

Area (ac)	0.09
Impervious Area (%)	93
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

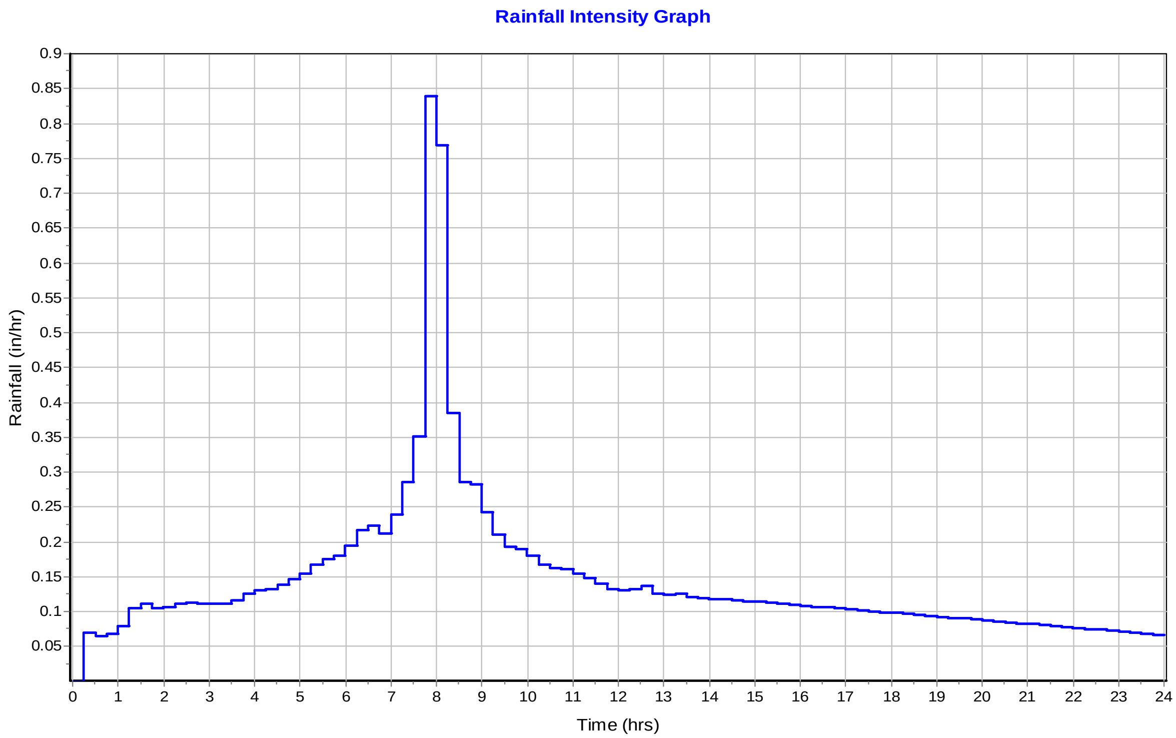
Composite Curve Number

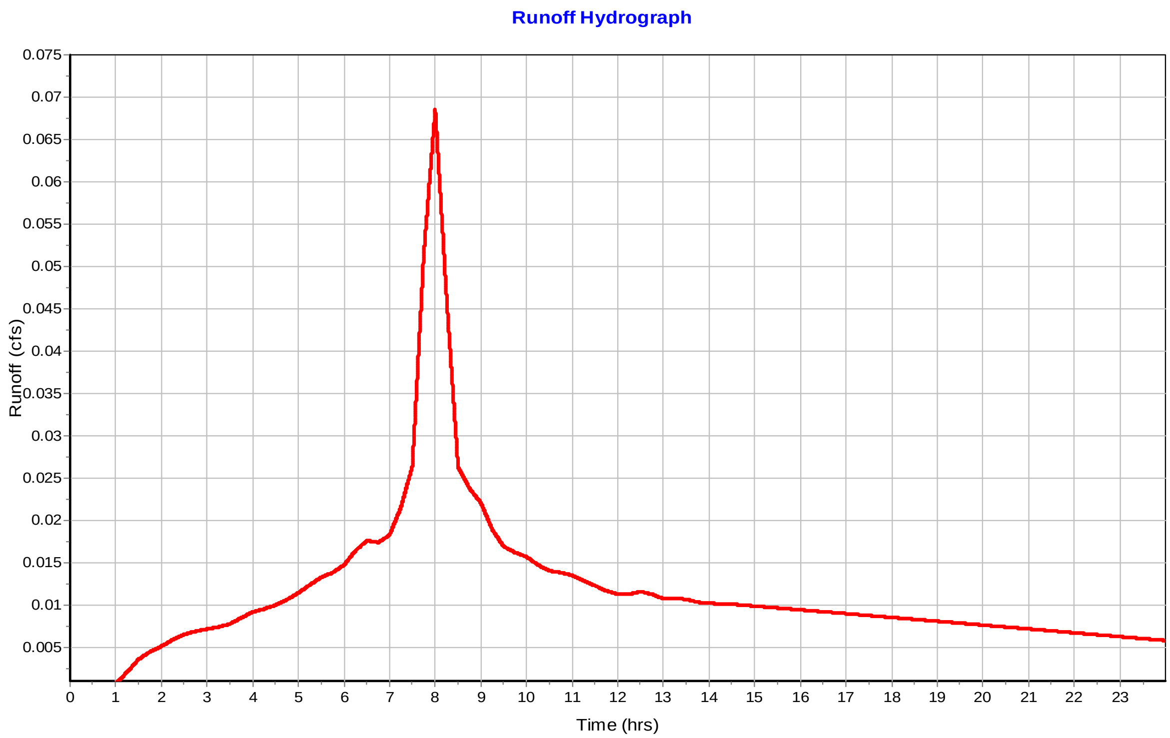
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.09		96.46

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.1
Peak Runoff (cfs)	0.07
Weighted Curve Number	96.46
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 21





Subbasin : SDCB 22

Input Data

Area (ac)	0.2
Impervious Area (%)	82
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

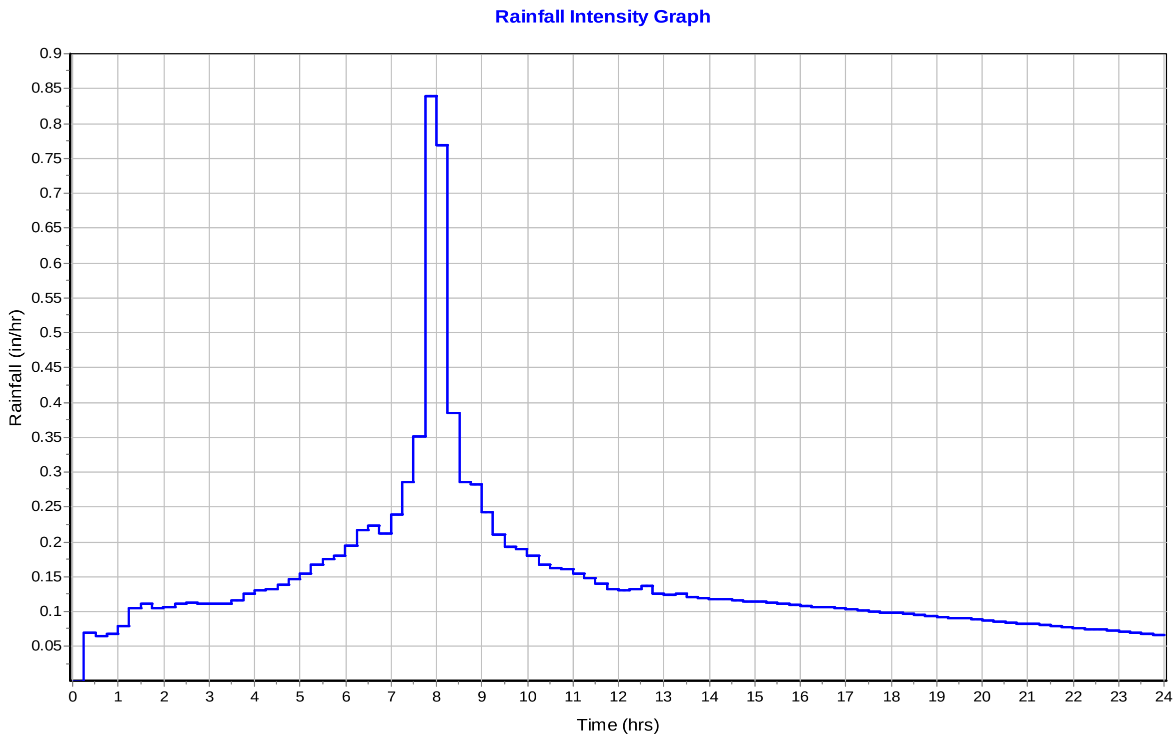
Composite Curve Number

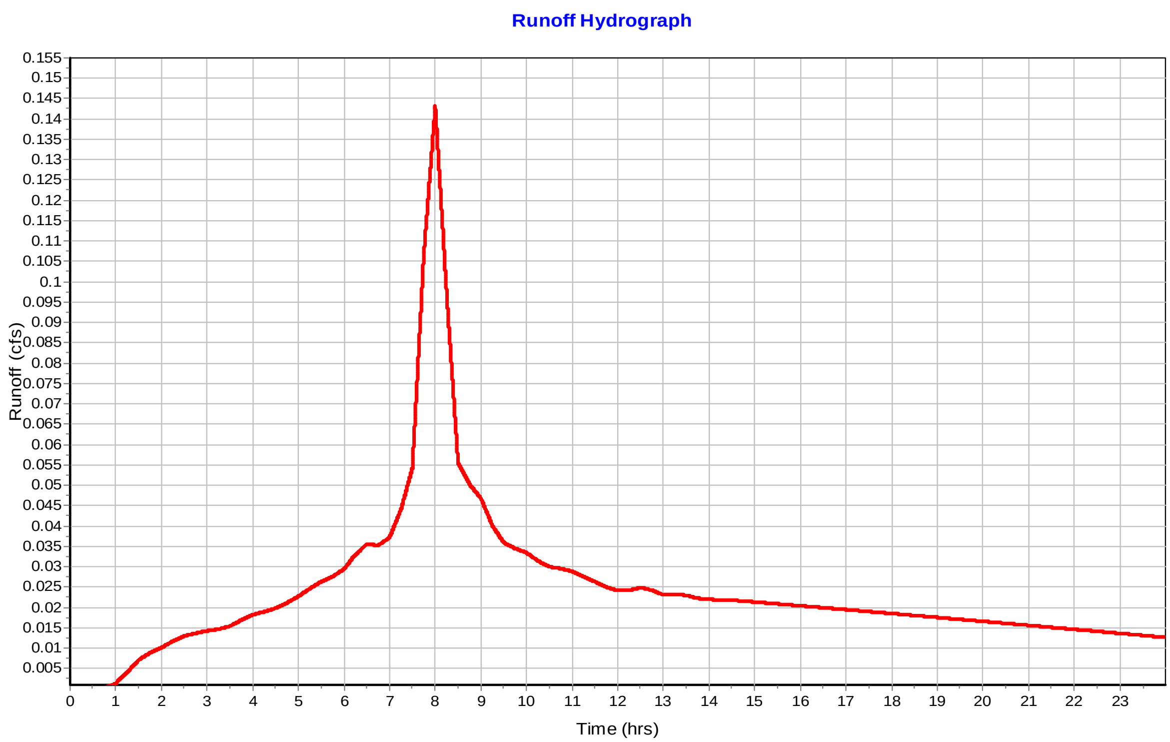
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.2		94.04

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.9
Peak Runoff (cfs)	0.14
Weighted Curve Number	94.04
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 22





Subbasin : SDCB 23

Input Data

Area (ac) 0.2
Impervious Area (%) 86
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

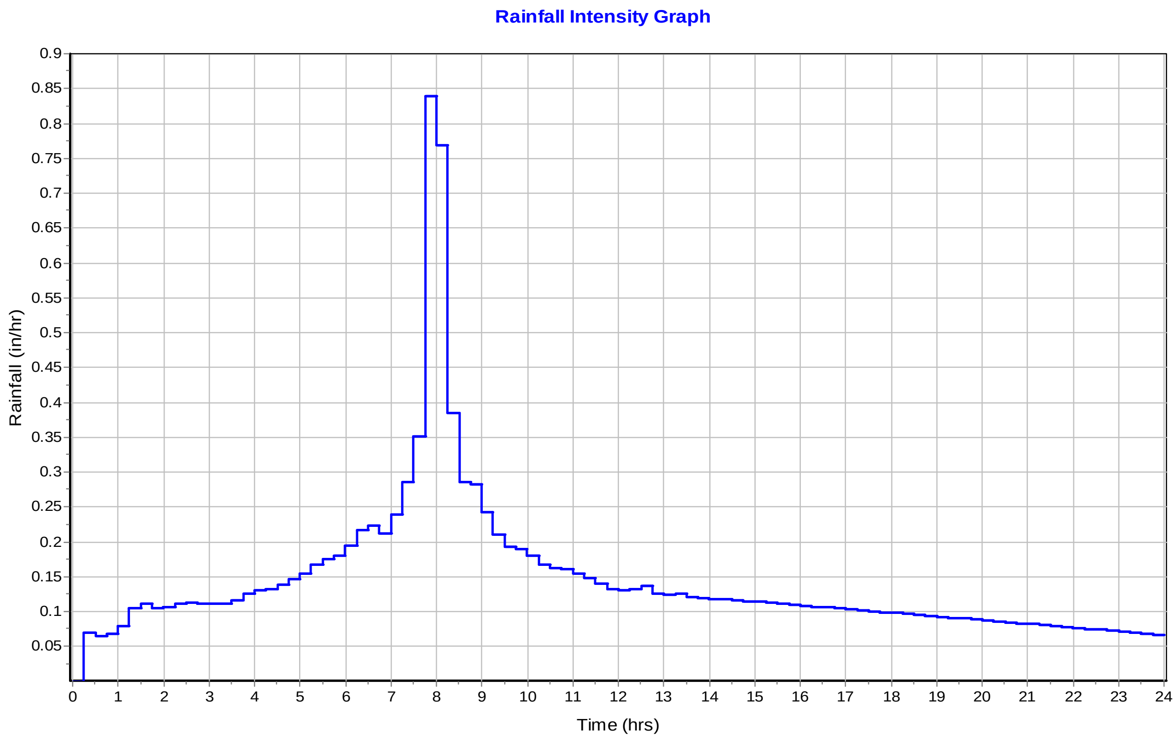
Composite Curve Number

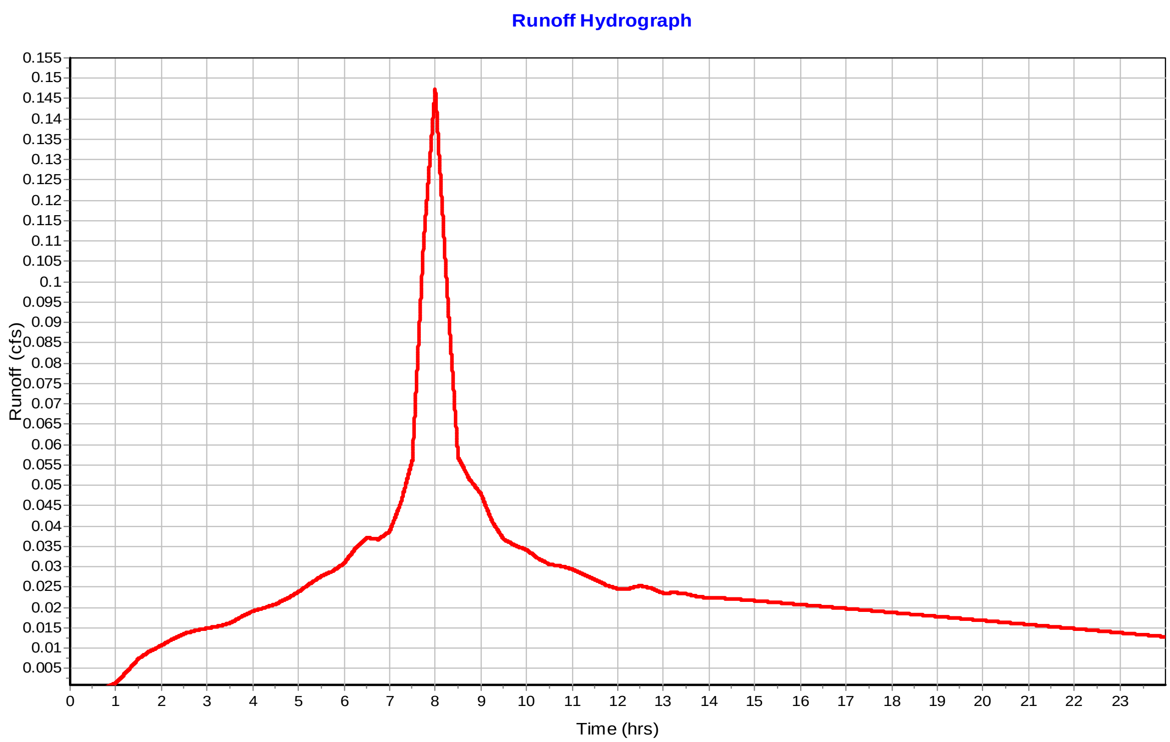
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.2		94.92

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 2.97
Peak Runoff (cfs) 0.15
Weighted Curve Number 94.92
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : SDCB 23





Subbasin : SDCB 24

Input Data

Area (ac) 0.02
Impervious Area (%) 85
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

Composite Curve Number

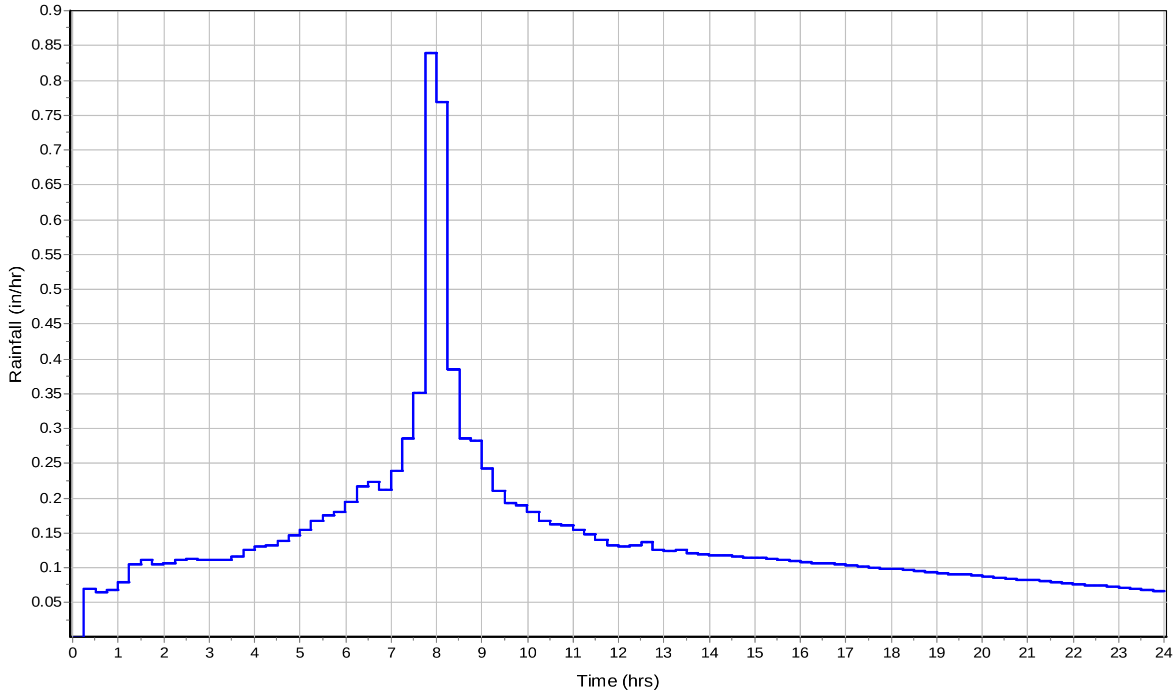
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.02		94.7

Subbasin Runoff Results

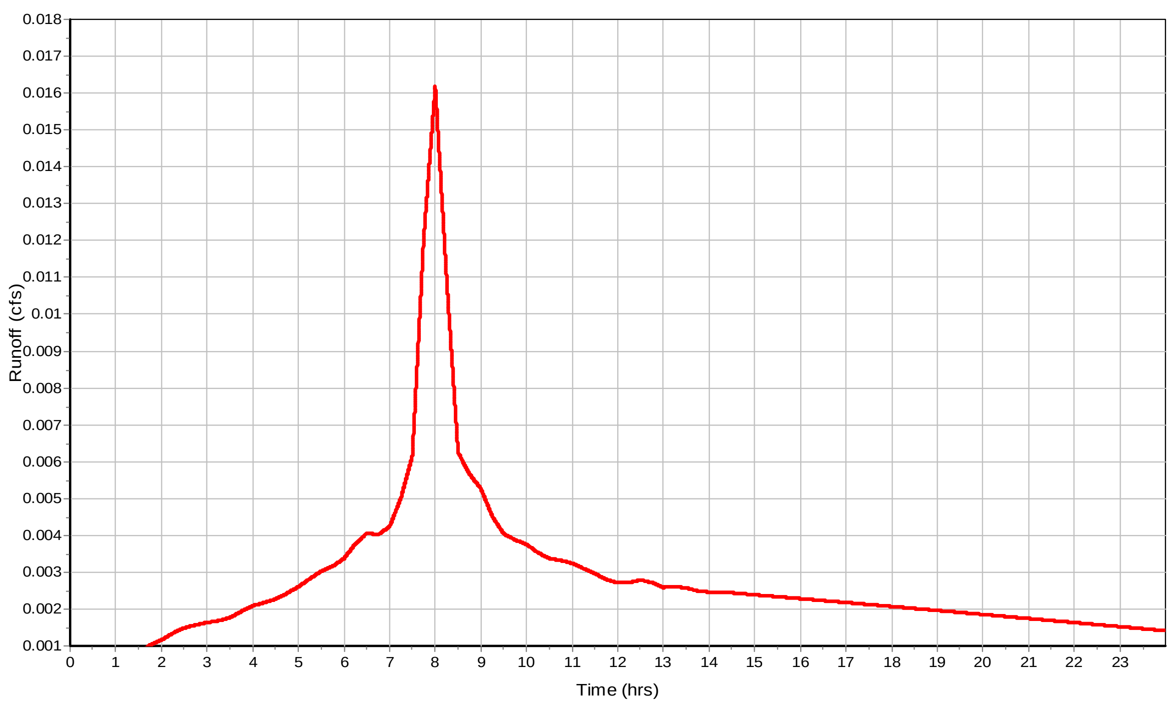
Total Rainfall (in) 3.46
Total Runoff (in) 2.95
Peak Runoff (cfs) 0.02
Weighted Curve Number 94.7
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : SDCB 24

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : SDCB 25

Input Data

Area (ac)	0.03
Impervious Area (%)	65
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

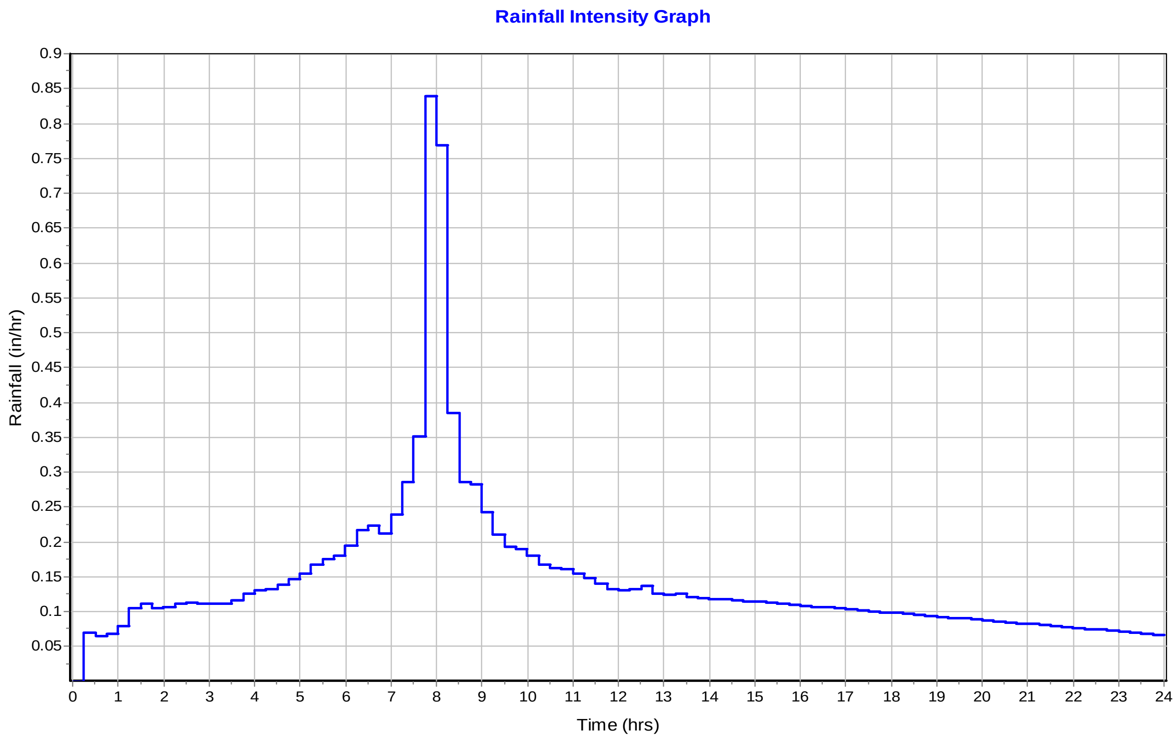
Composite Curve Number

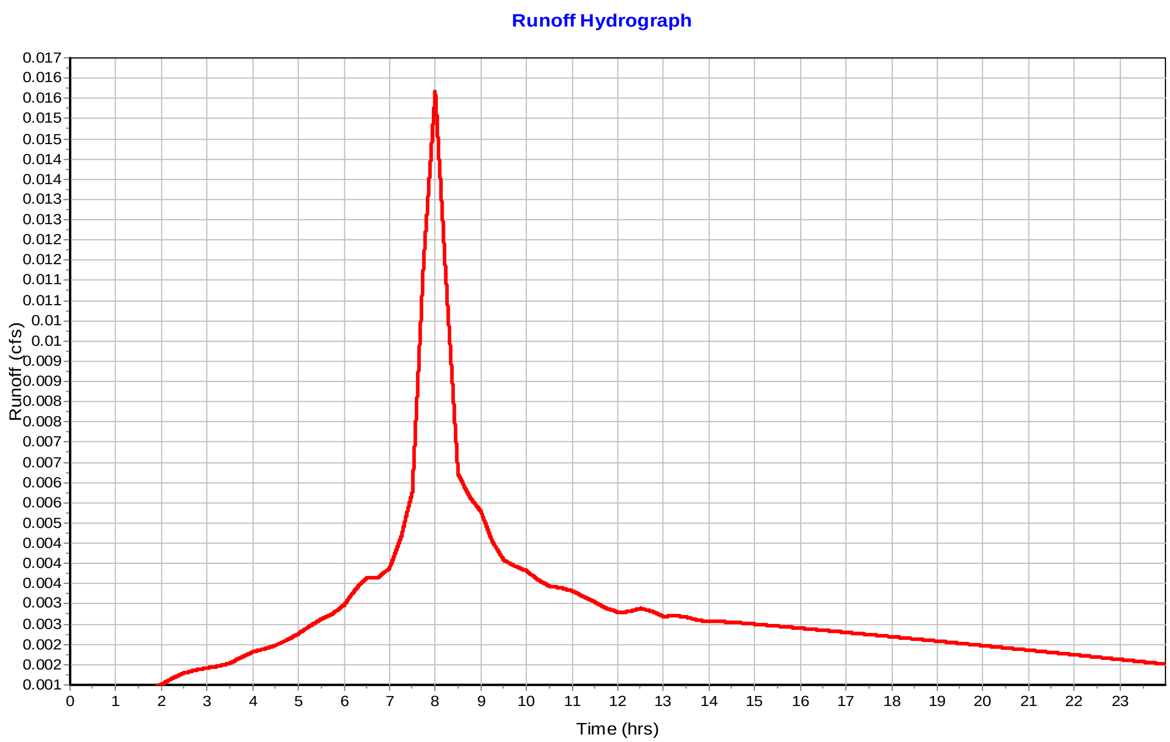
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.03		90.3

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.57
Peak Runoff (cfs)	0.02
Weighted Curve Number	90.3
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 25





Subbasin : SDCB 27

Input Data

Area (ac)	0.49
Impervious Area (%)	76
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

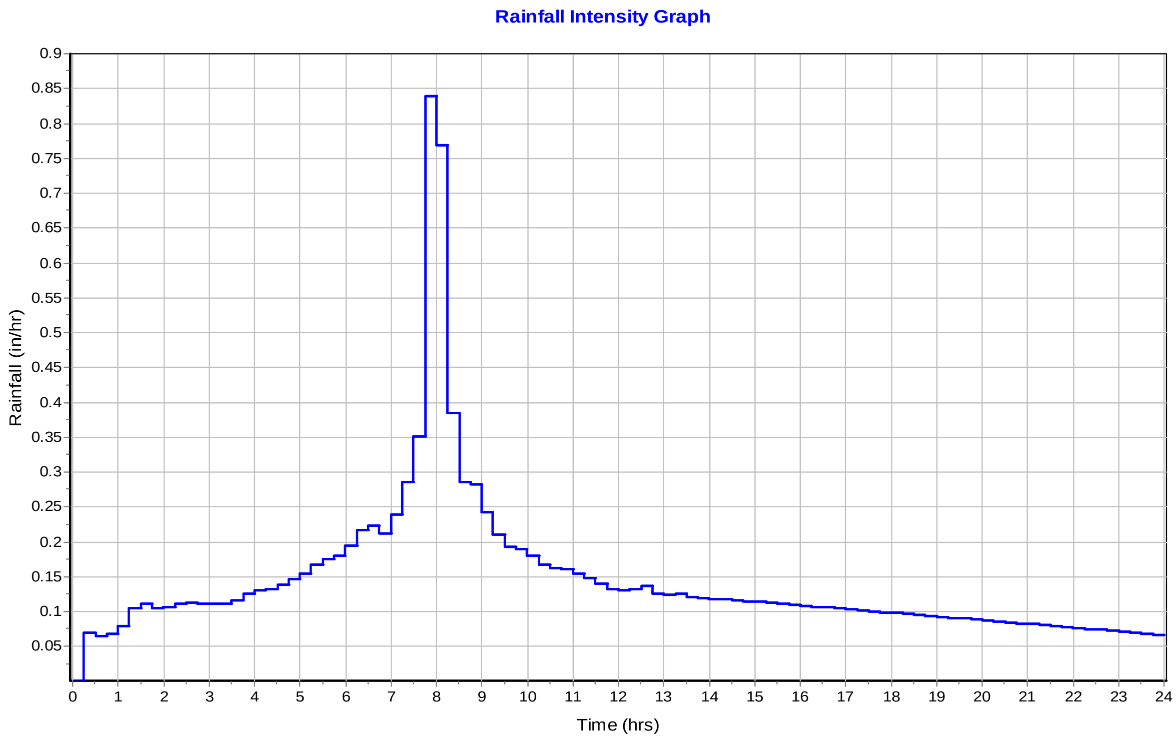
Composite Curve Number

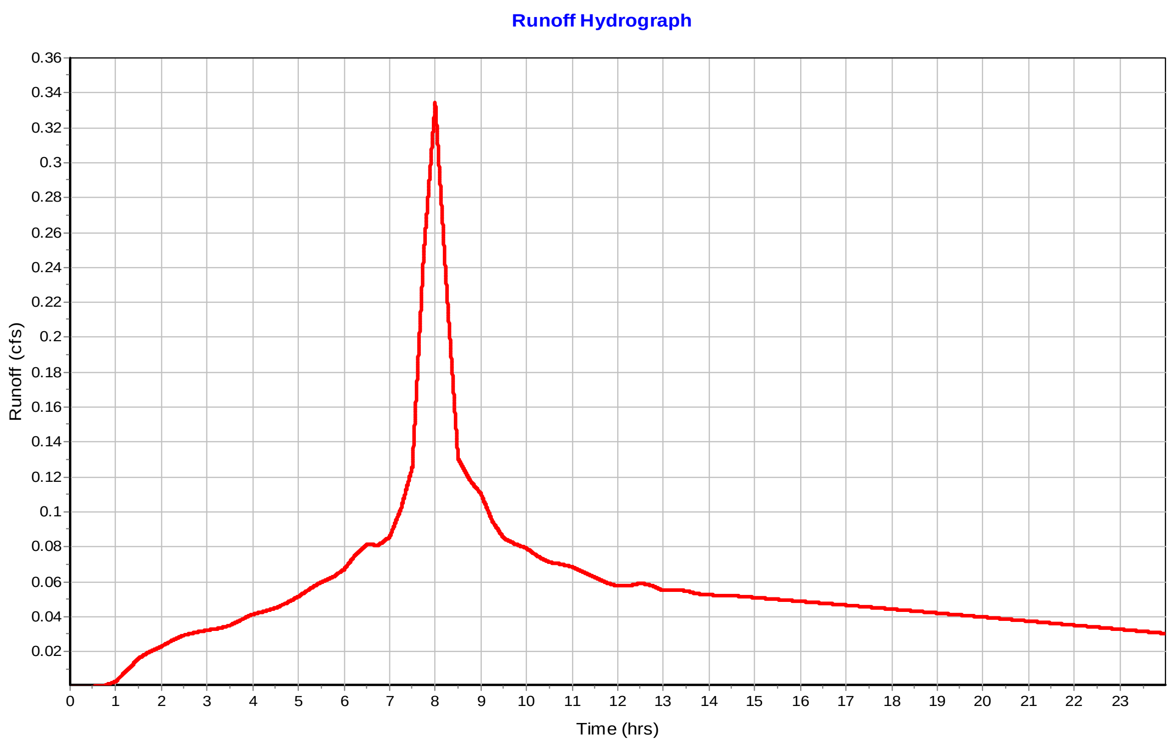
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.49		92.72

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.78
Peak Runoff (cfs)	0.33
Weighted Curve Number	92.72
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 27





Subbasin : SDCB 28

Input Data

Area (ac)	0.2
Impervious Area (%)	73
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

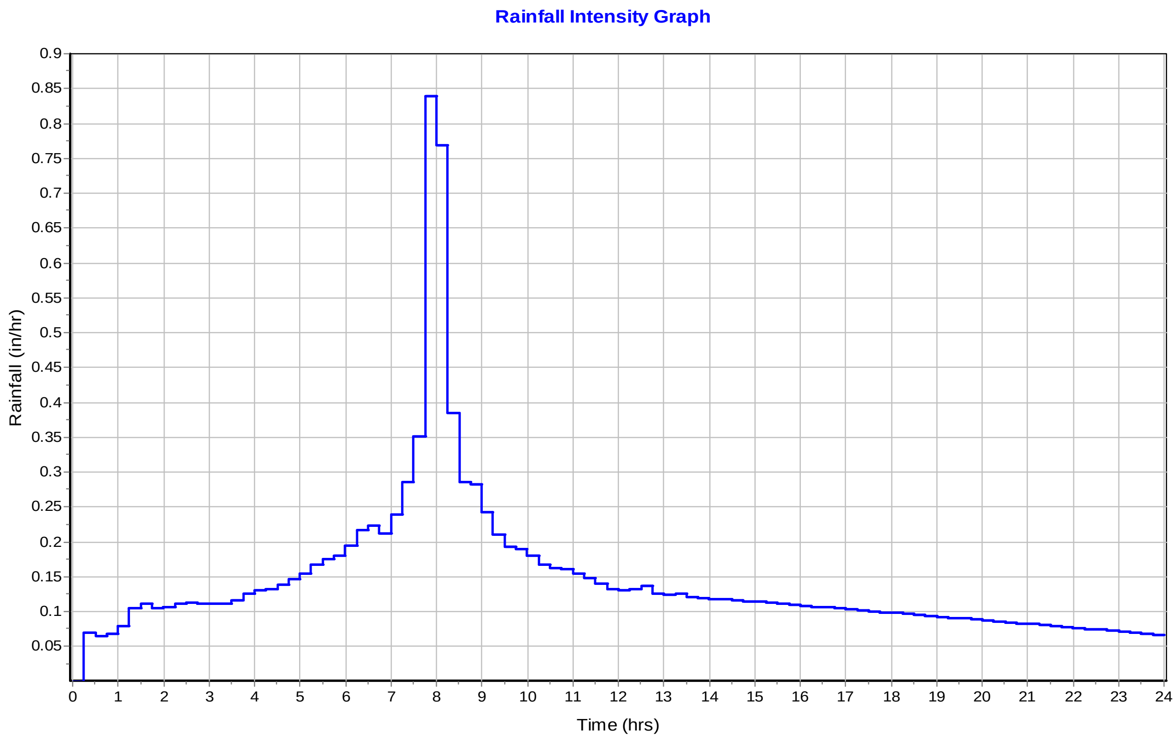
Composite Curve Number

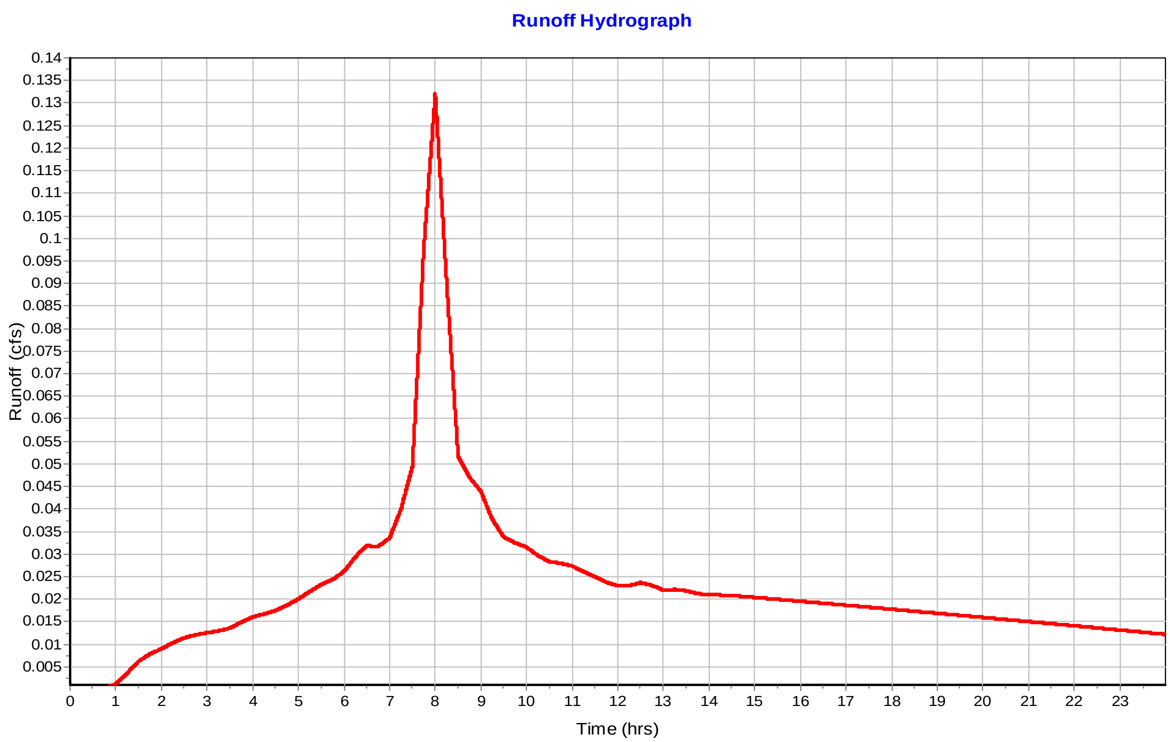
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.2		92.06

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.73
Peak Runoff (cfs)	0.13
Weighted Curve Number	92.06
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 28





Subbasin : SDCB 29

Input Data

Area (ac)	0.2
Impervious Area (%)	79
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

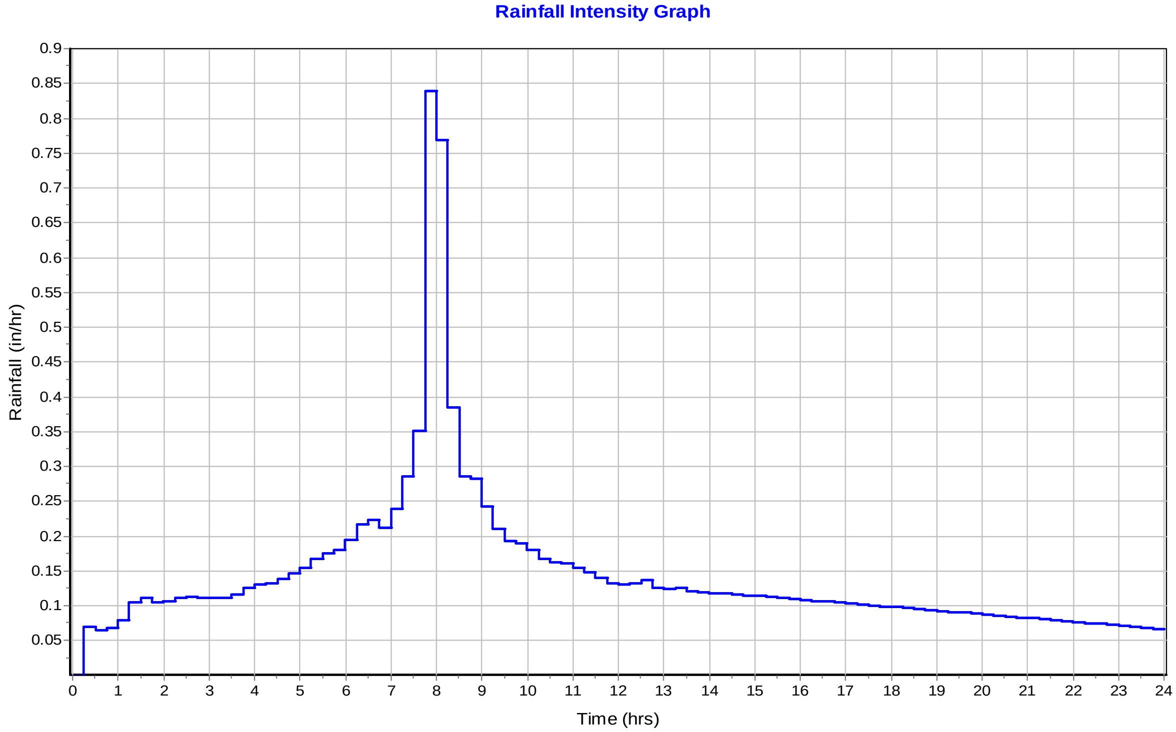
Composite Curve Number

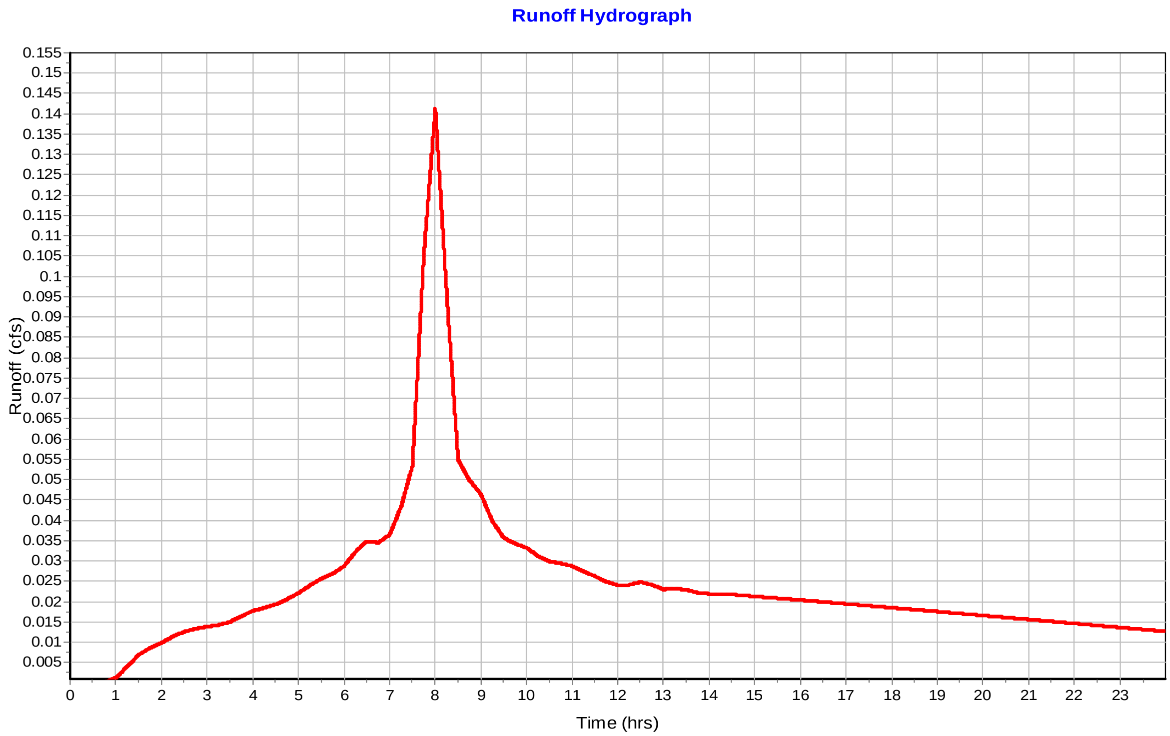
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.2		93.38

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.84
Peak Runoff (cfs)	0.14
Weighted Curve Number	93.38
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 29





Subbasin : SDCB 30

Input Data

Area (ac) 0.43
Impervious Area (%) 77
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

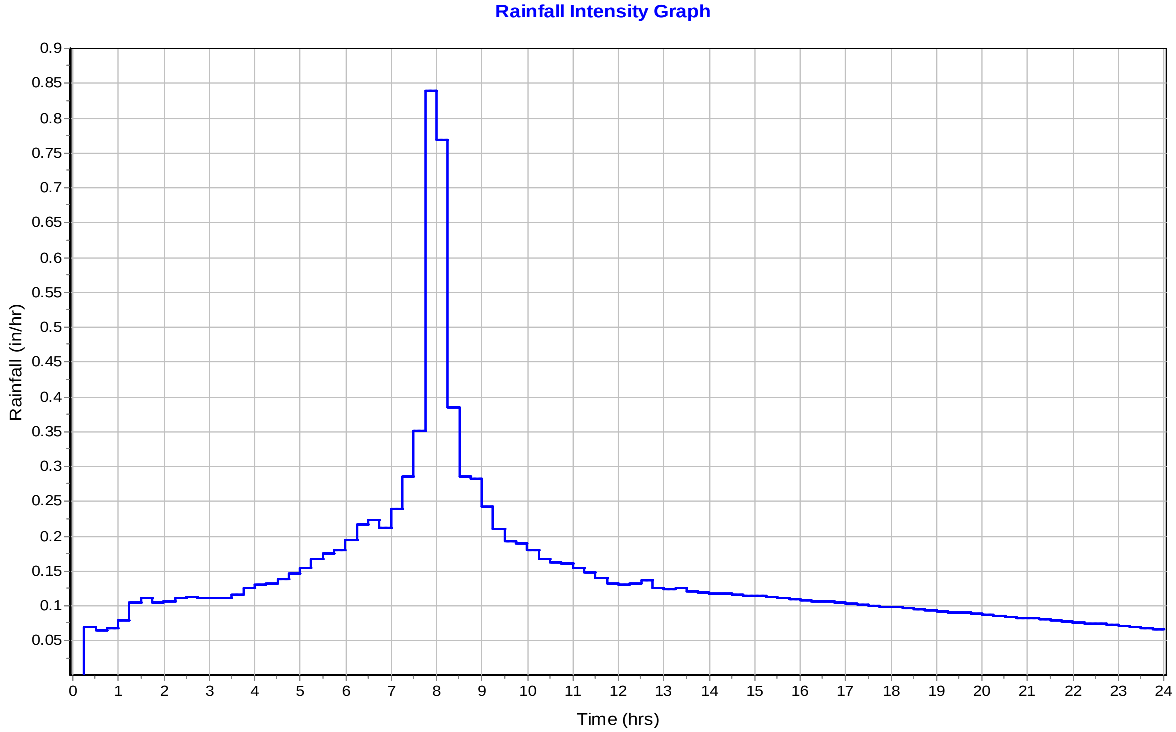
Composite Curve Number

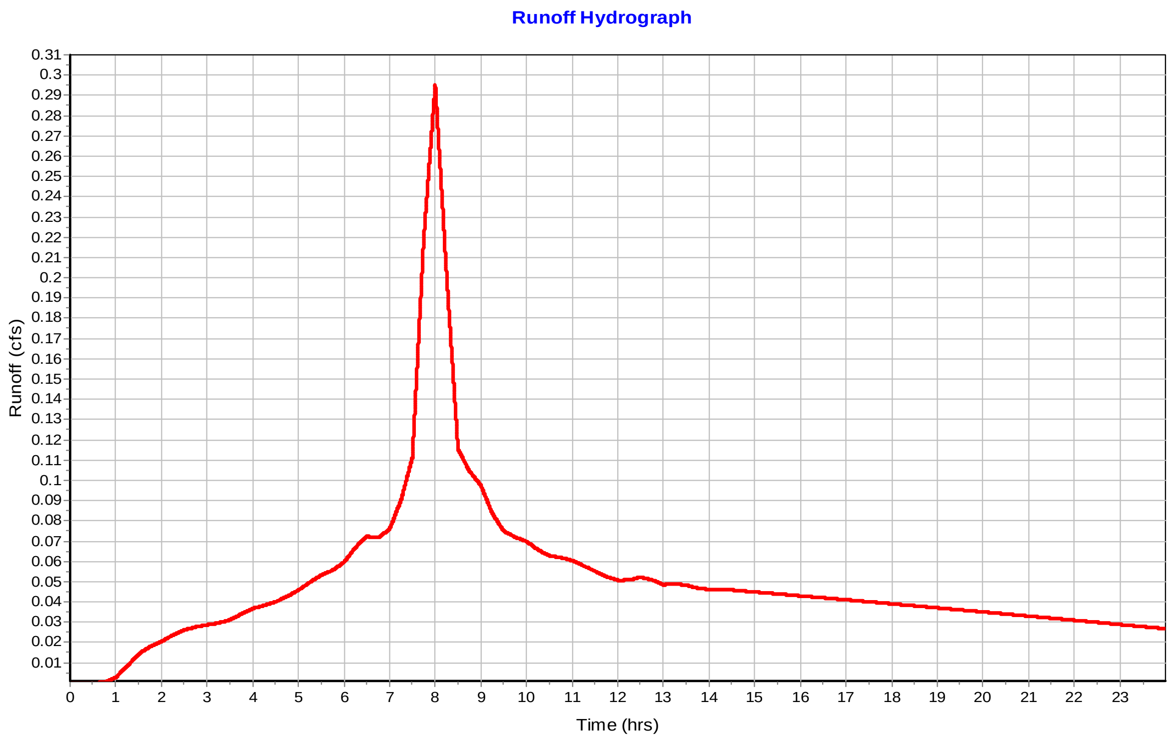
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.43		92.94

Subbasin Runoff Results

Total Rainfall (in) 3.46
Total Runoff (in) 2.8
Peak Runoff (cfs) 0.3
Weighted Curve Number 92.94
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : SDCB 30





Subbasin : SDCB 31

Input Data

Area (ac)	0.52
Impervious Area (%)	26
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

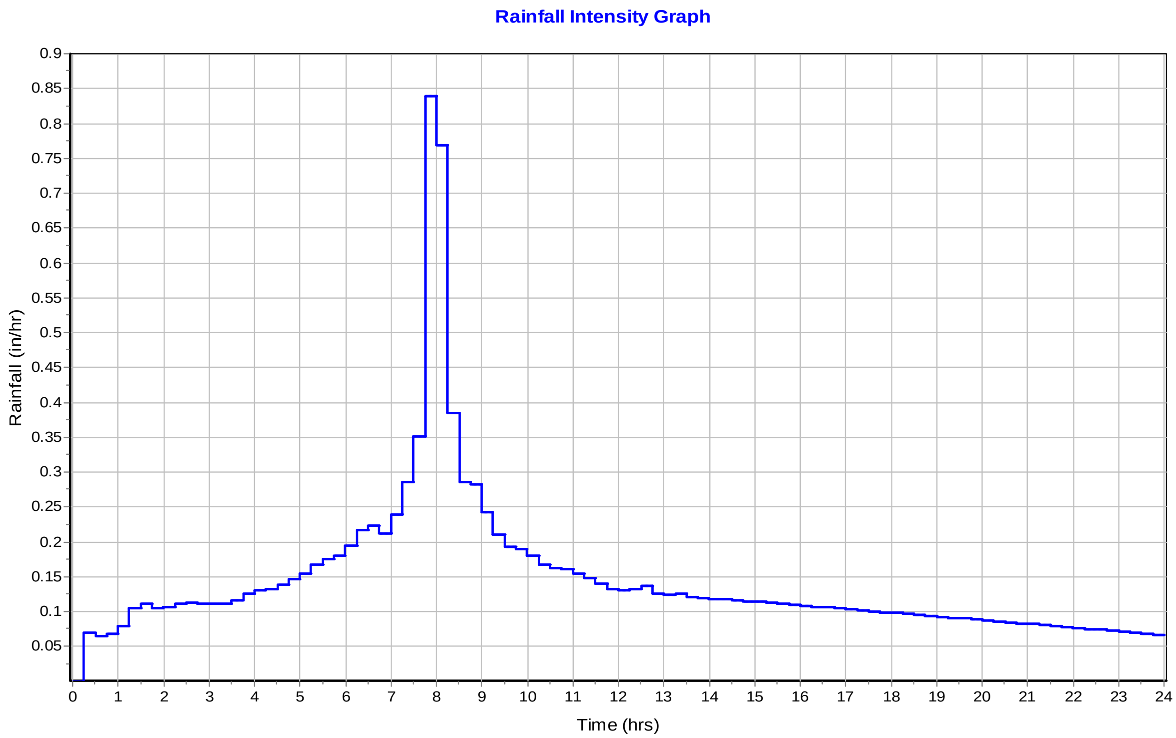
Composite Curve Number

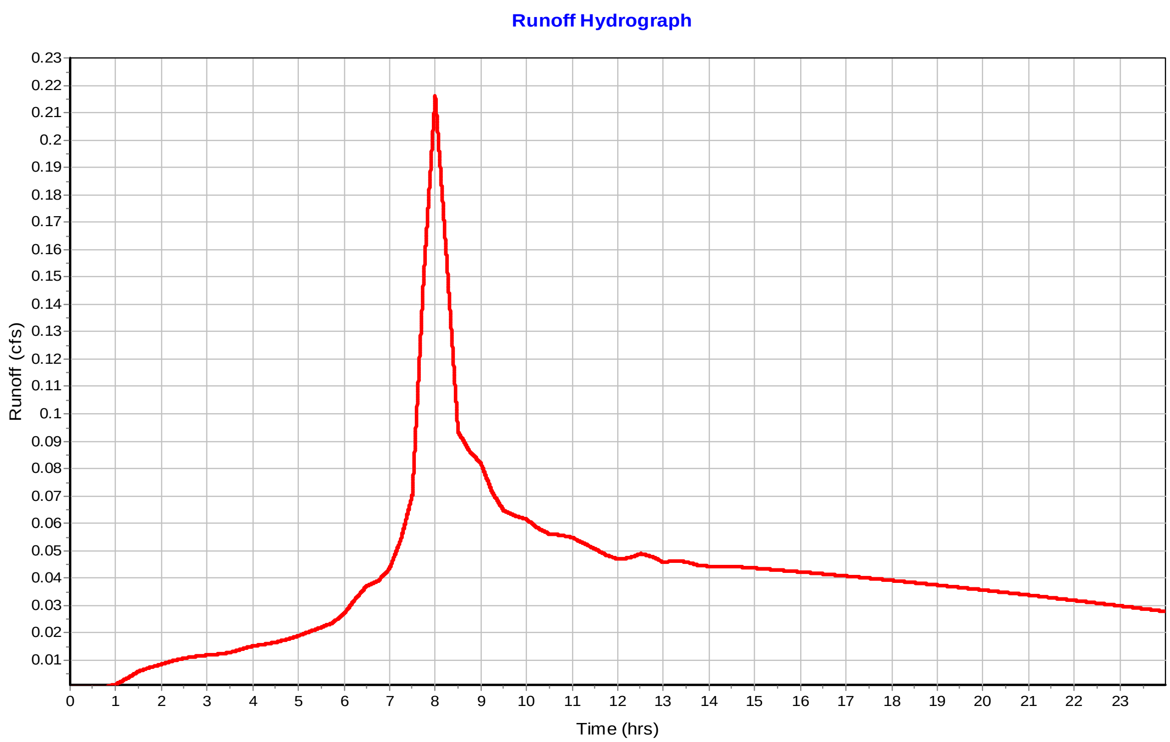
32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.52		81.72

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	1.84
Peak Runoff (cfs)	0.22
Weighted Curve Number	81.72
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 31





Subbasin : SDCB 32

Input Data

Area (ac)	0.19
Impervious Area (%)	73
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

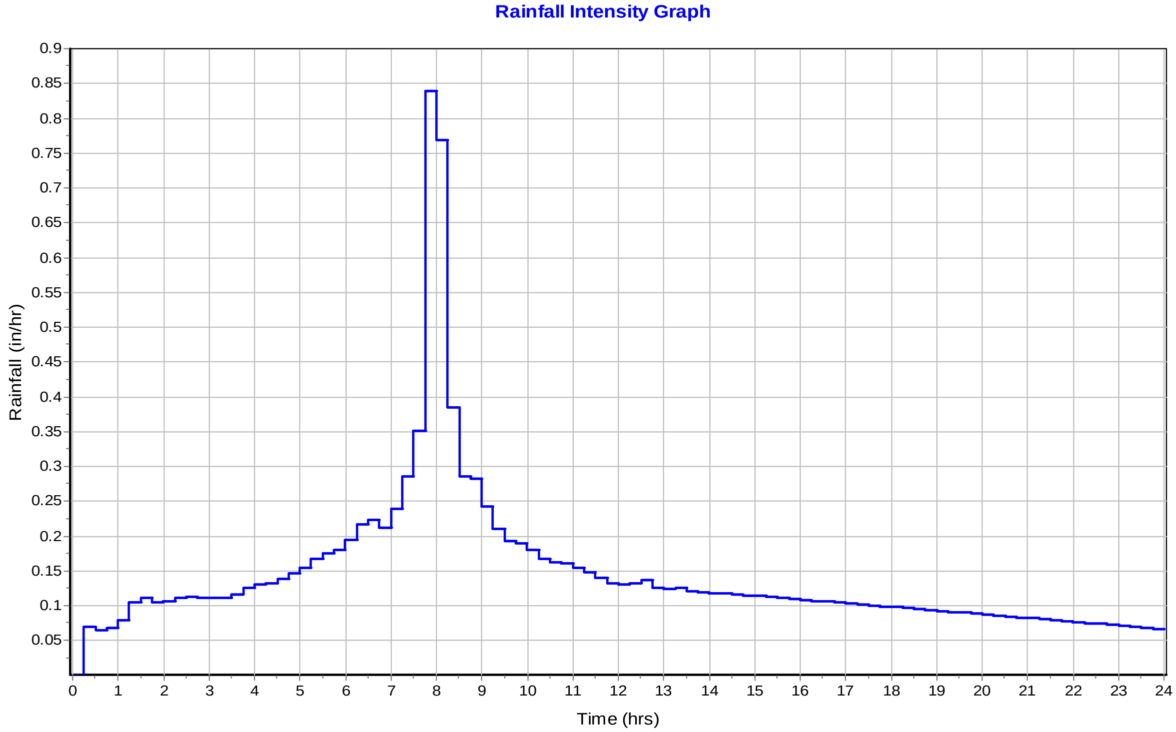
Composite Curve Number

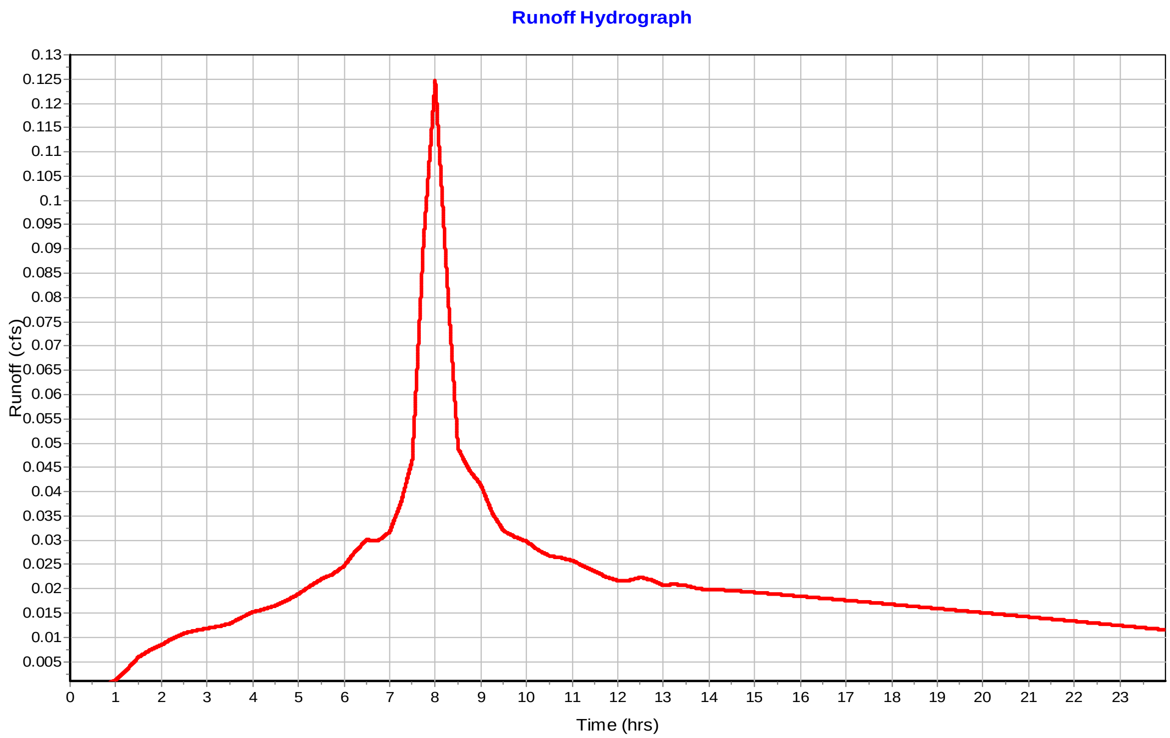
Soil/Surface Description 32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.19		92.06

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.73
Peak Runoff (cfs)	0.13
Weighted Curve Number	92.06
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 32





Subbasin : SDCB 33

Input Data

Area (ac)	0.23
Impervious Area (%)	83
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

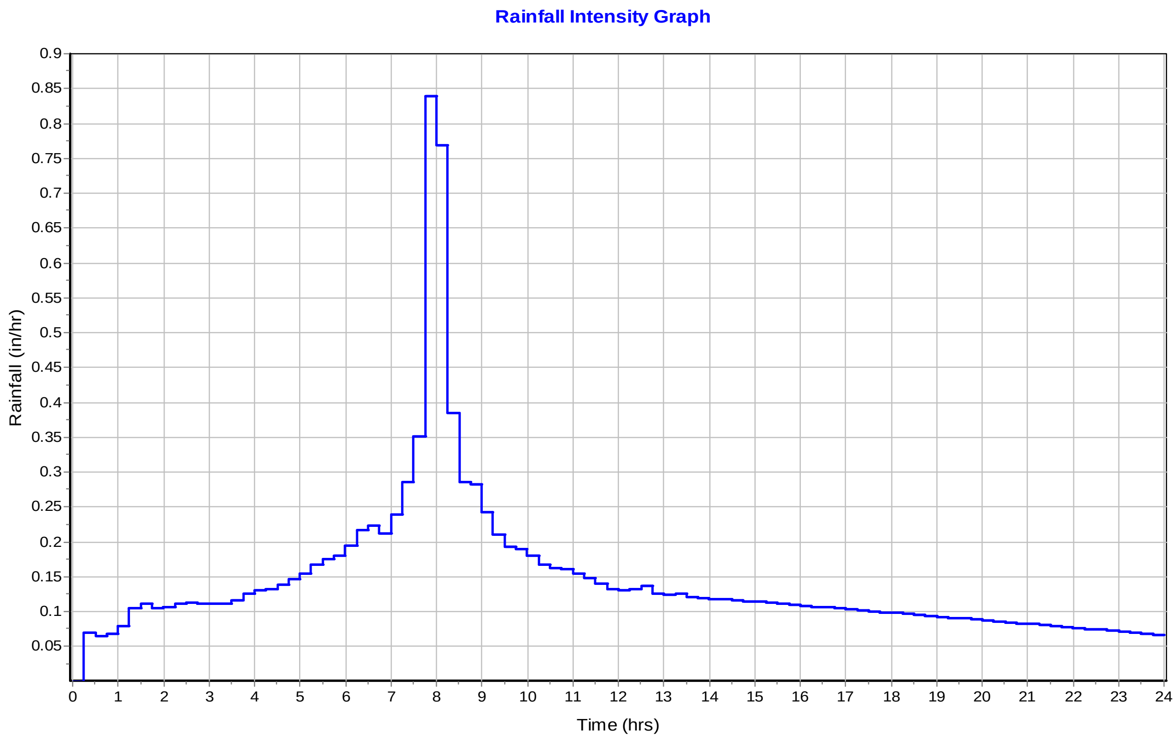
Composite Curve Number

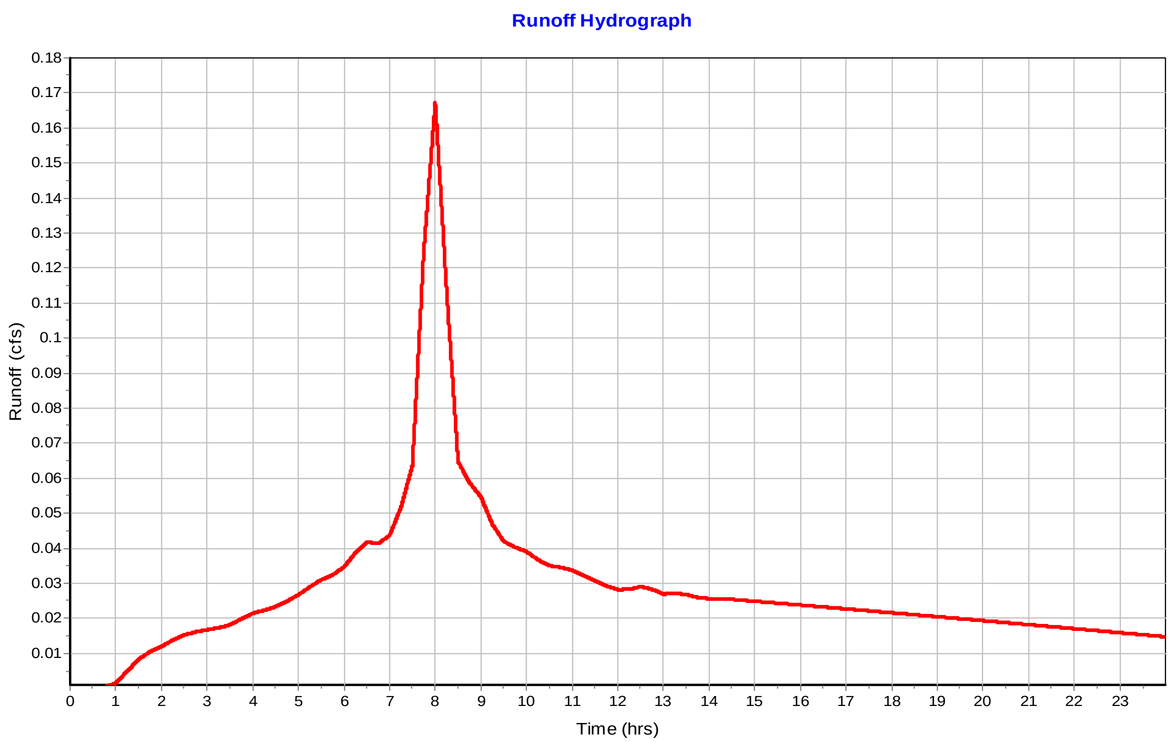
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.23		94.26

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.91
Peak Runoff (cfs)	0.17
Weighted Curve Number	94.26
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 33





Subbasin : SDCB 34

Input Data

Area (ac)	0.14
Impervious Area (%)	76
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

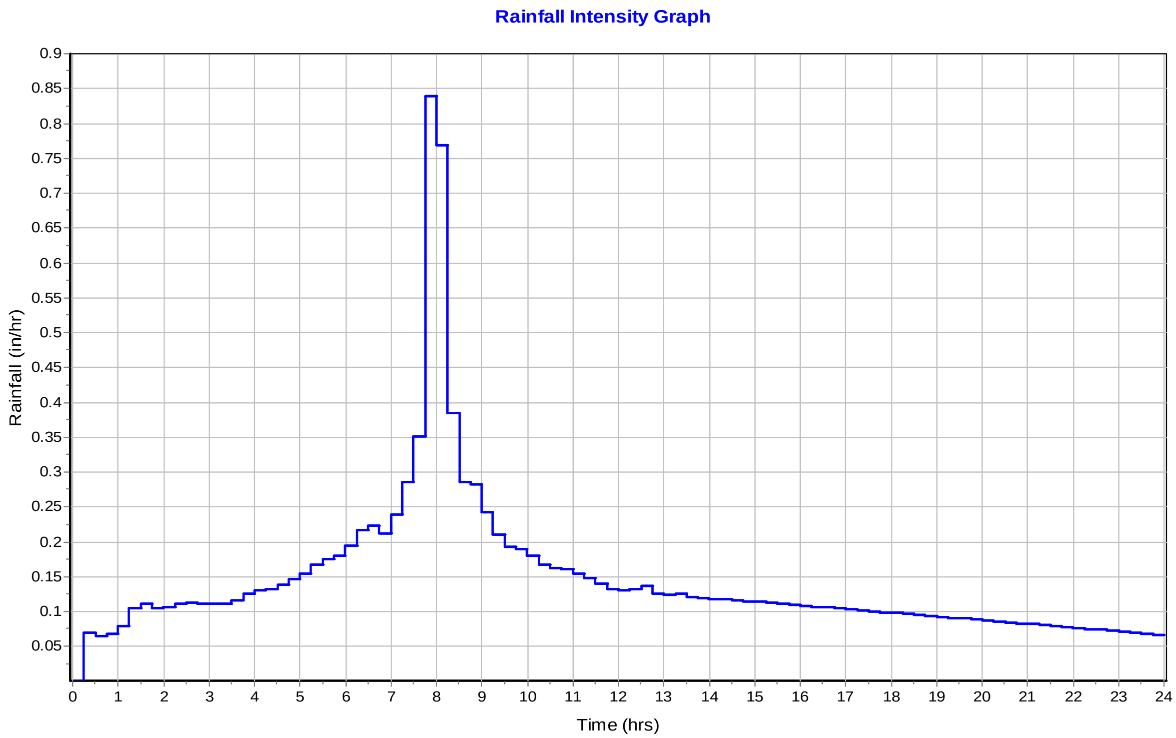
Composite Curve Number

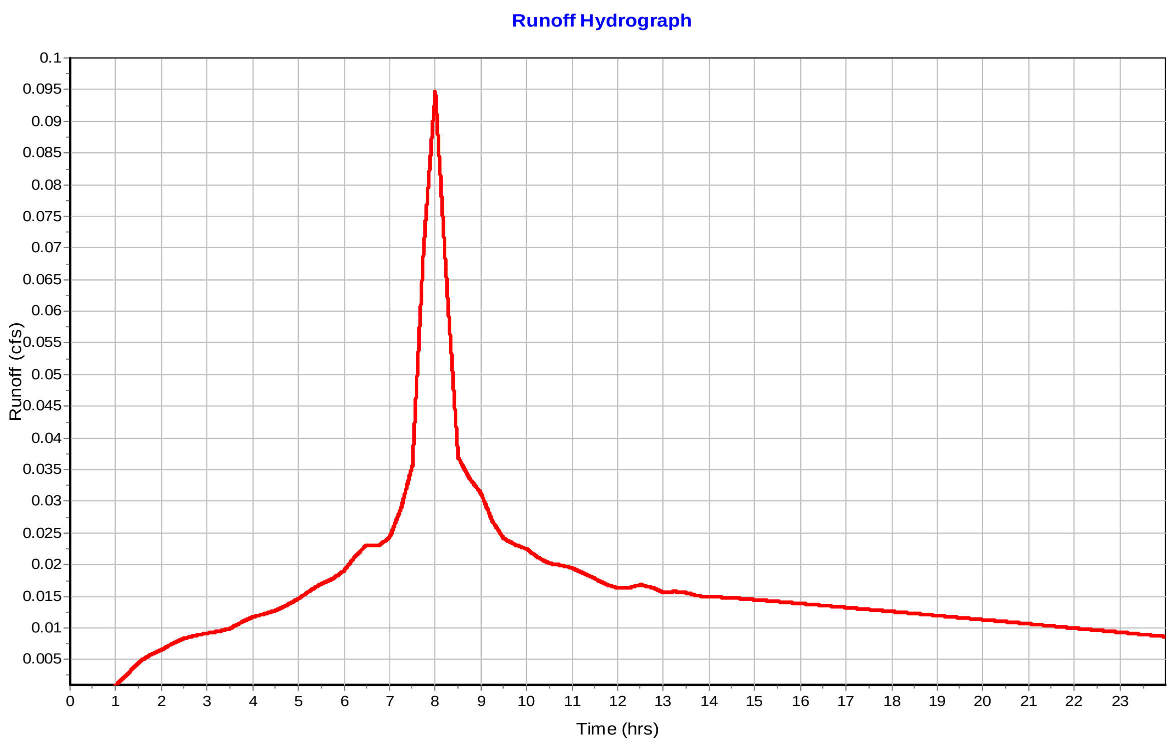
Soil/Surface Description 32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	0.14		92.72

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.78
Peak Runoff (cfs)	0.1
Weighted Curve Number	92.72
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 34





Subbasin : SDCB 36

Input Data

Area (ac)	0.36
Impervious Area (%)	79
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

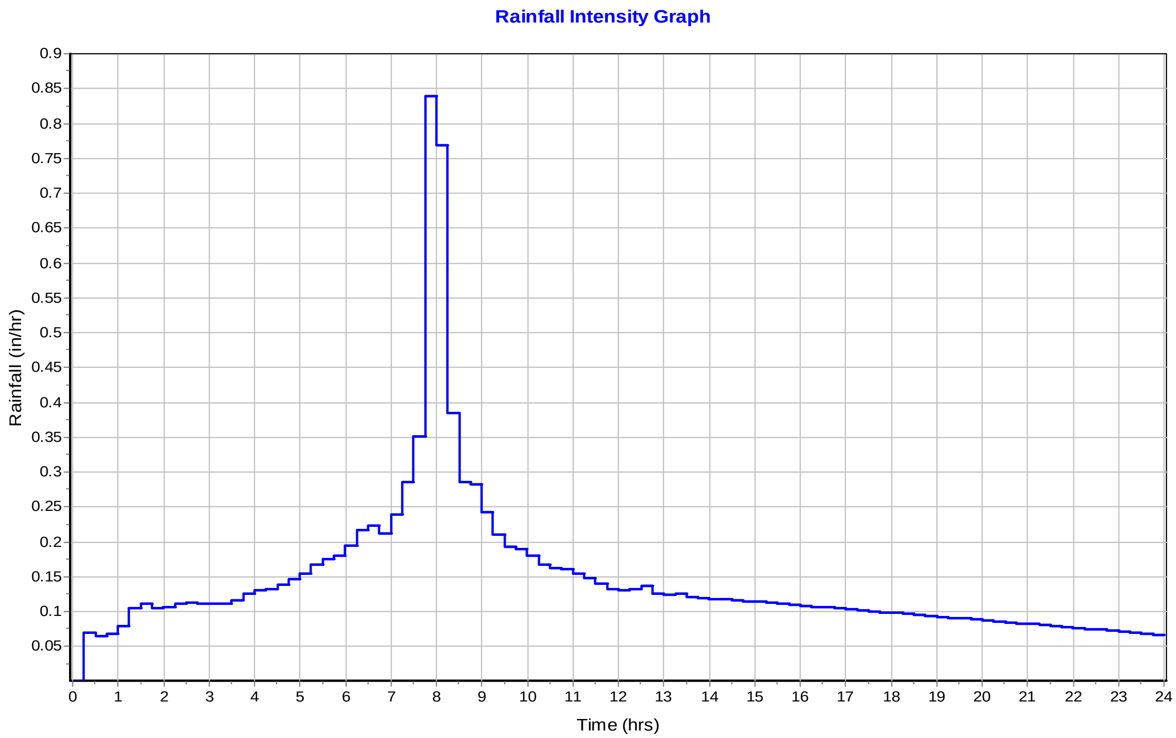
Composite Curve Number

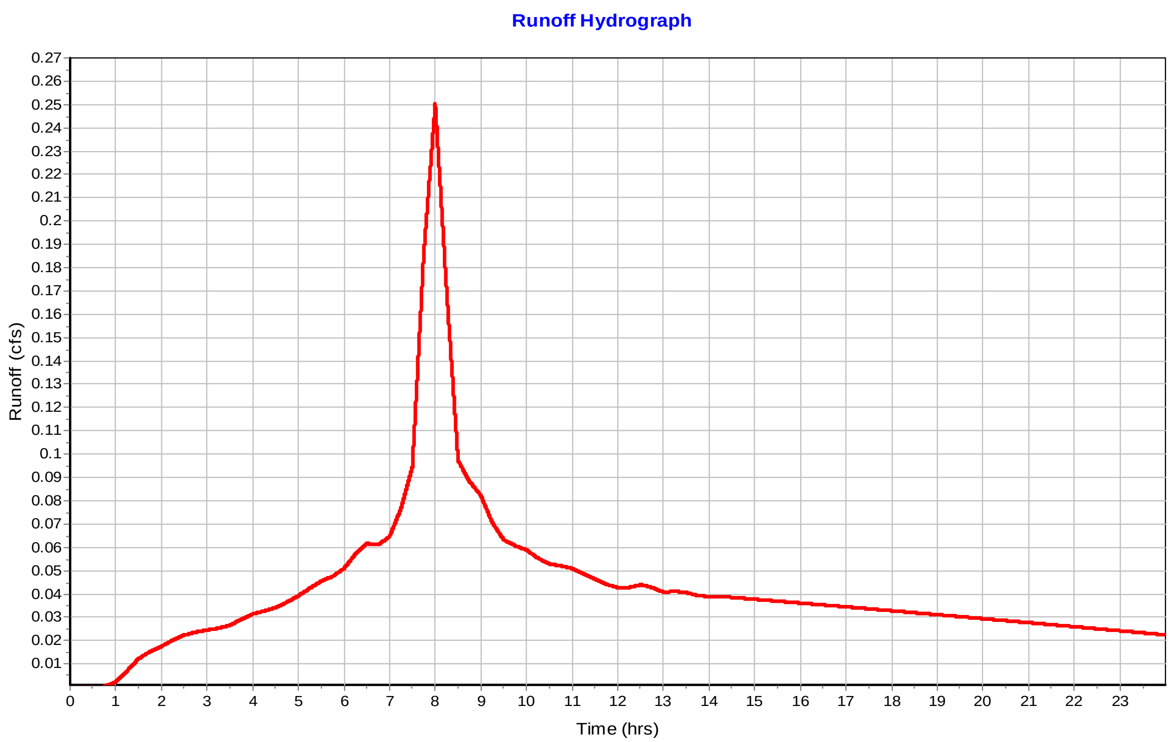
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.36		93.38

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.84
Peak Runoff (cfs)	0.25
Weighted Curve Number	93.38
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 36





Subbasin : SDCB 37

Input Data

Area (ac)	0.07
Impervious Area (%)	96
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

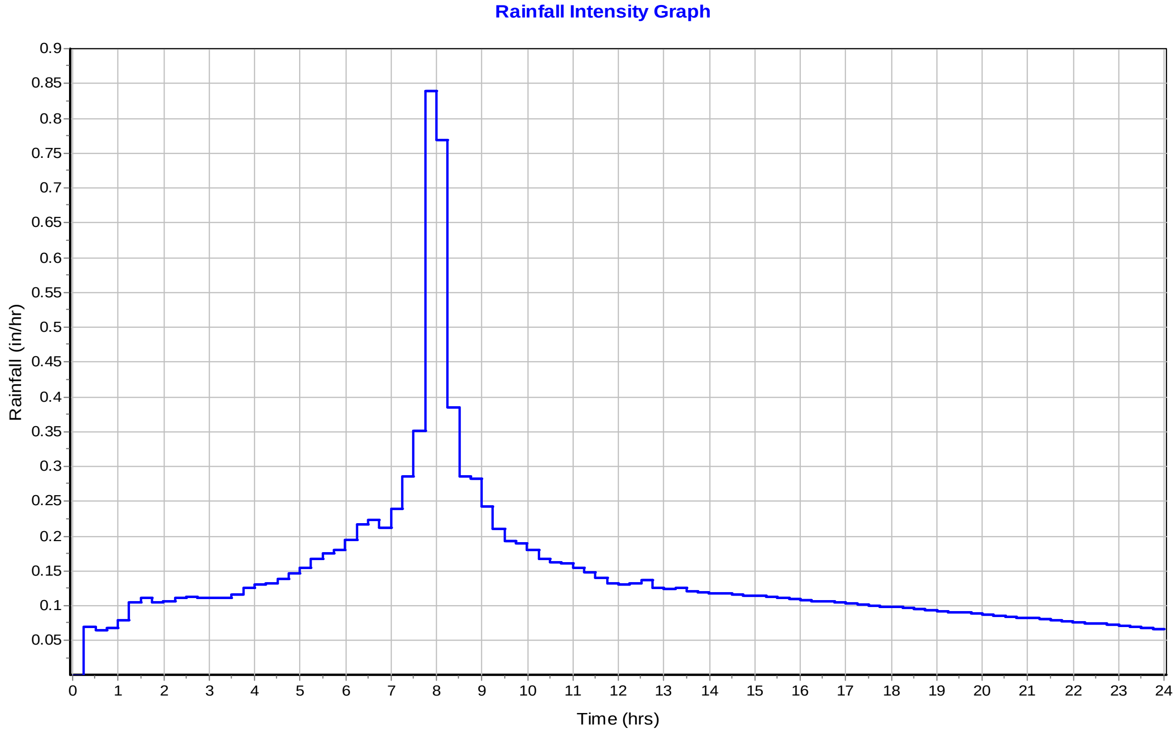
Composite Curve Number

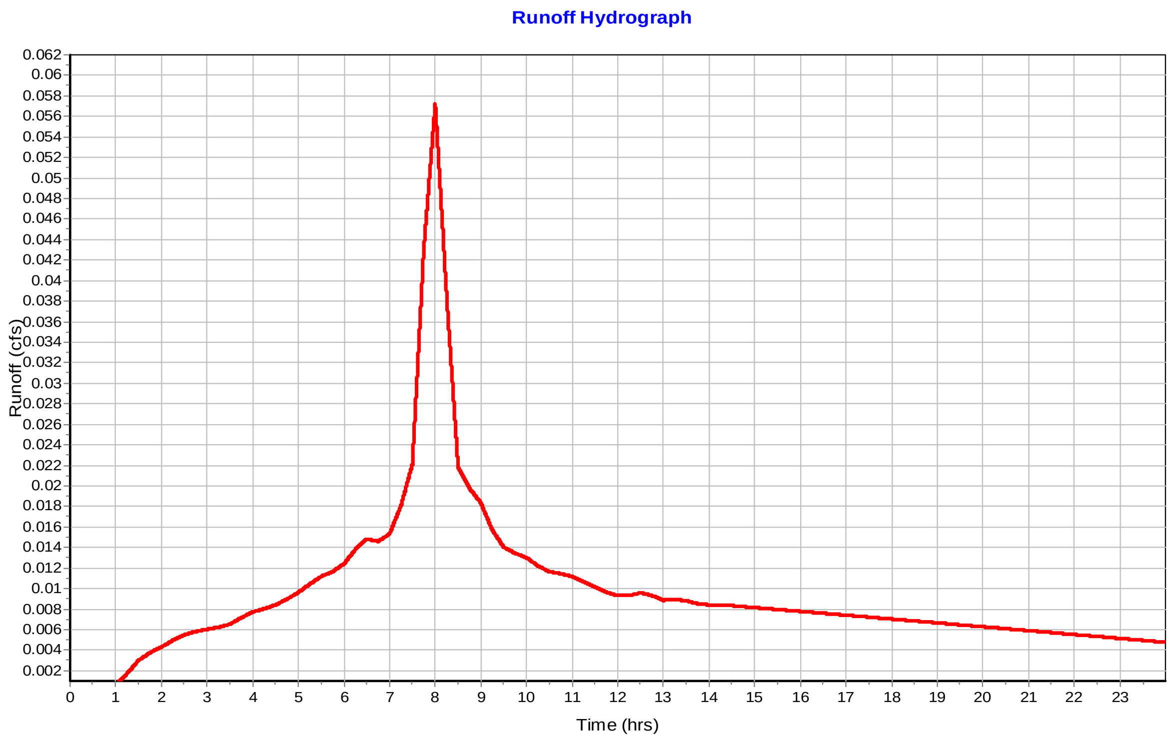
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.07		97.12

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	3.16
Peak Runoff (cfs)	0.06
Weighted Curve Number	97.12
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 37





Subbasin : SDCB 38

Input Data

Area (ac)	0.25
Impervious Area (%)	72
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

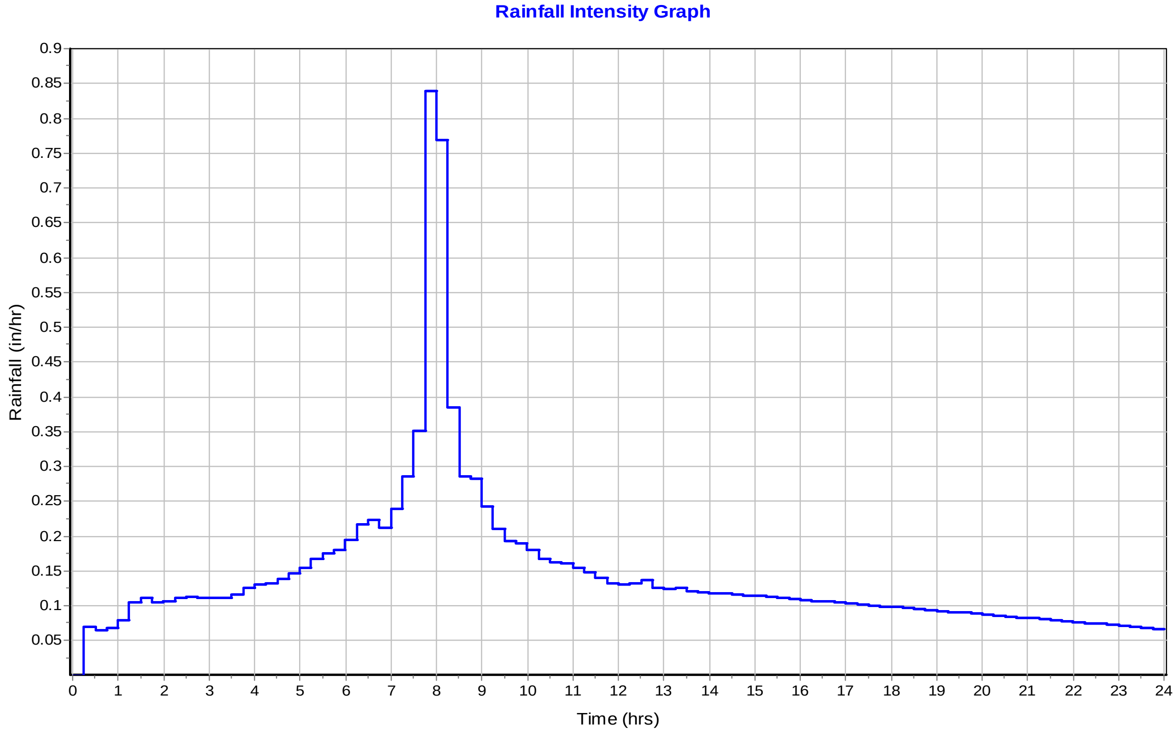
Composite Curve Number

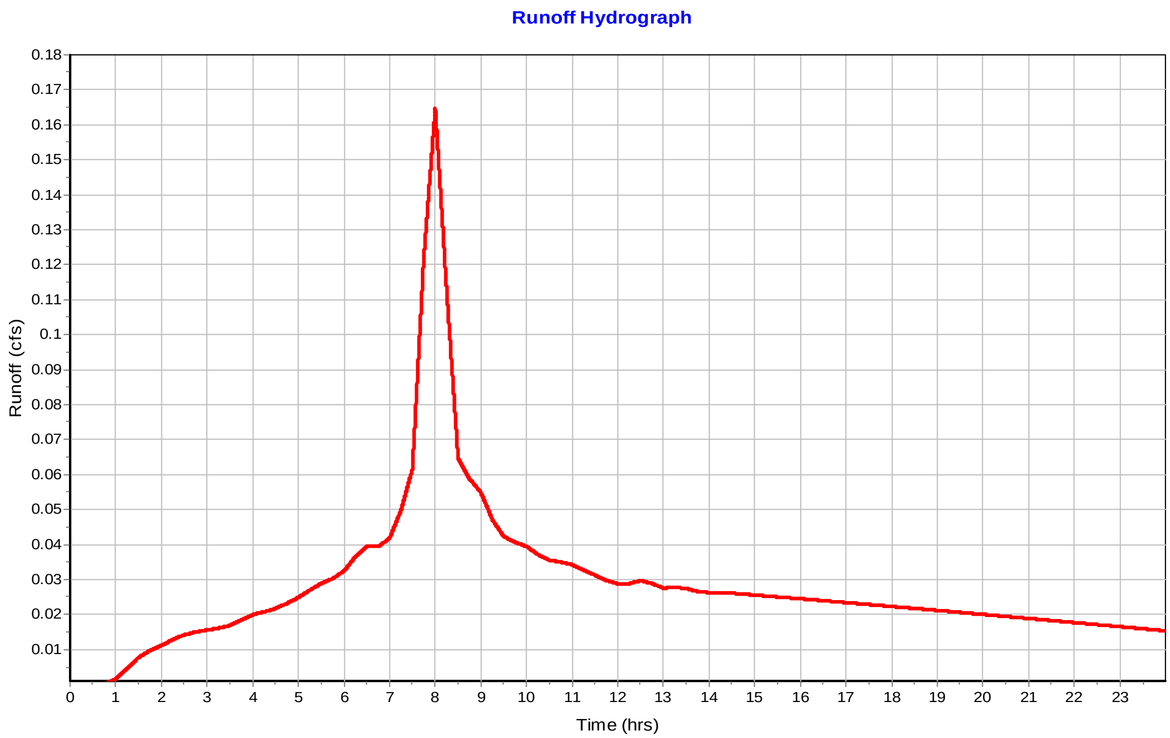
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.25		91.84

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	2.71
Peak Runoff (cfs)	0.17
Weighted Curve Number	91.84
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 38





Subbasin : SDCB 40

Input Data

Area (ac)	0.11
Impervious Area (%)	0
Impervious Area Curve Number	98
Pervious Area Curve Number	76
Rain Gage ID	Rain Gage-01

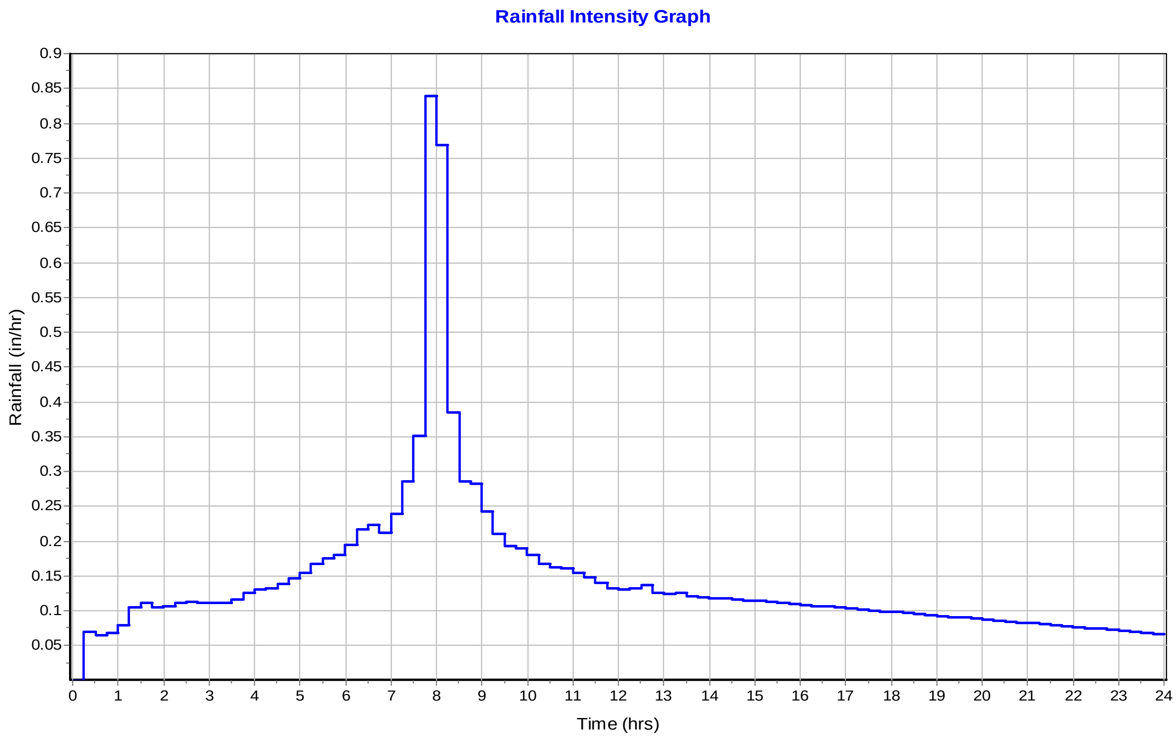
Composite Curve Number

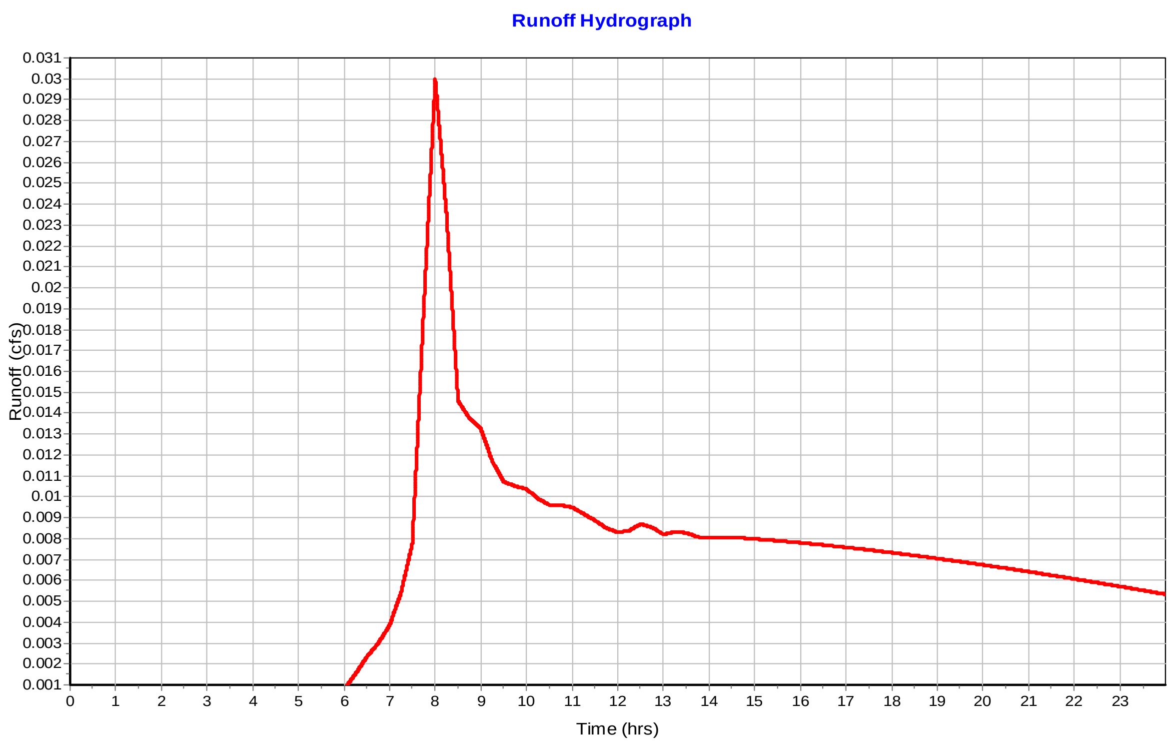
Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN		0.11		76

Subbasin Runoff Results

Total Rainfall (in)	3.46
Total Runoff (in)	1.34
Peak Runoff (cfs)	0.03
Weighted Curve Number	76
Time of Concentration (days hh:mm:ss)	0 00:06:00

Subbasin : SDCB 40





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	SDCB#01	66.90	74.84	7.94	67.40	0.50	0.00	-74.84	0.00	0.00
2	SDCB#02	69.50	72.40	2.90	0.00	-69.50	0.00	-72.40	0.00	22.84
3	SDCB#03	70.19	72.19	2.00	0.00	-70.19	0.00	-72.19	0.00	16.00
4	SDCB#04	70.47	72.64	2.17	0.00	-70.47	0.00	-72.64	0.00	18.04
5	SDCB#05	69.29	72.11	2.82	0.00	-69.29	0.00	-72.11	0.00	25.84
6	SDCB#06	69.06	73.03	3.97	0.00	-69.06	0.00	-73.03	0.00	39.64
7	SDCB#07	69.42	71.79	2.37	0.00	-69.42	0.00	-71.79	0.00	20.44
8	SDCB#08	69.67	72.45	2.78	0.00	-69.67	0.00	-72.45	0.00	25.36
9	SDCB#09	68.51	72.35	3.84	0.00	-68.51	0.00	-72.35	0.00	34.08
10	SDCB#10	67.90	76.96	9.06	68.40	0.50	0.00	-76.96	0.00	0.00
11	SDCB#11	73.48	76.58	3.10	0.00	-73.48	0.00	-76.58	0.00	29.20
12	SDCB#12	73.83	76.54	2.71	0.00	-73.83	0.00	-76.54	0.00	24.52
13	SDCB#13	73.87	76.58	2.71	0.00	-73.87	0.00	-76.58	0.00	24.52
14	SDCB#14	71.89	76.31	4.42	0.00	-71.89	0.00	-76.31	0.00	41.04
15	SDCB#15	71.68	76.25	4.57	0.00	-71.68	0.00	-76.25	0.00	42.84
16	SDCB#16	72.23	76.36	4.13	0.00	-72.23	0.00	-76.36	0.00	37.48
17	SDCB#17	72.75	76.55	3.80	0.00	-72.75	0.00	-76.55	0.00	37.60
18	SDCB#18	68.40	76.69	8.29	0.00	-68.40	0.00	-76.69	0.00	75.48
19	SDCB#19	70.35	75.25	4.90	0.00	-70.35	0.00	-75.25	0.00	46.80
20	SDCB#20	70.98	75.25	4.27	0.00	-70.98	0.00	-75.25	0.00	39.24
21	SDCB#21	71.81	75.25	3.44	0.00	-71.81	0.00	-75.25	0.00	33.28
22	SDCB#22	71.36	75.25	3.89	0.00	-71.36	0.00	-75.25	0.00	34.68
23	SDCB#23	71.93	75.25	3.32	0.00	-71.93	0.00	-75.25	0.00	27.84
24	SDCB#24	72.61	75.25	2.64	0.00	-72.61	0.00	-75.25	0.00	23.68
25	SDCB#25	72.79	75.25	2.46	0.00	-72.79	0.00	-75.25	0.00	21.52
26	SDCB#26	68.40	76.79	8.39	0.00	-68.40	0.00	-76.79	0.00	76.68
27	SDCB#27	71.20	75.25	4.05	0.00	-71.20	0.00	-75.25	0.00	36.52
28	SDCB#28	72.15	75.25	3.10	0.00	-72.15	0.00	-75.25	0.00	29.20
29	SDCB#29	71.72	75.40	3.68	0.00	-71.72	0.00	-75.40	0.00	32.16
30	SDCB#30	72.69	75.40	2.71	0.00	-72.69	0.00	-75.40	0.00	24.52
31	SDCB#31	70.25	77.16	6.91	0.00	-70.25	0.00	-77.16	0.00	70.92
32	SDCB#32	72.60	75.25	2.65	0.00	-72.60	0.00	-75.25	0.00	23.80
33	SDCB#33	70.81	75.25	4.44	0.00	-70.81	0.00	-75.25	0.00	41.28
34	SDCB#34	71.52	75.25	3.73	0.00	-71.52	0.00	-75.25	0.00	36.76
35	SDCB#35	68.40	77.00	8.60	0.00	-68.40	0.00	-77.00	0.00	79.20
36	SDCB#36	70.59	75.26	4.67	0.00	-70.59	0.00	-75.26	0.00	43.96
37	SDCB#37	71.52	75.67	4.15	0.00	-71.52	0.00	-75.67	0.00	41.80
38	SDCB#38	71.88	75.26	3.38	0.00	-71.88	0.00	-75.26	0.00	32.56
39	SDCB#40	73.22	76.27	3.05	0.00	-73.22	0.00	-76.27	0.00	24.60
40	SDCO#A1	72.71	76.38	3.67	0.00	-72.71	0.00	-76.38	0.00	36.00
41	SDCO#A2	73.21	76.54	3.33	0.00	-73.21	0.00	-76.54	0.00	33.96
42	SDCO#A3	74.00	75.03	1.03	0.00	-74.00	0.00	-75.03	0.00	6.36
43	SDCO#A4	73.96	75.89	1.93	0.00	-73.96	0.00	-75.89	0.00	17.16
44	SDCO#A5	73.23	76.82	3.59	0.00	-73.23	0.00	-76.82	0.00	37.08
45	SDCO#B1	74.33	78.08	3.75	0.00	-74.33	0.00	-78.08	0.00	36.96
46	SDCO#B2	75.11	77.80	2.69	0.00	-75.11	0.00	-77.80	0.00	26.28
47	SDCO#B3	75.28	77.92	2.64	0.00	-75.28	0.00	-77.92	0.00	25.68
48	SDCO#B4	75.41	77.95	2.54	0.00	-75.41	0.00	-77.95	0.00	24.48
49	SDCO#B5	71.99	78.08	6.09	0.00	-71.99	0.00	-78.08	0.00	67.08
50	SDCO#B6	72.81	78.02	5.21	0.00	-72.81	0.00	-78.02	0.00	56.52
51	SDCO#B7	72.87	77.95	5.08	0.00	-72.87	0.00	-77.95	0.00	54.96
52	SDCO#B8	72.81	78.02	5.21	0.00	-72.81	0.00	-78.02	0.00	56.52
53	SDCO#C1	72.21	76.85	4.64	0.00	-72.21	0.00	-76.85	0.00	37.68
54	SDCO#C10	72.74	76.81	4.07	0.00	-72.74	0.00	-76.81	0.00	41.16
55	SDCO#C2	74.28	76.87	2.59	0.00	-74.28	0.00	-76.87	0.00	25.08
56	SDCO#C3	74.37	76.91	2.54	0.00	-74.37	0.00	-76.91	0.00	24.48
57	SDCO#C4	74.29	76.83	2.54	0.00	-74.29	0.00	-76.83	0.00	24.48
58	SDCO#C5	71.44	76.97	5.53	0.00	-71.44	0.00	-76.97	0.00	56.76
59	SDCO#C6	72.54	77.11	4.57	0.00	-72.54	0.00	-77.11	0.00	48.84
60	SDCO#C7	72.66	76.99	4.33	0.00	-72.66	0.00	-76.99	0.00	45.96
61	SDCO#C8	72.19	76.97	4.78	0.00	-72.19	0.00	-76.97	0.00	51.36
62	SDCO#C9	72.19	76.88	4.69	0.00	-72.19	0.00	-76.88	0.00	48.60
63	SDCO#CLUB1	72.38	76.33	3.95	0.00	-72.38	0.00	-76.33	0.00	41.40
64	SDCO#CLUB2	72.72	76.59	3.87	0.00	-72.72	0.00	-76.59	0.00	40.44
65	SDCO#CLUB3	73.13	76.45	3.32	0.00	-73.13	0.00	-76.45	0.00	33.84
66	SDCO#CLUB4	72.72	76.62	3.90	0.00	-72.72	0.00	-76.62	0.00	40.80
67	SDCO#CLUB5	73.15	76.43	3.28	0.00	-73.15	0.00	-76.43	0.00	33.36
68	SDCO#COM01	70.38	73.56	3.18	0.00	-70.38	0.00	-73.56	0.00	30.16
69	SDCO#COM02	71.03	73.51	2.48	0.00	-71.03	0.00	-73.51	0.00	23.76

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
70	SDCO#COM03	71.46	73.53	2.07	0.00	-71.46	0.00	-73.53	0.00	16.68
71	SDCO#COM04	71.11	73.59	2.48	0.00	-71.11	0.00	-73.59	0.00	23.76
72	SDCO#COM05	71.34	73.62	2.28	0.00	-71.34	0.00	-73.62	0.00	21.36
73	SDCO#COM06	71.98	73.47	1.49	0.00	-71.98	0.00	-73.47	0.00	12.48
74	SDCO#COM07	70.58	73.18	2.60	0.00	-70.58	0.00	-73.18	0.00	23.20
75	SDCO#COM08	71.11	73.55	2.44	0.00	-71.11	0.00	-73.55	0.00	23.28
76	SDCO#COM09	70.17	73.63	3.46	0.00	-70.17	0.00	-73.63	0.00	33.48
77	SDCO#COM10	71.09	73.63	2.54	0.00	-71.09	0.00	-73.63	0.00	24.48
78	SDCO#COM11	71.09	73.63	2.54	0.00	-71.09	0.00	-73.63	0.00	24.48
79	SDCO#COM12	70.17	72.88	2.71	0.00	-70.17	0.00	-72.88	0.00	24.48
80	SDCO#COM13	70.87	73.41	2.54	0.00	-70.87	0.00	-73.41	0.00	24.48
81	SDCO#D1	72.84	77.30	4.46	0.00	-72.84	0.00	-77.30	0.00	45.48
82	SDCO#D2	74.65	77.29	2.64	0.00	-74.65	0.00	-77.29	0.00	25.68
83	SDCO#D3	74.71	77.29	2.58	0.00	-74.71	0.00	-77.29	0.00	24.96
84	SDCO#D4	73.53	77.46	3.93	0.00	-73.53	0.00	-77.46	0.00	41.16
85	SDCO#D5	74.47	77.03	2.56	0.00	-74.47	0.00	-77.03	0.00	24.72
86	SDCO#D6	74.79	77.33	2.54	0.00	-74.79	0.00	-77.33	0.00	24.48
87	SDCO#D7	74.72	77.28	2.56	0.00	-74.72	0.00	-77.28	0.00	24.72
88	SDCO#E1	72.07	76.54	4.47	0.00	-72.07	0.00	-76.54	0.00	47.64
89	SDCO#E2	72.43	76.80	4.37	0.00	-72.43	0.00	-76.80	0.00	46.44
90	SDCO#E3	73.14	76.57	3.43	0.00	-73.14	0.00	-76.57	0.00	35.16
91	SDCO#E4	72.64	76.50	3.86	0.00	-72.64	0.00	-76.50	0.00	40.32
92	SDCO#E5	72.96	76.75	3.79	0.00	-72.96	0.00	-76.75	0.00	39.48
93	SDCO#E6	73.56	76.50	2.94	0.00	-73.56	0.00	-76.50	0.00	29.28
94	SDCO#E7	74.24	76.76	2.52	0.00	-74.24	0.00	-76.76	0.00	24.24
95	SDCO#F1	71.77	77.26	5.49	0.00	-71.77	0.00	-77.26	0.00	59.88
96	SDCO#F2	72.50	76.98	4.48	0.00	-72.50	0.00	-76.98	0.00	47.76
97	SDCO#F3	73.46	77.21	3.75	0.00	-73.46	0.00	-77.21	0.00	39.00
98	SDCO#G1	73.29	77.07	3.78	0.00	-73.29	0.00	-77.07	0.00	39.36
99	SDCO#G2	74.47	77.01	2.54	0.00	-74.47	0.00	-77.01	0.00	24.48
100	SDCO#G3	72.89	77.15	4.26	0.00	-72.89	0.00	-77.15	0.00	43.08
101	SDCO#G4	74.22	76.76	2.54	0.00	-74.22	0.00	-76.76	0.00	24.48
102	SDCO#H1	72.76	77.10	4.34	0.00	-72.76	0.00	-77.10	0.00	44.04
103	SDCO#H2	73.13	77.02	3.89	0.00	-73.13	0.00	-77.02	0.00	40.68
104	SDCO#H3	74.20	76.74	2.54	0.00	-74.20	0.00	-76.74	0.00	24.48
105	SDCO#H4	72.79	77.00	4.21	0.00	-72.79	0.00	-77.00	0.00	44.52
106	SDCO#H5	72.94	75.70	2.76	0.00	-72.94	0.00	-75.70	0.00	27.12
107	SDCO#H6	74.06	76.59	2.53	0.00	-74.06	0.00	-76.59	0.00	24.36
108	WQ#1	67.90	73.16	5.26	0.00	-67.90	0.00	-73.16	0.00	45.12
109	WQ#2	70.66	76.71	6.05	0.00	-70.66	0.00	-76.71	0.00	38.56
110	WQ#3	69.48	76.48	7.00	0.00	-69.48	0.00	-76.48	0.00	45.96
111	WQ#4	69.60	76.07	6.47	0.00	-69.60	0.00	-76.07	0.00	65.64
112	WQ#5	70.30	76.23	5.93	0.00	-70.30	0.00	-76.23	0.00	53.16

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	SDCB#01	0.18	0.00	68.38	1.48	0.00	6.46	68.22	1.32	0 21:28	0 00:00	0.00	0.00
2	SDCB#02	0.44	0.18	70.20	0.70	0.00	2.20	69.97	0.47	0 08:01	0 00:00	0.00	0.00
3	SDCB#03	0.26	0.11	70.46	0.27	0.00	1.73	70.30	0.11	0 08:01	0 00:00	0.00	0.00
4	SDCB#04	0.08	0.04	70.61	0.14	0.00	2.03	70.53	0.06	0 08:00	0 00:00	0.00	0.00
5	SDCB#05	0.66	0.18	69.77	0.48	0.00	2.34	69.46	0.17	0 08:01	0 00:00	0.00	0.00
6	SDCB#06	0.23	0.10	69.31	0.25	0.00	3.72	69.16	0.10	0 08:00	0 00:00	0.00	0.00
7	SDCB#07	0.13	0.06	69.61	0.19	0.00	2.18	69.50	0.08	0 08:00	0 00:00	0.00	0.00
8	SDCB#08	0.07	0.04	69.81	0.14	0.00	2.64	69.73	0.06	0 08:00	0 00:00	0.00	0.00
9	SDCB#09	1.05	0.18	69.04	0.53	0.00	3.31	68.71	0.20	0 08:01	0 00:00	0.00	0.00
10	SDCB#10	0.07	0.00	70.47	2.57	0.00	6.49	69.99	2.09	1 00:00	0 00:00	0.00	0.00
11	SDCB#11	0.26	0.08	73.63	0.15	0.00	2.95	73.53	0.05	0 08:00	0 00:00	0.00	0.00
12	SDCB#12	0.08	0.08	73.97	0.14	0.00	2.57	73.89	0.06	0 08:00	0 00:00	0.00	0.00
13	SDCB#13	0.10	0.10	74.03	0.16	0.00	2.55	73.94	0.07	0 08:00	0 00:00	0.00	0.00
14	SDCB#14	0.53	0.14	72.24	0.35	0.00	4.07	72.02	0.13	0 08:01	0 00:00	0.00	0.00
15	SDCB#15	0.68	0.09	72.12	0.44	0.00	4.13	71.85	0.17	0 08:01	0 00:00	0.00	0.00
16	SDCB#16	0.31	0.09	72.47	0.24	0.00	3.89	72.33	0.10	0 08:00	0 00:00	0.00	0.00
17	SDCB#17	0.14	0.08	72.95	0.20	0.00	3.60	72.83	0.08	0 08:00	0 00:00	0.00	0.00
18	SDCB#18	1.97	0.00	70.47	2.07	0.00	6.22	69.99	1.59	1 00:00	0 00:00	0.00	0.00
19	SDCB#19	1.21	0.32	70.73	0.38	0.00	4.52	70.49	0.14	0 08:01	0 00:00	0.00	0.00
20	SDCB#20	0.90	0.08	71.42	0.44	0.00	3.83	71.15	0.17	0 08:01	0 00:00	0.00	0.00
21	SDCB#21	0.07	0.07	71.92	0.11	0.00	3.33	71.86	0.05	0 08:00	0 00:00	0.00	0.00
22	SDCB#22	0.75	0.14	71.76	0.40	0.00	3.49	71.51	0.15	0 08:01	0 00:00	0.00	0.00
23	SDCB#23	0.44	0.15	72.21	0.28	0.00	3.04	72.05	0.12	0 08:00	0 00:00	0.00	0.00
24	SDCB#24	0.03	0.02	72.70	0.09	0.00	2.55	72.65	0.04	0 08:01	0 00:00	0.00	0.00
25	SDCB#25	0.02	0.02	72.85	0.06	0.00	2.40	72.82	0.03	0 08:00	0 00:00	0.00	0.00
26	SDCB#26	1.20	0.00	70.47	2.07	0.00	6.32	69.99	1.59	1 00:00	0 00:00	0.00	0.00
27	SDCB#27	1.21	0.33	71.74	0.54	0.00	3.51	71.40	0.20	0 08:01	0 00:00	0.00	0.00
28	SDCB#28	0.23	0.13	72.39	0.24	0.00	2.86	72.25	0.10	0 08:01	0 00:00	0.00	0.00
29	SDCB#29	0.62	0.14	72.04	0.32	0.00	3.36	71.85	0.13	0 08:00	0 00:00	0.00	0.00
30	SDCB#30	0.30	0.30	72.97	0.28	0.00	2.43	72.80	0.11	0 08:00	0 00:00	0.00	0.00
31	SDCB#31	0.56	0.22	70.64	0.39	0.00	6.52	70.42	0.17	0 08:00	0 00:00	0.00	0.00
32	SDCB#32	0.20	0.12	72.83	0.23	0.00	2.42	72.69	0.09	0 08:00	0 00:00	0.00	0.00
33	SDCB#33	0.26	0.17	71.03	0.22	0.00	4.22	70.90	0.09	0 08:00	0 00:00	0.00	0.00
34	SDCB#34	0.09	0.09	71.67	0.15	0.00	3.58	71.59	0.07	0 08:00	0 00:00	0.00	0.00
35	SDCB#35	0.55	0.00	70.47	2.07	0.00	6.53	69.99	1.59	1 00:00	0 00:00	0.00	0.00
36	SDCB#36	0.47	0.25	70.81	0.22	0.00	4.45	70.68	0.09	0 08:00	0 00:00	0.00	0.00
37	SDCB#37	0.22	0.06	71.76	0.24	0.00	3.91	71.62	0.10	0 08:01	0 00:00	0.00	0.00
38	SDCB#38	0.16	0.16	72.08	0.20	0.00	3.18	71.96	0.08	0 08:00	0 00:00	0.00	0.00
39	SDCB#40	0.03	0.03	73.27	0.05	0.00	3.00	73.24	0.02	0 08:00	0 00:00	0.00	0.00
40	SDCO#A1	0.07	0.00	72.85	0.14	0.00	3.53	72.77	0.06	0 08:01	0 00:00	0.00	0.00
41	SDCO#A2	0.04	0.00	73.30	0.09	0.00	3.24	73.25	0.04	0 08:01	0 00:00	0.00	0.00
42	SDCO#A3	0.04	0.04	74.09	0.09	0.00	0.94	74.04	0.04	0 08:00	0 00:00	0.00	0.00
43	SDCO#A4	0.04	0.04	74.05	0.09	0.00	1.84	74.00	0.04	0 08:00	0 00:00	0.00	0.00
44	SDCO#A5	0.04	0.00	73.32	0.09	0.00	3.50	73.27	0.04	0 08:01	0 00:00	0.00	0.00
45	SDCO#B1	0.10	0.00	74.41	0.08	0.00	3.67	74.36	0.03	0 08:01	0 00:00	0.00	0.00
46	SDCO#B2	0.05	0.00	75.21	0.10	0.00	2.59	75.15	0.04	0 08:00	0 00:00	0.00	0.00
47	SDCO#B3	0.05	0.05	75.39	0.11	0.00	2.53	75.32	0.04	0 08:00	0 00:00	0.00	0.00
48	SDCO#B4	0.05	0.05	75.51	0.10	0.00	2.44	75.45	0.04	0 08:00	0 00:00	0.00	0.00
49	SDCO#B5	0.10	0.00	72.18	0.19	0.00	5.90	72.06	0.07	0 08:01	0 00:00	0.00	0.00
50	SDCO#B6	0.05	0.00	72.91	0.10	0.00	5.11	72.85	0.04	0 08:00	0 00:00	0.00	0.00
51	SDCO#B7	0.05	0.05	72.98	0.11	0.00	4.97	72.91	0.04	0 08:00	0 00:00	0.00	0.00
52	SDCO#B8	0.05	0.05	72.91	0.10	0.00	5.11	72.85	0.04	0 08:00	0 00:00	0.00	0.00
53	SDCO#C1	0.10	0.00	73.15	0.94	0.00	3.70	73.08	0.87	0 08:00	0 00:00	0.00	0.00
54	SDCO#C10	0.05	0.05	72.98	0.24	0.00	3.83	72.92	0.18	0 08:00	0 00:00	0.00	0.00
55	SDCO#C2	0.05	0.00	74.35	0.07	0.00	2.52	74.31	0.03	0 08:00	0 00:00	0.00	0.00
56	SDCO#C3	0.05	0.05	74.48	0.11	0.00	2.43	74.41	0.04	0 08:00	0 00:00	0.00	0.00
57	SDCO#C4	0.05	0.05	74.39	0.10	0.00	2.44	74.33	0.04	0 08:00	0 00:00	0.00	0.00
58	SDCO#C5	0.10	0.00	71.61	0.17	0.00	5.36	71.51	0.07	0 08:01	0 00:00	0.00	0.00
59	SDCO#C6	0.05	0.00	72.64	0.10	0.00	4.47	72.58	0.04	0 08:00	0 00:00	0.00	0.00
60	SDCO#C7	0.05	0.05	72.77	0.11	0.00	4.22	72.70	0.04	0 08:00	0 00:00	0.00	0.00
61	SDCO#C8	0.05	0.00	72.29	0.10	0.00	4.68	72.23	0.04	0 08:01	0 00:00	0.00	0.00
62	SDCO#C9	0.05	0.00	72.44	0.25	0.00	4.44	72.37	0.18	0 08:00	0 00:00	0.00	0.00
63	SDCO#CLUB1	0.05	0.00	72.46	0.08	0.00	3.87	72.41	0.03	0 08:01	0 00:00	0.00	0.00
64	SDCO#CLUB2	0.02	0.00	72.79	0.07	0.00	3.80	72.75	0.03	0 08:00	0 00:00	0.00	0.00
65	SDCO#CLUB3	0.02	0.02	73.20	0.07	0.00	3.25	73.16	0.03	0 08:00	0 00:00	0.00	0.00
66	SDCO#CLUB4	0.02	0.00	72.79	0.07	0.00	3.83	72.75	0.03	0 08:00	0 00:00	0.00	0.00
67	SDCO#CLUB5	0.02	0.02	73.22	0.07	0.00	3.21	73.18	0.03	0 08:00	0 00:00	0.00	0.00
68	SDCO#COM01	0.08	0.00	70.53	0.15	0.00	3.03	70.44	0.06	0 08:01	0 00:00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
69	SDCO#COM02	0.05	0.00	71.13	0.10	0.00	2.38	71.07	0.04	0 08:01	0 00:00	0.00	0.00
70	SDCO#COM03	0.05	0.05	71.75	0.29	0.00	1.78	71.68	0.22	0 08:00	0 00:00	0.00	0.00
71	SDCO#COM04	0.04	0.00	71.20	0.09	0.00	2.39	71.15	0.04	0 08:01	0 00:00	0.00	0.00
72	SDCO#COM05	0.04	0.00	71.43	0.09	0.00	2.19	71.38	0.04	0 08:00	0 00:00	0.00	0.00
73	SDCO#COM06	0.04	0.04	72.07	0.09	0.00	1.40	72.02	0.04	0 08:00	0 00:00	0.00	0.00
74	SDCO#COM07	0.03	0.00	70.67	0.09	0.00	2.51	70.62	0.04	0 08:00	0 00:00	0.00	0.00
75	SDCO#COM08	0.03	0.03	71.20	0.09	0.00	2.35	71.15	0.04	0 08:00	0 00:00	0.00	0.00
76	SDCO#COM09	0.04	0.00	70.24	0.07	0.00	3.39	70.20	0.03	0 08:00	0 00:00	0.00	0.00
77	SDCO#COM10	0.02	0.02	71.14	0.05	0.00	2.49	71.11	0.02	0 08:00	0 00:00	0.00	0.00
78	SDCO#COM11	0.02	0.02	71.16	0.07	0.00	2.47	71.12	0.03	0 08:00	0 00:00	0.00	0.00
79	SDCO#COM12	0.04	0.00	70.23	0.06	0.00	2.65	70.20	0.03	0 08:00	0 00:00	0.00	0.00
80	SDCO#COM13	0.04	0.04	70.95	0.08	0.00	2.46	70.90	0.03	0 08:00	0 00:00	0.00	0.00
81	SDCO#D1	0.10	0.00	72.96	0.12	0.00	4.34	72.89	0.05	0 08:01	0 00:00	0.00	0.00
82	SDCO#D2	0.10	0.00	74.79	0.14	0.00	2.50	74.71	0.06	0 08:00	0 00:00	0.00	0.00
83	SDCO#D3	0.10	0.10	74.88	0.17	0.00	2.41	74.77	0.06	0 08:00	0 00:00	0.00	0.00
84	SDCO#D4	0.10	0.00	73.63	0.10	0.00	3.83	73.57	0.04	0 08:01	0 00:00	0.00	0.00
85	SDCO#D5	0.05	0.00	74.55	0.08	0.00	2.48	74.50	0.03	0 08:00	0 00:00	0.00	0.00
86	SDCO#D6	0.05	0.05	74.87	0.08	0.00	2.46	74.82	0.03	0 08:00	0 00:00	0.00	0.00
87	SDCO#D7	0.05	0.05	74.82	0.10	0.00	2.46	74.76	0.04	0 08:00	0 00:00	0.00	0.00
88	SDCO#E1	0.13	0.00	72.25	0.18	0.00	4.29	72.14	0.07	0 08:01	0 00:00	0.00	0.00
89	SDCO#E2	0.13	0.00	72.60	0.17	0.00	4.20	72.50	0.07	0 08:01	0 00:00	0.00	0.00
90	SDCO#E3	0.13	0.00	73.31	0.17	0.00	3.26	73.21	0.07	0 08:00	0 00:00	0.00	0.00
91	SDCO#E4	0.07	0.00	72.76	0.12	0.00	3.74	72.69	0.05	0 08:01	0 00:00	0.00	0.00
92	SDCO#E5	0.07	0.00	73.08	0.12	0.00	3.67	73.01	0.05	0 08:00	0 00:00	0.00	0.00
93	SDCO#E6	0.07	0.07	73.68	0.12	0.00	2.82	73.61	0.05	0 08:00	0 00:00	0.00	0.00
94	SDCO#E7	0.13	0.13	74.41	0.17	0.00	2.35	74.31	0.07	0 08:00	0 00:00	0.00	0.00
95	SDCO#F1	0.08	0.08	71.90	0.13	0.00	5.36	71.82	0.05	0 08:00	0 00:00	0.00	0.00
96	SDCO#F2	0.08	0.00	72.57	0.07	0.00	4.41	72.53	0.03	0 08:00	0 00:00	0.00	0.00
97	SDCO#F3	0.08	0.08	73.60	0.14	0.00	3.61	73.52	0.06	0 08:00	0 00:00	0.00	0.00
98	SDCO#G1	0.08	0.00	73.40	0.11	0.00	3.67	73.33	0.04	0 08:01	0 00:00	0.00	0.00
99	SDCO#G2	0.08	0.08	74.60	0.13	0.00	2.41	74.52	0.05	0 08:00	0 00:00	0.00	0.00
100	SDCO#G3	0.06	0.00	73.03	0.14	0.00	4.12	72.95	0.06	0 08:01	0 00:00	0.00	0.00
101	SDCO#G4	0.06	0.06	74.34	0.12	0.00	2.42	74.27	0.05	0 08:00	0 00:00	0.00	0.00
102	SDCO#H1	0.08	0.00	72.84	0.08	0.00	4.26	72.79	0.03	0 08:01	0 00:00	0.00	0.00
103	SDCO#H2	0.08	0.00	73.27	0.14	0.00	3.75	73.18	0.05	0 08:01	0 00:00	0.00	0.00
104	SDCO#H3	0.08	0.08	74.33	0.13	0.00	2.41	74.25	0.05	0 08:00	0 00:00	0.00	0.00
105	SDCO#H4	0.07	0.00	72.89	0.10	0.00	4.11	72.83	0.04	0 08:01	0 00:00	0.00	0.00
106	SDCO#H5	0.07	0.00	73.07	0.13	0.00	2.63	72.99	0.05	0 08:01	0 00:00	0.00	0.00
107	SDCO#H6	0.07	0.07	74.18	0.12	0.00	2.41	74.11	0.05	0 08:00	0 00:00	0.00	0.00
108	WQ#1	1.05	0.00	68.46	0.56	0.00	4.70	68.31	0.41	0 08:01	0 00:00	0.00	0.00
109	WQ#2	0.26	0.00	70.74	0.08	0.00	5.97	70.69	0.03	0 08:00	0 00:00	0.00	0.00
110	WQ#3	0.68	0.00	70.47	0.99	0.00	6.01	70.09	0.61	1 00:00	0 00:00	0.00	0.00
111	WQ#4	1.21	0.00	70.47	0.87	0.00	5.60	70.17	0.57	1 00:00	0 00:00	0.00	0.00
112	WQ#5	1.20	0.00	70.68	0.38	0.00	5.55	70.45	0.15	0 08:01	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	{SD - Phase 1}.PIPE 02	108.10	69.83	0.33	69.29	0.00	0.54	0.5000	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
2	{SD - Phase 1}.PIPE 03	71.71	70.19	0.00	69.83	0.33	0.36	0.5000	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
3	{SD - Phase 1}.PIPE 04	55.25	70.47	0.00	70.19	0.00	0.28	0.5100	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
4	{SD - Phase 1}.PIPE 05	89.22	69.29	0.00	68.84	0.33	0.45	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
5	{SD - Phase 1}.PIPE 06	42.41	69.06	0.00	68.84	0.33	0.22	0.5200	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
6	{SD - Phase 1}.PIPE 07	72.15	69.42	0.00	69.06	0.00	0.36	0.5000	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
7	{SD - Phase 1}.PIPE 08	49.14	69.67	0.00	69.42	0.00	0.25	0.5100	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
8	{SD - Phase 1}.PIPE 09	21.39	68.51	0.00	68.40	0.50	0.11	0.5100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
9	{SD - Phase 1}.PIPE 11	5.71	73.48	0.00	72.83	2.17	0.65	11.3800	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
10	{SD - Phase 1}.PIPE 12	64.20	73.83	0.00	73.48	0.00	0.35	0.5500	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
11	{SD - Phase 1}.PIPE 13	78.00	73.87	0.00	73.48	0.00	0.39	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
12	{SD - Phase 1}.PIPE 14	42.96	71.89	0.00	71.68	0.00	0.21	0.4900	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
13	{SD - Phase 1}.PIPE 15	6.67	71.68	0.00	71.65	2.17	0.03	0.4500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
14	{SD - Phase 1}.PIPE 16	67.53	72.23	0.00	71.89	0.00	0.34	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
15	{SD - Phase 1}.PIPE 17	36.65	72.75	0.00	72.57	0.34	0.18	0.4900	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
16	{SD - Phase 1}.PIPE 18	54.55	68.40	0.00	68.40	0.50	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
17	{SD - Phase 1}.PIPE 20	126.79	70.98	0.00	70.35	0.00	0.63	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
18	{SD - Phase 1}.PIPE 21	57.67	71.81	0.00	71.31	0.33	0.50	0.8700	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
19	{SD - Phase 1}.PIPE 22	75.77	71.36	0.00	70.98	0.00	0.38	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20	{SD - Phase 1}.PIPE 23	113.35	71.93	0.00	71.36	0.00	0.57	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21	{SD - Phase 1}.PIPE 24	69.19	72.61	0.00	72.26	0.33	0.35	0.5100	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
22	{SD - Phase 1}.PIPE 25	34.45	72.79	0.00	72.61	0.00	0.18	0.5200	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
23	{SD - Phase 1}.PIPE 26	104.96	68.40	0.00	68.40	0.00	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
24	{SD - Phase 1}.PIPE 27	80.37	71.20	0.00	70.80	0.50	0.40	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25	{SD - Phase 1}.PIPE 28	122.98	72.15	0.00	71.54	0.34	0.61	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
26	{SD - Phase 1}.PIPE 29	82.06	71.72	0.00	71.20	0.00	0.52	0.6300	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
27	{SD - Phase 1}.PIPE 30	128.14	72.69	0.00	72.05	0.33	0.64	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
28	{SD - Phase 1}.PIPE 31	5.26	70.25	0.00	70.22	2.32	0.03	0.5700	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
29	{SD - Phase 1}.PIPE 40	52.18	73.22	0.00	71.20	0.00	2.02	3.8700	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
30	{SD - Phase 1}.PIPE B1	50.72	74.33	0.00	69.73	1.33	4.60	9.0700	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
31	{SD - Phase 1}.PIPE B2	60.72	75.11	0.00	74.50	0.17	0.61	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
32	{SD - Phase 1}.PIPE B3	16.77	75.28	0.00	75.11	0.00	0.17	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
33	{SD - Phase 1}.PIPE B4	85.66	75.41	0.00	74.50	0.17	0.91	1.0600	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
34	{SD - Phase 1}.PIPE B5	8.62	71.99	0.00	71.95	4.05	0.04	0.4600	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
35	{SD - Phase 1}.PIPE B6	81.80	72.81	0.00	71.99	0.00	0.82	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
36	{SD - Phase 1}.PIPE B7	6.36	72.87	0.00	72.81	0.00	0.06	0.9400	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
37	{SD - Phase 1}.PIPE B8	81.80	72.81	0.00	71.99	0.00	0.82	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
38	{SD - Phase 1}.PIPE C1	45.29	73.04	0.83	72.05	0.33	0.99	2.1900	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
39	{SD - Phase 1}.PIPE C10	54.90	72.88	0.14	72.33	0.14	0.55	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
40	{SD - Phase 1}.PIPE C2	22.10	74.28	0.00	73.21	1.00	1.07	4.8400	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
41	{SD - Phase 1}.PIPE C3	9.24	74.37	0.00	74.28	0.00	0.09	0.9700	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
42	{SD - Phase 1}.PIPE C4	108.05	74.29	0.00	73.21	1.00	1.08	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
43	{SD - Phase 1}.PIPE C5	7.93	71.44	0.00	71.40	3.50	0.04	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
44	{SD - Phase 1}.PIPE C6	109.73	72.54	0.00	71.44	0.00	1.10	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
45	{SD - Phase 1}.PIPE C7	12.01	72.66	0.00	72.54	0.00	0.12	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
46	{SD - Phase 1}.PIPE C8	45.14	72.19	0.00	71.74	0.30	0.45	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
47	{SD - Phase 1}.PIPE C9	13.55	72.33	0.14	72.19	0.00	0.14	1.0300	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
48	{SD - Phase 1}.PIPE COM01	37.51	70.38	0.00	70.19	0.00	0.19	0.5100	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No
49	{SD - Phase 1}.PIPE COM02	49.39	71.03	0.00	70.54	0.16	0.49	0.9900	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
50	{SD - Phase 1}.PIPE COM03	60.72	71.64	0.18	71.03	0.00	0.61	1.0000	CIRCULAR	6.000	6.000	0.0150	0.5000	0.5000	0.0000	0.00	No
51	{SD - Phase 1}.PIPE COM04	56.60	71.11	0.00	70.54	0.16	0.57	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
52	{SD - Phase 1}.PIPE COM05	22.78	71.34	0.00	71.11	0.00	0.23	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
53	{SD - Phase 1}.PIPE COM06	59.24	71.93	-0.05	71.34	0.00	0.59	1.0000	CIRCULAR	6.000	6.000	0.0150	0.5000	0.5000	0.0000	0.00	No
54	{SD - Phase 1}.PIPE COM07	21.49	70.58	0.00	70.47	0.00	0.11	0.5100	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
55	{SD - Phase 1}.PIPE COM08	36.57	71.11	0.00	70.74	0.16	0.37	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
56	{SD - Phase 1}.PIPE COM09	34.88	70.17	0.00	69.29	0.00	0.88	2.5200	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
57	{SD - Phase 1}.PIPE COM10	48.42	71.09	0.00	70.34	0.17	0.75	1.5500	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
58	{SD - Phase 1}.PIPE COM11	74.62	71.09	0.00	70.34	0.17	0.75	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
59	{SD - Phase 1}.PIPE COM12	16.26	70.17	0.00	69.67	0.00	0.50	3.0800	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
60	{SD - Phase 1}.PIPE COM13	45.72	70.87	0.00	70.34	0.17	0.53	1.1600	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
61	{SD - Phase 1}.PIPE D1	47.80	72.84	0.00	72.15	0.00	0.69	1.4400	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
62	{SD - Phase 1}.PIPE D2	163.60	74.65	0.00	73.01	0.17	1.64	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
63	{SD - Phase 1}.PIPE D3	6.36	74.71	0.00	74.65	0.00	0.06	0.9400	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
64	{SD - Phase 1}.PIPE D4	54.62	73.36	-0.17	72.05	0.33	1.31	2.4000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
65	{SD - Phase 1}.PIPE D5	32.05	74.47	0.00	73.53	0.00	0.94	2.9300	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
66	{SD - Phase 1}.PIPE D6	10.82	74.79	0.00	74.47	0.00	0.32	2.9600	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
67	{SD - Phase 1}.PIPE D7	119.28	74.72	0.00	73.53	0.00	1.19	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
68	{SD - Phase 1}.PIPE E1	42.30	71.90	-0.17	71.69	0.33	0.21	0.5000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
69	{SD - Phase 1}.PIPE E4	42.52	72.48	-0.16	72.26	0.33	0.22	0.5200	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
70	{SD - Phase 1}.PIPE G1	23.14	73.29	0.00	72.73	0.50	0.56	2.4200	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
71	{SD - Phase 1}.PIPE G2	118.43	74.47	0.00	73.29	0.00	1.18	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
72	{SD - Phase 1}.PIPE G3	29.24	72.89	0.00	72.75	0.00	0.14	0.4800	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
73	{SD - Phase 1}.PIPE G4	116.18	74.22	0.00	73.06	0.17	1.16	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
74	{SD - Phase 1}.PIPE H1	9.90	72.76	0.00	72.22	0.33	0.54	5.4500	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
75	{SD - Phase 1}.PIPE H2	20.00	73.13	0.00	72.93	0.17	0.20	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
76	{SD - Phase 1}.PIPE H3	106.86	74.20	0.00	73.13	0.00	1.07	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
77	{SD - Phase 1}.PIPE H4	24.70	72.79	0.00	72.18	0.50	0.61	2.4700	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
78	{SD - Phase 1}.PIPE H5	14.98	72.94	0.00	72.79	0.00	0.15	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
79	{SD - Phase 1}.PIPE H6	112.34	74.06	0.00	72.94	0.00	1.12	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
80	{SD - Phase 1}.PIPE RT-1	4.18	67.40	0.50	67.40	0.50	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
81	{SD - Phase 1}.PIPE RT-2	5.00	68.40	0.50	68.40	0.50	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
82	{SD - Phase 1}.PIPE RT-3	128.16	68.40	0.50	68.40	0.00	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
83	{SD - Phase 1}.PIPE WQ#4	40.09	69.60	0.00	69.40	1.00	0.20	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
84	{SD - Phase 2}.PIEP CLUB5	42.78	73.15	0.00	72.72	0.00	0.43	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
85	{SD - Phase 2}.PIPE 33	113.81	70.81	0.00	70.25	0.00	0.56	0.4900	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
86	{SD - Phase 2}.PIPE 34	74.43	71.52	0.00	71.14	0.33	0.38	0.5100	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
87	{SD - Phase 2}.PIPE 35	78.01	68.40	0.00	68.40	0.50	0.00	0.0000	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No
88	{SD - Phase 2}.PIPE 36	68.05	70.59	0.00	69.40	1.00	1.19	1.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
89	{SD - Phase 2}.PIPE 37	118.86	71.52	0.00	70.93	0.34	0.59	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
90	{SD - Phase 2}.PIPE 38	72.17	71.88	0.00	71.52	0.00	0.36	0.5000	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
91	{SD - Phase 2}.PIPE A1	22.91	72.71	0.00	72.60	0.00	0.11	0.4800	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
92	{SD - Phase 2}.PIPE A2	33.15	73.21	0.00	72.88	0.17	0.33	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
93	{SD - Phase 2}.PIPE A3	78.60	74.00	0.00	73.21	0.00	0.79	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
94	{SD - Phase 2}.PIPE A4	72.96	73.96	0.00	73.23	0.00	0.73	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
95	{SD - Phase 2}.PIPE A5	35.48	73.23	0.00	72.88	0.17	0.35	0.9900	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
96	{SD - Phase 2}.PIPE CLUB2	33.61	72.72	0.00	72.38	0.00	0.34	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
97	{SD - Phase 2}.PIPE CLUB3	40.66	73.13	0.00	72.72	0.00	0.41	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
98	{SD - Phase 2}.PIPE CLUB4	32.02	72.72	0.00	72.38	0.00	0.34	1.0600	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
99	{SD - Phase 2}.PIPE E2	35.98	72.43	0.00	72.07	0.00	0.36	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
100	{SD - Phase 2}.PIPE E3	71.44	73.14	0.00	72.43	0.00	0.71	0.9900	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
101	{SD - Phase 2}.PIPE E5	31.53	72.96	0.00	72.64	0.00	0.32	1.0100	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
102	{SD - Phase 2}.PIPE E6	59.72	73.56	0.00	72.96	0.00	0.60	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
103	{SD - Phase 2}.PIPE E7	109.59	74.24	0.00	73.14	0.00	1.10	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
104	{SD - Phase 2}.PIPE F1	151.81	71.77	0.00	70.25	0.00	1.52	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
105	{SD - Phase 2}.PIPE F2	17.47	72.50	0.00	69.90	1.50	2.60	14.8800	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
106	{SD - Phase 2}.PIPE F3	96.17	73.46	0.00	72.50	0.00	0.96	1.0000	CIRCULAR	6.000	6.000	0.0130	0.5000	0.5000	0.0000	0.00	No
107	PIPE 32	66.71	72.60	0.00	72.26	0.33	0.34	0.5100	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
108	PIPE CLUB1	35.74	72.21	-0.17	71.69	0.33	0.52	1.4500	CIRCULAR	8.040	8.040	0.0130	0.5000	0.5000	0.0000	0.00	No
109	PIPE WQ#1	6.39	67.90	0.00	67.87	0.97	0.03	0.4700	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
110	PIPE WQ#2	5.61	70.66	0.00	68.87	0.97	1.79	31.9100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
111	PIPE WQ#3	6.80	69.48	0.00	68.87	0.97	0.61	8.9700	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
112	PIPE WQ#4	40.09	69.60	0.00	69.40	-0.95	0.20	0.5000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No
113	PIPE WQ#5	45.10	70.30	0.00	69.40	1.00	0.90	2.0000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	{SD - Phase 1}.PIPE 02	0.44	0 08:01	0.74	0.59	1.86	0.97	0.42	0.64	0.00		Calculated
2	{SD - Phase 1}.PIPE 03	0.26	0 08:01	0.74	0.35	1.58	0.76	0.32	0.48	0.00		Calculated
3	{SD - Phase 1}.PIPE 04	0.08	0 08:00	0.75	0.10	0.81	1.14	0.21	0.31	0.00		Calculated
4	{SD - Phase 1}.PIPE 05	0.65	0 08:01	0.86	0.76	2.73	0.54	0.43	0.65	0.00		Calculated
5	{SD - Phase 1}.PIPE 06	0.23	0 08:01	0.87	0.26	2.05	0.34	0.23	0.35	0.00		Calculated
6	{SD - Phase 1}.PIPE 07	0.13	0 08:00	0.74	0.18	1.29	0.93	0.22	0.33	0.00		Calculated
7	{SD - Phase 1}.PIPE 08	0.07	0 08:00	0.75	0.10	1.09	0.75	0.17	0.25	0.00		Calculated
8	{SD - Phase 1}.PIPE 09	1.05	0 08:01	2.55	0.41	2.81	0.13	0.48	0.48	0.00		Calculated
9	{SD - Phase 1}.PIPE 11	0.26	0 08:00	4.08	0.06	5.41	0.02	0.13	0.19	0.00		Calculated
10	{SD - Phase 1}.PIPE 12	0.08	0 08:00	0.89	0.09	1.51	0.71	0.14	0.21	0.00		Calculated
11	{SD - Phase 1}.PIPE 13	0.10	0 08:00	0.86	0.12	1.67	0.78	0.15	0.23	0.00		Calculated
12	{SD - Phase 1}.PIPE 14	0.53	0 08:01	2.49	0.21	1.82	0.39	0.39	0.39	0.00		Calculated
13	{SD - Phase 1}.PIPE 15	0.68	0 08:01	2.39	0.29	2.39	0.05	0.39	0.39	0.00		Calculated
14	{SD - Phase 1}.PIPE 16	0.31	0 08:00	2.53	0.12	1.62	0.69	0.29	0.29	0.00		Calculated
15	{SD - Phase 1}.PIPE 17	0.14	0 08:00	0.85	0.17	1.79	0.34	0.19	0.28	0.00		Calculated
16	{SD - Phase 1}.PIPE 18	1.94	0 08:03	0.97	2.01	1.11	0.82	2.00	1.00	153.00		SURCHARGED
17	{SD - Phase 1}.PIPE 20	0.90	0 08:01	2.51	0.36	2.95	0.72	0.41	0.41	0.00		Calculated
18	{SD - Phase 1}.PIPE 21	0.07	0 08:00	1.13	0.06	1.74	0.55	0.11	0.17	0.00		Calculated
19	{SD - Phase 1}.PIPE 22	0.75	0 08:01	2.52	0.30	2.39	0.53	0.42	0.42	0.00		Calculated
20	{SD - Phase 1}.PIPE 23	0.44	0 08:00	2.53	0.17	1.84	1.03	0.34	0.34	0.00		Calculated
21	{SD - Phase 1}.PIPE 24	0.03	0 08:01	0.86	0.04	1.20	0.96	0.09	0.13	0.00		Calculated
22	{SD - Phase 1}.PIPE 25	0.02	0 08:00	0.87	0.02	0.70	0.82	0.08	0.11	0.00		Calculated
23	{SD - Phase 1}.PIPE 26	0.78	0 08:11	0.70	1.11	0.41	4.27	2.00	1.00	153.00		SURCHARGED
24	{SD - Phase 1}.PIPE 27	1.20	0 08:01	2.51	0.48	3.06	0.44	0.50	0.50	0.00		Calculated
25	{SD - Phase 1}.PIPE 28	0.22	0 08:01	0.85	0.26	2.08	0.99	0.23	0.35	0.00		Calculated
26	{SD - Phase 1}.PIPE 29	0.62	0 08:00	2.84	0.22	1.94	0.70	0.43	0.43	0.00		Calculated
27	{SD - Phase 1}.PIPE 30	0.29	0 08:00	0.86	0.34	2.24	0.95	0.27	0.40	0.00		Calculated
28	{SD - Phase 1}.PIPE 31	0.55	0 08:00	2.69	0.21	2.28	0.04	0.35	0.35	0.00		Calculated
29	{SD - Phase 1}.PIPE 40	0.03	0 08:00	7.01	0.00	0.17	5.12	0.29	0.29	0.00		Calculated
30	{SD - Phase 1}.PIPE B1	0.10	0 08:01	3.64	0.03	4.41	0.19	0.35	0.52	0.00		Calculated
31	{SD - Phase 1}.PIPE B2	0.05	0 08:00	0.56	0.08	1.72	0.59	0.10	0.20	0.00		Calculated
32	{SD - Phase 1}.PIPE B3	0.05	0 08:00	0.56	0.09	1.65	0.17	0.10	0.21	0.00		Calculated
33	{SD - Phase 1}.PIPE B4	0.05	0 08:00	0.58	0.08	1.76	0.81	0.10	0.20	0.00		Calculated
34	{SD - Phase 1}.PIPE B5	0.09	0 08:01	0.38	0.25	1.59	0.09	0.17	0.34	0.00		Calculated
35	{SD - Phase 1}.PIPE B6	0.05	0 08:00	0.56	0.09	1.02	1.34	0.14	0.29	0.00		Calculated
36	{SD - Phase 1}.PIPE B7	0.05	0 08:00	0.54	0.09	1.58	0.07	0.11	0.21	0.00		Calculated
37	{SD - Phase 1}.PIPE B8	0.05	0 08:00	0.56	0.09	1.02	1.34	0.14	0.29	0.00		Calculated
38	{SD - Phase 1}.PIPE C1	0.10	0 08:00	1.79	0.05	2.66	0.28	0.11	0.16	0.00		Calculated
39	{SD - Phase 1}.PIPE C10	0.05	0 08:00	0.56	0.09	1.64	0.56	0.10	0.21	0.00		Calculated
40	{SD - Phase 1}.PIPE C2	0.05	0 08:00	1.23	0.04	2.96	0.12	0.07	0.14	0.00		Calculated
41	{SD - Phase 1}.PIPE C3	0.05	0 08:00	0.55	0.09	2.00	0.08	0.09	0.18	0.00		Calculated
42	{SD - Phase 1}.PIPE C4	0.05	0 08:00	0.56	0.08	1.73	1.04	0.10	0.20	0.00		Calculated
43	{SD - Phase 1}.PIPE C5	0.10	0 08:01	0.86	0.11	1.54	0.09	0.16	0.23	0.00		Calculated
44	{SD - Phase 1}.PIPE C6	0.05	0 08:00	0.56	0.09	1.12	1.63	0.13	0.27	0.00		Calculated
45	{SD - Phase 1}.PIPE C7	0.05	0 08:00	0.56	0.09	1.64	0.12	0.10	0.21	0.00		Calculated
46	{SD - Phase 1}.PIPE C8	0.05	0 08:01	0.56	0.09	1.71	0.44	0.10	0.20	0.00		Calculated
47	{SD - Phase 1}.PIPE C9	0.05	0 08:00	0.57	0.08	1.63	0.14	0.10	0.21	0.00		Calculated
48	{SD - Phase 1}.PIPE COM01	0.08	0 08:01	0.75	0.11	0.88	0.71	0.21	0.32	0.00		Calculated
49	{SD - Phase 1}.PIPE COM02	0.05	0 08:01	0.56	0.08	1.70	0.48	0.10	0.20	0.00		Calculated
50	{SD - Phase 1}.PIPE COM03	0.05	0 08:00	0.49	0.10	1.59	0.64	0.10	0.21	0.00		Calculated
51	{SD - Phase 1}.PIPE COM04	0.04	0 08:01	0.56	0.07	1.59	0.59	0.09	0.18	0.00		Calculated
52	{SD - Phase 1}.PIPE COM05	0.04	0 08:01	0.56	0.07	1.56	0.24	0.09	0.18	0.00		Calculated
53	{SD - Phase 1}.PIPE COM06	0.04	0 08:00	0.51	0.07	1.50	0.66	0.09	0.18	0.00		Calculated
54	{SD - Phase 1}.PIPE COM07	0.03	0 08:00	0.86	0.04	0.83	0.43	0.12	0.18	0.00		Calculated
55	{SD - Phase 1}.PIPE COM08	0.03	0 08:00	0.56	0.06	1.55	0.39	0.08	0.17	0.00		Calculated
56	{SD - Phase 1}.PIPE COM09	0.04	0 08:00	1.92	0.02	0.30	1.94	0.27	0.41	0.00		Calculated
57	{SD - Phase 1}.PIPE COM10	0.02	0 08:00	0.70	0.02	1.44	0.56	0.06	0.11	0.00		Calculated
58	{SD - Phase 1}.PIPE COM11	0.02	0 08:00	0.56	0.04	1.40	0.89	0.07	0.14	0.00		Calculated
59	{SD - Phase 1}.PIPE COM12	0.04	0 08:00	2.12	0.02	1.07	0.25	0.10	0.15	0.00		Calculated
60	{SD - Phase 1}.PIPE COM13	0.04	0 08:00	0.60	0.06	1.65	0.46	0.08	0.17	0.00		Calculated
61	{SD - Phase 1}.PIPE D1	0.09	0 08:01	1.45	0.07	1.25	0.64	0.18	0.27	0.00		Calculated
62	{SD - Phase 1}.PIPE D2	0.10	0 08:01	0.56	0.17	2.11	1.29	0.14	0.28	0.00		Calculated
63	{SD - Phase 1}.PIPE D3	0.10	0 08:00	0.54	0.18	1.88	0.06	0.15	0.31	0.00		Calculated
64	{SD - Phase 1}.PIPE D4	0.10	0 08:01	1.99	0.05	2.88	0.32	0.10	0.15	0.00		Calculated
65	{SD - Phase 1}.PIPE D5	0.05	0 08:00	0.96	0.05	2.03	0.26	0.09	0.18	0.00		Calculated
66	{SD - Phase 1}.PIPE D6	0.05	0 08:00	0.96	0.05	2.41	0.07	0.08	0.16	0.00		Calculated
67	{SD - Phase 1}.PIPE D7	0.05	0 08:00	0.56	0.09	1.70	1.17	0.10	0.20	0.00		Calculated
68	{SD - Phase 1}.PIPE E1	0.13	0 08:02	0.53	0.25	2.16	0.33	0.17	0.35	0.00		Calculated

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
69	{SD - Phase 1}.PIPE E4	0.07	0 08:01	0.53	0.12	1.79	0.40	0.12	0.24	0.00		Calculated
70	{SD - Phase 1}.PIPE G1	0.08	0 08:01	0.87	0.09	2.66	0.14	0.11	0.21	0.00		Calculated
71	{SD - Phase 1}.PIPE G2	0.08	0 08:00	0.56	0.14	2.19	0.90	0.12	0.24	0.00		Calculated
72	{SD - Phase 1}.PIPE G3	0.06	0 08:01	0.39	0.16	1.10	0.44	0.17	0.34	0.00		Calculated
73	{SD - Phase 1}.PIPE G4	0.06	0 08:00	0.56	0.11	1.88	1.03	0.11	0.23	0.00		Calculated
74	{SD - Phase 1}.PIPE H1	0.08	0 08:01	2.83	0.03	3.30	0.05	0.08	0.12	0.00		Calculated
75	{SD - Phase 1}.PIPE H2	0.08	0 08:01	0.56	0.14	1.91	0.17	0.13	0.26	0.00		Calculated
76	{SD - Phase 1}.PIPE H3	0.08	0 08:00	0.56	0.14	1.91	0.93	0.13	0.26	0.00		Calculated
77	{SD - Phase 1}.PIPE H4	0.07	0 08:01	0.88	0.07	2.54	0.16	0.09	0.19	0.00		Calculated
78	{SD - Phase 1}.PIPE H5	0.07	0 08:01	0.56	0.12	2.01	0.12	0.11	0.22	0.00		Calculated
79	{SD - Phase 1}.PIPE H6	0.07	0 08:00	0.56	0.12	1.80	1.04	0.12	0.24	0.00		Calculated
80	{SD - Phase 1}.PIPE RT-1	0.18	0 21:28	3.50	0.05	1.11	0.06	0.98	0.49	0.00		Calculated
81	{SD - Phase 1}.PIPE RT-2	0.07	1 00:00	3.20	0.02	0.86	0.10	2.00	1.00	153.00		SURCHARGED
82	{SD - Phase 1}.PIPE RT-3	0.52	0 08:01	0.63	0.82	0.64	3.34	2.00	1.00	153.00		SURCHARGED
83	{SD - Phase 1}.PIPE WQ#4	1.21	0 08:01	2.52	0.48	2.97	0.22	0.93	0.93	0.00		Calculated
84	{SD - Phase 2}.PIEP CLUB5	0.02	0 08:00	0.56	0.04	1.41	0.51	0.07	0.14	0.00		Calculated
85	{SD - Phase 2}.PIPE 33	0.26	0 08:00	2.50	0.10	1.29	1.47	0.30	0.30	0.00		Calculated
86	{SD - Phase 2}.PIPE 34	0.09	0 08:00	0.86	0.11	1.64	0.76	0.15	0.22	0.00		Calculated
87	{SD - Phase 2}.PIPE 35	0.54	0 08:00	0.81	0.66	0.55	2.36	2.00	1.00	153.00		SURCHARGED
88	{SD - Phase 2}.PIPE 36	0.47	0 08:00	4.71	0.10	3.68	0.31	0.54	0.54	0.00		Calculated
89	{SD - Phase 2}.PIPE 37	0.22	0 08:01	0.85	0.26	2.07	0.96	0.23	0.34	0.00		Calculated
90	{SD - Phase 2}.PIPE 38	0.16	0 08:00	0.85	0.19	1.64	0.73	0.22	0.33	0.00		Calculated
91	{SD - Phase 2}.PIPE A1	0.07	0 08:01	0.84	0.09	0.91	0.42	0.19	0.28	0.00		Calculated
92	{SD - Phase 2}.PIPE A2	0.04	0 08:01	0.56	0.06	1.56	0.35	0.09	0.18	0.00		Calculated
93	{SD - Phase 2}.PIPE A3	0.04	0 08:00	0.56	0.06	1.57	0.83	0.09	0.18	0.00		Calculated
94	{SD - Phase 2}.PIPE A4	0.04	0 08:00	0.56	0.07	1.57	0.77	0.09	0.18	0.00		Calculated
95	{SD - Phase 2}.PIPE A5	0.04	0 08:01	0.56	0.07	1.56	0.38	0.09	0.18	0.00		Calculated
96	{SD - Phase 2}.PIPE CLUB2	0.02	0 08:01	0.56	0.04	1.29	0.43	0.07	0.15	0.00		Calculated
97	{SD - Phase 2}.PIPE CLUB3	0.02	0 08:00	0.56	0.04	1.39	0.49	0.07	0.14	0.00		Calculated
98	{SD - Phase 2}.PIPE CLUB4	0.02	0 08:01	0.58	0.04	1.30	0.41	0.07	0.15	0.00		Calculated
99	{SD - Phase 2}.PIPE E2	0.13	0 08:01	0.56	0.23	2.12	0.28	0.18	0.35	0.00		Calculated
100	{SD - Phase 2}.PIPE E3	0.13	0 08:01	0.56	0.23	2.20	0.54	0.17	0.34	0.00		Calculated
101	{SD - Phase 2}.PIPE E5	0.07	0 08:00	0.57	0.12	1.78	0.30	0.12	0.24	0.00		Calculated
102	{SD - Phase 2}.PIPE E6	0.07	0 08:00	0.56	0.12	1.84	0.54	0.12	0.24	0.00		Calculated
103	{SD - Phase 2}.PIPE E7	0.13	0 08:00	0.56	0.23	2.27	0.80	0.17	0.34	0.00		Calculated
104	{SD - Phase 2}.PIPE F1	0.08	0 08:00	0.56	0.15	0.80	3.16	0.26	0.52	0.00		Calculated
105	{SD - Phase 2}.PIPE F2	0.08	0 08:00	2.16	0.04	5.11	0.06	0.26	0.52	0.00		Calculated
106	{SD - Phase 2}.PIPE F3	0.08	0 08:00	0.56	0.15	2.66	0.60	0.11	0.21	0.00		Calculated
107	PIPE 32	0.19	0 08:01	0.86	0.23	2.00	0.56	0.22	0.32	0.00		Calculated
108	PIPE CLUB1	0.05	0 08:01	1.68	0.03	2.06	0.29	0.08	0.12	0.00		Calculated
109	PIPE WQ#1	1.05	0 08:01	2.44	0.43	2.71	0.04	0.50	0.50	0.00		Calculated
110	PIPE WQ#2	0.26	0 08:00	20.13	0.01	5.18	0.02	0.52	0.52	0.00		Calculated
111	PIPE WQ#3	0.71	0 08:53	10.67	0.07	4.15	0.03	0.99	0.99	0.00		Calculated
112	PIPE WQ#4	1.21	0 08:01	4.87	0.25	3.31	0.20	0.49	0.49	0.00		Calculated
113	PIPE WQ#5	1.20	0 08:01	5.03	0.24	4.81	0.16	0.58	0.58	0.00		Calculated

Storage Nodes

Storage Node : R-TANK 1

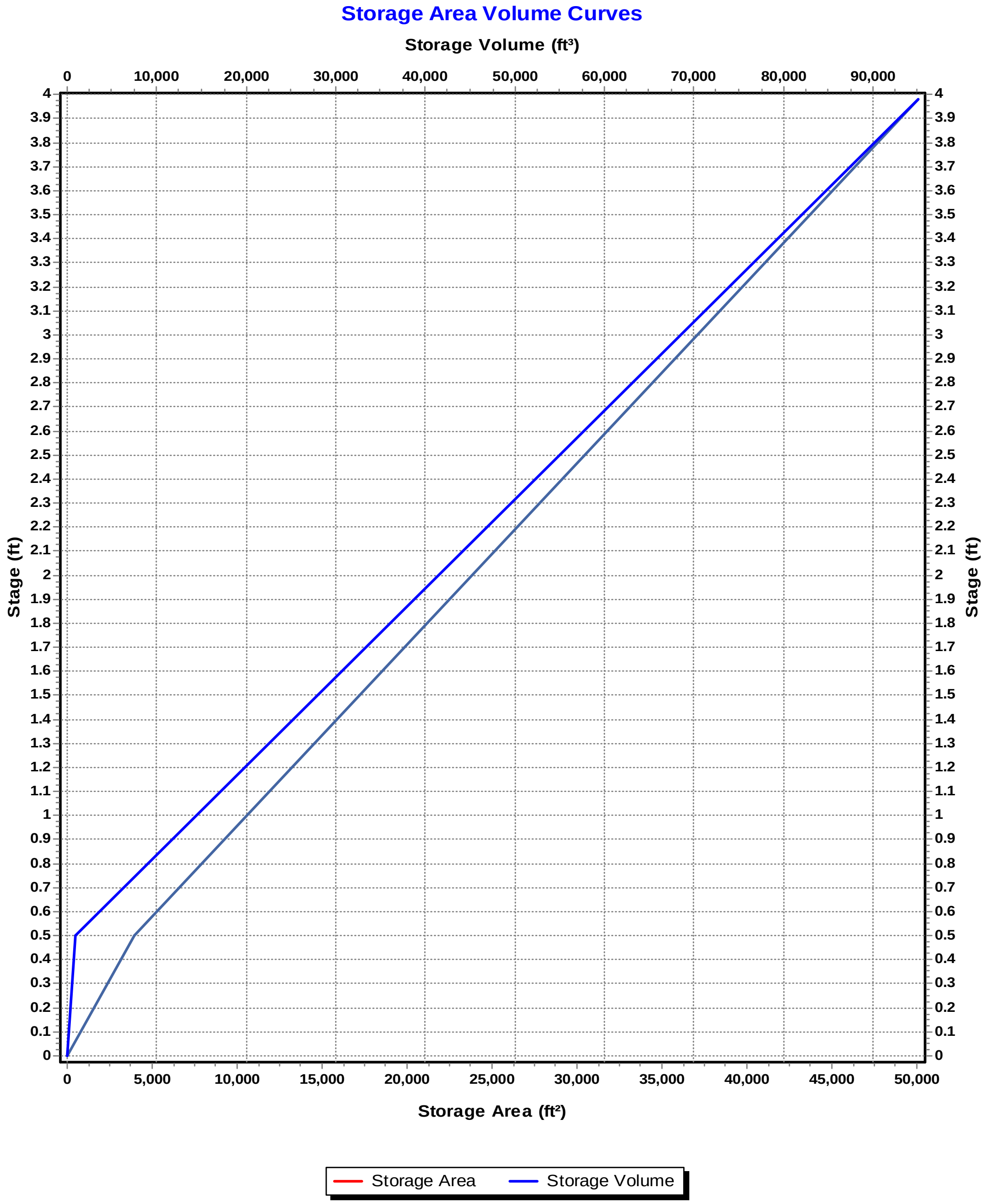
Input Data

Invert Elevation (ft) 66.90
Max (Rim) Elevation (ft) 70.88
Max (Rim) Offset (ft) 3.98
Initial Water Elevation (ft) 67.40
Initial Water Depth (ft) 0.50
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : R-TANK 1

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0	0
0.5	3971	992.75
3.98	50099	95074.55


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Stage (ft)
Storage Area (ft²)
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
Storage Area
Storage Volume

Storage Node : R-TANK 1 (continued)

Output Summary Results

Peak Inflow (cfs) 1.11
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 0.18
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 68.38
Max HGL Depth Attained (ft) 1.48
Average HGL Elevation Attained (ft) 68.22
Average HGL Depth Attained (ft) 1.32
Time of Max HGL Occurrence (days hh:mm) 0 21:28
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Storage Node : R-TANK 2

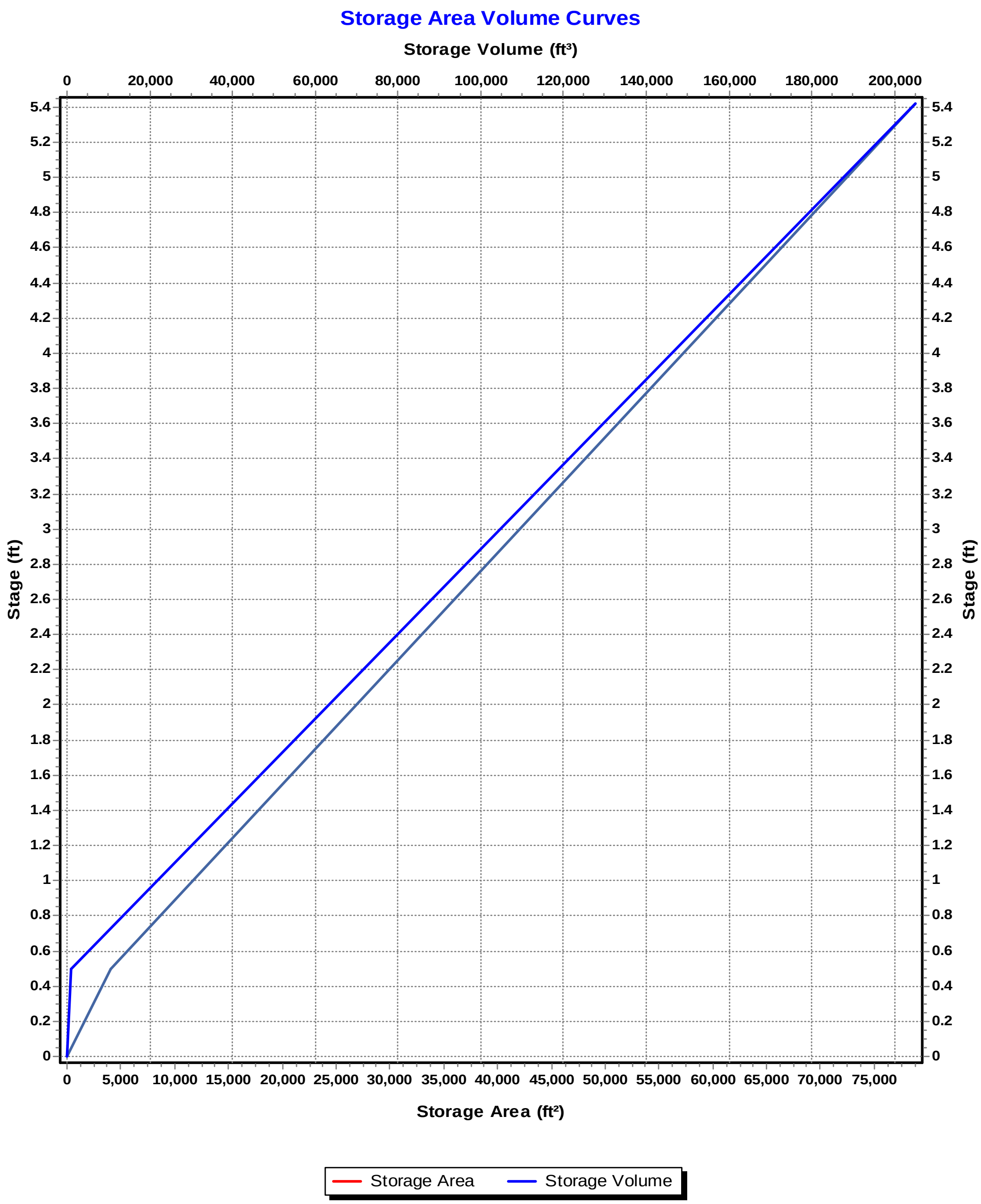
Input Data

Invert Elevation (ft) 67.90
Max (Rim) Elevation (ft) 73.32
Max (Rim) Offset (ft) 5.42
Initial Water Elevation (ft) 68.40
Initial Water Depth (ft) 0.50
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : R TANK 2

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0	0
0.5	4100	1025
5.42	78829	205030.34


Storage Area Volume Curves
Storage Volume (ft³)
0 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000 180,000 200,000
Stage (ft)
5.4 5.2 5 4.8 4.6 4.4 4.2 4 3.8 3.6 3.4 3.2 3 2.8 2.6 2.4 2.2 2 1.8 1.6 1.4 1.2 1 0.8 0.6 0.4 0.2 0
0 5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000 45,000 50,000 55,000 60,000 65,000 70,000 75,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : R-TANK 2 (continued)

Output Summary Results

Peak Inflow (cfs) 2.87
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 0.3
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 70.47
Max HGL Depth Attained (ft) 2.57
Average HGL Elevation Attained (ft) 69.99
Average HGL Depth Attained (ft) 2.09
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Storage Node : R-TANK 3

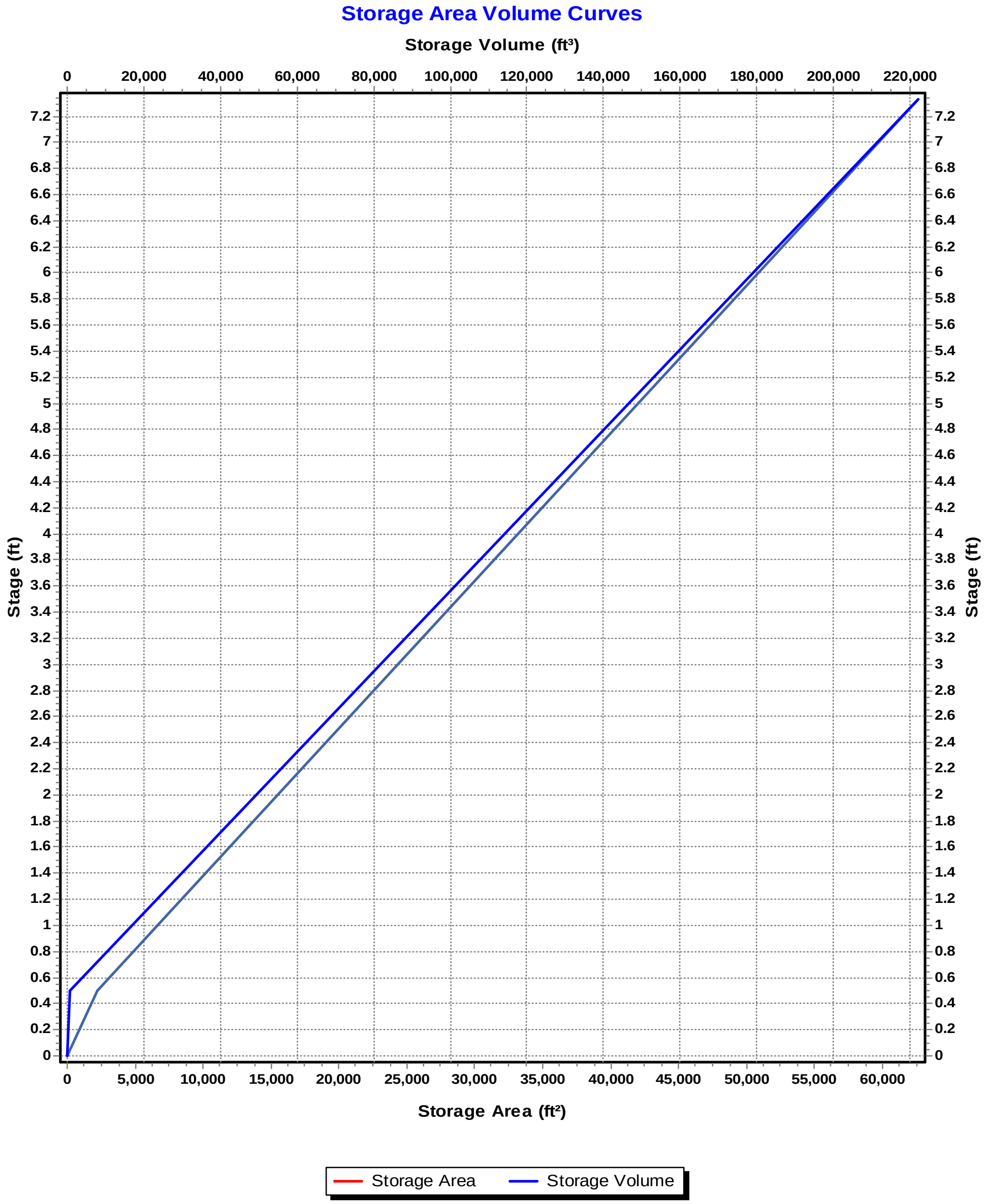
Input Data

Invert Elevation (ft) 67.90
Max (Rim) Elevation (ft) 75.23
Max (Rim) Offset (ft) 7.33
Initial Water Elevation (ft) 68.40
Initial Water Depth (ft) 0.50
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : R TANK 3

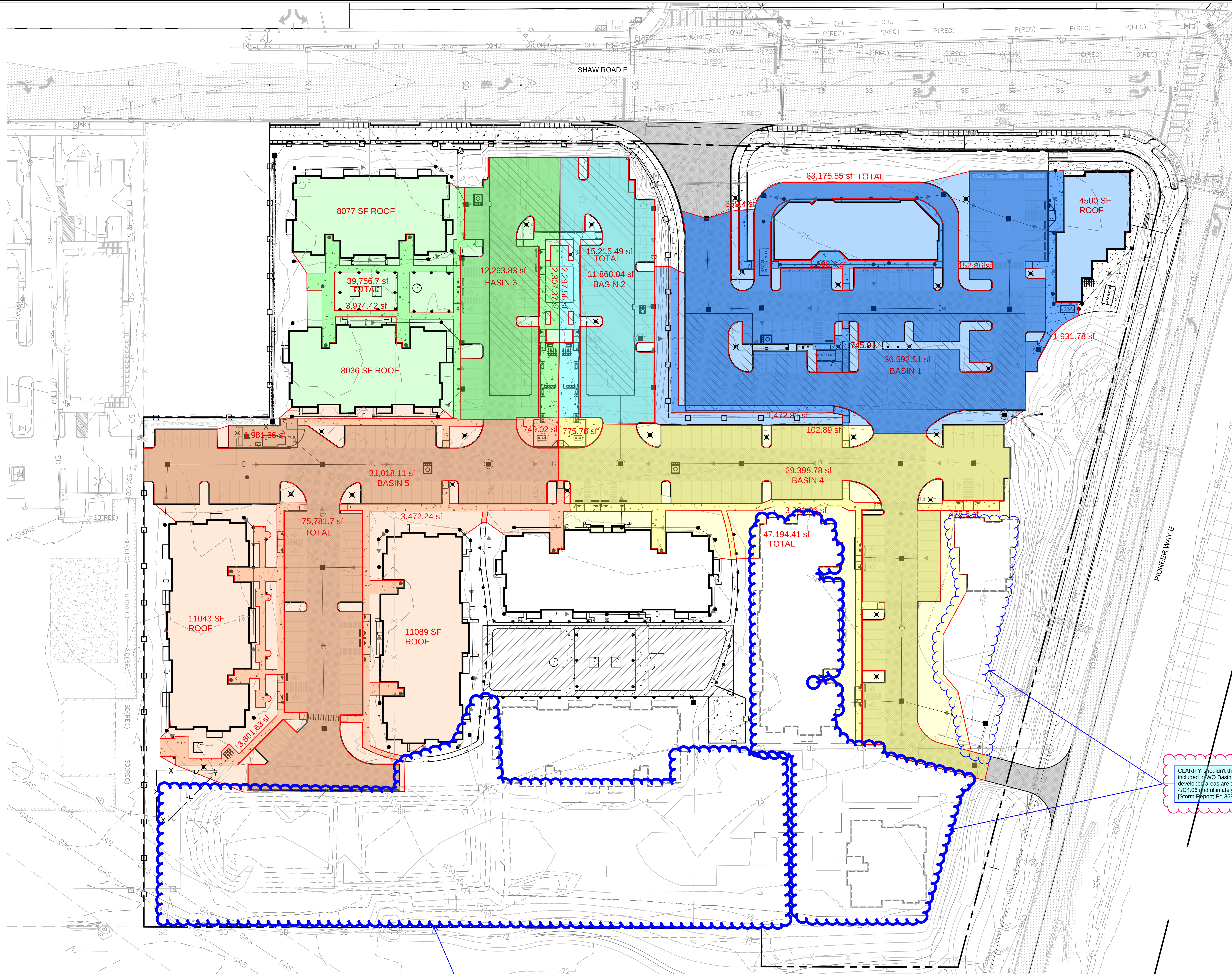
Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0	0
0.5	2263	565.75
7.33	62623	222151.44


Storage Area Volume Curves
Storage Volume (ft³)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
220,000
Stage (ft)
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Stage (ft)
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : R-TANK 3 (continued)

Output Summary Results

Peak Inflow (cfs) 1.8
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 0
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 70.47
Max HGL Depth Attained (ft) 2.57
Average HGL Elevation Attained (ft) 69.99
Average HGL Depth Attained (ft) 2.09
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0



GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

BASIN 1: 1.45 AC TOTAL
-ASPHALT: 0.85 AC
-LANDSCAPE: 0.22 AC
-ROOF: 0.24 AC
-PERVIOUS SIDEWALK: 0.14 AC

BASIN 2: 0.35 AC TOTAL
-ASPHALT: 0.28 AC
-LANDSCAPE: 0.01 AC
-ROOF: 0 AC
-PERVIOUS SIDEWALK: 0.06 AC

BASIN 3: 0.91 AC
-ASPHALT: 0.29 AC
-LANDSCAPE: 0.10 AC
-ROOF: 0.37 AC
-PERVIOUS SIDEWALK: 0.15 AC

BASIN 4: 1.08 AC
-ASPHALT: 0.71 AC
-LANDSCAPE: 0.28 AC
-ROOF: 0 AC
-PERVIOUS SIDEWALK: 0.09 AC

BASIN 5: 1.74 AC
-ASPHALT: 0.72 AC
-LANDSCAPE: 0.28 AC
-ROOF: 0.51 AC
-PERVIOUS SIDEWALK: 0.23 AC

CLARIFY-shouldn't these PH2 areas be included in WQ Basin 4 since the future developed areas are discharging to Profile 4/C4.06 and ultimately the WQ4 Biopod? [Storm Report; Pg 359 of 448]

Portions yes, revised

Please clarify that WQ for this area will be addressed in PH2. [Storm Report; Pg 359 of 448]

Correct, added note

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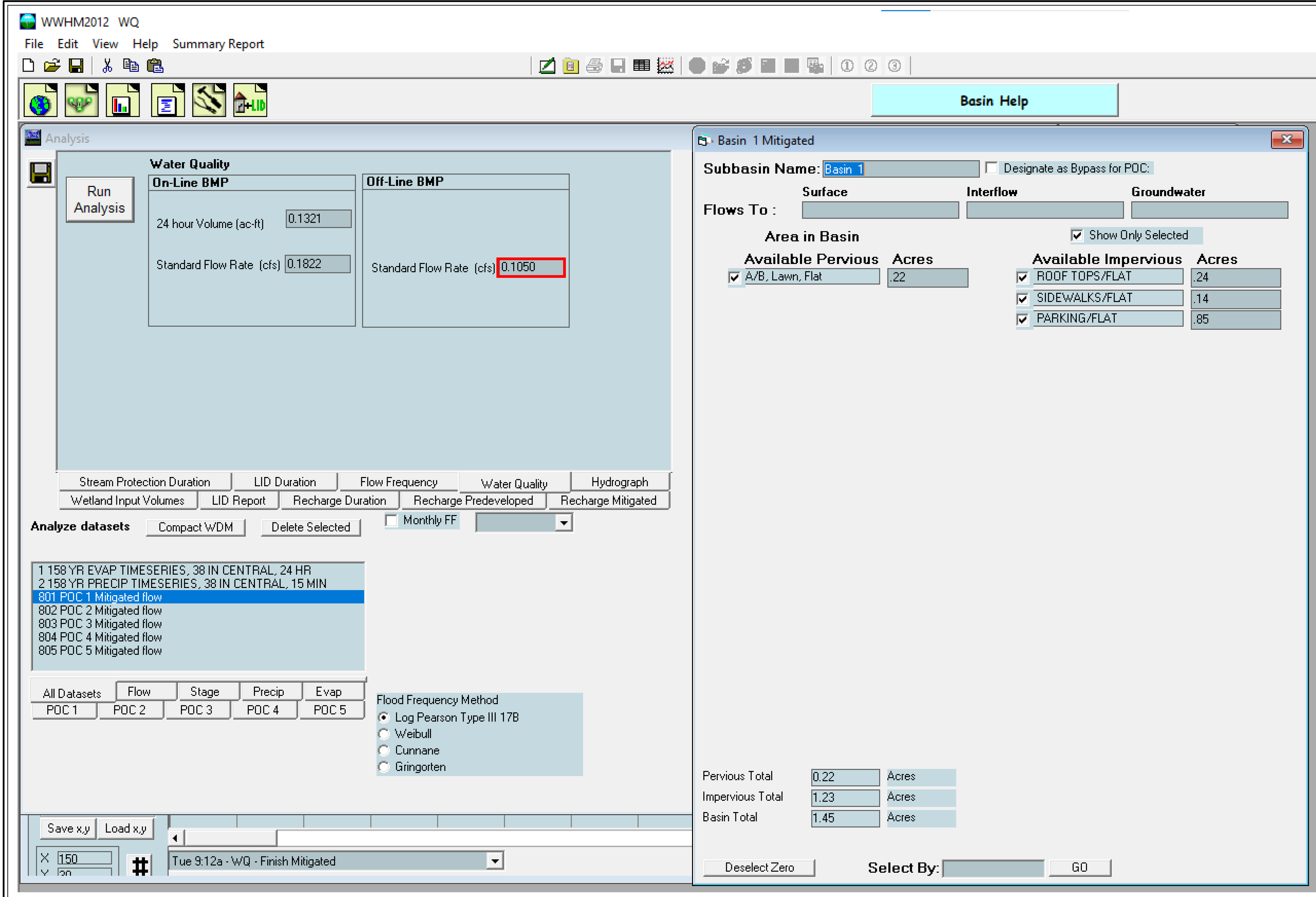
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

WQ BASIN MAP

EAST TOWN CENTER

D-2

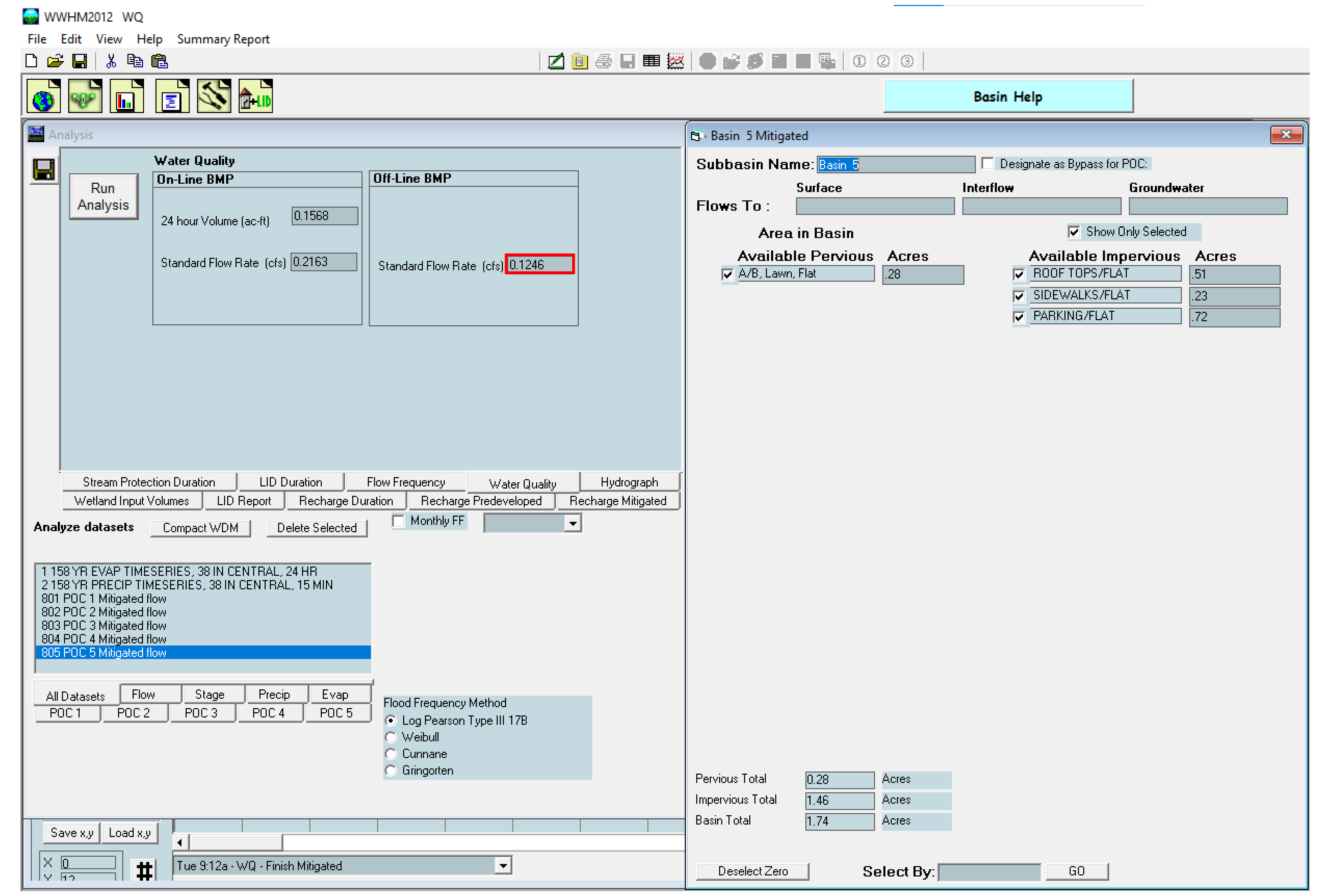


BASIN 1: OFFLINE FLOW RATE = 0.1050 CFS

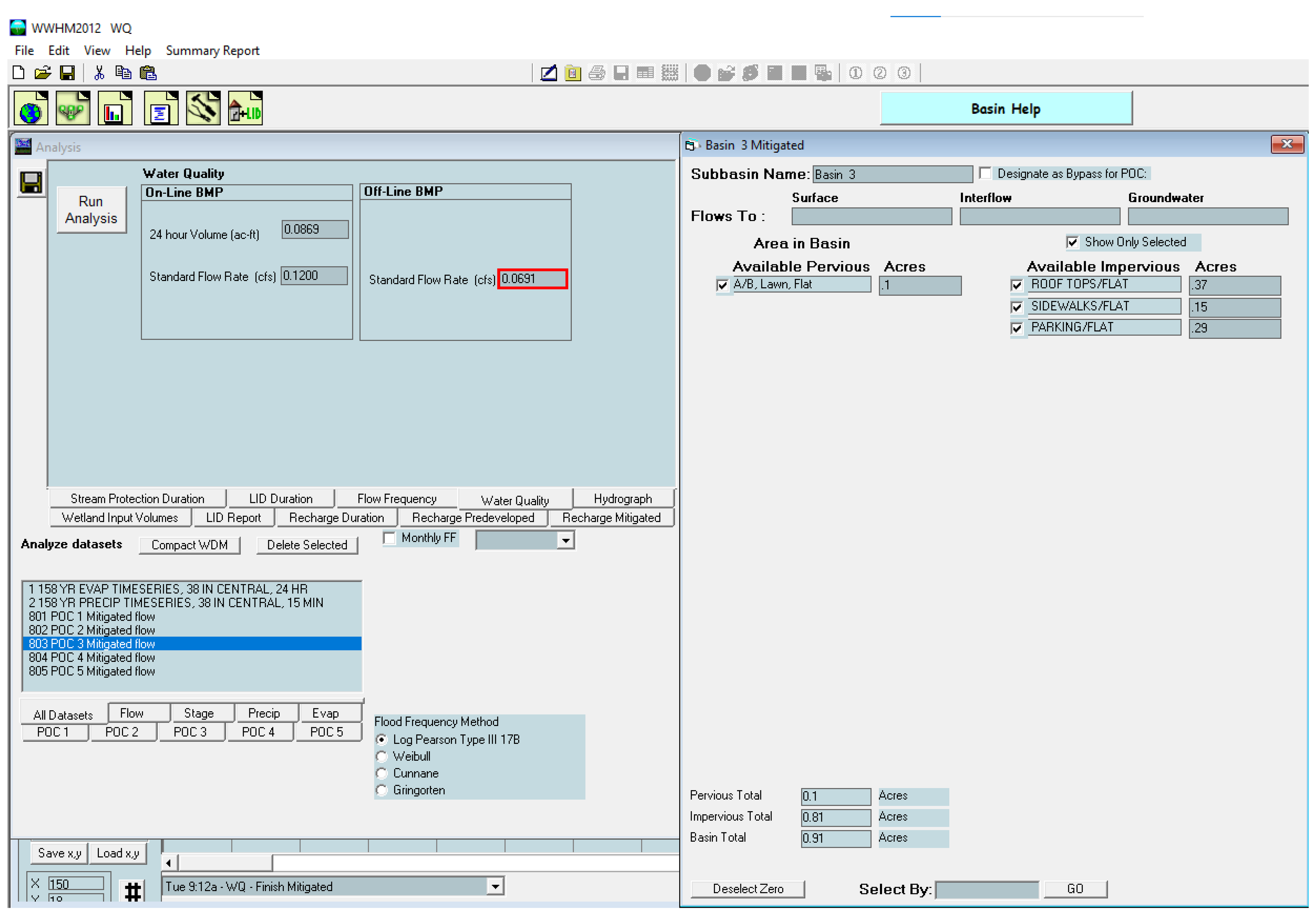
6X8 BIOPOD PERFORMANCE SPECIFICATIONS WITH WQ FLOW CAPACITY HIGHLIGHTED. SEE FOLLOWING PAGE FOR FULL DETAIL FROM OLDCASTLE

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.144 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.128 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

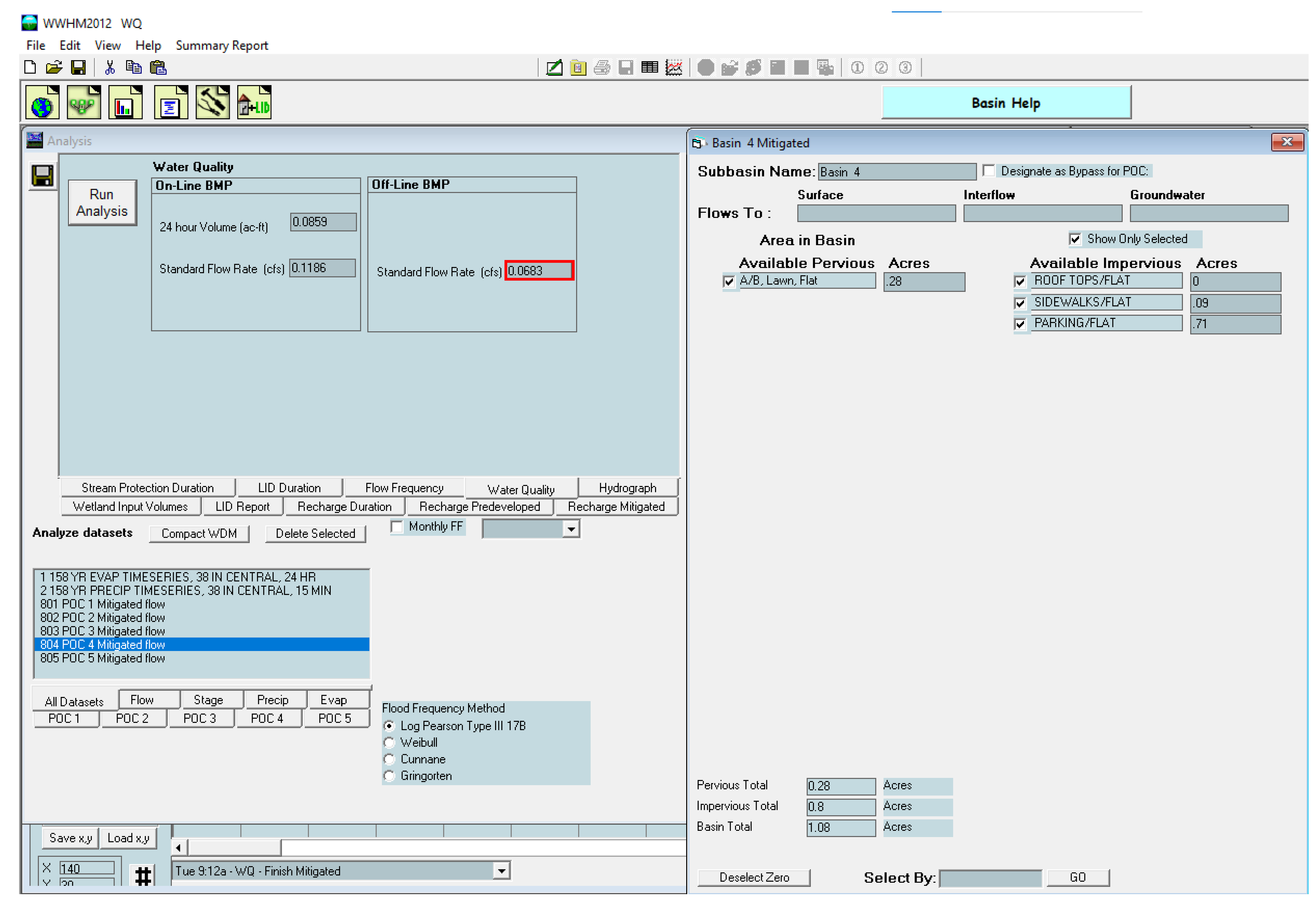
BASIN 1: 0.1050 CFS < 0.128 CFS
BASIN 3: 0.0691 CFS < 0.128 CFS
BASIN 4: 0.0683 CFS < 0.128 CFS
BASIN 5: 0.1246 CFS < 0.128 CFS



BASIN 5: OFFLINE FLOW RATE = 0.1246 CFS



BASIN 3: OFFLINE FLOW RATE = 0.0691 CFS



BASIN 4: OFFLINE FLOW RATE = 0.0683 CFS

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316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

WQ CALCS FOR 6x8 BIOPOD

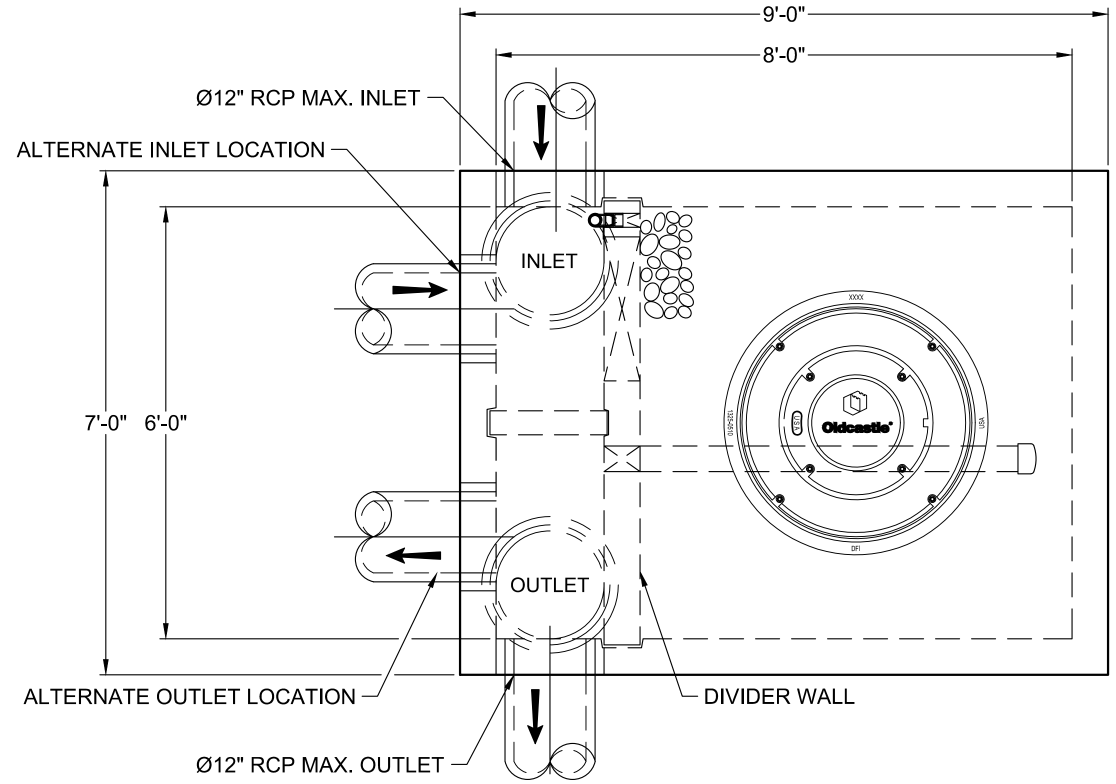
EAST TOWN CROSSING

D-2

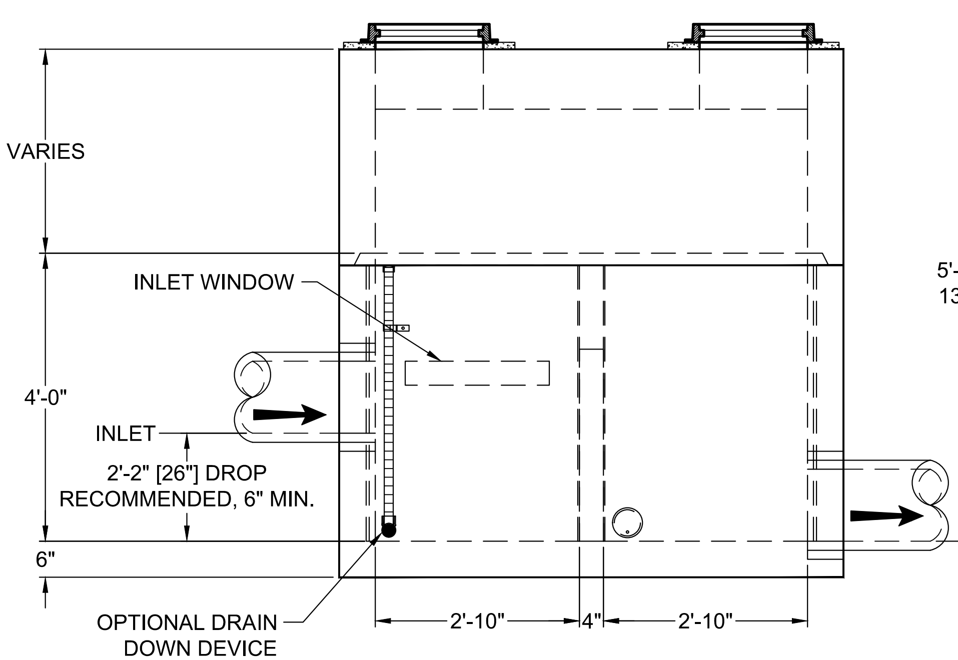
2230752

SITE SPECIFIC DATA				
Structure ID				ID
Treatment Flow Rate (cfs)				-
Peak Flow Rate (cfs)				-
Rim Elevation				-
Top of Vault Elevation				-
Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-
Notes:				

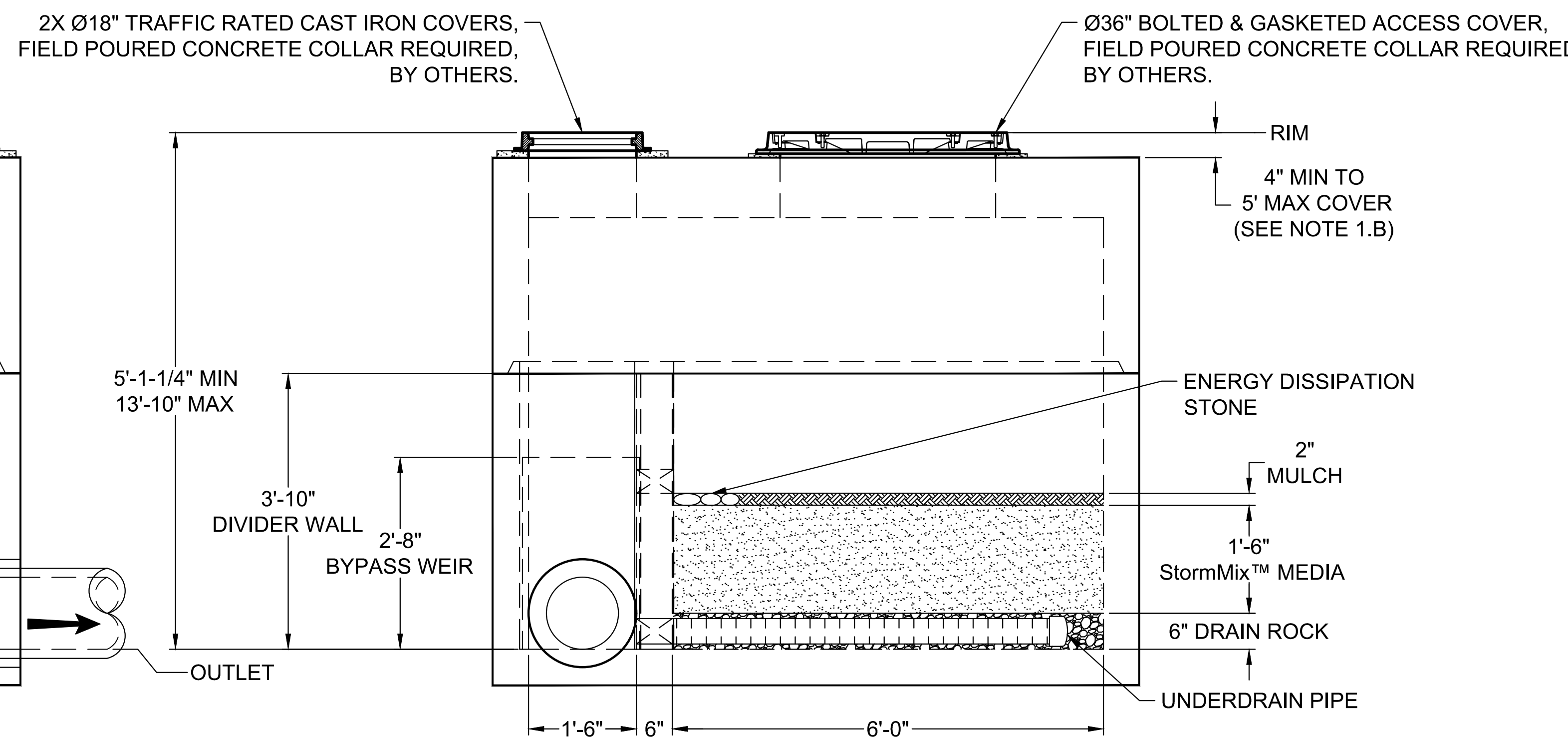
PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.144 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.128 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	



PLAN VIEW



LEFT END VIEW



ELEVATION VIEW

NOTES:

1. DESIGN LOADINGS:
   A. AASHTO HS-20-44 (WITH IMPACT)
   B. DESIGN SOIL COVER: 5'-0" MAXIMUM
   C. ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
   D. LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
   E. LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
   F. NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
2. CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
3. REINFORCING: REBAR, ASTM A615/A706, GRADE 60
4. CEMENT: ASTM C150
5. REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
6. REFERENCE STANDARD:
   A. ASTM C890
   B. ASTM C913
   C. ACI 318-14
7. THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY FY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW.
8. INLET AND OUTLET HOLES WILL BE FACTORY CORED/CAST PER PLANS AND CUSTOMER REQUIREMENTS. INLET AND OUTLET LOCATIONS CAN BE MIRRORED.
9. CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
10. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
11. SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
12. MAXIMUM PICK WEIGHTS*:
    A. TOP: XX,XXX LBS
    B. BASE: XX,XXX LBS*
    (* COMBINED WEIGHT OF BASE INCLUDES BYPASS WEIR, DIVIDER WALL, ROCK & MEDIA)
13. INTERNALS SHALL CONSIST OF UNDERDRAIN PIPE, ROCK, STORMMIX™ MEDIA, MULCH, DIVIDER WALL, BYPASS WEIR AND OPTIONAL DRAIN DOWN.

Bioretention/
Biofiltration

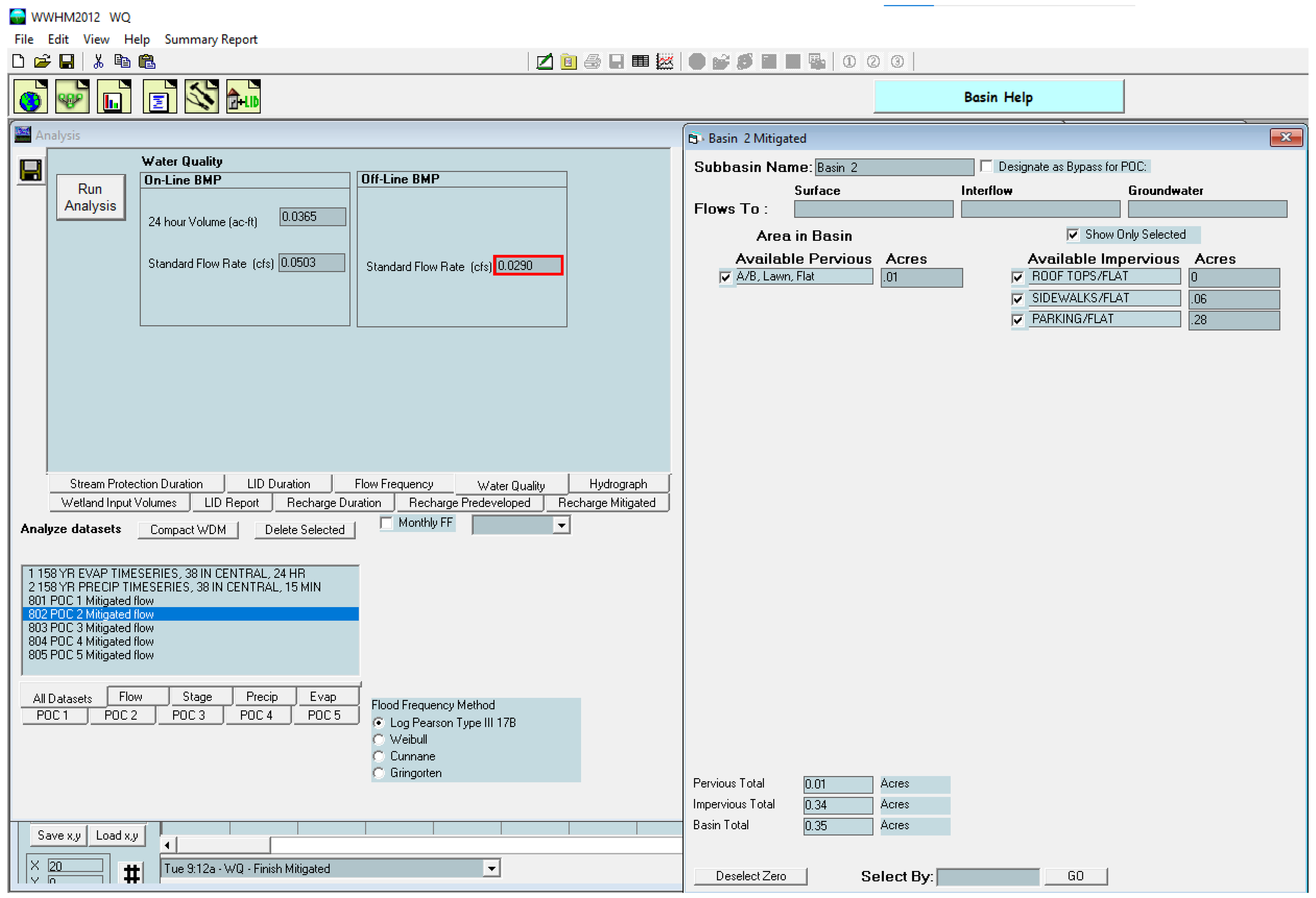
Oldcastle Infrastructure™
A CRH COMPANY
Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

BioPod™ Biofilter System (STANDARD)
Underground Vault with Internal Bypass

CUSTOMER
-

PROJECT NAME
-

SHEET NAME	REVISION	SHEET
Specifier Drawing BPU-68IB	- REV DATE -	1 OF 1



BASIN 2: OFFLINE FLOW RATE = 0.0290 CFS

4X6 BIOPOD PERFORMANCE SPECIFICATIONS WITH WQ FLOW CAPACITY HIGHLIGHTED. SEE FOLLOWING PAGE FOR FULL DETAIL FROM OLDCASTLE

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.064 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.057 cfs
Bypass Capactiy	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

BASIN 2: 0.0290 CFS < 0.057 CFS

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Land Surveyors
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316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

WQ CALCS

EAST TOWN CROSSING

D-2

2230752

SITE SPECIFIC DATA				
Structure ID				ID
Treatment Flow Rate (cfs)				-
Peak Flow Rate (cfs)				-
Rim Elevation				-
Top of Vault Elevation				-
Pipe Data	**Pipe Location**	**Pipe Size**	**Pipe Type**	**Invert Elevation**
Inlet	-	-	-	-
Outlet	-	-	-	-
Notes:				

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.064 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.057 cfs
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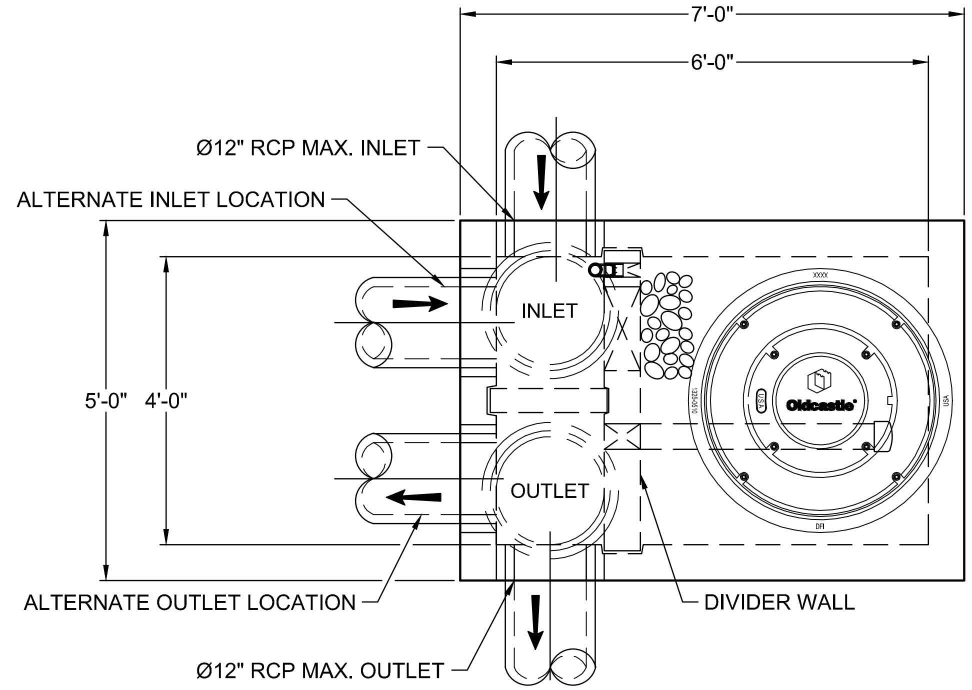
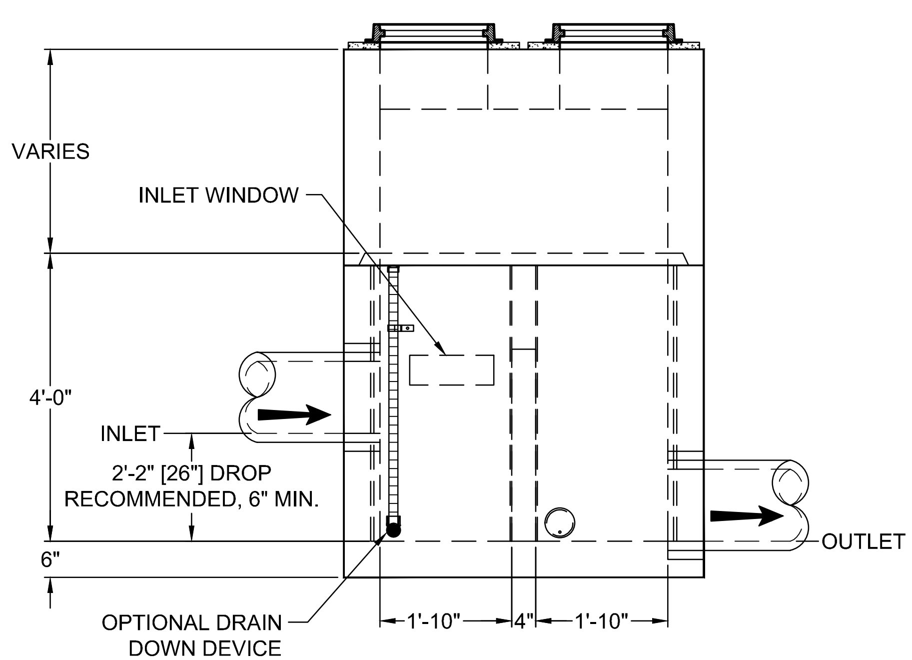
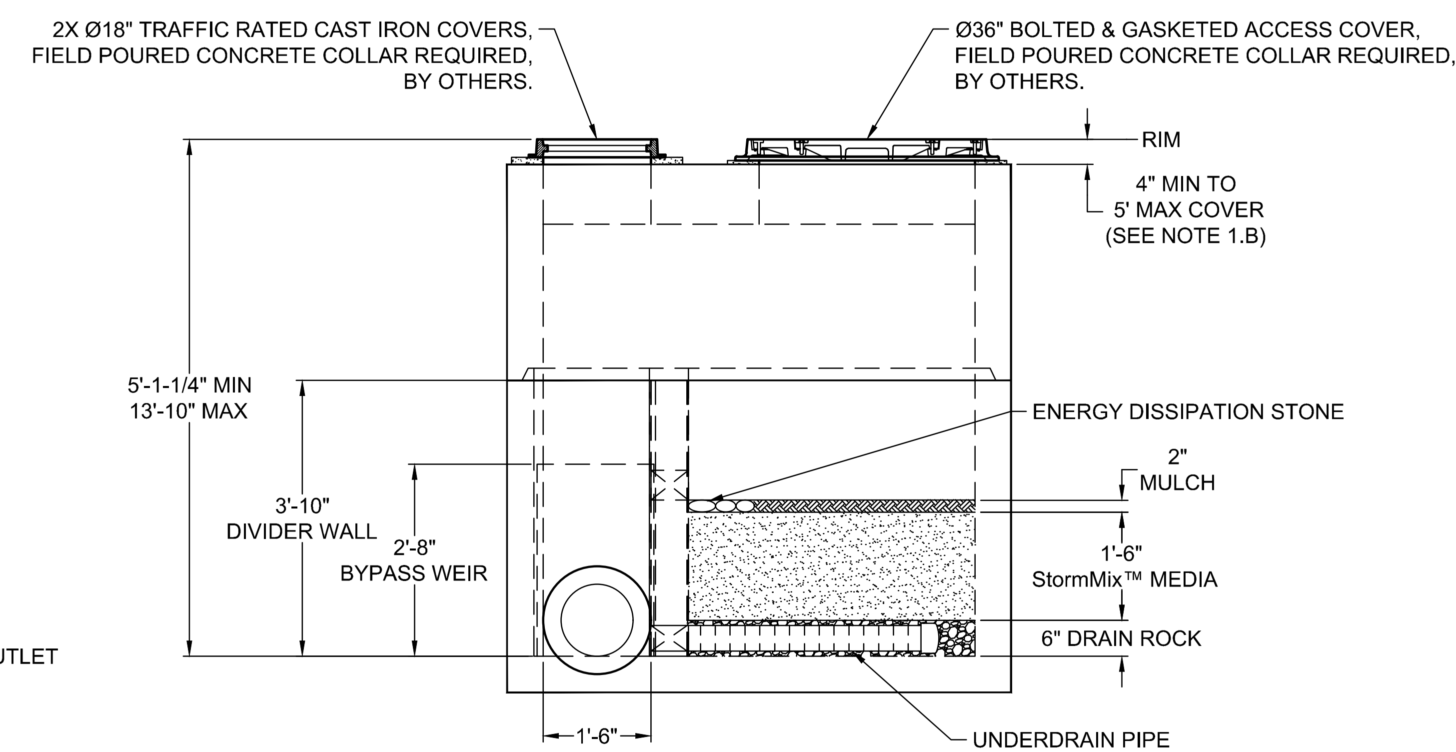
*Contact Oldcastle for alternative treatment flow capacities.



PLAN VIEW



LEFT END VIEW



ELEVATION VIEW

NOTES:

1. DESIGN LOADINGS:
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   B. DESIGN SOIL COVER: 5'-0" MAXIMUM
   C. ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
   D. LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
   E. LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
   F. NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
2. CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
3. REINFORCING: REBAR, ASTM A615/A706, GRADE 60
4. CEMENT: ASTM C150
5. REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
6. REFERENCE STANDARD:
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12. MAXIMUM PICK WEIGHTS":
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    B. BASE: XX,XXX LBS* (* COMBINED WEIGHT OF BASE INCLUDES BYPASS WEIR, DIVIDER WALL, ROCK & MEDIA)
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Bioretention/ Biofiltration

Oldcastle Infrastructure™ A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

BioPod™ Biofilter System (STANDARD)

Underground Vault with Internal Bypass

CUSTOMER		
-		
PROJECT NAME		
-		
SHEET NAME	REVISION	SHEET
Specifier Drawing BPU-46IB	- REV DATE -	1 OF 1

WASHINGTON STATE DEPARTMENT OF ECOLOGY

March 2022

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), DISSOLVED METALS (ENHANCED), AND PHOSPHORUS TREATMENT

For

Oldcastle Infrastructure, Inc.'s
The BioPod™ Biofilter
(Formerly the TreePod Biofilter)

Ecology's Decision

Based on Oldcastle Infrastructure, Inc. application submissions for The BioPod™ Biofilter (BioPod), Ecology hereby issues the following use level designation:

1) General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:
   - Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.
   - Constructed with a minimum media thickness of 18-inches (1.5-feet)
2) Ecology approves the BioPod at the hydraulic loading rate listed above, 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 2.7.6 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) For systems that have a drain down outlet, designers must increase the water quality design flow rate calculated in Item 2, above, to account for the water that will enter the initial bay but won't be treated by the engineered soil. Multiply the flow rate determined above by 1.05

to determine the required flowrate for the BioPod unit.

4) The GULD has no expiration date, but may be amended or revoked by Ecology.

Ecology's Conditions of Use

The BioPod shall comply with these conditions:

1) Applicants shall design, assemble, install, operate, and maintain the BioPod installations in accordance with Oldcastle Infrastructure Inc.'s applicable manuals and the Ecology Decision.

2) The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in Ecology Decision, Item 3, above) and the hydraulic loading rate (as identified in Ecology Decision, Item 1, above). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the hydraulic loading rate (converted to ft/sec) to obtain the required surface area (sq ft) of the BioPod unit.

3) BioPod media shall conform to the specifications submitted to and approved by Ecology.

4) The applicant tested the BioPod without plants. This GULD applies to the BioPod Stormwater Treatment System whether plants are included in the final product or not.

5) Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on 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 filter treatment device.

   - The BioPod is designed for a target maintenance interval of 1 year. Maintenance includes replacing the mulch, assessing plant health, removal of trash, and raking the top few inches of engineered media.
   - The BioPod system initially tested at the Lake Union Ship Canal Test Facility in Seattle, WA required maintenance after 1.5 months, or 6.3% of a water year. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. Runoff from the Test Facility may be unusual and maintenance requirements of systems installed at the Test Facility may not be indicative of typical maintenance requirements. Because of this, the initial version of the GULD required Oldcastle to subsequently "conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest". Quarterly testing from a 15-month maintenance frequency assessment conducted on a BioPod system installed along a roadway in Des Moines, WA indicated the system was able to treat a full water year before requiring maintenance.
   - Test results provided to Ecology from a BioPod System evaluated in a lab following New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs have indicated the BioPod System is capable of longer maintenance intervals.
   - Owners/operators must inspect BioPod systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators 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 the 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.

6) Install the BioPod in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.
7) Discharges from the BioPod shall not cause or contribute to water quality standard violations in receiving waters.

Approved Alternate Configurations

BioPod Internal Bypass

1) The BioPod Internal Bypass configuration may be combined with a Curb Inlet, Grated Inlet, and Piped-In Inlet. Water quality flows and peak flows are directed from the curb, overhead grate, or piped inlet to a contoured inlet rack. The inlet rack disperses water quality flows over the top surface of the biofiltration chamber. Excess flows are diverted over a curved bypass weir to the outlet area without passing through the treatment area. Both water quality flows and bypass flows are combined in the outlet area prior to being discharged out of the system.
2) To select a BioPod Internal Bypass unit, the designer must determine the size of the standard unit using the sizing guidance described above. Systems that have an internal bypass may use the off-line water quality design flow rate.
3) The internal bypass configuration has a maximum flow rate of 900 gallons per minute. Sites where the anticipated flow rate at the treatment device is larger than 900 gpm must use an external bypass, or size the treatment device for the on-line water quality design flow rate.

Applicant:	Oldcastle Infrastructure, Inc.
Applicant's Address:	7100 Longe St, Suite 100 Stockton, CA 95206

Application Documents:

BioPod™ Stormwater Filter Maintenance Frequency Assessment, Prepared for Oldcastle Infrastructure, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2022

Technical Evaluation Report TreePod™ BioFilter System Performance Certification Project, Prepared for Oldcastle, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., January 2018

Application for Pilot Use Level Designation, TreePod™ Biofilter – Stormwater Treatment System, Oldcastle Stormwater Solutions, May 2016

Emerging Stormwater Treatment Technologies Application for Certification: The TreePod™ Biofilter, Oldcastle Stormwater Solutions, April 2016

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the BioPod™ Biofilter operating at a hydraulic loading rate of 153 inches per hour is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L.
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L.
- 50% or greater total phosphorus for influent concentrations 0.1 to 0.5 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Oldcastle Infrastructure, Inc. has shown Ecology, through laboratory and field testing, that the BioPod™ Biofilter is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

- Herrera Environmental Consultants, Inc. conducted monitoring of the BioPod™ Biofilter at the Lake Union Ship Canal Test Facility in Seattle Washington between November 2016 and April 2018. Herrera collected flow-weight composite samples during 14 separate storm events and peak flow grab samples during 3 separate storm events. The system was sized at an infiltration rate of 153 inches per hour or a hydraulic loading rate of 1.6 gpm/ft^2.

- The D_{50} of the influent PSD ranged from 3 to 292 microns, with an average D_{50} of 28 microns.
    - Influent TSS concentrations ranged from 17 mg/L to 666 mg/L, with a mean concentration of 98 mg/L. For all samples (influent concentrations above and below 100 mg/L) the bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean TSS reduction was 84% and the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the mean TSS effluent concentration was 8.2 mg/L.
    - Dissolved copper influent concentrations from the 17 events ranged from 9.0 µg/L to 21.1 µg/L. The 21.1 µg/L data point was reduced to 20.0 µg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean dissolved copper reduction was 35%.
    - Dissolved zinc influent concentrations from the 17 events ranged from 26.1 µg/L to 43.3 µg/L. A bootstrap estimate of the LCL95 of the mean dissolved zinc reduction was 71%.
    - Total phosphorus influent concentrations from the 17 events ranged from 0.064 mg/L to 1.56 mg/L. All influent data greater than 0.5 mg/L were reduced to 0.5 mg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean total phosphorus reduction was 64%.
    - The system experienced rapid sediment loading and needed to be maintained after 1.5 months. Monitoring personnel observed similar sediment loading issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.
- Herrera Environmental Consultants, Inc. conducted a maintenance frequency assessment of the BioPod™ installed along a roadway in Des Moines, WA between September 2020 and January 2022.
    - Herrera collected influent grab samples during 10 storm events and paired effluent samples during 5 storm events. Influent concentrations ranged from 1 mg/L to 164 mg/L, with a median concentration of 23 mg/L. Effluent concentrations ranged from 1 mg/L to 19 mg/L, with a median of 5 mg/L.
    - Herrera collected influent PSD samples during 3 storm events. The D_{50} for the samples were 42, 1306, and 57 microns. The 1306 micron value was collected during an event with an influent TSS concentration of 1 mg/L. It is assumed this sample was atypical and that it contained a few grains of very coarse sand and almost no other particles.
    - Herrera used a water truck to conduct flow testing 7 times to assess how long the system could filter at the design flow rate without bypass. Results show the system was able to treat up to a full water year before the system needed maintenance.

Laboratory Testing

- Good Harbour Laboratories (GHL) conducted laboratory testing at their site in Mississauga, Ontario in October 2017 following the New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs. The testing evaluated a 4-foot by 6-foot standard biofiltration chamber and inlet contour rack with bypass weir. The test sediment used during the testing was custom blended by GHL using various commercially available silica sands, which had an average d_{50} of 69 µm. Based on the lab test results:

  - GHL evaluated removal efficiency over 15 events at a Maximum Treatment Flow Rate (MTFR) of 37.6 gpm, which corresponds to a MTFR to effective filtration treatment area ratio of 1.80 gpm/ft^2. The system, operating at 100% of the MTFR with an average influent concentration of 201.3 mg/L, had an average removal efficiency of 99 percent.
  - GHL evaluated sediment mass loading capacity over an additional 16 events using an influent SSC concentration of 400 mg/L. The first 11 runs were evaluated at 100% of the MTFR. The BioPod began to bypass, so the remaining 5 runs were evaluated at 90% of the MTFR. The total mass of the sediment captured was 245.0 lbs and the cumulative mass removal efficiency was 96.3%.

- Herrera Environmental Consultants Inc. conducted laboratory testing in September 2014 at the Seattle University Engineering Laboratory. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of twelve different media blends. Based on this testing, Oldcastle Infrastructure, Inc. selected one media blend, Mix 8, for inclusion in their TAPE evaluation of the BioPod™ Biofilter.
  - Herrera evaluated Mix 8 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column. The column contained 18-inches of Mix 8 on top of 6-inches of pea gravel. The BioPod will normally include a 3-inch mulch layer on top of the media layer; however, this was not included in the laboratory testing.
  - Mix 8 has a hydraulic conductivity of 218 inches per hour; however, evaluation of the pollutant removal ability of the media was based on an infiltration rate of 115 inches per hour. The media was tested at 75%, 100%, and 125% of the infiltration rate. Based on the lab test results:
    - The system was evaluated using natural stormwater. The dissolved copper and dissolved zinc concentrations in the natural stormwater were lower than the TAPE influent standards; therefore, the stormwater was spiked with 66.4 mL of 100 mg/L Cu solution and 113.6 mL of 1,000 mg/L Zn solution.
    - The BioPod removed an average of 81% of TSS, with a mean influent concentration of 48.4 mg/L and a mean effluent concentration of 9.8 mg/L.
    - The BioPod removed an average of 94% of dissolved copper, with a mean influent concentration of 10.6 µg/L and a mean effluent concentration of 0.6 µg/L.
    - The BioPod removed an average of 97% of dissolved zinc, with a mean influent concentration of 117 µg/L and a mean effluent concentration of 4 µg/L.
    - The BioPod removed an average of 97% of total phosphorus, with a mean influent concentration of 2.52 mg/L and a mean effluent concentration of 0.066 mg/L. When total phosphorus influent concentrations were capped at the TAPE upper limit of 0.5 mg/L, calculations showed an average removal of 87%.

Other BioPod Related Issues to be Addressed by the Company:

1. None identified at this time.

Technology Description: Download at https://oldcastleprecast.com/stormwater/bioretention-biofiltration-applications/bioretention-biofiltration-solutions/

Contact Information:

Applicant: Chris Demarest
Oldcastle Infrastructure, Inc.
(925)667-7100
Chris.demarest@oldcastle.com

Applicant website: https://oldcastleprecast.com/stormwater/

Ecology web link: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 870-0983
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
March 2018	GULD granted for Basic Treatment
March 2018	Provisional GULD granted for Enhanced and Phosphorus Treatment
June 2016	PULD Granted
April 2018	GULD for Basic and Provisional GULD for Enhanced and Phosphorus granted, changed name to BioPod from TreePod
July 2018	GULD for Enhanced and Phosphorus granted
September 2018	Changed Address for Oldcastle
December 2018	Added minimum media thickness requirement
May 2019	Changed language on who must Install and maintain the device from Oldcastle to Applicants
August 2019	Added text on sizing using infiltration rate and water quality design flow rate
October 2019	Added text describing ability to use off-line design water quality flow rate for sizing due to internal bypass
December 2021	Extended approval to installations without plants, added sizing adjustment when using facilities with a drawdown outlet
March 2022	Added results from the maintenance frequency assessment to the Ecology's Conditions of Use and the Findings of Fact sections

APPENDIX D-3

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.58
Program License Number: 201710010
Project Simulation Performed on: 10/21/2023 12:41 PM
Report Generation Date: 10/24/2023 8:24 AM

Input File Name: 20231013 Storm Model Combined with Full Bypass.fld
Project Name: East Town
Analysis Title:
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 3
Precipitation Station : 95004005 Puget West 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951040 Puget West 40 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

This is correct

********** Default HSPF Parameters Used (Not Modified by User) ***************

********************** **WATERSHED DEFINITION** **********************

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	10.650	10.650
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	10.650	10.650

----------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : All Basins ----------
-------Area (Acres) --------
C, Forest, Flat 10.650

Subbasin Total 10.650

----------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3

---------- Subbasin : Upper Basin ----------
-------Area (Acres) --------
C, Lawn, Flat 3.330
ROADS/FLAT 2.820
ROOF TOPS/FLAT 1.850

Subbasin Total 8.000

---------- Subbasin : Lower Basin ----------
-------Area (Acres) --------
C, Lawn, Flat 0.860

ROADS/FLAT 0.900
ROOF TOPS/FLAT 0.240

Subbasin Total 2.000

---------- Subbasin : Bypass ----------
-------Area (Acres) --------
C, Lawn, Flat 0.250
ROADS/FLAT 0.400

Subbasin Total 0.650

**************************** LINK DATA *******************************

----------------------SCENARIO: PREDEVELOPED
Number of Links: 0

**************************** LINK DATA *******************************

----------------------SCENARIO: POSTDEVELOPED
Number of Links: 3

Updated calcs and provided

--
Link Name: Tandem RTank
Link Type: Structure
Downstream Link Name: Commercial RTank

VERIFY-5ft of live storage places riser top at El. 73.40. RTank 3 top of storage is El. 75.23. It appears that as RTank 3 fills, RTank 2 will go into overflow before RTank 3 storage is fully utilized (See comments Sht C4.07 too). [Storm Report; Pg 372 of 448]

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 105.00
Max Pond Elevation (ft) : 105.50
Storage Depth (ft) : 5.00
Pond Bottom Length (ft) : 250.0
Pond Bottom Width (ft) : 146.0
Pond Side Slopes (ft/ft) : Z1= 0.00 Z2= 0.00 Z3= 0.00 Z4= 0.00
Bottom Area (sq-ft) : 36500.
Area at Riser Crest El (sq-ft) : 36,500.
(acres) : 0.838
Volume at Riser Crest (cu-ft) : 182,500.
(ac-ft) : 4.190
Area at Max Elevation (sq-ft) : 36500.
(acres) : 0.838
Vol at Max Elevation (cu-ft) : 200,750.
(ac-ft) : 4.609

Coordinate calculations to reflect the actual control risers being used with the individual RTank system for each subasin. [Storm Report; Pg 372 of 448]

Revised Plans

CLARIFY-the combined total storage for RTank2 and RTank3 is 141,452cf (78,829 + 62,623) per civil plans, Sht C4.21 and C4.31. [Storm Report; Pg 372 of 448]

Revised ACF Exhibits

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

VERIFY-18in called out on Sht C4.07. [Storm Report; Pg 372 of 448]

Revised Plans

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.070
Riser Crest Elevation : 105.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

Revised Plans

VERIFY-1.37 per Plans, Sht C4.07. [Storm Report; Pg 372 of 448]

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.50
Orientation : Horizontal

Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 103.75
Diameter (in) : 1.25
Orientation : Vertical
Elbow : No

VERIFY-El. 74.21 (5.81ft) called out on Sht C4.07.
[Storm Report; Pg 373 of 448]

VERIFY-2.25in called out on Sht C4.07.
[Storm Report; Pg 373 of 448]

Updated Plans

Link Name: Commercial RTank
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.00
Max Pond Elevation (ft) : 102.20
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 55.0
Pond Bottom Width (ft) : 183.0
Pond Side Slopes (ft/ft) : Z1= 0.00 Z2= 0.00 Z3= 0.00 Z4= 0.00
Bottom Area (sq-ft) : 10065.
Area at Riser Crest El (sq-ft) : 10,065.
(acres) : 0.231
Volume at Riser Crest (cu-ft) : 20,130.
(ac-ft) : 0.462
Area at Max Elevation (sq-ft) : 10065.
(acres) : 0.231
Vol at Max Elevation (cu-ft) : 22,143.
(ac-ft) : 0.508

Updated Plans to coordinate with calculations

Coordinate calculations to reflect the actual control risers being used with the individual RTank system for each subasin.
[Storm Report; Pg 373 of 448]

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

VERIFY-12in called out on Sht C4.07.
[Storm Report; Pg 373 of 448]

Updated Plans

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.230
Riser Crest Elevation : 102.00 ft

Hydraulic Structure Geometry

Number of Devices: 3

Updated Plans

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.25
Diameter (in) : 2.25
Orientation : Horizontal
Elbow : No

VERIFY-El. 100.00?
[Storm Report; Pg 373 of 448]

VERIFY-2.06 per Plans, Sht C4.07.
[Storm Report; Pg 373 of 448]

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 101.25
Diameter (in) : 3.00
Orientation : Vertical
Elbow : No

VERIFY-El. 68.30 (0.9ft) called out on Sht C4.07.
[Storm Report; Pg 373 of 448]

---Device Number 3 ---
Device Type : Circular Orifice
Control Elevation (ft) : 101.75
Diameter (in) : 3.50
Orientation : Horizontal
Elbow : Yes

VERIFY-Orifice is not called out on plans, Sht C4.07.
[Storm Report; Pg 373 of 448]

Link Name: POC
Link Type: Copy
Downstream Link: None

*********************FLOOD FREQUENCY AND DURATION STATISTICS*******************

--------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

--------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 3

********** Link: POC   **********   Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.285
5-Year	0.395
10-Year	0.447
25-Year	0.593
50-Year	0.650
100-Year	0.673
200-Year	0.739
500-Year	0.828

***********Groundwater Recharge Summary *************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: All Basins	1826.020
Total:	1826.020

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Upper Basin	394.532
Subbasin: Lower Basin	101.891
Subbasin: Bypass	29.619
Link: Tandem RTank	Not Computed
Link: Commercial RTank	Not Computed
Link: POC 0.000	
Total:	526.042

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 11.557 ac-ft/year, Post Developed: 3.329 ac-ft/year

***********Water Quality Facility Data *************

--------------------SCENARIO: PREDEVELOPED

Number of Links: 0

--------------------SCENARIO: POSTDEVELOPED

Number of Links: 3

********** Link: POC **********

2-Year Discharge Rate : 0.285 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 999.00 cfs
Off-line Design Discharge Rate (91% Exceedance): 999.00 cfs

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 3755.28
Inflow Volume Including PPT-Evap (ac-ft): 3755.28
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 3755.28
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

***********__Compliance Point Results__ *************

Scenario Predeveloped Compliance Subbasin: All Basins

Scenario Postdeveloped Compliance Link: POC

*** **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	0.293	2-Year	0.285
5-Year	0.432	5-Year	0.395
10-Year	0.564	10-Year	0.447
25-Year	0.728	25-Year	0.593
50-Year	0.886	50-Year	0.650
100-Year	0.945	100-Year	0.673
200-Year	0.969	200-Year	0.739
500-Year	1.000	500-Year	0.828

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** **Flow Duration Performance** ****

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-1.3%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-1.3%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-74.1%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

Appendix E

- Construction Stormwater Pollution Prevention Plan (CSWPPP)

Construction Stormwater Pollution Prevention Plan

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230723.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2023

Construction Stormwater Pollution Prevention Plan

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230723.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2023

I hereby state that this Construction Stormwater Pollution Prevention Plan for the East Town Crossing project has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Table of Contents

Exhibits

Appendix F

Appendix G

Inspection Logs

Appendix H

Best Management Practices (BMPs)

Please ADD BMPS C102, C107, C122, C150, C151, C152, C153, C209, and C241. [Storm Report; Pg 380 of 448]

Added

1.0 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act (FWPCA), also known as the Clean Water Act (CWA), to restore and maintain the quality of the nation's waterways. The ultimate goal was to make sure that rivers and streams were fishable, swimmable, and drinkable. In 1987, the Water Quality Act (WQA) added provisions to the CWA that allowed the Environmental Protection Agency to govern stormwater discharges from construction sites. The National Pollutant Discharge Elimination System (NPDES) General Permit includes provisions for development of a Stormwater Pollution Prevention Plan (SWPPP) to maximize the potential benefits of pollution prevention and sediment and erosion control measures at construction sites.

The proposed project will disturb more than 1 acre of area, and therefore is required to obtain an NPDES General Permit for Stormwater Associated with Construction Activities.

The 2019 Department of Ecology (DOE) *Stormwater Management Manual for Western Washington (SMMWW)* requires a Construction SWPPP for projects that add or replace more than 2,000 square feet of impervious surfaces. The proposed project will exceed this threshold; therefore, a Construction SWPPP is required.

Development, implementation, and maintenance of the Construction SWPPP will provide the selected General Contractor with the framework for reducing soil erosion and minimizing pollutants in stormwater during construction of the proposed project. The Construction SWPPP will:

- Define the characteristics of the site and the type of construction that will occur.
- Describe the practices that will be implemented to control erosion and the release of pollutants in stormwater.
- Create an implementation schedule to ensure that the practices described in this Construction SWPPP are in fact implemented, and to evaluate the plan's effectiveness in reducing erosion, sediment, and pollutant levels in stormwater discharged from the site.
- Describe the final stabilization/termination design to minimize erosion and prevent stormwater impacts after construction is complete.

This Construction SWPPP:

- Identifies the SWPPP Coordinator with a description of this person's duties.
- Identifies the Stormwater Pollution Prevention Team (SWPP Team) that will assist in implementation of the Construction SWPPP during construction.
- Describes the existing site conditions, including existing land use for the site, the soil types at the site, as well as the location of surface waters that are located on or next to the site.
- Identifies the body or bodies of water that will receive runoff from the construction site, including the ultimate body of water that receives the stormwater.
- Identifies the drainage areas and potential stormwater contaminants.
- Describes the stormwater management controls and various Best Management Practices (BMPs) necessary to reduce erosion, sediment, and pollutants in stormwater discharge.
- Describes the facility monitoring plan and how controls will be coordinated with construction activities.
- Describes the implementation schedule and provisions for amendment of the plan.

Revised to reflect current approach

REVISE to reflect current WQ desgn approach. [Storm Report; Pg 382 of 448]

2.0 Project Description

The East Town Crossing project proposes to develop an approximately 10.93-acre site located on Tax Parcels 0420264021, 0420264053, 0420264054, 0420351066, 0420351030, 0420351029, 0420351026 in the City of Puyallup, Washington. Refer to Appendix A, Exhibit A-1 for the Vicinity Map.

The developed site includes 8 multifamily buildings, 1 property management/clubhouse building, 2 commercial buildings, associated parking, road access, and utilities. Perimeter and island landscaping will be provided as required by the City of Puyallup. The paved areas will drain to the proposed catch basins located the sites proposed local low points. Runoff collected in these catch basins will be conveyed to one of three R-Tanks where stormwater will be detained. Control structures will control the release of stormwater to a downstream 8'x20' Modular Wetland prior to discharging to the enhanced channel that lines the east and north of the site. Stormwater ultimately discharges to the Puyallup River via open channels alongside E Pioneer, running west.

DOE?

DOE

The proposal will follow the stormwater management design criteria outlined in the DOW 2019 *SMMWW*. Control methods during construction include working during the dry season, minimizing the amount of area that is disturbed at any given time, installing a stabilized construction entrance, placing inlet protection at catch basins and culvert entrances, utilizing straw wattles and Baker Tank and filtration assembly designed by Clearwater Services, and utilizing silt fence, if necessary.

Refer to Appendix F, Exhibits F-1 and F-2 for the TESC Plan and TESC Notes and Details respectively.

3.0 Existing Site Conditions

Revised

The existing area is approximately 10.93 acres and is currently developed and undeveloped land cover. Within the seven parcels, a network of dirt and gravel access roads connect E Pioneer, Shaw Rd E, and the commercial property to the south. In the southwest parcels, there is an existing residential structure and a vacant residential lot. The majority of the landcover is made up of tall grass, shrubs, and a few trees.

SEE comments in Section 1.2.1. [Storm Report; Pg 382 of 448]

The site contains a detention pond that receives runoff from the commercial property to the south before overflowing into the existing channel lining the east and north of the property. Apart from the detention pond, the site generally slopes from southeast to northwest with sections of the eastern side of the site discharging to the natural channel to the east The large majority of runoff discharges to the northern portion of the channel. A topographical survey of the project was prepared by Abbey Road Group. that shows existing site conditions. See Appendix A, Exhibit A-2 for the Existing Conditions Map.

SEE comments in Section 2.1. [Storm Report; Pg 382 of 448]

Noted

4.0 Adjacent Areas and Drainage

In existing conditions, the commercial property to the south drains to the detention pond located on the southeastern parcel of the site and discharges to the channel lining the eastern portion of the site. The detention pond will be maintained in Phase 1 of construction, however, will be replaced by an underground detention system in Phase 2.

Shaw Road E to the west contains its own stormwater collection and conveyance system which prevents discharge to the site. However, Pioneer E to the north drains into channels on either side of the road, including the channel on the north end of the project site. Frontage improvements are proposed in this project during phase 2 that will redirect runoff to the downstream connection via an enhanced stream.

Revised

SEE comments in Section 2.2.
[Storm Report; Pg 383 of 448]

along?

along

Stormwater leaves the site via the channel that runs around the east and north of the site. A culvert collects the water from the channel and directs it northwest under the intersection of E Pioneer and Shaw Road E. A channel then runs across E Pioneer on the roadside of the railroad before it intersects another culvert directing water to the Puyallup River less than a mile away.

FYI-It is more than a mile to the Puyallup River along the project's release route which includes the Pioneer Way north ditch and main stem of Deer Creek.
[Storm Report; Pg 6 of 448]

5.0 Critical Areas

There are no known critical areas on or near the project site.

Revised

6.0 Soils

The National Resources Conservation Service (NRCS) classifies the onsite soils as Briscot Loam in the northern two-thirds of the site and Puyallup fine sandy loam in the lower third of the site. Appendix A, Exhibit A-4 provides the NRCS soil map. Briscot Loam is classified as hydrologic soil group B/D with poorly draining characteristics. Puyallup fine sandy loam is classified as hydrologic soil group A with well-draining characteristics.

In addition to the NRCS information, Krazan & Associates, Inc prepared a geotechnical report for the site. On March 4, 2021, two large-scale pilot infiltration tests were completed. Based on the results presented in the Geotechnical Report, it was determined that the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Due to this, in opposition of the NRCS report, the entire site is not recommended for any infiltration due to the presence of unfavorable soils.

In relation to construction efforts, original testing by Krazan & Associates, Inc. shows that the underlying soils are unsuitable for supporting traffic loads when wet. It is recommended that a Geotechnical Engineer is present to provide guidance during construction.

See Appendix B, Exhibit B-1 for the Krazan & Associates, Inc. Geotechnical Engineering Report and Appendix B-2 for the Migizi Group Geotechnical Letter.

7.0 Potential Erosion Problems

Based on an investigation by Krazan & Associates, Inc., there are steep slopes located roughly 300 feet to the south and east of the site mapped as moderate to high for shallow landslide susceptibility and moderate for deep susceptibility. However, there are no historic landslides or debris mapped at the nearby slopes. Due to the presence of a developed and partially developed parcel separating the landslide hazard and the site, Krazan & Associates, Inc. believes there is minimum to no risk to the planned development from nearby slopes.

soil?

soil

In relation to onsite soil, underlying soul is unsuitable for supporting traffic loads when wet. Appropriate measures should be taken to stabilize soils for construction work before the wet season.

8.0 Construction Stormwater Pollution Prevention Elements

The purpose of this section is to describe how each of the 12 Construction Stormwater Pollution Prevention elements has been addressed and to identify the type and location of BMPs used to satisfy the required element. If an element is not applicable to the project, a reason is provided.

8.1 Mark Clearing Limits

Please add BMP C102.
[Storm Report; Pg 383 of 448]

Added

Prior to beginning land-disturbing activities, clearing limits will be marked with high visibility plastic or metal fencing (BMP C103) as shown on the TESC Plan in Appendix F, Exhibit F-1. All vegetated areas outside the marked clearing limits shall be preserved in existing conditions. Fencing will also be used to protect the existing storm facility.

Please add BMP C107.
[Storm Report; Pg 384 of 448]

Added

8.2 Establish Construction Access

A stabilized construction entrance (BMP C105) is proposed at the northeast corner of the site off E Pioneer. If sediment is transported onto the road surface, the road shall be cleaned by shoveling or sweeping prior to washing. Sediment removal by washing alone will not be allowed. If sediment is tacked from the site, the City of Puyallup may require stabilization of internal roads to contain the sediment or require the installation of wheel wash basins.

tracked?

tracked

8.3 Control Flow Rates

Straw wattles shall be provided to prevent erosion and control flow rates leaving the site. The velocity of water leaving the site shall not exceed 3 ft/s if the discharge is to the existing channel. Clearwater Services has designed a Baker Tank and filtration assembly to control the stormwater release rate and quality before its discharge to the channel. Permanent flow control systems must be constructed and functioning prior to constructing hard surfaces.

Added

8.4 Install Sediment Controls

As part of initial construction activities, BMPs will be installed to trap sediment onsite. Inlet Protection (BMP C220) for existing catch basins and proposed catch basins within the project area and in the adjacent streets that may receive runoff shall be implemented. Silt fence (BMP C233) will be placed along all downgradient boundaries of the proposed project limits to prevent sediment laden runoff from leaving the site.

Add BMP C241 and state "sediment pond sizing calculations included in the CFG Permit PRGR20230972.
[Storm Report; Pg 384 of 448]

Please add "and dust control".
[Storm Report; Pg 384 of 448]

8.5 Stabilize Soils

Exposed areas and soil stockpiles must be stabilized according to the following schedule:

Added

1. From April 1 to October 31, all disturbed areas at final grade and all exposed areas that are scheduled to remain unworked for more than 30 days shall be stabilized within 10 days.

2. From November 1 to March 31, all exposed soils at final grade shall be stabilized immediately using permanent or temporary measures. Exposed soils with an area greater than 5,000 square feet that are scheduled to remain unworked for more than 24 hours, and exposed areas of less than 5,000 square feet that will remain unworked for more than 7 days shall be stabilized immediately.

All disturbed areas that are not planned to be constructed on within 90 days from time of clearing and grading shall be revegetated with the native vegetation.

Add BMPs C120, 121, 123, and C140.
[Storm Report; Pg 384 of 448]

8.6 Protect Slopes

The majority of the site has flat slopes of 0-3%. There are small, isolated areas with slopes greater than 3%, however, no slopes over 20% are being disturbed. All exposed soil not covered by buildings, roadway, or sidewalks will be Hydroseeded, and their slopes will be no greater than 2:11.

Added

2:1?

2:1

Add: "Baker Tank sizing calculations included in the CFG Permit PRGR20230972.
[Storm Report; Pg 384 of 448]

Added note

8.7 Protect Drain Inlets

Storm drain inlets shall be protected so that surface water runoff does not enter the conveyance system without first being filtered. Inlets shall be inspected weekly, at a minimum, and daily during storm events. Storm Drain Inlet Protection (BMP C220) will be provided.

Added

Add: "(if approved by the AHJ)".
[Storm Report; Pg 385 of 448]

8.8 Stabilize Channels and Outlets

There is an existing channel alongside E Pioneer that will be protected as necessary. Provide stabilization, including armoring material adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

8.9 Control Pollutants

All waste materials will be collected and stored in a securely closed metal dumpster. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied a minimum of once per week, and the trash will be hauled to the local landfill. No construction materials will be buried onsite. All personnel will be instructed regarding the correct procedure for waste disposal. All sanitary waste will be collected from the portable units a minimum of three times per week. Good housekeeping and spill control practices will be followed during construction to minimize stormwater contamination from petroleum products, fertilizers, and concrete.

Table 1 below lists several pollutants that are commonly found on construction sites that have the potential to contaminate storm runoff. These pollutants will be present, mainly in areas of building and pavement construction. The Contractor and the SWPPP/TESC Coordinator will be responsible for identifying areas where these pollutants are being used and monitor runoff coming from these areas. Pollutant sources will be covered with plastic if contaminated runoff is observed from these areas. If contaminated runoff is found in the sediment trap or soils, the Erosion Control Specialist will direct the Contractor to remove the polluted water/soil and dispose of it in an approved area offsite.

Table 1 – Potential Construction Site Stormwater Pollutants

Trade Name Material	Chemical/Physical Description(1)	Stormwater Pollutants(1)
Pesticides (insecticides, fungicides, herbicide, rodenticides)	Various colored to colorless liquid, powder, pellets, or grains	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic
Fertilizer	Liquid or solid grains	Nitrogen, phosphorous
Plaster	White granules or powder	Calcium sulphate, calcium carbonate, sulfuric acid
Cleaning solvents	Colorless, blue, or yellow-green liquid	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates
Asphalt	Black solid	Oil, petroleum distillates
Concrete	White solid	Limestone, sand
Glue, adhesives	White or yellow liquid	Polymers, epoxies
Paints	Various colored liquid	Metal oxides, Stoddard solvent, talc, calcium carbonate, arsenic
Curing compounds	Creamy white liquid	Naphtha
Wastewater from construction equipment washing	Water	Soil, oil & grease, solids
Wood preservatives	Clear amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium

Please add BMP C209.
[Storm Report; Pg 385 of 448]

Included in 8.8

Trade Name Material	Chemical/Physical Description[1]	Stormwater Pollutants[1]
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	Mineral oil
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE
Diesel fuel	Clear, blue-green to yellow liquid	Petroleum distillate, oil & grease, naphthalene, xylenes
Kerosene	Pale yellow liquid petroleum hydrocarbon	Coal oil, petroleum distillates
Antifreeze/coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)
Erosion	Solid Particles	Soil, Sediment

(1) Data obtained from MSDS when available

8.9.1 Required BMPs

The following BMPs or equivalent measures are required of all businesses and agencies during concrete pouring and asphalt application at temporary sites:

- Employees must be educated on the pollution hazards of concrete and asphalt application and cutting.
- Loose aggregate chunks and dust must be swept or shoveled and collected (not hosed down a storm drain) for recycling or proper disposal at the end of each workday, especially at work sites such as streets, driveways, parking lots, sidewalks, curbs, and gutters where rain can readily pick up the loose material and carry it to the nearest stormwater conveyance. Small amounts of excess concrete, grout, and mortar can be disposed of in the trash.
- Storm drain covers or similarly effective containment devices must be placed over all nearby drains at the beginning of each day. Shovel or vacuum slurry and remove from the site. All accumulated runoff and solids must be collected and properly disposed at the end of each workday, or more often if necessary.
- Exposed aggregate washing, where the top layer of unhardened concrete is hosed or scraped off to leave a rough finish, must be done with a mechanism for containment and collection of the discarded concrete slurry (such as the storm drain covers mentioned above). The easiest way to contain the washwater will be to direct the washings to a hole in the ground where the water can percolate into the ground and the solids later covered with soil.
- If directed to a drain, a catch basin filter insert must be used to remove the solids. This is especially useful if the activity must proceed on rainy days.
- Cleaning of concrete application and mixing equipment or concrete vehicles on the work site must be done in a designated area where the rinse water is controlled. The rinse water must either be collected for proper disposal or put into a hole in the ground where the water can percolate away, and the solids later covered with soil or recovered and disposed or recycled.

The use of any treatment BMP must not result in the violation of groundwater, surface water, or drinking water quality standards.

Added

Please add: "Clean dewatering water shall not be routed through stormwater sediment ponds." [Storm Report; Pg 385 of 448]

8.10 Control Dewatering

Most proposed improvements are above the observed groundwater, with the exception of some utility installment. Should groundwater be encountered during construction, dewatering control measures shall be used to prevent untreated discharge of sediment-laden water. Measures may include vehicle transport offsite for legal disposal in a manner that does not pollute surface waters, or use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Add: "(if approved by the AHJ)". [Storm Report; Pg 385 of 448]

Added

8.11 Maintain BMPs

Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure performance of their intended functions.

Sediment control BMPs such as silt fencing and drain inlet protection shall be inspected weekly or after a runoff-producing event. Temporary erosion and sediment control BMPs will be removed within 30 days after final site stabilization is achieved. The following inspection and maintenance practices will be used to maintain erosion and sediment controls:

- Built-up sediment will be removed from silt fencing when it has reached one-third the height of the fence.
- Silt fences will be inspected for depth of sediment, tears in the fabric, attachment to the fence posts, and to determine that fence posts are firmly in the ground. Accumulated sediment will be removed from behind the fence.
- Temporary and permanent seeding will be inspected for bare spots, washouts, and healthy growth.
- The Contractor Certified Erosion and Sedimentation Control Lead (CESCL) will provide erosion control inspection services and stormwater disposal monitoring through construction. The City Inspector will be notified of daily construction activities and scheduled meetings between the Erosion Control Inspector and the Contractor.

The maintenance inspection report will be made after each inspection. Copies of the report forms to be completed by the SWPPP Coordinator are attached as Appendix G of this Construction SWPPP. Completed forms will be provided to the City Inspector and will also be maintained onsite during the entire construction project. If construction activities or design modifications are made to the site plan that could impact stormwater, or if AHBL determines that the measures are not adequate to prevent erosion and the discharge of sediment from the site (based on turbidity measurements), this Construction SWPPP will be amended appropriately. The amended Construction SWPPP will have a description of the new activities that contribute to the increased pollutant loading and the planned source control activities.

8.12 Manage the Project

The following practices will be required during construction to properly manage activities:

- Comply with seasonal work limitations.
- Inspect, maintain, and repair BMPs.
- Identify a Certified Erosion and Sediment Control Lead (CESCL).

- Maintain the Construction SWPPP onsite at all times, including narrative and plans.

9.0 Construction Sequence and Phasing

9.1 Construction Sequence

The construction sequence is described below:

1. Arrange and attend a pre-construction meeting with the City of Puyallup.
2. Stake/flag clearing and construction limits.
3. Construct all temporary erosion control BMPs according to the TESC plan. Install inlet sediment protection in existing catch basins.
4. Install construction entrance.
5. Demolish existing site features indicated for removal.
6. Maintain erosion control measures in accordance with City of Puyallup standards and manufacturer recommendations.
7. Rough grade and fill site. All grading shall be done in conformance with the grading plan.
8. Construct storm system and install inlet sediment protection to new basins.
9. Install all remaining site utilities and associated infrastructure.
10. Apply erosion control mulch and seeding, straw mulch or equal, to areas that will not be brought to final grade or permanently vegetated within 7 days of exposure during the dry season, and 2 days of exposure during the wet season (October 1 – April 30).
11. Relocate erosion control measures or install new measures so that, as the site conditions change, the erosion and sediment control is always in accordance with the City of Puyallup Construction SWPPP minimum requirements.
12. Final grade site and install final surface treatments. Ensure that surface water is positively directed toward proposed storm collection facilities.
13. Remove remaining temporary erosion control items once site has been stabilized and upon approval of the City of Puyallup.

9.2 Construction Phasing

Work under this permit will be completed in two phases. Refer to the associated Plans.

Please REVISE to "TBD".
[Storm Report; Pg 388 of 448]

Revised

10.0 Construction Schedule

Construction is scheduled to begin in XXX and is expected to be completed in XXX. The majority of earth moving activities will be scheduled during the dry season. During construction, measures will be taken to prevent the transportation of sediment from the site to receiving waters. These measures include the use of:

- (BMP C103)

Added

Please ADD BMPS C102, C107, C122, C150, C151, C152, C153, C209, and C241. [Storm Report; Pg 389 of 448]

- Stabilized Construction Entrance (BMP C105)
- Temporary and Permanent Seeding (BMP C120)
- Mulching (BMP C121)
- Plastic Covering (BMP C123)
- Dust Control (BMP C140)
- Storm Drain Inlet Protection (BMP C220)
- Silt Fence (BMP C233)

11.0 Financial/Ownership Responsibilities

The contractor is responsible for obtaining performance and maintenance bonds in accordance with City of Puyallup requirements.

12.0 Certified Erosion and Sediment Control Lead (CESCL)

The General Contractor shall be required to provide a CESCL prior to construction. Once this individual is identified, the City Inspector will be notified.

The Contractor will designate their CESCL here:

Name: ______________________________

Address: ______________________________

Phone: ______________________________

Fax Number: ______________________________

The CESCL is required to meet DOE certification requirements. The City Inspector will be provided with CESCL information.

The duties of the CESCL include:

- Implement the Construction SWPPP/TESC plan with the aid of the SWPP Team.
- Oversee maintenance practices identified as BMPs in the Construction SWPPP.
- Conduct or provide for inspection and monitoring activities.
- Sample stormwater for turbidity using a turbidity meter.
- Identify other potential pollutant sources and make sure they are added to the plan.
- Identify any deficiencies in the Construction SWPPP and make sure they are corrected.
- Ensure that any changes in construction plans are addressed in the Construction SWPPP.

To aid in the implementation of the Construction SWPPP, the members of the SWPP Team include the following: General Contractor, CESCL, City of Puyallup Inspector, City of Puyallup, the geotechnical engineering consultant, and AHBL.

The General Contractor will ensure that all housekeeping and monitoring procedures are implemented, while the CESCL will ensure the integrity of the structural BMPs. The SWPP Team will observe construction and erosion control practices and recommend revisions or additions to the Construction SWPPP and drawings.

This analysis is based on data and records either supplied to or obtained by AHBL, Inc. These documents are referenced within the text of the analysis. The analysis has been prepared utilizing procedures and practices within the standard accepted practices of the industry. We conclude that this project, as proposed, will not create any new problems within the existing downstream drainage system. This project will not noticeably aggravate any existing downstream problems due to either water quality or quantity.

AHBL, Inc.

Christopher Watt
Project Engineer

CJW/

October 2023

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List the Pollution Prevention Team, their title, and contact info for the project. For persons yet to be determined, use "TBD". [Storm Report; Pg 390 of 448]

EXAMPLE:

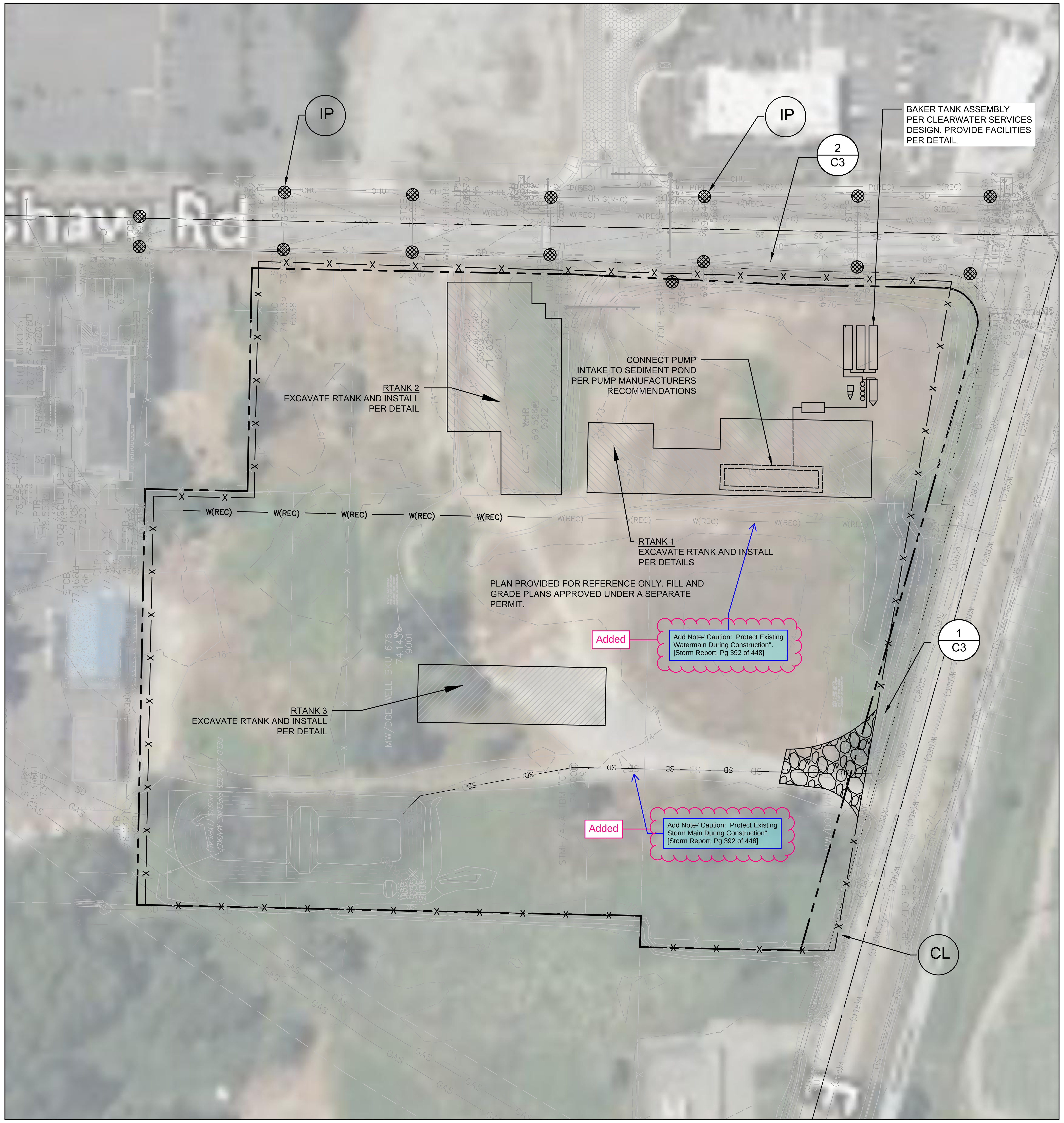
Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	TBD	
Resident Engineer	Jeff McInnis	253.414.1992
Emergency Ecology Contact	TBD	
Emergency Permittee/ Owner Contact	Greg Helle	253.606.6799
Non-Emergency Owner Contact	TBD	
Monitoring Personnel	TBD	
Ecology Regional Office	Southwest Regional Office - Lacey	360.407.6300

Added

Provide Monitoring and Sampling criteria...for reference, see Ecology's CSWPPP template. [Storm Report; Pg 390 of 448]

Added to body of report based on DOE template

Appendix F



N

GRAPHIC SCALE

0 10 20 40

1" = 20 FEET

NOTE:

MAINTAIN SEDIMENT POND AND BAKER TANKS AS DESIGNED IN CLEAR, FILL AND GRADE PLANS

TESC LEGEND:

CL	CLEARING/ GRADING/ DISTURBED LIMITS	
FF	FILTER FABRIC FENCE SEE DETAIL	2 / C2
CE	CONSTRUCTION ENTRANCE	1 / C2
IP	INLET PROTECTION	3 / C2

AHBL
TACOMA · SEATTLE
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

TESC PLAN

EAST TOWN CROSSING

F-1

TESC INSPECTION NOTES:

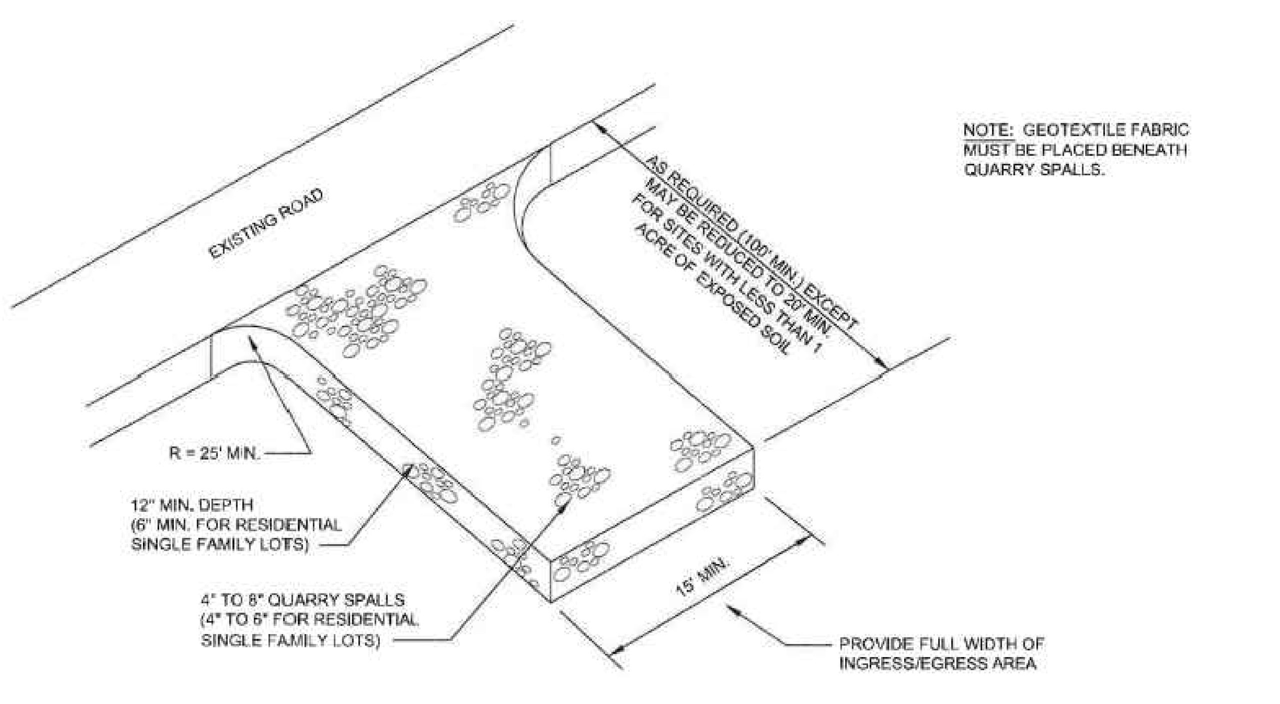
1. INSPECT ALL INLET PROTECTION ON CATCH BASINS. CLEAN OR REPLACE IF FULL OF SEDIMENT /DEBRIS AND REPAIR/REPLACE AS NEEDED IF DAMAGED TO MAINTAIN PROTECTION.
2. INSPECT ALL PERMANENT AND TEMPORARY STABILIZED SLOPES. REPAIR ANY DAMAGED SECTIONS AND RE-VEGETATE AS NEEDED TO ENSURE THE ESTABLISHMENT OF VEGETATION AND THAT NO EROSION OF THE SLOPES OCCUR.
3. INSPECT ALL FILTER FABRIC FENCING FOR SIGNS OF EROSION, DAMAGE OR FAILURES. REPAIR AND/OR REPLACE AS NEEDED. SEE FILTER FABRIC NOTES. SEDIMENT BUILD-UP ALONG FENCE SHALL BE REMOVED WHEN REACHES 1/3 THE FENCE HEIGHT. IF EROSION IS OCCURRING, CONTRACTOR SHALL INSTALL ADDITIONAL EROSION CONTROL MEASURES AS NEEDED TO PREVENT EROSION.
4. ANY FILL/CUT SLOPES SHALL BE INSPECTED FOR EROSION. IF SIGNS OF EROSION ARE PRESENT, INSTALL APPROPRIATE BMPS AS NEEDED TO STOP EROSION AND STABILIZE SLOPES.
5. TESC LEAD RESPONSIBLE FOR NOTIFYING ENGINEER IF ADDITIONAL MEASURES ARE WARRANTED.

PERMANENT STABILIZATION NOTES:

1. ALL EXPOSED SOILS AND SLOPES SHALL BE SEEDED OR OTHERWISE STABILIZED IMMEDIATELY AFTER CONSTRUCTION AND GRADING ACTIVITIES HAVE BEEN COMPLETED.
2. SILT FENCE, IF DEEMED APPROPRIATE, SHALL REMAIN FOR A MINIMUM OF 30 DAYS AFTER THE FINAL STABILIZATION OF THE SLOPES HAS OCCURRED.
3. ALL TEMPORARY EROSION CONTROL BMP'S SHALL BE REMOVED 30 DAYS AFTER FINAL STABILIZATION HAS OCCURRED AS DIRECTED BY CITY OR COUNTY INSPECTOR.
4. CONTRACTOR SHALL REFER TO THE CONSTRUCTION SWPP FOR APPLICABLE BMPS.

CONSTRUCTION ENTRANCE NOTES:

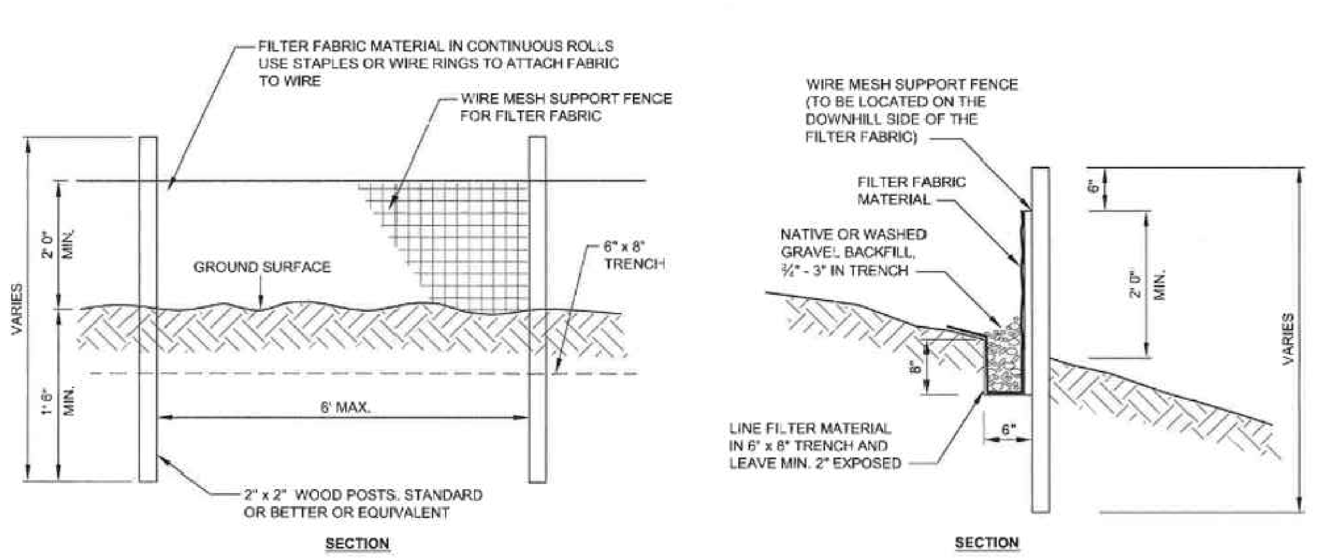
1. MATERIAL SHALL BE 4" TO 8" QUARRY SPALLS (4 TO 6 INCH FOR RESIDENTIAL SINGLE FAMILY LOTS) AND MAY BE TOP-DRESSED WITH 1 TO 3 INCH ROCK.
2. THE ROCK PAD SHALL BE AT LEAST 12" THICK AND 100' LONG (REDUCED TO 20 FEET FOR SITES LESS THAN 1 ACRE OF DISTURBED SOIL) WIDTH SHALL BE FULL WIDTH OF INGRESS AND EGRESS AREA. SMALLER PADS MAY BE APPROVED FOR SINGLE-FAMILY RESIDENTIAL AND COMMERCIAL SITES .
3. ADDITIONAL ROCK SHALL BE ADDED PERIODICALLY TO MAINTAIN FUNCTION OF THE PAD.
4. IF THE PAD DOES NOT ADEQUATELY REMOVE MUD FROM THE VEHICLE WHEELS, THE WHEELS SHALL BE HOSED OFF BEFORE THE VEHICLE ENTERS A PAVED STREET.THE WASHING SHALL BE DONE ON AN AREA COVERED WITH CRUSHED ROCK AND WASH WATER SHALL DRAIN TO A SEDIMENT RETENTION FACILITY OR THROUGH A SILT FENCE.



1 CONSTRUCTION ENTRANCE
SCALE:NTS

FILTER FABRIC FENCE NOTES:

1. SUPPORT POST, WITH A MINIMUM 6-INCH OVERLAP. AND SECURELY FASTENED AT BOTH ENDS TO POSTS.
2. POSTS SHALL BE SPACED A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 30 INCHES).
3. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 8 INCHES WIDE AND 12 INCHES DEEP ALONG THE LINE OF POSTS
4. AND UPSLOPE FROM THE BARRIER. THIS TRENCH SHALL BE BACKFILLED WITH WASHED GRAVEL.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH LONG, TIE WIRES OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 20 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
7. WHEN EXTRA-STRENGTH FILTER FABRIC AND CLOSER POST SPACING IS USED, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH A CASE, THE FILTER FABRIC IS STAPLED OR WIRED DIRECTLY TO THE POSTS WITH ALL OTHER PROVISIONS OF ABOVE NOTES APPLYING.
8. FILTER FABRIC FENCES SHALL NOT BE REMOVED BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.
9. FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.
10. SILT FENCES WILL BE INSTALLED PARALLEL TO ANY SLOPE CONTOURS.
11. CONTRIBUTING LENGTH TO FENCE WILL NOT BE GREATER THAN 100 FEET.
12. DO NOT INSTALL BELOW AN OUTLET PIPE OR WEIR.
13. INSTALL DOWNSLOPE OF EXPOSED AREAS.
14. DO NOT DRIVE OVER OR FILL OVER SILT FENCES.



2 FILTER FABRIC FENCE
SCALE:NTS

AMENDED SOILS NOTES:

- SOIL AMENDMENTS ARE REQUIRED FOR ALL DISTURBED AREAS IN ACCORDANCE WITH BMP L613: POST-CONSTRUCTION SOIL QUALITY AND DEPTH OF THE 2021 SURFACE WATER MANAGEMENT MANUAL
- AMENDED SOILS SHALL BE A MINIMUM OF 8" (NON-COMPACTED) WITH SUBSOILS SCARIFIED AT LEAST 4" WITH INCORPORATION OF THE UPPER MATERIAL TO AVOID STRATIFIED LAYERS, WHERE FEASIBLE.
- QUALITY OF COMPOST AND OTHER MATERIALS USED TO MEET THE ORGANIC CONTENT REQUIREMENTS ARE AS FOLLOWS:

a. THE ORGANIC CONTENT FOR "PRE-APPROVED" AMENDMENT RATES CAN BE MET ONLY USING COMPOST THAT MEETS THE DEFINITION OF "COMPOSTED MATERIALS" IN WAC 173-350-220. THE WAC IS AVAILABLE ONLINE AT: HTTP://WWW.ECY.WA.GOV/PROGRAMS/SWFA/FACILITIES/350.HTML THE COMPOST MUST ALSO HAVE AN ORGANIC MATTER CONTENT OF 35% TO 65%, AND A CARBON TO NITROGEN RATIO BELOW 25:1. THE CARBON TO NITROGEN RATIO MAY BE AS HIGH AS 35: 1 FOR PLANTINGS COMPOSED ENTIRELY OF PLANTS NATIVE TO THE PUGET SOUND LOWLANDS REGION.
b. CALCULATED AMENDMENT RATES MAY BE MET THROUGH USE OF COMPOSTED MATERIALS AS DEFINED ABOVE; OR OTHER ORGANIC MATERIALS AMENDED TO MEET THE CARBON TO NITROGEN RATIO REQUIREMENTS, AND MEETING THE CONTAMINANT STANDARDS OF GRADE A COMPOST.

- USE ONE OF THE FOLLOWING OPTIONS TO MEET THE POST CONSTRUCTION SOIL QUALITY AND DEPTH REQUIREMENTS. USE THE MOST RECENT VERSION OF "GUIDELINES FOR RESOURCES FOR IMPLEMENTING SOIL QUALITY AND DEPTH BMP T5.13" TO MEET THE REQUIREMENTS OF THIS BMP. THIS GUIDANCE CAN BE FOUND ONLINE AT:WWW.SOILSFORSALMON.ORG

a. LEAVE NATIVE VEGETATION AND SOIL UNDISTURBED, AND PROTECT FROM COMPACTION DURING CONSTRUCTION
b. AMEND EXISTING SITE TOPSOIL OR SUBSOIL EITHER AT DEFAULT "PRE-APPROVED" RATES, OR AT CUSTOM CALCULATED RA TES BASED ON SPECIFIC TESTS OF THE SOIL AND AMENDMENT
c. STOCKPILE EXISTING TOPSOIL DURING GRADING, AND REPLACE IT PRIOR TO PLANTING. STOCKPILED TOPSOIL MUST ALSO BE AMENDED IF NEEDED TO MEET THE ORGANIC MATTER OR DEPTH REQUIREMENTS, EITHER AT A DEFAULT "PRE-APPROVED" RATE OR AT A CUSTOM CALCULATED RATE.
d. IMPORT TOPSOIL MIX OF SUFFICIENT ORGANIC CONTENT AND DEPTH TO MEET THE REQUIREMENTS. MORE THAN ONE METHOD MAY BE USED ON DIFFERENT PORTIONS OF THE SAME SITE. SOIL THAT ALREADY MEETS THE DEPTH AND ORGANIC MATTER QUALITY STANDARDS, AND IS NOT COMPACTED, DOES NOT NEED TO BE AMENDED.

- AMENDED SOILS SHALL BE MAINTAINED AS FOLLOWS:

a. SOIL QUALITY AND DEPTH SHOULD BE ESTABLISHED TOWARD THE END OF CONSTRUCTION AND ONCE ESTABLISHED, SHOULD BE PROTECTED FROM COMPACTION, SUCH AS FROM LARGE MACHINERY USE, AND FROM EROSION.
b. SOIL SHOULD BE PLANTED AND MULCHED AFTER INSTALLATION.
c. PLANT DEBRIS OR ITS EQUIVALENT SHOULD BE LEFT ON THE SOIL SURFACE TO REPLENISH ORGANIC MA TIER.
d. IT SHOULD BE POSSIBLE TO REDUCE USE OF IRRIGATION, FERTILIZERS, HERBICIDES AND PESTICIDES. THESE ACTIVITIES SHOULD BE ADJUSTED WHERE POSSIBLE,RATHER THAN CONTINUING TO IMPLEMENT FORMERLY ESTABLISHED PRACTICES.

- SEE PROJECT CONSTRUCTION SWPPP FOR ADDITIONAL INFORMATION OR SECTION 2.2.1.4 OF CHAPTER 2 OF VOLUME 6 OF THE 2021 SURFACE WATER MANAGEMENT MANUAL

MULCHING NOTES:

1. MULCH MATERIALS USED SHALL BE STRAW OR HAY, AND SHALL BE APPLIED AT THE RATE OF 75-100 POUNDS PER 1000 SQ. FT. (APPX 2" THICK).
2. MULCH SHALL BE APPLIED IN ALL AREAS WITH EXPOSED SLOPES GREATER THAN 2: 1.
3. MULCHING SHALL BE USED IMMEDIATELY AFTER SEEDING OR IN AREAS WHICH CANNOT BE SEEDED BECAUSE OF THE SEASON.
4. ALL AREAS NEEDING MULCH SHALL BE COVERED BY NOVEMBER 1.

CONTRACTOR NOTES:

1. INLET PROTECTION SHALL BE INSTALLED IN ALL NEWLY CONSTRUCTED CATCH BASINS AND ALONG ALL IMPACTED FRONTAGE AND OFFSITE AREAS PER THE REQUIREMENTS OF THE COUNTY INSPECTOR PER DETAIL 5 ON THIS SHEET 5.
2. CONSTRUCTION FENCE CAN BE UTILIZED IN PLACE OF FILTER FABRIC FENCE ONLY IN AREAS WHERE THE GRADES DO NOT ALLOW THE POTENTIAL FOR ANY STORMWATER TO LEAVE THE SITE.
3. ALL DEMOLISHED MATERIALS SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT A CITY APPROVED LOCATION AND IN A MANNER CONSISTENT WITH CURRENT REGULATIONS AND REQUIREMENTS.
4. ALL AREAS THAT WILL BE UNWORKED FOR MORE THAN SEVEN (7) DAYS DURING THE DRY SEASON OR TWO (2) DAYS DURING THE WET SEASON, SHALL BE COVERED WITH STRAW, WOOD FIBER MULCH, COMPOST, PLASTIC SHEETING, OR OTHER EQUIVALENT PER CURRENT CITY OR COUNTY STANDARDS. SEE SEEDING NOTES AND MULCHING NOTES ON THIS SHEET.
5. CONTRACTOR SHALL DESIGNATE A WASHINGTON DEPT OF ECOLOGY CERTIFIED EROSION CONTROL LEAD PERSON, AND SHALL COMPLY WITH THE CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP) PREPARED FOR THE PROJECT.
6. AT ANY TIME DURING CONSTRUCTION IT IS DETERMINED BY THE CITY OR COUNTY THAT MUD AND DEBRIS ARE BEING TRACKED ONTO PUBLIC STREETS WITH INSUFFICIENT CLEANUP, ALL WORK SHALL CEASE ON THE PROJECT UNTIL THIS CONDITION IS CORRECTED. THE CONTRACTOR AND/OR THE OWNER SHALL IMMEDIATELY TAKE ALL STEPS NECESSARY TO PREVENT FUTURE TRACKING OF MUD AND DEBRIS INTO THE PUBLIC ROW, WHICH MAY INCLUDE THE INSTALLATION OF A WHEEL WASH FACILITY ON-SITE.
7. SEDIMENT LADEN RUNOFF SHALL NOT BE ALLOWED TO DISCHARGE BEYOND THE LIMITS OF THE IMPROVEMENTS. ADDITIONAL MEASURES SHALL BE INSTALLED AS NEEDED.
8. SAND BAGS SHALL BE SECURELY PLACED AROUND INSTALLED CATCH BASINS WITH INLET PROTECTION AS FIELD AND WEATHER CONDITIONS WARRANT SO TO PROTECT ALL DISPERSION AND INFILTRATION TRENCHES SEDIMENT LADEN RUNOFF.
9. TREES WITHIN WORKING LIMITS TO BE SAVED, SHALL BE MARKED AS SUCH ON SITE AND PROTECTION FENCE PLACED AROUND EACH TREE.

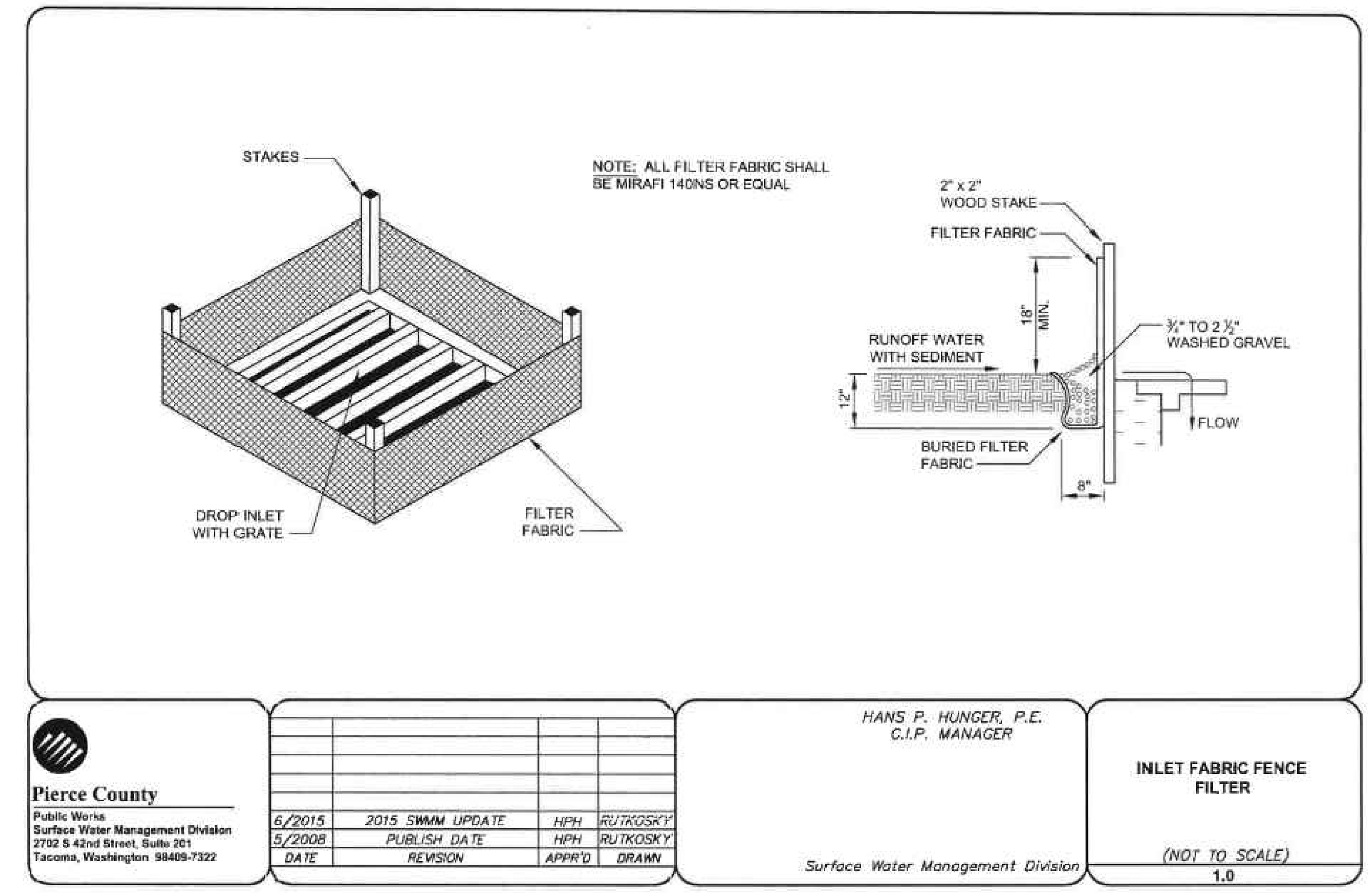
SEEDING NOTES:

1. THE FOLLOWING SEED MIXTURE SHALL BE AS BELOW AND SHALL BE APPLIED AT THE RATE RECOMMENDED BY THE SUPPLIER.

TABLE D.3.2.B TEMPORARY EROSION CONTROL SEED MIX

	% WEIGHT	% PURITY	% GERMINATION
CHEWINGS OR RED FESCUE FESTUCA *RUBRA VAR. COMMUTATA OR FESTUCA RUBRA*	40	98	90
ANNUAL OR PERENNIAL RYE *LOLIUM MULTIFLORUM OR LOLIUM PERENNE*	40	98	90
REDTOP OR COLONIAL BENTGRASS *AGROSTIS ALBA OR AGROSTIS TENUIS*	10	92	85
WHITE DUTCH CLOVER *TRIFOLIUM REPENS*	10	98	90

2. SEED BEDS PLANTED BETWEEN MAY 1 AND OCTOBER 31 WILL REQUIRE IRRIGATION AND OTHER MAINTENANCE AS NECESSARY TO FOSTER AND PROTECT THE ROOT STRUCTURE.
3. FOR SEED BEDS PLANTED BETWEEN OCTOBER 31 AND APRIL 30, ARMORING OF THE SEED BED WILL BE NECESSARY. {E.G., GEOTEXTILES, JUTE MAT, CLEAR PLASTIC COVERING),
4. BEFORE SEEDING, INSTALL NEEDED SURFACE RUNOFF CONTROL MEASURES SUCH AS GRADIENT TERRACES, INTERCEPTOR DIKES, SWALES, LEVEL SPREADERS AND SEDIMENT BASINS.
5. THE SEEDBED SHALL BE FIRM WITH A FAIRLY FINE SURFACE, FOLLOWING SURFACE ROUGHENING. PERFORM ALL OPERATIONS ACROSS OR AT RIGHT ANGLES TO THE SLOPE.
6. FERTILIZERS ARE TO BE USED ACCORDING TO SUPPLIER'S RECOMMENDATIONS. AMOUNTS USED SHOULD BE MINIMIZED, ESPECIALLY ADJACENT TO WATER BODIES AND WETLANDS.



Storm Water Manual Details - Section C

3 INLET PROTECTION
SCALE:NTS

Include filter sock detail also.
[CSWPPP; 393 of 448]

Included. In plans as well

AHBL
TACOMA · SEATTLE
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

TESC NOTES AND DETAILS

EAST TOWN CROSSING

F-2

Appendix G

Inspection Logs

East Town Crossing

Stormwater Pollution Prevention Plan

Inspection and Maintenance Report Form

To be completed every 7 days and within 24 hours of a rainfall event of 0.5 inches or more

Inspector: Date:

Inspector's Qualifications:

Days since last rainfall: Amount of last rainfall: inches

Stabilization Measures

Drainage Area	Date Since Last Disturbance	Date of Next Disturbance	Stabilized (yes/No)	Stabilized With	Condition

Stabilization required:

To be performed by: ________________________________ On or before: ________________

____

East Town Crossing

Stormwater Pollution Prevention Plan

Inspection and Maintenance Report Form

Site Entrance:

Date:

Temporary Construction Entrance

Drainage Area Perimeter	Does Rock Pad Adequately Remove Mud from Vehicle Wheels?	Is Rock Pad Clogged with Mud?	Have Quarry Spalls Been Moved to the Roadway?

Maintenance required for temporary construction entrances:

To be performed by: ________________________________ On or before: ________________

____

East Town Crossing

Stormwater Pollution Prevention Plan

Inspection and Maintenance Report Form

Perimeter Structural Controls:

Date:

Silt Fence

Drainage Area Perimeter	Has Silt Reached 1/3 of Fence Height?	Is Fence Properly Secured?	Is There Evidence of Washout or Overtopping?

Maintenance required for silt fence and straw bales:

To be performed by: ______________________________ On or before: _______________

____

East Town Crossing

Stormwater Pollution Prevention Plan

Inspection and Maintenance Report Form

Inlet Protection:

Date:

Storm Drain Barriers

Inlet	Has Silt Reached 1/3 of Barrier Height?	Is Barrier Properly Secured?	Is There Evidence of Washout or Overtopping?

Maintenance required for storm drain barriers:

To be performed by: ________________________________ On or before: ________________

____

East Town Crossing

Stormwater Pollution Prevention Plan

Inspection and Maintenance Report Form

Changes required to the pollution prevention plan:

Reasons for changes:

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.

Signature: ____ Date: ___________________

Appendix H

Best Management Practices (BMPs)

Please ADD BMPS C102, C107, C122, C150, C151, C152, C153, C209, and C241. [Storm Report; Pg 400 of 448]

Added

burying and smothering vegetation.

- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate install fabric silt fence in accordance with BMP C233: Silt Fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100’ minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100’).

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.

Table II-3.2: Stabilized Construction Access Geotextile Standards (continued)

Geotextile Property	Required Value
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½″	99-100

Table II-3.3: Stabilized Construction Access Alternative Material Requirements (continued)

Sieve Size	Percent Passing
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

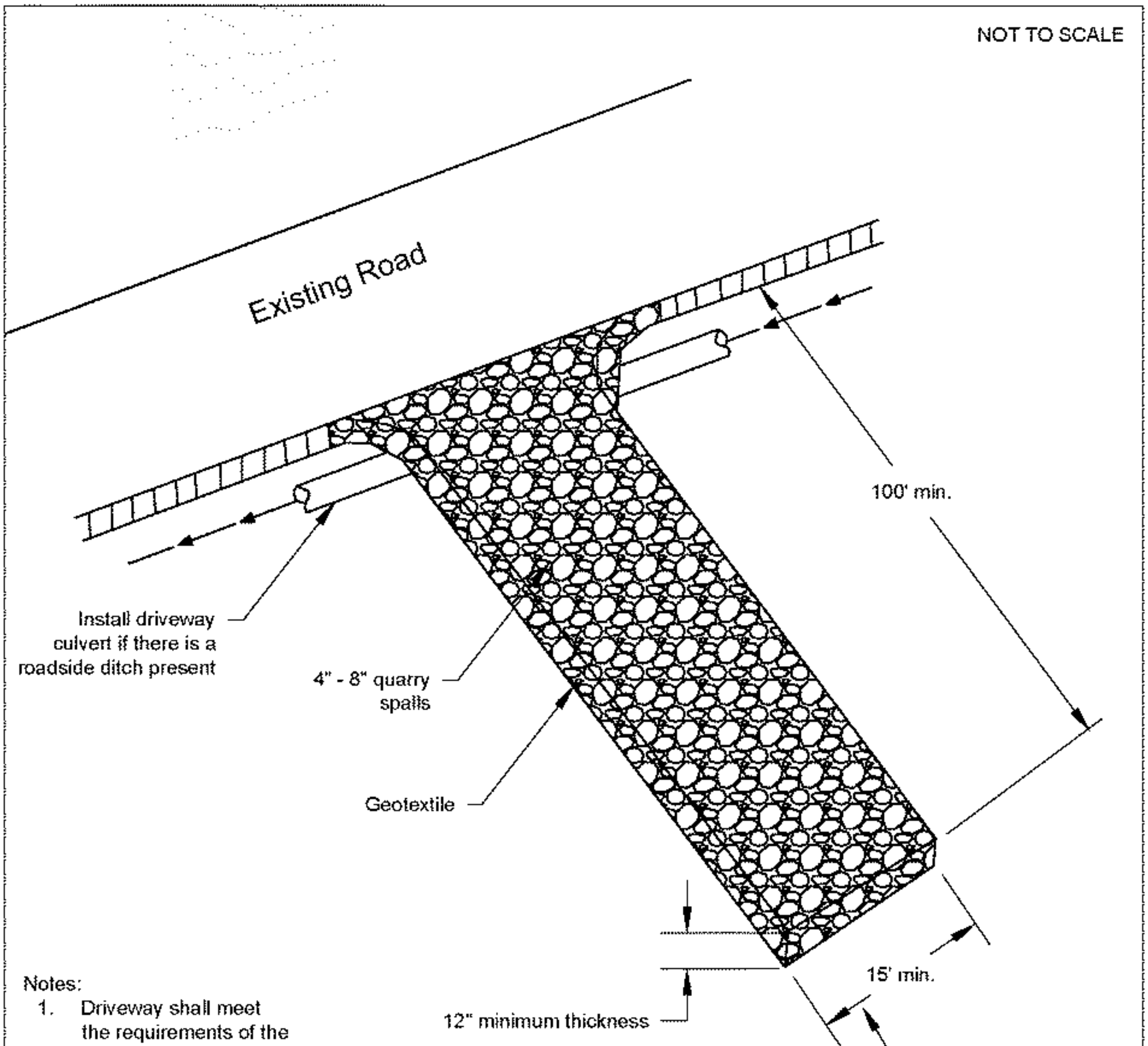
Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Notes:

1. Driveway shall meet the requirements of the permitting agency.
2. It is recommended that the access be crowned so that runoff drains off the pad.

DEPARTMENT OF ECOLOGY
State of Washington

Stabilized Construction Access

Revised June 2018

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed before water flow; install sod in the channel bottom — over top of hydromulch and erosion control blankets.

- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
    - Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
    - Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:

    - Installing the mulch, seed, fertilizer, and tackifier in one lift.
    - Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
    - Hold straw in place with a standard tackifier.

  Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

    - Irrigation.
    - Reapplication of mulch.
    - Repair of failed slope surfaces.

  This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).

- Seed may be installed by hand if:
    - Temporary and covered by straw, mulch, or topsoil.
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include

recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.
- Consult the local suppliers or the local conservation district for their recommendations. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fes-	*Festuca arundin-*	75-80	98	90

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
cue	*acea* or *Festuca elatior*			
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum,

permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made of wood, recycled cellulose, hemp, or kenaf;

- compost;
- or blends of these.

Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Recycled cellulose may contain polychlorinated biphenyl (PCBs). Ecology recommends that products should be evaluated for PCBs prior to use.

Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.

Any mulch or tackifier product used shall be installed per the manufacturer's instructions.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table II-3.6: Mulch Standards and Guidelines. Consult with the local supplier or the local conservation district for their recommendations. Increase the application rate until the ground is 95% covered (i.e. not visible under the mulch layer). Note: Thickness may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Where the option of "Compost" is selected, it should be a coarse compost that meets the size gradations listed in Table II-3.5: Size Gradations of Compost as Mulch Material when tested in accordance with Test Method 02.02-B found in *Test Methods for the Examination of Composting and Compost* (Thompson, 2001).

Table II-3.5: Size Gradations of Compost as Mulch Material

Sieve Size	Percent Passing
3"	100%
1"	90% - 100%
3/4"	70% - 100%
1/4"	40% - 100%

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material. Consult the Hydraulic Permit Authority (HPA) for mulch mixes if applicable.

Maintenance Standards

The thickness of the mulch cover must be maintained.

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

Table II-3.6: Mulch Standards and Guidelines

Mulch Material	Guideline	Description
Straw	Quality Standards	Air-dried; free from undesirable seed and coarse material.
	Application Rates	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre
	Remarks	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	Quality Standards	No growth inhibiting factors.
	Application Rates	Approx. 35-45 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre
	Remarks	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 - 1 inch clog hydromulch equipment. Fibers should be kept to less than 3/4 inch.
Compost	Quality Standards	No visible water or dust during handling. Must be produced per WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs per cubic yard)
	Remarks	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125: Topsoiling / Composting or BMP T5.13: Post-Construction Soil Quality and Depth. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	Quality Standards	Gradations from fines to 6 inches in length for texture, variation, and interlocking properties. Include a mix of various sizes so that the average size is between 2- and 4- inches.
	Application Rates	2" thick min.;

Table II-3.6: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
	Remarks	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If permanent seeding or planting is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment. Note: thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.
Wood-Based Mulch	Quality Standards	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs. per cubic yard)
	Remarks	This material is often called "wood straw" or "hog fuel". The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	Quality Standards	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.
	Application Rates	2" thick min.
	Remarks	Cost-effective protection when applied with adequate thickness. A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and 1/2-inches. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. [Specification 9-14.4(4) from the *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016)

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5H:1V, net and blanket installers may need to be roped and harnessed for safety.
- They cost at least $4,000-6,000 per acre installed.

Advantages of nets and blankets include:

- Installation without mobilizing special equipment.
- Installation by anyone with minimal training
- Installation in stages or phases as the project progresses.
- Installers can hand place seed and fertilizer as they progress down the slope.
- Installation in any weather.
- There are numerous types of nets and blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

An alternative to nets and blankets in some limited conditions is BMP C202: Riprap Channel Lining. Ensure that BMP C202: Riprap Channel Lining is appropriate before using it as a substitute for nets and blankets.

Design and Installation Specifications

- See Figure II-3.3: Channel Installation (Clackamas County et al., 2008) and Figure II-3.4: Slope Installation for typical orientation and installation of nets and blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of nets and blankets on slopes:
    1. Complete final grade and track walk up and down the slope.
    2. Install hydromulch with seed and fertilizer.
    3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
    4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches. NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
    5. Roll the net/blanket slowly down the slope as the installer walks backward. NOTE: The net/blanket rests against the installer's legs. Staples are installed as the net/blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. The net/blanket is not to be allowed to roll down the slope on its own as this stretches the net/blanket, making it impossible to maintain soil contact. In addition, no one is allowed to walk on the net/blanket after it is in place.
    6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper net/blanket should overlap the leading edge of the lower net/blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.
- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the designer consult the manufacturer's information and that a site visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Division 8-01 and Division 9-14 (WSDOT, 2016).
- Use jute matting in conjunction with mulch (BMP C121: Mulching). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If

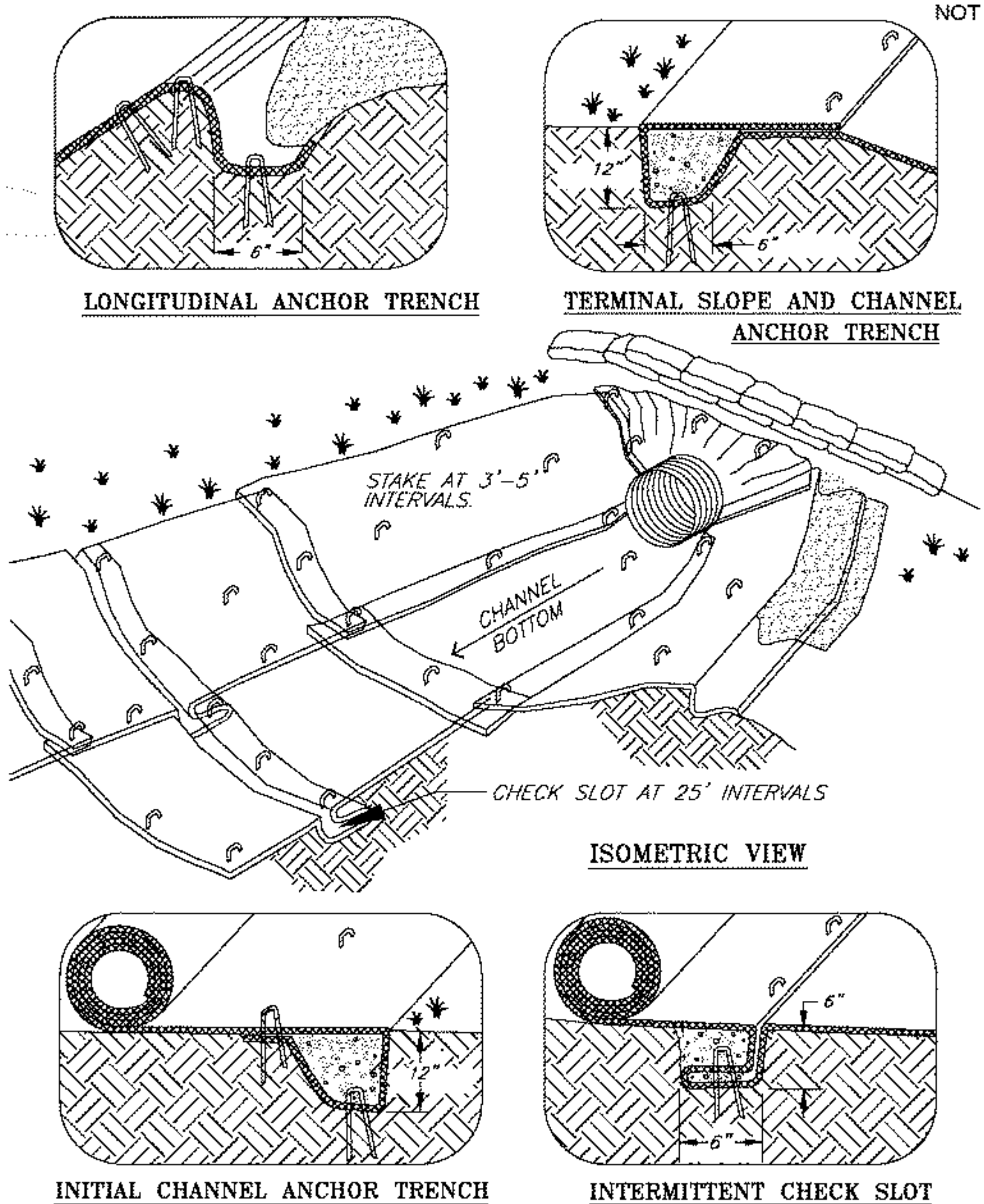
synthetic blankets are used, the soil should be hydromulched first.

- 100-percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning it breaks down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

Figure II-3.3: Channel Installation



Notes:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.

(Clackamas County et al., 2008)

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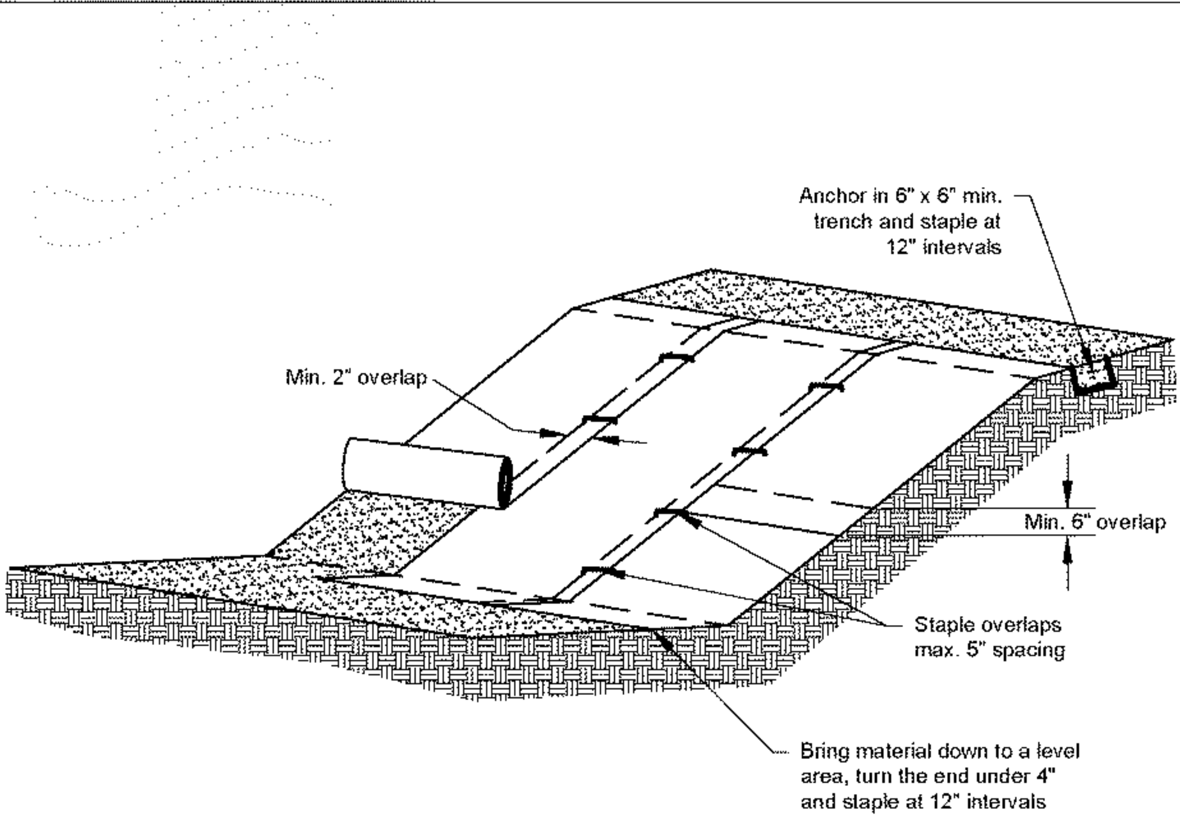
Channel Installation

Revised July 2016

Figure II-3.4: Slope Installation



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/mattings tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

NOT TO SCALE

DEPARTMENT OF ECOLOGY State of Washington

Slope Installation

Revised June 2016

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. However, the relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for applications greater than six months.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Although the plastic material is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP.
- Whenever plastic is used to protect slopes, install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    - Temporary ditch liner.
    - Pond liner in temporary sediment pond.
    - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    - Emergency slope protection during heavy rains.
    - Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    1. Run plastic up and down the slope, not across the slope.
    2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.

3. Provide a minimum of 8-inch overlap at the seams.
4. On long or wide slopes, or slopes subject to wind, tape all seams.
5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil, which causes extreme erosion.
8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C124: Sodding

Purpose

The purpose of sodding is to establish turf for immediate erosion protection and to stabilize drainage paths where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded, and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

1. Shape and smooth the surface to final grade in accordance with the approved grading plan. Consider any areas (such as swales) that need to be overexcavated below design elevation to allow room for placing soil amendment and sod.
2. Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. See https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost for further information.
3. Fertilize according to the sod supplier's recommendations.
4. Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
5. Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
6. Roll the sodded area and irrigate.
7. When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage ways, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control. Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

  Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes

compliance with this BMP.

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
    - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
    - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
    - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
    - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
    - Encourage the use of alternate, paved routes, if available.
    - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
    - Limit dust-causing work on windy days.
    - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric and steel “T” posts.

- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear Plastic, 6 mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw Bales for mulching
- Quarry Spalls
- Washed Gravel
- Geotextile Fabric
- Catch Basin Inserts
- Steel "T" Posts
- Silt fence material
- Straw Wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction project components include, but are not limited to:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal
2. Concrete wash-out areas (see BMP C154: Concrete Washout Area)
3. De minimus washout to formed areas awaiting concrete

Design and Installation Specifications

- Wash concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to BMP C154: Concrete Washout Area for information on concrete washout areas.
    - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in BMP C154: Concrete Washout Area.
- Wash small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) into designated concrete washout areas or into formed areas awaiting concrete pour.
- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no designated concrete washout areas (or formed areas, allowed as described above) are available. Dispose of contained concrete and concrete washwater (process water) properly.

- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMP C252: Treating and Disposing of High pH Water for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
    - Significant concrete work (as defined in the CSWGP).
    - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
    - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created through sawcutting or surfacing from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate ground water or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate ground water or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

Use at construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds

BMP C160: Certified Erosion and Sediment Control Lead

Purpose

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements. Construction sites one acre or larger that discharge to waters of the State must designate a Certified Erosion and Sediment Control Lead (CESCL) as the responsible representative.

Conditions of Use

A CESCL shall be made available on projects one acre or larger that discharge stormwater to surface waters of the state. Sites less than one acre may have a person without CESCL certification conduct inspections.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology.

  Ecology has provided the minimum requirements for CESCL course training, as well as a list of ESC training and certification providers at:

  https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control

  OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC). For additional information go to:

  http://www.envirocertintl.org/cpesc/

Specifications

- CESCL certification shall remain valid for three years.
- The CESCL shall have authority to act on behalf of the contractor or project proponent and shall be available, or on-call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL. See II-2 Construction Stormwater Pollution Prevention Plans (Construction SWPPPs).
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region, but must be on site whenever earthwork activities are

occurring that could generate release of turbid water.

- Duties and responsibilities of the CESCL shall include, but are not limited to the following:
  - Maintaining a permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
  - Directing BMP installation, inspection, maintenance, modification, and removal.
  - Updating all project drawings and the Construction SWPPP with changes made.
  - Completing any sampling requirements including reporting results using electronic Discharge Monitoring Reports (WebDMR).
  - Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.
  - Keeping daily logs, and inspection reports. Inspection reports should include:
    - Inspection date/time.
    - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
    - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
    - Any water quality monitoring performed during inspection.
    - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
    - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
      1. Locations of BMPs inspected.
      2. Locations of BMPs that need maintenance.
      3. Locations of BMPs that failed to operate as designed or intended.
      4. Locations of where additional or different BMPs are required.

BMP C162: Scheduling

Purpose

Sequencing a construction project reduces the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

thickness is 2 feet.

    - For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.
    - Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.

- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters can add significant amounts of sediment into the roof drain system. If possible, delay installing lawn and yard drains until just before landscaping, or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table II-3.10: Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding may occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area requirement: 30'x30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No	Paved or Earthen	Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap	N/A	N/A	18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection

Excavated drop inlet protection consists of an excavated impoundment around the storm drain inlet. Sediment settles out of the stormwater prior to entering the storm drain. Design and installation specifications for excavated drop inlet protection include:

- Provide a depth of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation should be no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape the excavation to fit the site, with the longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water.
- Clear the area of all debris.

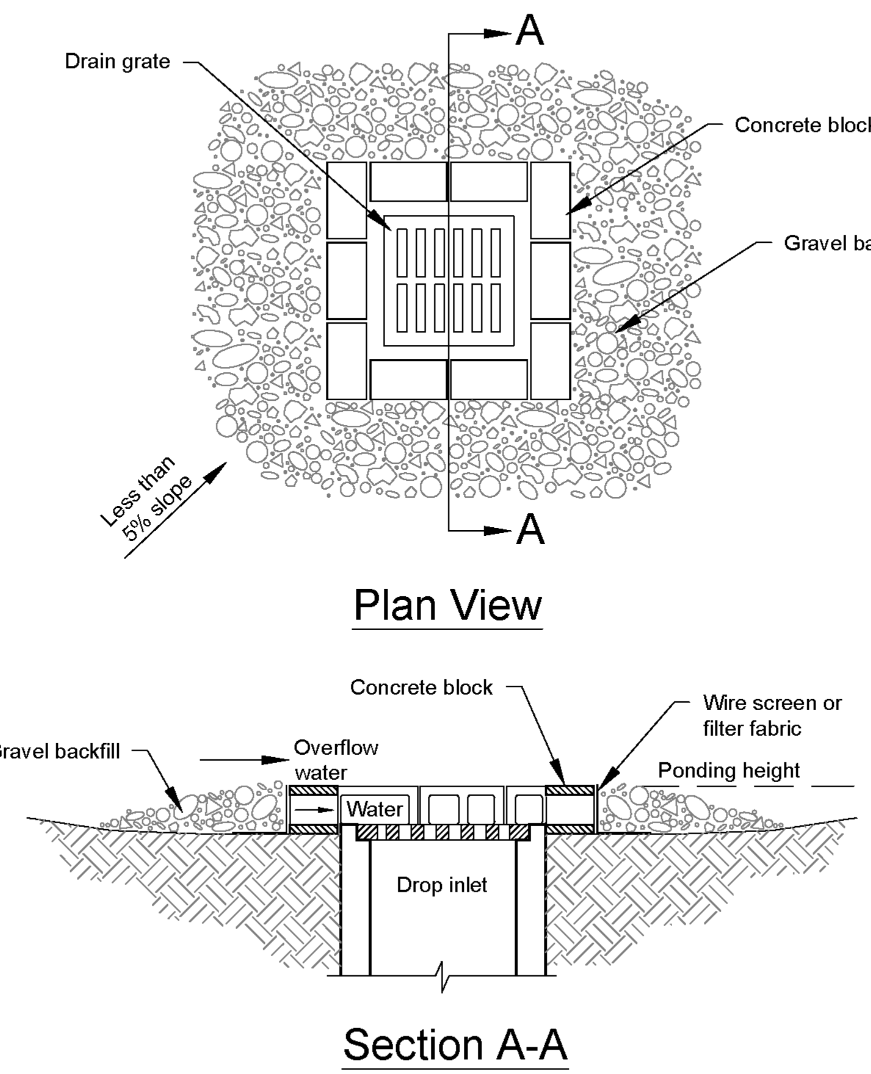
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

A block and gravel filter is a barrier formed around the inlet with standard concrete blocks and gravel. See Figure II-3.17: Block and Gravel Filter. Design and installation specifications for block gravel filters include:

- Provide a height of 1 to 2 feet above the inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a pressure treated wood 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side to allow for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel to just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet, as follows:
    - Provide a slope of 3H:1V on the upstream side of the berm.
    - Provide a slope of 2H:1V on the downstream side of the berm.
    - Provide a 1-foot wide level stone area between the gravel berm and the inlet.
    - Use stones 3 inches in diameter or larger on the upstream slope of the berm.
    - Use gravel ½- to ¾-inch at a minimum thickness of 1-foot on the downstream slope of the berm.

Figure II-3.17: Block and Gravel Filter



Notes:

1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing the inlet. A temporary dike may be necessary on the downslope side of the structure.

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Block and Gravel Filter

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Gravel and Wire Mesh Filter

Gravel and wire mesh filters are gravel barriers placed over the top of the inlet. This method does not provide an overflow. Design and installation specifications for gravel and wire mesh filters include:

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
  - Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
  - Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
  - Provide at least a 12-inch depth of aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters

Catch basin filters are designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way. Design and installation specifications for catch basin filters include:

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catch basin filter in the catch basin just below the grating.

Curb Inlet Protection with Wooden Weir

Curb inlet protection with wooden weir is an option that consists of a barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

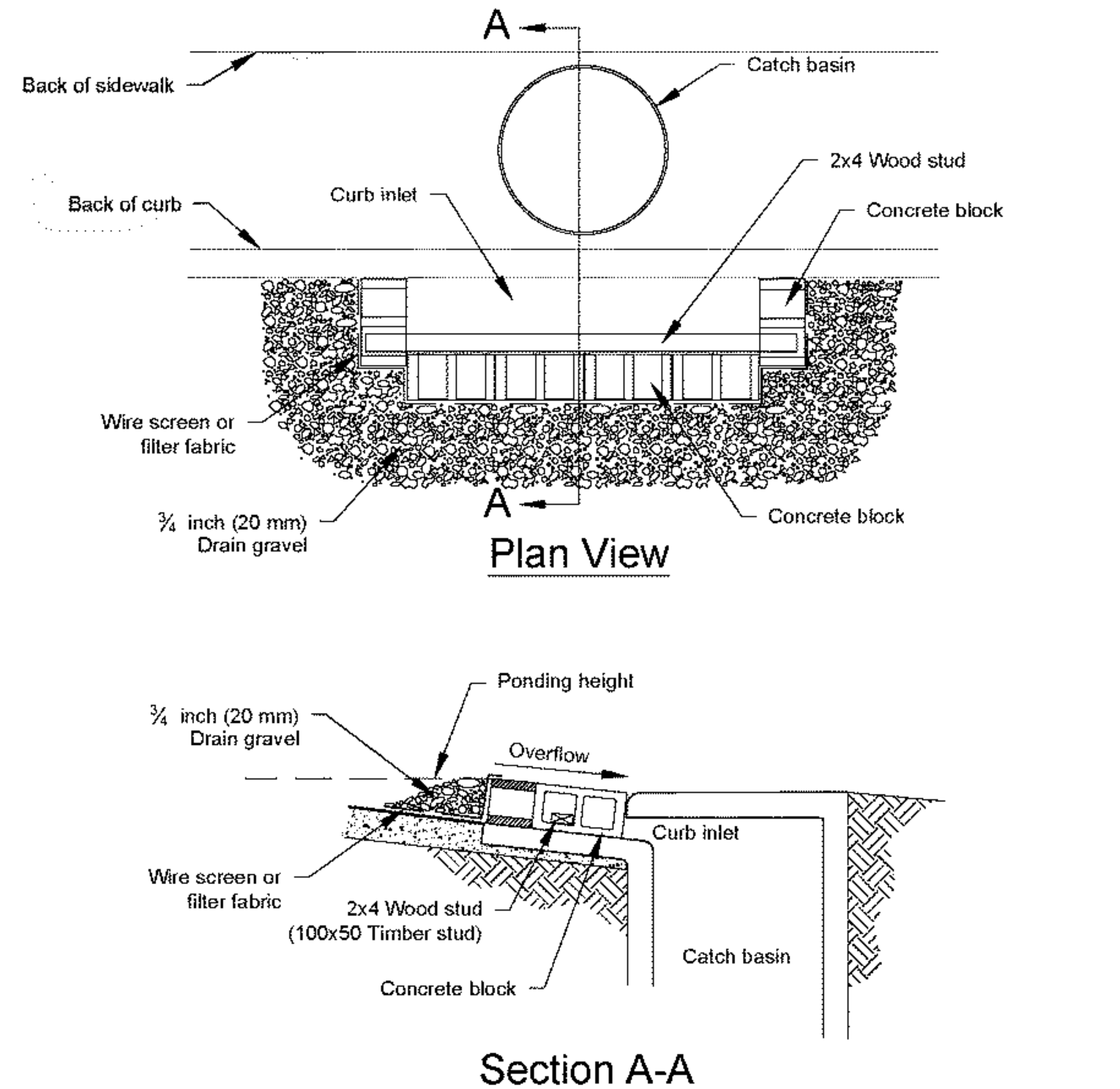
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

Block and Gravel Curb Inlet Protection

Block and gravel curb inlet protection is a barrier formed around a curb inlet with concrete blocks and gravel. See Figure II-3.18: Block and Gravel Curb Inlet Protection. Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Figure II-3.18: Block and Gravel Curb Inlet Protection



Notes:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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Block and Gravel Curb Inlet Protection

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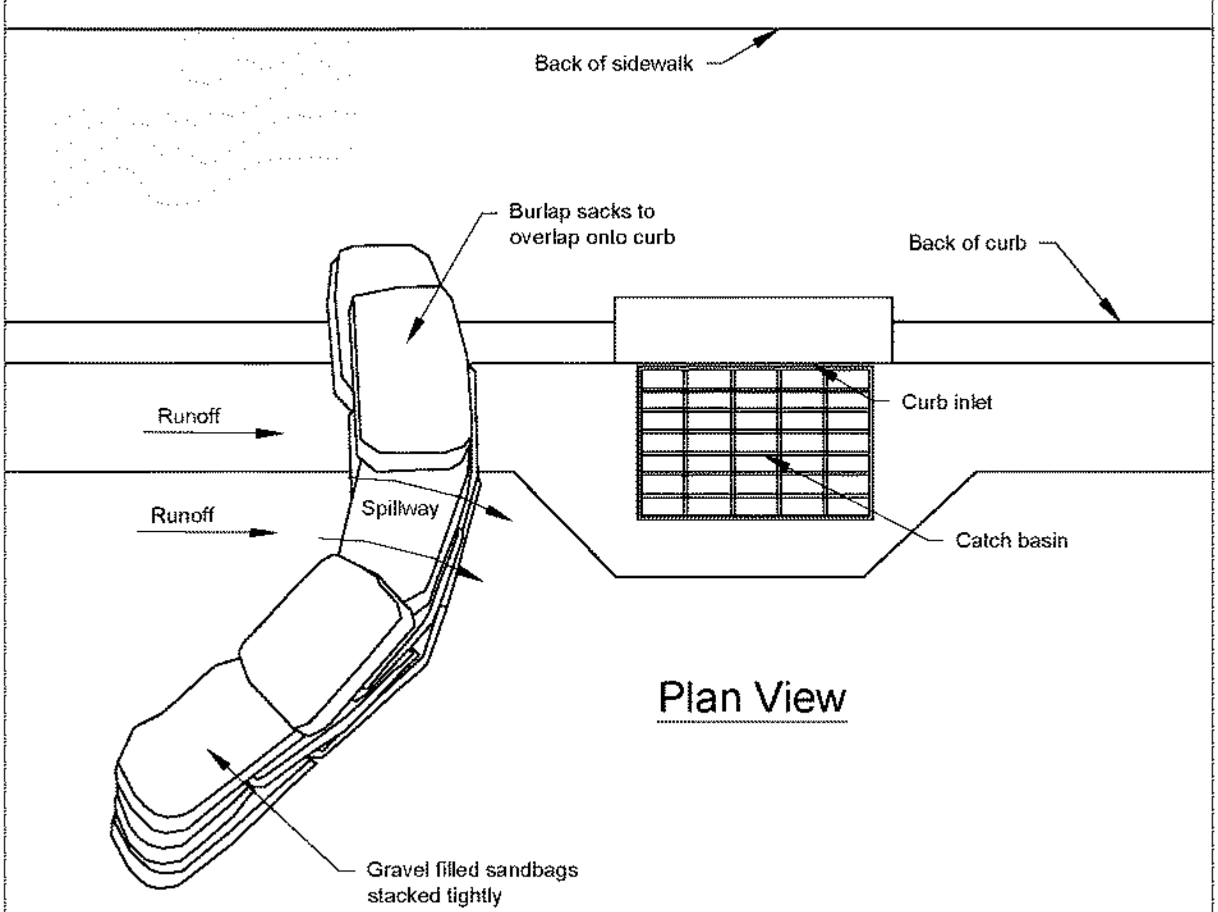
Curb and Gutter Sediment Barrier

Curb and gutter sediment barrier is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II-3.19: Curb and Gutter Barrier. Design and installation specifications for curb and gutter sediment barrier include:

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the upstream side of the berm. Size the trap to sediment trap standards for protecting a culvert inlet.

Figure II-3.19: Curb and Gutter Barrier



Notes:

1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven 'geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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Curb and Gutter Barrier

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Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. Clean and replace clogged catch basin filters. For rock and gravel filters, pull away the rocks from the inlet and clean or replace. An alternative approach would be to use the clogged rock as fill and put fresh rock around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C231: Brush Barrier

Purpose

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Brush barriers may be used downslope of disturbed areas that are less than one-quarter acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be directed to a sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment trapping BMP, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

Design and Installation Specifications

- Height: 2 feet (minimum) to 5 feet (maximum).
- Width: 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.

BMP C233: Silt Fence

Purpose

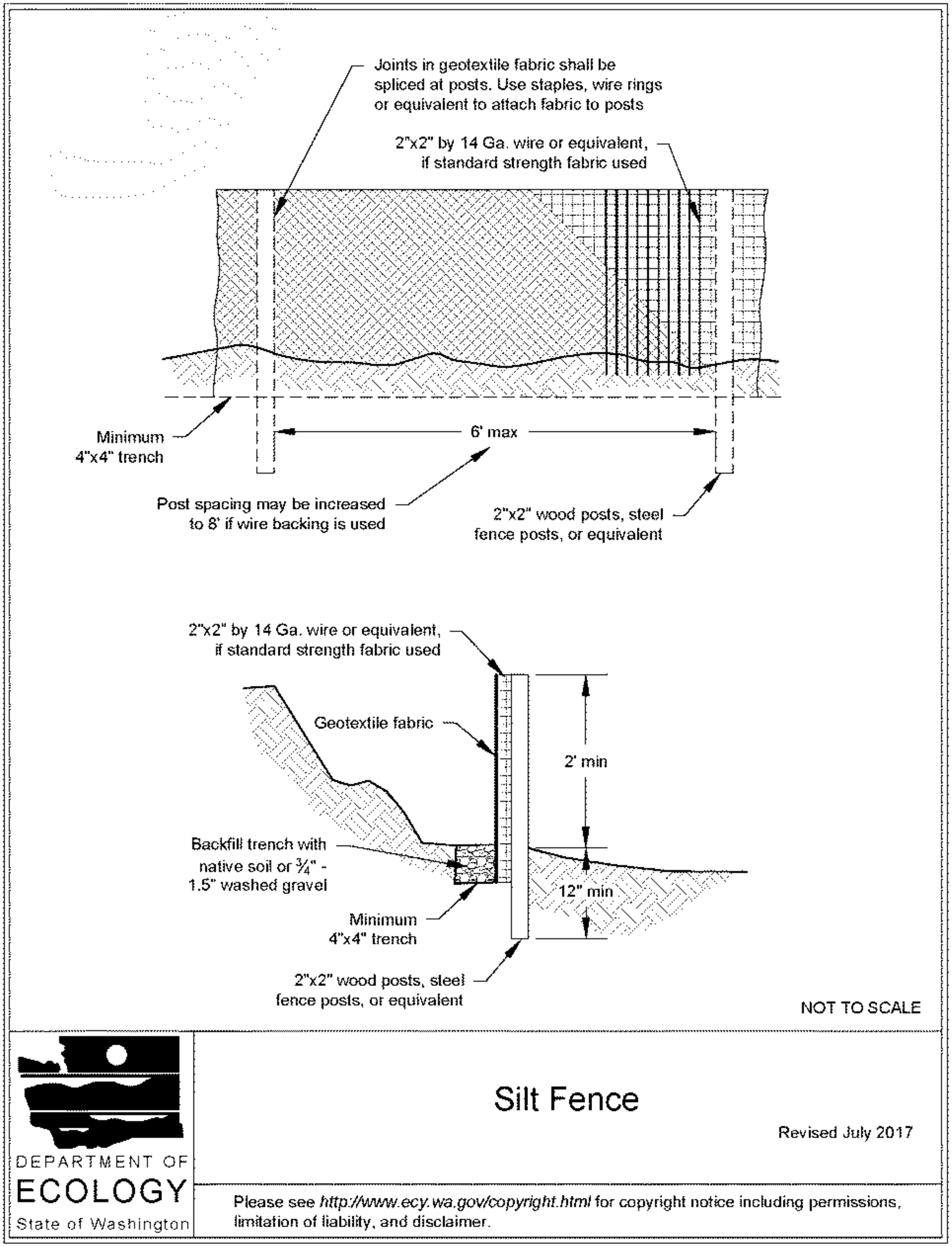
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent sediment carried by runoff from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment trapping BMP.
- Do not construct silt fences in streams or use in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

Figure II-3.22: Silt Fence



Design and Installation Specifications

- Use in combination with other construction stormwater BMPs.
- Maximum slope steepness (perpendicular to the silt fence line) 1H:1V.
- Maximum sheet or overland flow path length to the silt fence of 100 feet.
- Do not allow flows greater than 0.5 cfs.
- Use geotextile fabric that meets the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table II-3.11: Geotextile Fabric Standards for Silt Fence):

Table II-3.11: Geotextile Fabric Standards for Silt Fence

Geotextile Property	Minimum Average Roll Value
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Support standard strength geotextiles with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F to 120°F.
- One-hundred percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by the local jurisdiction.
- Refer to Figure II-3.22: Silt Fence for standard silt fence details. Include the following Standard Notes for silt fence on construction plans and specifications:
    1. The Contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    2. Construct silt fences in areas of clearing, grading, or drainage prior to starting those activities.

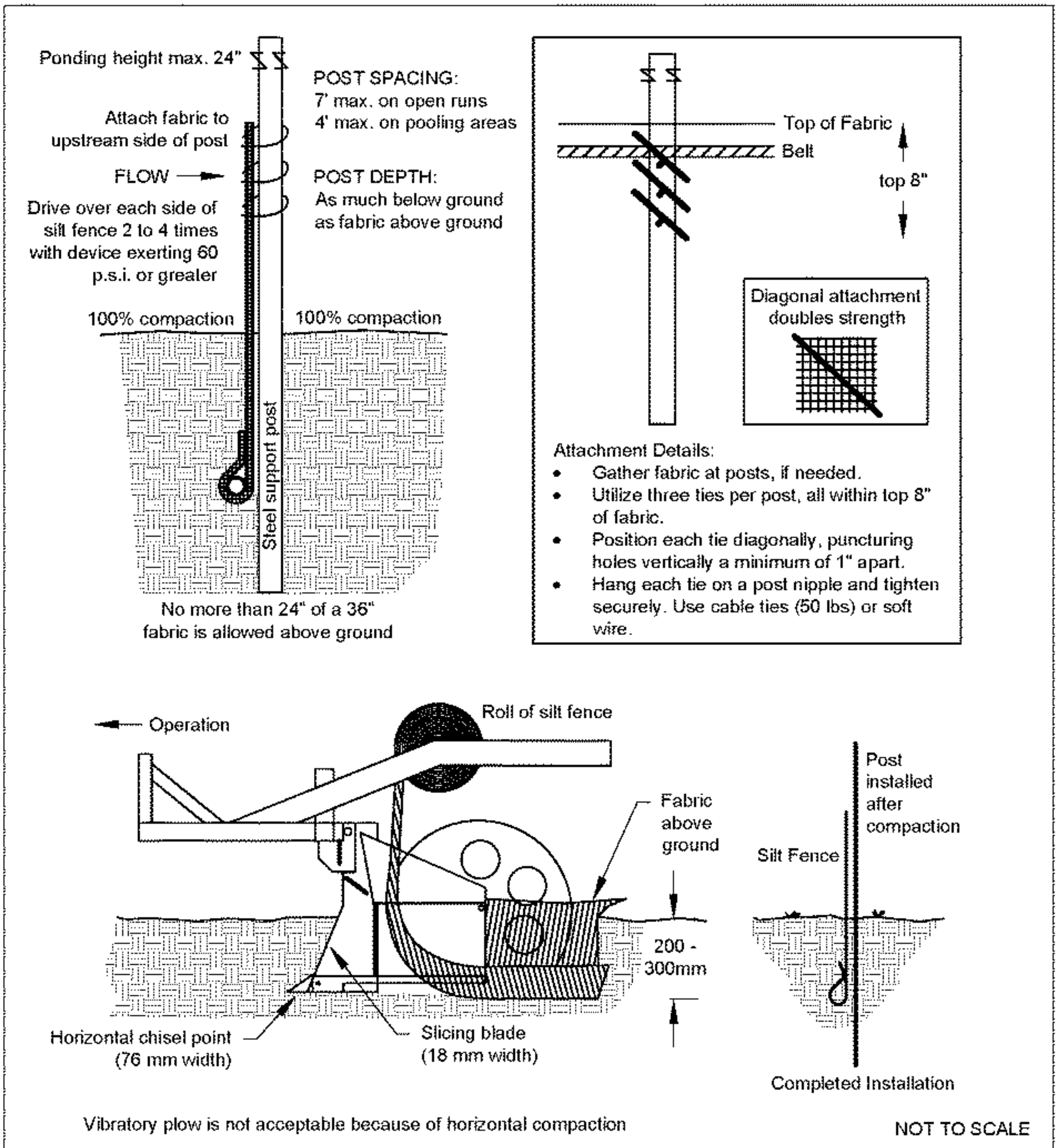
3. The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.
4. The geotextile fabric shall be sewn together at the point of manufacture to form fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent silt fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
5. Attach the geotextile fabric on the up-slope side of the posts and secure with staples, wire, or in accordance with the manufacturer's recommendations. Attach the geotextile fabric to the posts in a manner that reduces the potential for tearing.
6. Support the geotextile fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the geotextile fabric up-slope of the mesh.
7. Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the geotextile fabric it supports.
8. Bury the bottom of the geotextile fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the geotextile fabric, so that no flow can pass beneath the silt fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.
9. Drive or place the silt fence posts into the ground 18-inches min. A 12–inch min. depth is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Increase fence post min. depths by 6 inches if the fence is located on slopes of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
10. Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
    - Wood with minimum dimensions of 2 inches by 2 inches by 3 feet. Wood shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.
    - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
    - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
    - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
11. Locate silt fences on contour as much as possible, except at the ends of the fence,

where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.

12. If the fence must cross contours, with the exception of the ends of the fence, place check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.
    - Check dams shall be approximately 1-foot deep at the back of the fence. Check dams shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
    - Check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Refer to Figure II-3.23: Silt Fence Installation by Slicing Method for slicing method details. The following are specifications for silt fence installation using the slicing method:
    1. The base of both end posts must be at least 2- to 4-inches above the top of the geo-textile fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
    2. Install posts 3- to 4-feet apart in critical retention areas and 6- to 7-feet apart in standard applications.
    3. Install posts 24-inches deep on the downstream side of the silt fence, and as close as possible to the geotextile fabric, enabling posts to support the geotextile fabric from upstream water pressure.
    4. Install posts with the nipples facing away from the geotextile fabric.
    5. Attach the geotextile fabric to each post with three ties, all spaced within the top 8-inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1-inch vertically apart. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
    6. Wrap approximately 6-inches of the geotextile fabric around the end posts and secure with 3 ties.
    7. No more than 24-inches of a 36-inch geotextile fabric is allowed above ground level.
    8. Compact the soil immediately next to the geotextile fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck the fabric deeper into the ground if necessary.

Figure II-3.23: Silt Fence Installation by Slicing Method



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Silt Fence Installation by Slicing Method

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Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment trapping BMP.
- Check the uphill side of the silt fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence and remove the trapped sediment.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace geotextile fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose

Vegetated strips reduce the transport of coarse sediment from a construction site by providing a physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to BMP C241: Sediment Pond (Temporary) or other sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a vegetated strip, rather than by a sediment trapping BMP, is when the following criteria are met (see Table II-3.12: Contributing Drainage Area for Vegetated Strips):

Table II-3.12: Contributing Drainage Area for Vegetated Strips

Average Contributing Area Slope	Average Contributing Area Percent Slope	Max Contributing area Flowpath Length
1.5H : 1V or flatter	67% or flatter	100 feet
2H : 1V or flatter	50% or flatter	115 feet
4H : 1V or flatter	25% or flatter	150 feet
6H : 1V or flatter	16.7% or flatter	200 feet
10H : 1V or flatter	10% or flatter	250 feet