
Targeted Drainage Report for:
Grandview North LLC – Smokey Point Development

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Executive Summary

The proposal is to construct a multi-use development with two buildings onsite consisting commercial and residential uses. Improvements will include buildings, parking, pickleball court, sidewalk, open space, and landscaping. Frontage improvements along Smokey Point will be included in construction.

Compliance with Minimum Requirements:

1	<i>Prepare Stormwater Site Plan</i>	A stormwater site plan report and drawing are presented in this document.
2	<i>SWPPP</i>	A SWPPP will be submitted with the construction plans
3	<i>Water Pollution Source Control</i>	BMPs for source control will be noted in the SWPPP.
4	<i>Preserve Natural Drainage</i>	All stormwater runoff from the proposed development will be discharged to Smokey Point ROW, consistent with Natural Drainage.
5	<i>On-site Stormwater Management</i>	All stormwater runoff from the proposed development will be detained and discharged at a controlled rate.
6	<i>Runoff Treatment</i>	Runoff treatment for the proposed parking lot areas will be provided through Contech Stormfilter, or equivalent.
7	<i>Flow Control</i>	Flow control for the proposed development will be met using a detention system to detain and release runoff at a controlled rate.
8	<i>Stormwater Discharge to Wetland</i>	There are no known wetlands existing within the area of disturbance or on-site.
9	<i>Inspection, Operation and Maintenance</i>	Operation & Maintenance Manual will be provided with construction plans.

Vicinity Map

PROPERTY DESCRIPTION

The project site is in a portion of Section 23, Township 31 North, Range 05 East W.M. More specifically the site is located at 16523 & 16517 Smokey Point Boulevard Arlington WA 98223. The property is identified by tax parcel # 31052800204400 and # 31052800201100 shown below in Figure 1, highlighted in yellow.



Figure 1: Vicinity Map.
Not to scale (Source PDS Mapper)

DRAINAGE INFORMATION SUMMARY FORM

Parcel Total Area: **2.06± acres**

Area of Disturbance: **2.37± acres**

Number of Lots (if applies): 2

Summary Table

Drainage Basin Information	Individual Basin Information
	A
On-site Sub-basin Area (acres)	2.37
Type of Storage Proposed	StormTank Detention System
Appx. Dead Storage Vol (cf)	2,629
Appx. Live Storage Vol (cf)	34,456
Soil Type(s) (Natural Resource Conservation Service)	Custer Fine Sandy Loam
Pre-developed Discharge Rates	
Q (cfs.)	
2 yr.	0.0747
10 yr.	0.1453
50 yr./100 yr.	0.2259/0.2660
Redevelopment Area (acres)	
Post-development Runoff Rates (without quantity controls)	
Q (cfs.)	
2 yr.	0.8905
10 yr.	1.4873
50 yr./100 yr.	2.1324/2.4448
Post-development Runoff Rates (with quantity controls)	
Q (cfs.)	
2 yr.	0.0434
10 yr.	0.0893
50 yr./100 yr.	0.1526/0.1878
Offsite Upstream Area	
Number of acres	0

MR #1 Stormwater Site Plan Narrative

PROJECT DESCRIPTION

The proposal is to construct a multi-use development with two buildings onsite consisting of 103 residential units and 3,984 sf commercial. The three story building along Smokey Point frontage will consist of commercial and tenant amenities with sixteen covered parking stalls on the ground floor with residential units on the upper floors. The three story building on the back of the south lot will consist of residential units on all floors. Onsite improvements will include 133 parking stalls, pickleball court, sidewalk, open space, and landscaping. Frontage improvements along Smokey Point will include median, drive aisle, ten angled parking spaces, curb, gutter, sidewalk, and street trees. Additional offsite improvements will connect the onsite drive aisle, west of Building 2, to the existing drive aisle on parcel 31052800201500 to the south.

METHODOLOGY

Drainage calculations for the on-site area have been prepared using the 2019 Department of Ecology Stormwater Management Manual for Western Washington (DOE SMMWW). The proposed onsite impervious surface will be approximately 65,280 sq ft, and the offsite impervious surface will be approximately 34,940 sq ft, the development will be required to meet minimum requirements (MRs) 1-9 according to Volume I of the Department of Ecology Stormwater Management Manual for Western Washington (DOE SMMWW). The proposed detention system is sized using the 2012 Western Washington Hydrology Model (WWHM).

EXISTING CONDITIONS

The 2.06 acre parcels are located in the commercial corridor with mixed use overlay zoning district in Arlington. The site is bounded by Smokey Point Boulevard and a single family residence to the west, 166th Pl NE, a utility district, and early learning center to the north, a recovery center to the south and a vacant lot to the east. The property is currently vacant.

The west portion of the site adjacent to Smokey Point Boulevard is graveled, and the remainder of the site that extends east is undeveloped and covered with vegetation. There is an existing PUD easement across the north edge of the property and a transformer and overhead power lines are located within the easement. The existing frontage along Smokey Point Boulevard and 166th Pl NE frontage consists of a travel lanes, curb, gutter, and sidewalk. The property is fenced with a chain link fence along all property lines except the very easterly and southerly property lines. Access to the property is through two driveways, one at the south end of Smokey Point Boulevard frontage and the other at the east end of 166th Pl NE frontage.

A geotechnical engineering report was prepared by Geotest Services, Inc. (See separate report). They excavated 6 test pits across the site, to depths between 6 ft and 8.5 ft. The test pits in the western part of property encountered 0.5 to 2 ft of fill over a topsoil found to a depth of a 1 to 2.5 ft below grade. Native soils were then encountered consisting of medium dense, weathered tan to orange, moist to wet, slightly silty, poorly graded sands. These soils transition to

saturated, gray, poorly graded sands with depth. The east portion of the property has similar native soils but lacking the fill and topsoil layer. Groundwater was encountered between 2 ft to 5 ft below ground surface and this concurs with Washington Department Ecology Well Log Viewer indicates a regional water table in the recessional outwash to be at a depth of 4 BGS in the vicinity of the site.

According to NRCS the soils onsite are classified as Custer Fine Sandy Loam. (See Appendix). Custer Fine Sandy Loam is very deep, poorly drained soil, the surface layer is dark grayish brown fine sandy loam approximately 9 inches thick and the upper part of the subsoil is loamy fine sand approximately 7 inches thick. The substratum extends to a depth of 60 inches or more and is gravelly coarse sand. Custer Fine Sandy Loam is considered a hydraulic soil group C/D soil.

Table 1: Existing Impervious Surfaces

Area Description	Area (square feet)
Gravel Drive	45,430 sq ft
Concrete slabs	1,362 sq ft
Electrical Transformers	160 sq ft
Total	48,314 sq ft

DEVELOPED CONDITIONS

The proposed conditions include two buildings, drive aisles, parking stalls, pickleball court, sidewalk, open space, and landscaping. Frontage improvements along Smokey Point will include median, drive aisle, angled parking, curb, gutter, sidewalk, and street trees.

Table 2: Proposed Onsite Surfaces

Area Description	Area (square feet)
Roof Area	27,275 sq ft
Asphalt Parking/Drive	36,798 sq ft
Concrete Sidewalk	3,224 sq ft
Concrete Dumpster Pad	257 sq ft
Sports Court Area	950 sq ft
Landscaping & Pervious Open Space	21,341 sq ft
Total	89,845 sq ft

Table 3: Proposed Offsite Surfaces

Area Description	Area (square feet)
Asphalt Parking/Drive	6,219 sq ft
Concrete Sidewalk	1,664 sq ft
Landscaping	3,352 sq ft
Dumpster Pad	238 sq ft
Total	11,469 sq ft

UPSTREAM ANALYSIS

The site is located in a well-developed area with a relatively flat topography in the vicinity of the site. The only undeveloped adjacent property is located to the east and there is a drainage swale located along the property line that will intercept any runoff before entering the site. The site is bounded by developed roads and parcels of land on all other sides so should result in no runoff entering the site.

DOWNSTREAM ANALYSIS

The gravel area along the west of the property is relatively flat but will flow onto Smokey Point Boulevard and enter the City storm drainage infrastructure. The east portion of the lot is flat and infiltrates into the groundwater.

FLOW CONTROL

Flow control will be provided through a detention system for all runoff on-site. The StormTank Module detention system is located beneath the parking area. These systems are discussed further in MR 7.

RUNOFF TREATMENT

Runoff treatment for the proposed pollution generating surfaces will be provided through catch basin stormfilters designed by Contech Engineered Solutions or equivalent. The stormfilters will remove any pollutants from the surface runoff before conveying it to the detention system. The number of stormfilter cartridges required to treat the pollution generating surfaces will be provided on the construction plans and will be calculated using the formula provided by Contech and water quality flow rates determined using the WWHM model.

MR #2 Stormwater Pollution Prevention Plan Narrative

SWPP Report will be submitted independent to this report at civil construction review.

MR #3 Water Pollution Source Control

No known pollution generating activities described in volume IV, chapters 3 and 4 of the DOE SMMWW will be performed on-site during construction, or are proposed for the developed site following construction. Any sources of pollution that may result from the construction activity will be controlled according to SWPPP Element #9, Control Pollutants.

MR #4 Preservation of Natural Drainage Patterns

The stormwater runoff from the developed area will be discharged into the City of Arlington Stormwater infrastructure on Smokey Point Boulevard, thus maintaining the natural drainage patterns.

MR #5 On-Site Stormwater Management

The project must meet MRs 1-9 and is a parcel less than 5 acres located within the Urban Growth Area so must meet Low Impact Development Performance Standard or List #2 per Table 2.5.1 of the DOE SWMMWW. A feasibility analysis for the BMPs in List #2 was prepared (See Appendix). It was determined that there was no feasible BMPs to mitigate for the impervious areas onsite. A detention system is therefore proposed to mitigate the stormwater runoff for the roof area and hard surfaces from the developed conditions. This detention system will be constructed from ST-24 StormTank modules. See MR #7 for more information on the StormTank detention system proposed.

BMP T5.13 Post Construction Soil Quality and Depth:

Post Construction Soil Quality and Depth will be used on site to recondition those areas that were impacted due to construction activities. Those areas to be reconditioned have been identified on the construction plans. The existing on-site topsoil will be stockpiled for use to meet the post construction soil standard. If the quantity or quality of the stock piled on-site topsoil is insufficient, the soil amendment areas can be tilled and compost added to the soil prior to final seeding. The intent of this BMP is to restore the pre-developed drainage characteristics of the soil. The specific requirements for the post construction soil quality and depth will be detailed on the construction plans.

MR #6 Runoff Treatment

Runoff treatment for the proposed pollution generating surfaces will be provided through catch basin stormfilters designed by Contech Engineered Solutions or equivalent. The stormfilters will remove any pollutants from the surface runoff before conveying it to the detention system. The number of stormfilter cartridges required to treat the pollution generating surfaces will be provided on the construction plans and will be calculated using the formula provided by Contech and water quality flow rates determined using the WWHM model.

MR #7 Flow Control

Flow control will be met through a detention system using ST-24 StormTank Modules. A WWHM model (See Appendix) was created to size the system to meet flow control requirements.

Stormtank Detention System

The runoff from the remaining hard surfaces and roof area will be mitigated through a detention system consisting of Stormtank ST-24 modules. The size of detention system was determined by modelling the system as a vault with the height of an installed ST-24 module to determine the required

capacity and outlet structure in WWHM (See Appendix). The system requires 1 ft of backfill around the perimeter of the modules and 2 ft of cover above the modules. The surrounding stone can be included in the storage capacity. A cross section can be seen in Figure 2 below. The system will be located below the parking area and will have an outlet into the existing catch basin to the south of the site in Smokey Point Boulevard. The system will be lined with an impermeable liner “Enviro Liner 1030” or equivalent. The bottom of the levelling pad will be located at an elevation of 115.5 ft which is the wet season high groundwater elevation.

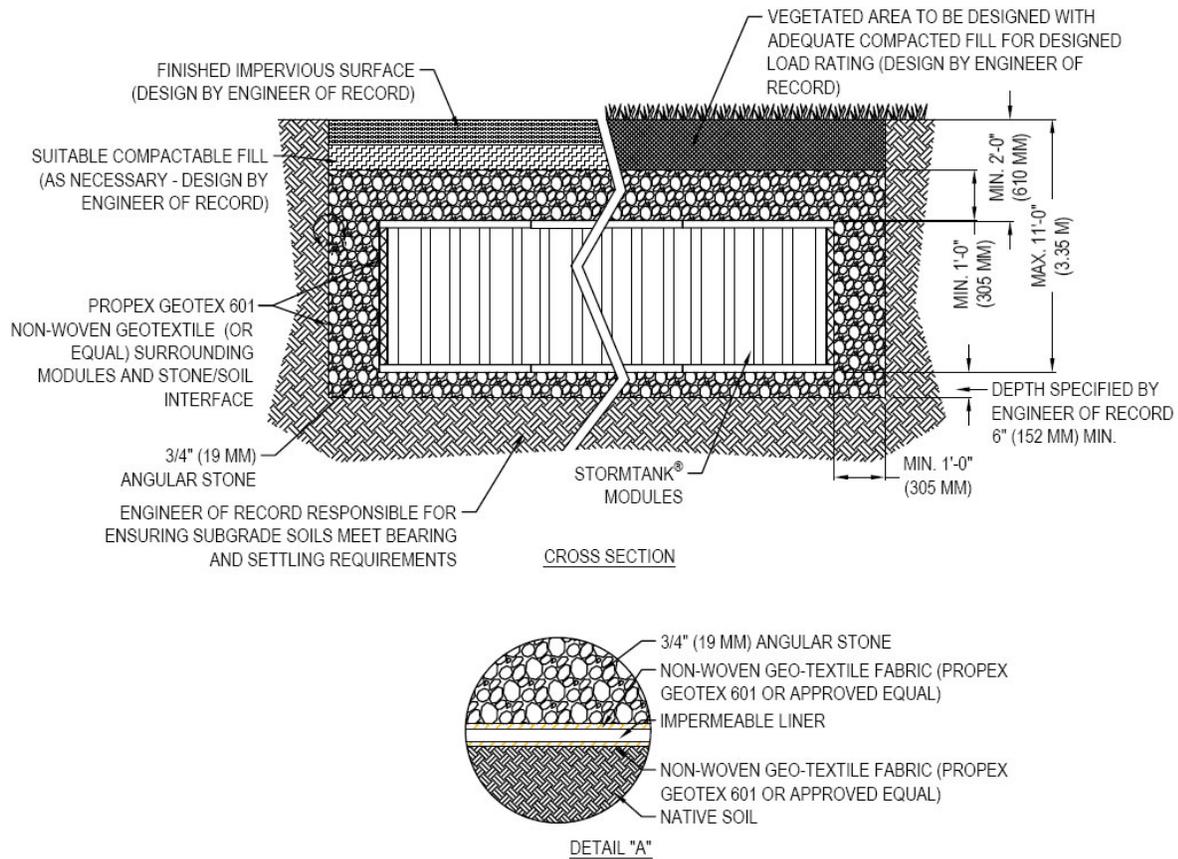


Figure 2: StormTank Detail

MR #8 Wetland Protection

There are no wetlands on site or within the area of disturbance.

MR #9 Operations & Maintenance

An operation and maintenance manual will be provided with construction plans.

Appendices

Appendix A - NRCS Soils Report

Appendix B - List 2 BMP Feasibility Analysis

Appendix C - WWHM Report



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 Snohomish County Area, Washington



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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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

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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

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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.

Custom Soil Resource Report Soil Map



Map Scale: 1:1,000 if printed on A landscape (11" x 8.5") sheet.

0 10 20 40 60 Meters

0 45 90 180 270 Feet

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: Snohomish County Area, Washington
 Survey Area Data: Version 22, Jun 4, 2020

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

Date(s) aerial images were photographed: Sep 26, 2018—Oct 16, 2018

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
13	Custer fine sandy loam	2.5	100.0%
Totals for Area of Interest		2.5	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.

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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.

Snohomish County Area, Washington

13—Custer fine sandy loam

Map Unit Setting

National map unit symbol: 2hy0

Elevation: 0 to 150 feet

Mean annual precipitation: 32 to 50 inches

Mean annual air temperature: 48 to 50 degrees F

Frost-free period: 150 to 200 days

Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Custer, undrained, and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Custer, Undrained

Setting

Landform: Outwash plains

Parent material: Glacial outwash

Typical profile

H1 - 0 to 9 inches: fine sandy loam

H2 - 9 to 35 inches: sand

H3 - 35 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: 20 to 40 inches to strongly contrasting textural stratification

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 5w

Hydrologic Soil Group: C/D

Forage suitability group: Wet Soils (G002XN102WA)

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Minor Components

Norma, undrained

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Custom Soil Resource Report

Indianola

Percent of map unit: 5 percent

Hydric soil rating: No

Custer, drained

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Soils with Few Limitations (G002XN502WA)

Hydric soil rating: Yes

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MR #5 List #2 Analysis

Project to use BMPs from List #2 or meet LID performance standards (Table I-3.1 DOE)

List #2:

- Roof Surface:
 - BMP T5.30 full dispersion or Downspout Full Infiltration
 - Site is unable to meet the 100 ft minimum flowpath required.
 - Unable to meet 5 ft minimum separation from groundwater
 - INFEASIBLE
 - BMP T7.30 Bioretention
 - Unable to meet separation from groundwater and setbacks from property lines with current site layout.
 - INFEASIBLE
 - BMP T5.10B Downspout Dispersion Systems
 - Unable to meet minimum required flow path due to the narrow property.
 - INFEASIBLE
 - BMP T5.10C Perforated Stub-Out Connections
 - Due to relatively flat topography and shallow detention system proposed, there is insufficient depth to install perforated stub-out connections in-line between the building and proposed detentions system.
 - INFEASIBLE
- Other Hard Surfaces:
 - BMP T5.30 full dispersion
 - Site is unable to meet the 100 ft minimum flowpath required.
 - INFEASIBLE
 - BMP T5.15 Permeable pavement
 - The applicant has concerns about the lifespan of these and does not want to use them
 - INFEASIBLE
 - BMP T7.30 Bioretention
 - Unable to meet separation from groundwater and setbacks from property lines with current site layout.
 - INFEASIBLE
 - BMP T5.12 Sheet Flow Dispersion or BMP T5.11 Concentrated Flow Dispersion
 - Due to the narrow site and the proposed site layout it is determined that there would be insufficient area to implement these BMPs for the proposed hard surfaces.
 - INFEASIBLE

Conclusion

It has been determined that all BMPs listed under List #2 are infeasible for this project. A detention system is proposed to meet flow control requirements and comply with MR#5.

WWHM2012
PROJECT REPORT

General Model Information

Project Name: 22868 Stormtank design 1
Site Name: SMOKEY POINT DEVELOPMENT
Site Address: 16523 SMOKEY POINT BLVD
City: ARLINGTON
Report Date: 9/6/2022
Gage: Everett
Data Start: 1948/10/01
Data End: 2009/09/30
Timestep: 15 Minute
Precip Scale: 0.000 (adjusted)
Version Date: 2021/08/18
Version: 4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

PREDEVELOPED NORTH PARCEL

Bypass: No

GroundWater: No

Pervious Land Use acre
C, Forest, Flat 0.659

Pervious Total 0

Impervious Land Use acre

Impervious Total 0

Basin Total 0

Element Flows To:
Surface Interflow Groundwater

PREDEVELOPED SOUTH PARCEL

Bypass: No

GroundWater: No

Pervious Land Use acre
C, Forest, Flat 1.549

Pervious Total 0

Impervious Land Use acre

Impervious Total 0

Basin Total 0

Element Flows To:
Surface Interflow Groundwater

Offsite Area A

Bypass: No

GroundWater: No

Pervious Land Use
C, Forest, Flat acre
0.014

Pervious Total 0

Impervious Land Use acre

Impervious Total 0

Basin Total 0

Element Flows To:
Surface Interflow Groundwater

Mitigated Land Use

DEVELOPED NORTH PARCEL

Bypass: No

GroundWater: No

Pervious Land Use acre
C, Lawn, Flat 0.057

Pervious Total 0

Impervious Land Use acre
ROADS FLAT 0.217
ROOF TOPS FLAT 0.233
SIDEWALKS FLAT 0.007

Impervious Total 0

Basin Total 0

Element Flows To:
Surface Interflow Groundwater
Vault 2 Vault 2

DEVELOPED SOUTH PARCEL

Bypass:	No
GroundWater:	No
Pervious Land Use C, Lawn, Flat	acre 0.455
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.609
ROOF TOPS FLAT	0.392
SIDEWALKS FLAT	0.092
Impervious Total	0
Basin Total	0

Element Flows To:		
Surface	Interflow	Groundwater
Vault 2	Vault 2	

Offsite Area A

Bypass:	No
GroundWater:	No
Pervious Land Use C, Forest, Flat	acre 0.014
Pervious Total	0
Impervious Land Use	acre
Impervious Total	0
Basin Total	0

Element Flows To:		
Surface	Interflow	Groundwater
Vault 2	Vault 2	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 2

Width: 132.020431518555 ft.
 Length: 132.7411675916 ft.
 Depth: 3 ft.
 Discharge Structure
 Riser Height: 2 ft.
 Riser Diameter: 18 in.
 Orifice 1 Diameter: 1.18 in. Elevation:0 ft.
 Orifice 2 Diameter: 2.39 in. Elevation:1.194 ft.
 Orifice 3 Diameter: 1.07 in. Elevation:1.72083333333333 ft.
 Element Flows To:
 Outlet 1 Outlet 2

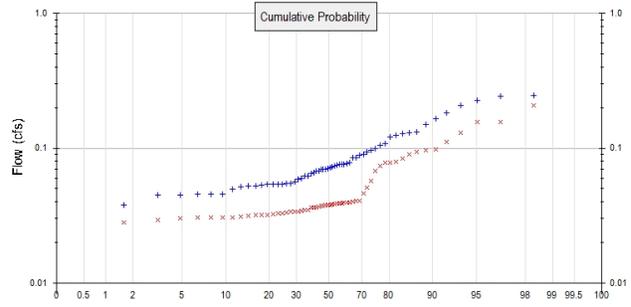
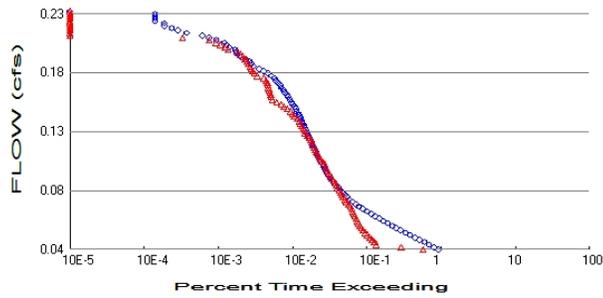
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.402	0.000	0.000	0.000
0.0333	0.402	0.013	0.006	0.000
0.0667	0.402	0.026	0.009	0.000
0.1000	0.402	0.040	0.011	0.000
0.1333	0.402	0.053	0.013	0.000
0.1667	0.402	0.067	0.015	0.000
0.2000	0.402	0.080	0.016	0.000
0.2333	0.402	0.093	0.018	0.000
0.2667	0.402	0.107	0.019	0.000
0.3000	0.402	0.120	0.020	0.000
0.3333	0.402	0.134	0.021	0.000
0.3667	0.402	0.147	0.022	0.000
0.4000	0.402	0.160	0.023	0.000
0.4333	0.402	0.174	0.024	0.000
0.4667	0.402	0.187	0.025	0.000
0.5000	0.402	0.201	0.026	0.000
0.5333	0.402	0.214	0.027	0.000
0.5667	0.402	0.228	0.028	0.000
0.6000	0.402	0.241	0.029	0.000
0.6333	0.402	0.254	0.030	0.000
0.6667	0.402	0.268	0.030	0.000
0.7000	0.402	0.281	0.031	0.000
0.7333	0.402	0.295	0.032	0.000
0.7667	0.402	0.308	0.033	0.000
0.8000	0.402	0.321	0.033	0.000
0.8333	0.402	0.335	0.034	0.000
0.8667	0.402	0.348	0.035	0.000
0.9000	0.402	0.362	0.035	0.000
0.9333	0.402	0.375	0.036	0.000
0.9667	0.402	0.388	0.037	0.000
1.0000	0.402	0.402	0.037	0.000
1.0333	0.402	0.415	0.038	0.000
1.0667	0.402	0.429	0.039	0.000
1.1000	0.402	0.442	0.039	0.000
1.1333	0.402	0.455	0.040	0.000
1.1667	0.402	0.469	0.040	0.000
1.2000	0.402	0.482	0.053	0.000
1.2333	0.402	0.496	0.072	0.000

1.2667	0.402	0.509	0.084	0.000
1.3000	0.402	0.523	0.093	0.000
1.3333	0.402	0.536	0.101	0.000
1.3667	0.402	0.549	0.108	0.000
1.4000	0.402	0.563	0.115	0.000
1.4333	0.402	0.576	0.121	0.000
1.4667	0.402	0.590	0.126	0.000
1.5000	0.402	0.603	0.132	0.000
1.5333	0.402	0.616	0.137	0.000
1.5667	0.402	0.630	0.141	0.000
1.6000	0.402	0.643	0.146	0.000
1.6333	0.402	0.657	0.151	0.000
1.6667	0.402	0.670	0.155	0.000
1.7000	0.402	0.683	0.159	0.000
1.7333	0.402	0.697	0.167	0.000
1.7667	0.402	0.710	0.174	0.000
1.8000	0.402	0.724	0.180	0.000
1.8333	0.402	0.737	0.185	0.000
1.8667	0.402	0.751	0.190	0.000
1.9000	0.402	0.764	0.195	0.000
1.9333	0.402	0.777	0.200	0.000
1.9667	0.402	0.791	0.204	0.000
2.0000	0.402	0.804	0.209	0.000
2.0333	0.402	0.818	0.310	0.000
2.0667	0.402	0.831	0.491	0.000
2.1000	0.402	0.844	0.723	0.000
2.1333	0.402	0.858	0.996	0.000
2.1667	0.402	0.871	1.303	0.000
2.2000	0.402	0.885	1.637	0.000
2.2333	0.402	0.898	1.993	0.000
2.2667	0.402	0.911	2.364	0.000
2.3000	0.402	0.925	2.745	0.000
2.3333	0.402	0.938	3.130	0.000
2.3667	0.402	0.952	3.512	0.000
2.4000	0.402	0.965	3.886	0.000
2.4333	0.402	0.979	4.246	0.000
2.4667	0.402	0.992	4.587	0.000
2.5000	0.402	1.005	4.903	0.000
2.5333	0.402	1.019	5.191	0.000
2.5667	0.402	1.032	5.449	0.000
2.6000	0.402	1.046	5.675	0.000
2.6333	0.402	1.059	5.869	0.000
2.6667	0.402	1.072	6.034	0.000
2.7000	0.402	1.086	6.175	0.000
2.7333	0.402	1.099	6.300	0.000
2.7667	0.402	1.113	6.494	0.000
2.8000	0.402	1.126	6.630	0.000
2.8333	0.402	1.139	6.764	0.000
2.8667	0.402	1.153	6.895	0.000
2.9000	0.402	1.166	7.023	0.000
2.9333	0.402	1.180	7.149	0.000
2.9667	0.402	1.193	7.273	0.000
3.0000	0.402	1.206	7.395	0.000
3.0333	0.402	1.220	7.515	0.000
3.0667	0.000	0.000	7.633	0.000

Analysis Results

POC 1



+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area: 2.222
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.526
Total Impervious Area: 1.55

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.07466
5 year	0.114531
10 year	0.14528
25 year	0.189274
50 year	0.225914
100 year	0.265985

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.043391
5 year	0.068152
10 year	0.089331
25 year	0.12251
50 year	0.152559
100 year	0.187794

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.075	0.034
1950	0.076	0.038
1951	0.068	0.032
1952	0.054	0.031
1953	0.045	0.031
1954	0.244	0.036
1955	0.096	0.078
1956	0.085	0.095
1957	0.105	0.046
1958	0.076	0.035

1959	0.075	0.037
1960	0.070	0.039
1961	0.133	0.074
1962	0.065	0.032
1963	0.108	0.034
1964	0.078	0.028
1965	0.065	0.038
1966	0.038	0.032
1967	0.077	0.033
1968	0.094	0.039
1969	0.228	0.035
1970	0.054	0.034
1971	0.085	0.098
1972	0.063	0.036
1973	0.059	0.038
1974	0.128	0.037
1975	0.052	0.031
1976	0.054	0.036
1977	0.045	0.034
1978	0.054	0.031
1979	0.149	0.034
1980	0.070	0.030
1981	0.055	0.031
1982	0.071	0.068
1983	0.121	0.033
1984	0.073	0.112
1985	0.089	0.079
1986	0.209	0.157
1987	0.099	0.130
1988	0.052	0.077
1989	0.052	0.030
1990	0.070	0.041
1991	0.072	0.038
1992	0.055	0.039
1993	0.045	0.029
1994	0.050	0.039
1995	0.073	0.084
1996	0.124	0.057
1997	0.247	0.208
1998	0.046	0.032
1999	0.059	0.039
2000	0.045	0.097
2001	0.018	0.026
2002	0.068	0.040
2003	0.053	0.038
2004	0.089	0.090
2005	0.062	0.038
2006	0.166	0.051
2007	0.131	0.041
2008	0.184	0.156
2009	0.056	0.039

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2473	0.2083
2	0.2439	0.1568
3	0.2276	0.1563

4	0.2085	0.1301
5	0.1838	0.1121
6	0.1655	0.0985
7	0.1493	0.0972
8	0.1326	0.0945
9	0.1310	0.0898
10	0.1280	0.0841
11	0.1244	0.0794
12	0.1213	0.0778
13	0.1079	0.0775
14	0.1051	0.0741
15	0.0995	0.0681
16	0.0961	0.0574
17	0.0936	0.0512
18	0.0893	0.0462
19	0.0887	0.0408
20	0.0848	0.0406
21	0.0847	0.0400
22	0.0776	0.0394
23	0.0770	0.0393
24	0.0763	0.0393
25	0.0760	0.0389
26	0.0753	0.0389
27	0.0746	0.0387
28	0.0732	0.0382
29	0.0729	0.0382
30	0.0717	0.0380
31	0.0711	0.0379
32	0.0702	0.0378
33	0.0700	0.0375
34	0.0696	0.0371
35	0.0682	0.0368
36	0.0678	0.0363
37	0.0655	0.0363
38	0.0648	0.0361
39	0.0625	0.0346
40	0.0622	0.0346
41	0.0594	0.0344
42	0.0592	0.0340
43	0.0560	0.0338
44	0.0548	0.0338
45	0.0546	0.0335
46	0.0538	0.0328
47	0.0537	0.0327
48	0.0537	0.0323
49	0.0536	0.0321
50	0.0531	0.0321
51	0.0525	0.0321
52	0.0521	0.0315
53	0.0515	0.0310
54	0.0497	0.0308
55	0.0455	0.0308
56	0.0452	0.0307
57	0.0452	0.0304
58	0.0451	0.0303
59	0.0446	0.0292
60	0.0379	0.0283
61	0.0179	0.0255

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0373	19590	12106	61	Pass
0.0392	16989	6201	36	Pass
0.0411	14675	2866	19	Pass
0.0430	12726	2695	21	Pass
0.0449	10930	2505	22	Pass
0.0469	9437	2351	24	Pass
0.0488	8171	2160	26	Pass
0.0507	7075	2014	28	Pass
0.0526	6130	1884	30	Pass
0.0545	5311	1806	34	Pass
0.0564	4654	1716	36	Pass
0.0583	4066	1653	40	Pass
0.0602	3548	1590	44	Pass
0.0621	3136	1529	48	Pass
0.0640	2759	1469	53	Pass
0.0659	2447	1420	58	Pass
0.0678	2145	1376	64	Pass
0.0697	1892	1329	70	Pass
0.0716	1656	1281	77	Pass
0.0735	1508	1213	80	Pass
0.0754	1370	1131	82	Pass
0.0773	1249	1076	86	Pass
0.0792	1154	1027	88	Pass
0.0811	1069	988	92	Pass
0.0830	1009	950	94	Pass
0.0850	948	904	95	Pass
0.0869	888	861	96	Pass
0.0888	825	832	100	Pass
0.0907	777	792	101	Pass
0.0926	733	758	103	Pass
0.0945	686	723	105	Pass
0.0964	648	686	105	Pass
0.0983	622	656	105	Pass
0.1002	603	640	106	Pass
0.1021	584	619	105	Pass
0.1040	561	593	105	Pass
0.1059	538	566	105	Pass
0.1078	507	529	104	Pass
0.1097	487	508	104	Pass
0.1116	473	482	101	Pass
0.1135	457	466	101	Pass
0.1154	440	448	101	Pass
0.1173	424	430	101	Pass
0.1192	410	417	101	Pass
0.1211	394	401	101	Pass
0.1231	380	389	102	Pass
0.1250	368	374	101	Pass
0.1269	353	357	101	Pass
0.1288	341	335	98	Pass
0.1307	333	317	95	Pass
0.1326	322	308	95	Pass
0.1345	313	297	94	Pass
0.1364	304	283	93	Pass

0.1383	293	272	92	Pass
0.1402	284	260	91	Pass
0.1421	276	245	88	Pass
0.1440	265	221	83	Pass
0.1459	257	211	82	Pass
0.1478	241	199	82	Pass
0.1497	234	181	77	Pass
0.1516	226	163	72	Pass
0.1535	212	149	70	Pass
0.1554	205	130	63	Pass
0.1573	195	113	57	Pass
0.1592	187	110	58	Pass
0.1611	177	108	61	Pass
0.1631	166	106	63	Pass
0.1650	160	103	64	Pass
0.1669	151	101	66	Pass
0.1688	146	99	67	Pass
0.1707	135	98	72	Pass
0.1726	128	93	72	Pass
0.1745	121	87	71	Pass
0.1764	111	72	64	Pass
0.1783	100	65	65	Pass
0.1802	86	62	72	Pass
0.1821	75	59	78	Pass
0.1840	63	57	90	Pass
0.1859	59	54	91	Pass
0.1878	56	52	92	Pass
0.1897	50	49	98	Pass
0.1916	42	46	109	Pass
0.1935	39	42	107	Pass
0.1954	37	38	102	Pass
0.1973	36	29	80	Pass
0.1992	30	26	86	Pass
0.2012	28	23	82	Pass
0.2031	26	20	76	Pass
0.2050	20	16	80	Pass
0.2069	16	7	43	Pass
0.2088	13	0	0	Pass
0.2107	8	0	0	Pass
0.2126	6	0	0	Pass
0.2145	5	0	0	Pass
0.2164	4	0	0	Pass
0.2183	4	0	0	Pass
0.2202	3	0	0	Pass
0.2221	3	0	0	Pass
0.2240	3	0	0	Pass
0.2259	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 2 POC	<input type="checkbox"/>	324.32			<input type="checkbox"/>	0.00			
Total Volume Infiltrated		324.32	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

