Draft Conceptual Stormwater Management Plan

Gateway Pacific Terminal

Whatcom County, Washington

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July 3, 2014

Project No. 091515338C

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PREFACE

Pacific International Terminals, Inc. (PI Terminals) proposes to develop the Gateway Pacific Terminal (the Terminal), a multimodal terminal for transfer of dry bulk commodities, at Cherry Point in Whatcom County, Washington (Figure 1). Construction and operation of the Terminal and associated facilities require the approval of local, state, and federal agencies. Agency decision makers are to be informed of the potential environmental impacts of the proposed project by preparation of an environmental impact statement (EIS) under the National Environmental Policy Act (NEPA) and EIS under the State Environmental Policy Act (SEPA).

This Draft Conceptual Stormwater Management Plan is one of several technical reports prepared on behalf of PI Terminals that provide scientific technical information about the existing conditions of the proposed project area, and in some cases, the projected effects of project operations and associated conceptual plans. It is provided to the lead federal, state, and local agencies for their use in preparation of a Draft EIS, to support specific project permit applications submitted to local, state, and federal agencies, and as part of the consultation process with resource agencies and affected Indian nations.

A more detailed description of the proposed Terminal, including a complete list of proposed commodities, is provided in Appendix B, Project Description for the Revised Site Layout, in the *Gateway Pacific Terminal Project Alternatives Report* (PI Terminals 2014).

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DRAFT CONCEPTUAL STORMWATER MANAGEMENT PLAN

Gateway Pacific Terminal
Whatcom County, Washington

1.0 REPORT ORGANIZATION

This plan has been produced to provide preliminary stormwater management information for the Gateway Pacific Terminal (Terminal) project.

The report is organized to address the requirements of Section 215, "Required Components of a Stormwater Design Report" in Chapter 2 of the *Whatcom County Development Standards* (Whatcom County 2002). These requirements are intended to provide guidance for a complete and detailed Stormwater Design Report. This Draft Conceptual Stormwater Management Plan was developed during the initial phase of the project's environmental review process and addresses the key components at a conceptual level. Future plans and reports would include details on stormwater conveyance system design, engineering details for stormwater flow control structures, and detailed plans for managing stormwater during construction.

This report is organized into the following sections:

- Section 1: Report Organization (this section)
- Section 2: Introduction – Describes the purpose, objectives, and general approach (methodology).
- Section 3: Project Overview – Provides a brief summary of the proposed Terminal project.
- Section 4: Existing and Predeveloped Site Conditions – Describes the existing and predevelopment site conditions that apply to developing hydrologic models.
- Section 5: Stormwater Evaluation for Proposed Conditions – Describes proposed improvements, including changes in land cover, proposed water use, and changes in site hydrology and drainage characteristics due to the proposed development.
- Section 6: Stormwater Management Plan – Describes preliminary-level plans for managing stormwater at the Terminal, including:
  - Identification of the regulatory requirements and design criteria for the stormwater management system; and
  - Identification of stormwater management facilities and low-impact development (LID) integrated management practices at the preliminary level.

- Section 7: Compliance Status of the Proposed Project – Presents a preliminary assessment of potential hydrologic impacts and describes how the proposed stormwater management facilities would control impacts.
- Section 8: Limitations – Presents limitations of information in this draft plan and any limitations need to be considered in use of information presented here.
- Section 9: References – Presents a list of references cited in the text.
- Appendices A through E – Include supporting information used in preparing this plan
  - Appendix A: Hydrologic Modeling describes the hydrologic modeling performed, presents the input data for the hydrologic models, and provides the hydrologic modeling reports output by the modeling software.
  - Appendix B: Preliminary Stormwater Drainage Plan is comprised of preliminary engineering drawings that show conveyance paths and proposed stormwater management facilities.
  - Appendix C: Proposed Modifications to Existing Streams and Drainage Courses summarizes changes that will occur to existing drainages and streams as a result of the proposed improvements and surface water mitigation plans.
  - Appendix D: Stormwater Management Requirements summarizes the requirements of Whatcom County and the Washington Department of Ecology for new development projects.
  - Appendix E: Low Impact Development Practices Evaluated for Project presents background information about potential practices to reduce the hydrologic impact of the project by reducing stormwater runoff volumes through design features to promote infiltration and evapotranspiration processes.

2.0 INTRODUCTION

The proposed Terminal would be a new industrial facility located in Whatcom County, Washington. Designed for export of dry bulk commodities, the proposed Terminal would include a deep-draft wharf with access trestle, dry bulk commodities handling and storage facilities, and rail access. The Terminal would be built, owned, and operated by Pacific International Terminals, Inc. (PI Terminals).

The proposed Teminal is not the first land development to affect the project area. Historically much of the area was forested and portions were known to have wetlands. In the past, roadways were built to access the vicinity, and forests were cut and timber was extracted. Small homesteads were established throughout the area. Stormwater was managed through t, drainage ditches constructed to redirect and drain surface water from pastures, farm fields, and road beds. Additionally, culverts were installed to convey water collected in roadside ditches and streams. In the last fifty years, forest has reestablishedacross approximately one-third of the area, while roadways and drainage remain and portions of the area remain in use for hayfields and grazing.

The Terminal would directly affect approximately 278 acres. As is typical with any land development, to build the proposed facilities, areas of the landscape would be cleared of vegetation, graded, and infrastructure would be constructed. This transformation of the landscape has the potential to affect the movement and quality of surface water in the project area and in the vicinity.

Development would necessitate managing stormwater, such as preventing adverse impacts to downstream and on-site streams and their tributaries and to wetlands; and also would present opportunities, such as restoration of historic stream channels. In addition to technical analysis, this report explains some of the challenges and opportunities for PI Terminals in managing stormwater and presents strategies that could be used. Development of the proposed Terminal would alter drainage patterns, change the amount of stormwater runoff, and could potentially affect water quality. In mitigating stormwater effects, PI Terminals also would have the opportunity to restore hydrologic conditions in some areas to approximately mimic predevelopment runoff conditions.

This Draft Conceptual Stormwater Management Plan addresses the management of runoff following precipitation events (stormwater) by identifying the predevelopment and existing site hydrologic conditions, describing the proposed landscape changes that would potentially affect stormwater flow patterns and water quality, and discussing the effect of the proposed stormwater management plan on site hydrology and water quality. In general, land development changes an area's hydrology and water quality. Impervious surfaces increase the amount (volume) and flow rate of runoff. Some surfaces contain pollutants that can be washed into the runoff. If left uncontrolled, changes in runoff quantity and quality can have impacts on downstream surface water features. These impacts can

include, for example, increased risk of streambed scour, channelization, and/or streambank erosion. Water quality also can be impacted by the introduction of pollutants, and disturbance to the natural filtration removal processes that may occur in currently undeveloped vegetated areas.

In addition to surface water changes, groundwater resources can be affected by changing the location and rates of groundwater recharge, or by increasing the flow of groundwater from aquifers disturbed by site grading.

To address these potential impacts, stormwater management practices are typically implemented to:

- Slow the release of water from a developed property and promote infiltration of rainwater into the ground (stormwater quantity controls and LID practices);
- Minimize the release of pollutants from materials and activities exposed to rainfall (source controls); and
- Treat stormwater to remove pollutants (stormwater quality controls).

These practices and controls are implemented through an integrated suite of practices and facilities that together constitute a stormwater control plan.

To minimize environmental, hydrological, or water quality changes that may result from new developments, there are Washington State and Whatcom County regulations. The Washington State Department of Ecology (Ecology) and Whatcom County have identified “minimum requirements” that are to be addressed for design, construction and and operation of a constructed facility. This Draft Conceptual Stormwater Management Plan addresses Whatcom County’s requirements and Ecology requirements to the extent possible at the current conceptual design stage of the Terminal project. Appendix D has a code comparison between Ecology’s and Whatcom County’s minimum requirements.

As the Terminal’s environmental review process moves forward, new information is available, and the engineering design is refined, information presented here would be revised and incorporated into a Stormwater Design Report that would be submitted for review and approval.

2.1 Types of Water Discharges

A new industrial development might discharge water from several sources, all of which are subject to regulation. These include industrial stormwater, natural stormwater, process water, and sanitary wastewater. Surface runoff from rainfall is categorized as either *industrial stormwater*—if it comes in to contact with potentially polluting surfaces—or as *natural stormwater* if it does not. In addition to stormwater, industrial facilities must manage non-stormwater water that is generated through

operations. Water used in an industrial process or comes into contact with an industrial product is referred to as *process water* and must be treated to certain standards prior to release. *Sanitary wastewater* is water generated after potable water is used in non-industrial process, for example, sanitation facilities, employee kitchens, and other similar uses.

2.2 Purpose and Objectives of this Draft Conceptual Stormwater Management Plan

The purpose of this Draft Conceptual Stormwater Management Plan is to provide preliminary stormwater management information and other information pertaining to:

- Stormwater management systems proposed for the Terminal;
- Projected Terminal water use;
- Preliminary identification of potential pollutants and sources;
- Management of non-stormwater (wastewater and industrial) discharges; and
- Proposed implementation of certain LID practices.

PI Terminals has adopted a watershed management approach for the project as an key aspect to mitigate potential effects of Terminal development.

This approach has several objectives:

- Understand the current condition and function of the entire watershed from a hydrologic and hydrogeologic standpoint.
- Reestablish the probable predevelopment stream flow pattern for the watershed, which goes beyond the standard requirement of maintaining existing discharge rates for only those areas within the project footprint.
- Manage stormwater at a watershed level by identifing multiple appropriate locations for stormwater discharge. This approach is used instead of combining flows to just a few discharge locations regardless of upbasin or downbasin effects.
- Identify and incorporate multiple types of LID practices to promote infiltration and support evapotranspiration.
- Identify oportunities in stormwater management to improve fish habitat, including fish passage and aquatic habitat function.
- Engineer surface water storage and treatment as a prefered management approach, instead of underground facilities such as vaults or concrete-lined facilities. This allows for stormwater

facilities that more closly reflect natural systems, provides opportunity for vegetation and soil processes to reduce runoff volumes and remove pollutants, and potentially provides other secondary benefits.

This report:

- Describes project area conditions pertinent to evaluating stormwater management;
- Describes stormwater regulations that would be applied to the development;
- Presents the conceptual stormwater management strategy for the project;
- Provides preliminary engineering design of proposed facilities and improvements that mitigates potential stormwater impacts and complies with stormwater regulations;
- Identifies anticipated Terminal water uses and anticipated associated water discharges;
- Provides information on proposed water treatment methods;
- Provides preliminary evaluation of potential hydrologic conditions; and
- Identifies and evaluates stormwater management approaches and best management practices (BMPs) for Terminal operations.

2.3 Stormwater Regulatory Overview

The Terminal would be required to comply with Whatcom County's minimum requirements for stormwater management (Whatcom County 2002). Additionally, the project would likely be required to conform to Ecology's stormwater management requirements. As part of the development approval process in Whatcom County, a final approved Stormwater Design Report would be required.

The environmental review process is under way and the engineering design is at a conceptual stage. Therefore this draft plan does not include detailed design information. For example, sizing and locations of all the conveyances that would ultimately be needed to manage stormwater is not included. Details on the maintenance requirements for any of the proposed stormwater facilities are not included in this plan, but would be provided as part of a future Stormwater Design Report prepared to meet Whatcom County Development Standards.

2.4 General Approach

The general approach to identifying water uses, future discharges, and the preliminary stormwater management design required a number of different analyses and computations.:

- Drainage patterns were analyzed using topographic data to define existing watershed basins.

- The watershed basins were then further subdivided hierarchically into sub-watersheds, subbasins, and catchments. These were used in simulation modeling and to evaluate stormwater runoff.
- Land cover types and soil types were identified and mapped.
- In coordination with the design team, opportunities and strategies to implement low impact development practices were reviewed to identify compatibililty of potential practices with site uses, site soils, and groundwater contraints.
- Surface water conditions were simulated using MGSFlood (versions 4.29 and 4.34) for three different scenarios:
  - Existing condition;
  - Predeveloped condition (prior to around 1900 when construction of currently existing roads and drainage ditches likely occurred); and
  - Proposed condition (following construction of the proposed Terminal).

Based on these analyses, individual catchments that would require stormwater detention facilities to manage stormwater runoff were identified and stormwater facilities were sized to meet the stormwater flow control and treatment requirements. Additional discussion of this process is provided in Appendix A.

Following sizing of the stormwater facilities, additional hydrologic modeling scenarios were developed addressing larger subbasin areas (several catchments together) that would contribute surface flow to existing streams or wetlands. Selected locations (called points of interest (POIs) for this report) were identified as focal point locations on the site because they are locations where surface flows currently become concentrated (for example, where the roadway drainages enter the major streams, where existing roadway culverts are located, and where streams discharge.). The potential change in flow for those streams receiving discharges from the proposed development was evaluated by comparing the proposed flow condition with the existing condition and with the predeveloped flow condition at these Points of Interest.

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3.0 PROJECT OVERVIEW

This section presents a brief overview of the proposed Terminal. A more detailed description of the Terminal project is presented in Appendix B, Revised Site Layout Project Description, in the *Gateway Pacific Terminal Project Alternatives Report* (PI Terminals 2014).

3.1 General Information

The project area is defined as the area of land for which PI Terminals has ownership and also includes acres of roadways within that area. This comprises a total of approximately 1,500 acres. The actual project development footprint would be approximately 278 acres of the 1,500-acre project area.

The project area is located west of Ferndale, Washington, with a street address of 4750 Gulf Road (Figure 1). The Terminal development would be generally bounded by Aldergrove Road, Kickerville Road, the Strait of Georgia, and Jackson Road (Figure 2). Gulf Road, sometimes labeled on maps as Powder Plant Road, runs north-south through the center of the project area.

The area drains to the Strait of Georgia, a portion of the Salish Sea.

The project area and adjacent areas are zoned heavy industrial and adjacent major landowners include British Petroleum (BP) Cherry Point Refinery, ALCOA-Intalco Works., BNSF Railway Company and Washington Department of Natural Resources. An underground pipeline corridor and a Bonneville Power Administration (BPA) transmission line cross the project area approximately north to south. The BNSF Railway Company's Custer Spur rail line transects the eastern edge of the project area. Whatcom County roads cross the project area (Figure 2).

3.2 Project Description

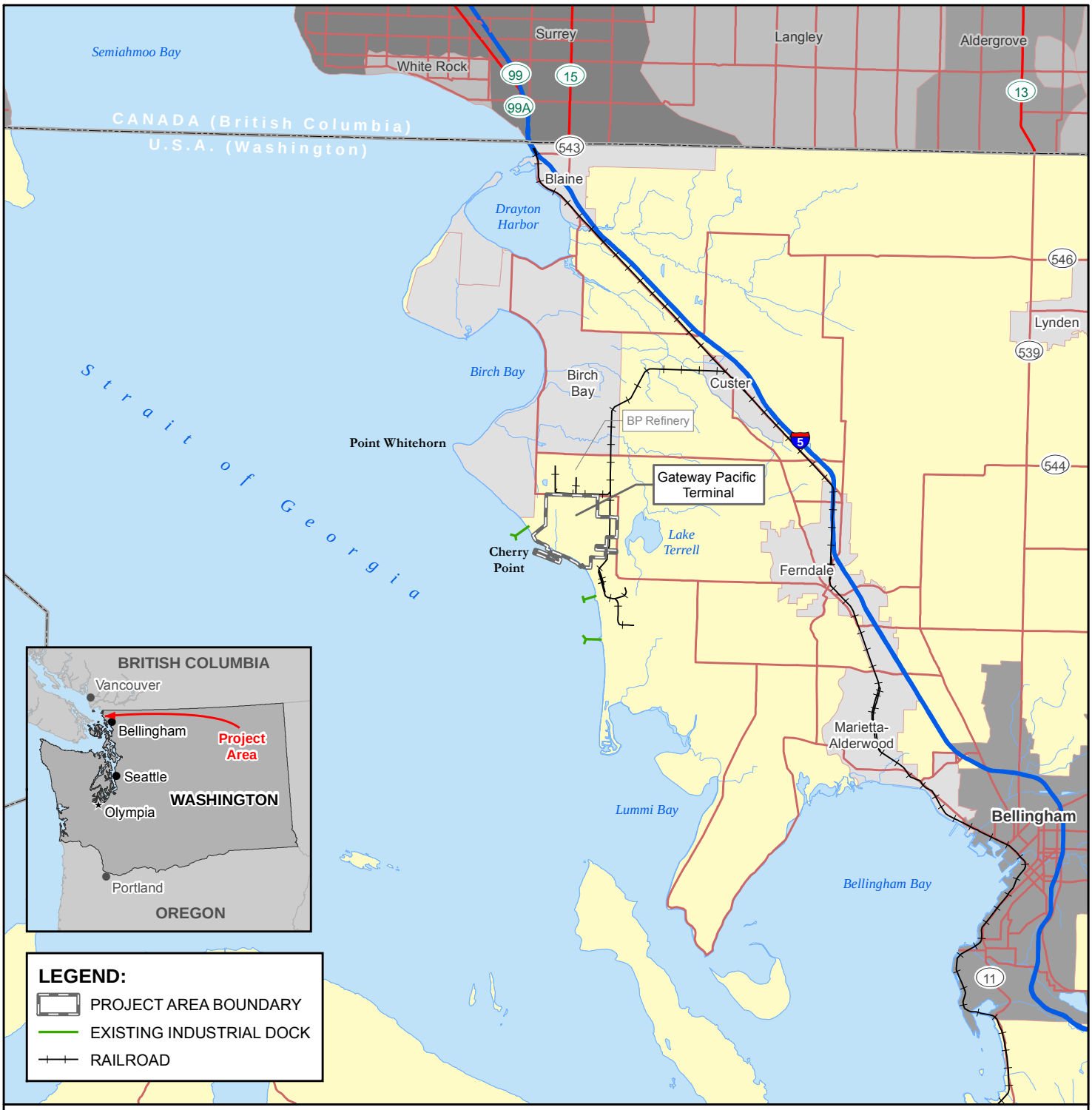
The proposed Terminal includes development of facilities that transfer and store commodities and provide administrative services for the Terminal. A deep-water wharf and access trestle would be developed to provide berths for up to three ships. Dry bulk commodities would be delivered to the Terminal by rail and exported by ship.

Commodities that may be handled at the Terminal include coal, grain products, potash, calcined petroleum coke, and other bulk commodities. The type and quantity of dry bulk commodities that would be managed during the operating life of the Terminal may change over time.

The Terminal would be serviced by a Figure-8 rail loop with specific facilities for operations. Development would include commodities storage as open storage and closed storage facilities

(A-frame structures and silos), and infrastructure to move commodities, including material handling conveyors and access roadways.

Storm drainage infrastructure and stormwater management facilities would be an integral part of the Terminal's design. Drainage infrastructure would collect and convey runoff to stormwater detention and treatment facilities. Process water and sanitary wastewater would be collected and routed to separate (non-stormwater) water treatment facilities sized for the contributing flow.



AMEC 11810 North Creek Parkway N Bothell, WA 98011	amec	Pacific International Terminals	CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL	DWN BY: SD	DATUM: NAD83	DATE: JUNE 2014
TITLE: VICINITY MAP	CHK'D BY: KD	REV. NO.: -	PROJECT NO.: 091515338C-02-04
	PROJECTION: WA SP North, Ft.	SCALE: 1 inch=3 miles	FIGURE NO.: FIGURE 1

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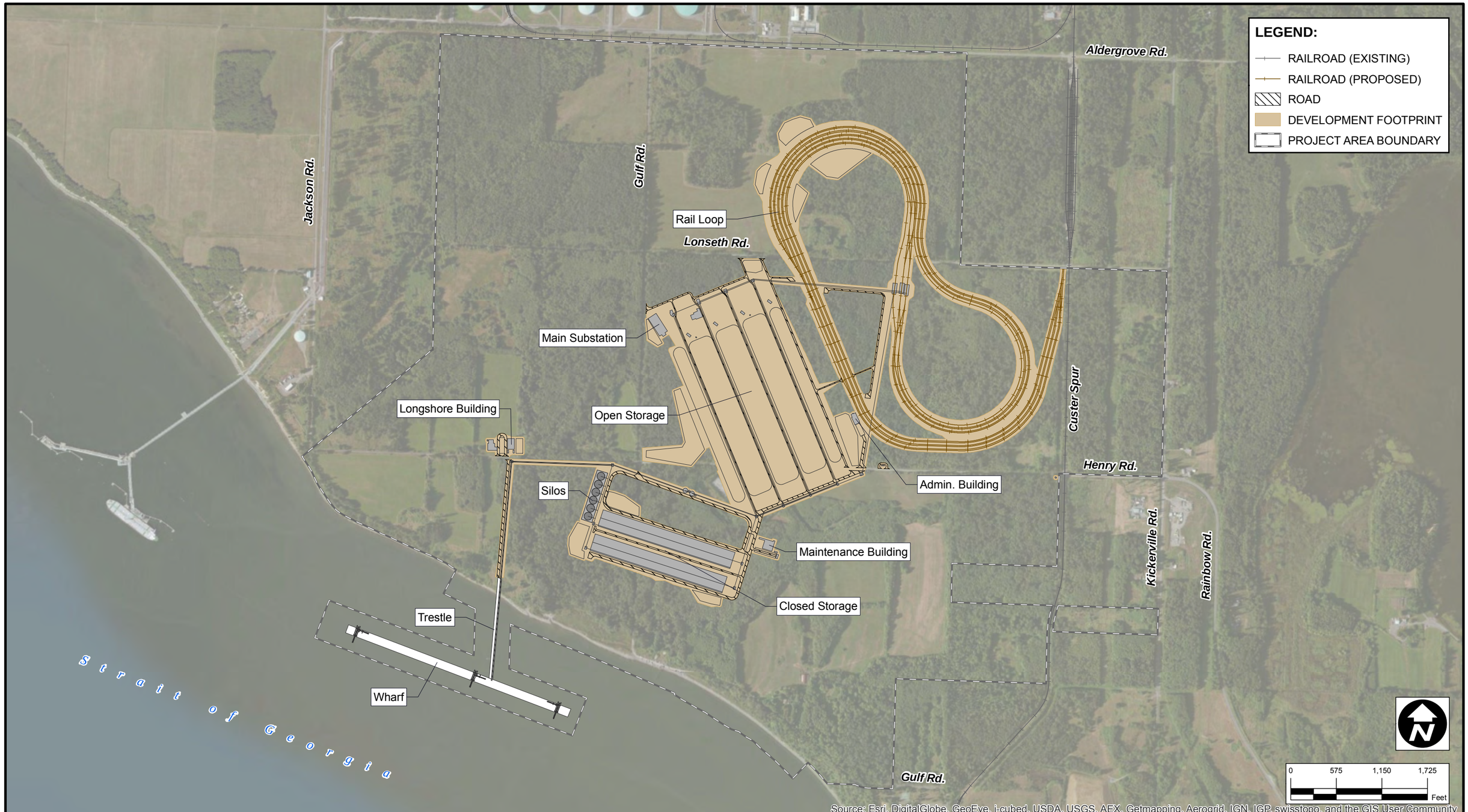

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

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DWN BY:	SD
CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,150 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED PROJECT LAYOUT

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 2

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4.0 EXISTING AND PREDEVELOPED CONDITIONS

This section describes the existing and predeveloped conditions at the location of the proposed Terminal and describes the steps taken to characterize conditions for stormwater analysis. Existing conditions are described first, followed by a discussion of conditions in the project area prior to any development.

4.1 Existing Conditions

This section describes the evaluation of existing conditions for the site.

4.1.1 Vegetation and Land Cover

The project area has limited development and is vegetated. Current vegetation types include pastures, hayfields, mowed utility corridors, forest, and areas of shrubs. To quantify the current distribution of vegetation and other land cover, the project area was classified into vegetation cover types that are typically used in stormwater analyses. Figure 3 shows the land cover types currently and their classifications in the project area.

Impervious surfaces in the project area are also shown on Figure 3. Impervious surfaces include Whatcom County roads that cross the area and two unused building foundations and associated gravel roads and parking area that are located south of Henry Road. A small residential structure and hay barn are in the southeast portion.

Four stock ponds and an existing stormwater pond are located south of Henry Road (Figure 3). Based on AMEC staff observations, the existing ponds have been consistently full of water throughout the wet season and do not appear to provide flow control benefits outside of the period in October when summer evaporation losses are replenished with the first rains each fall.

4.1.2 Topography, Geology, and Soils

Very little topographic relief exists over much of the project area, with most of the area having slopes of 3 percent or less. The highest elevations are along the eastern boundary at approximately 225 feet. Topography generally slopes gently towards Streams 1 or 2. The Stream 1 corridor has steep slopes south of Lonseth Road, with the stream's channel becoming progressively more entrenched toward the south. Steep bluffs occur at the Strait of Georgia shoreline, but are missing from the vicinity of Gulf Road at the shoreline. Figure 4 shows wetland and drainage features, and existing topographic contours, and Figure 5 provides the USGS topographic mapping for the project area and vicinity.

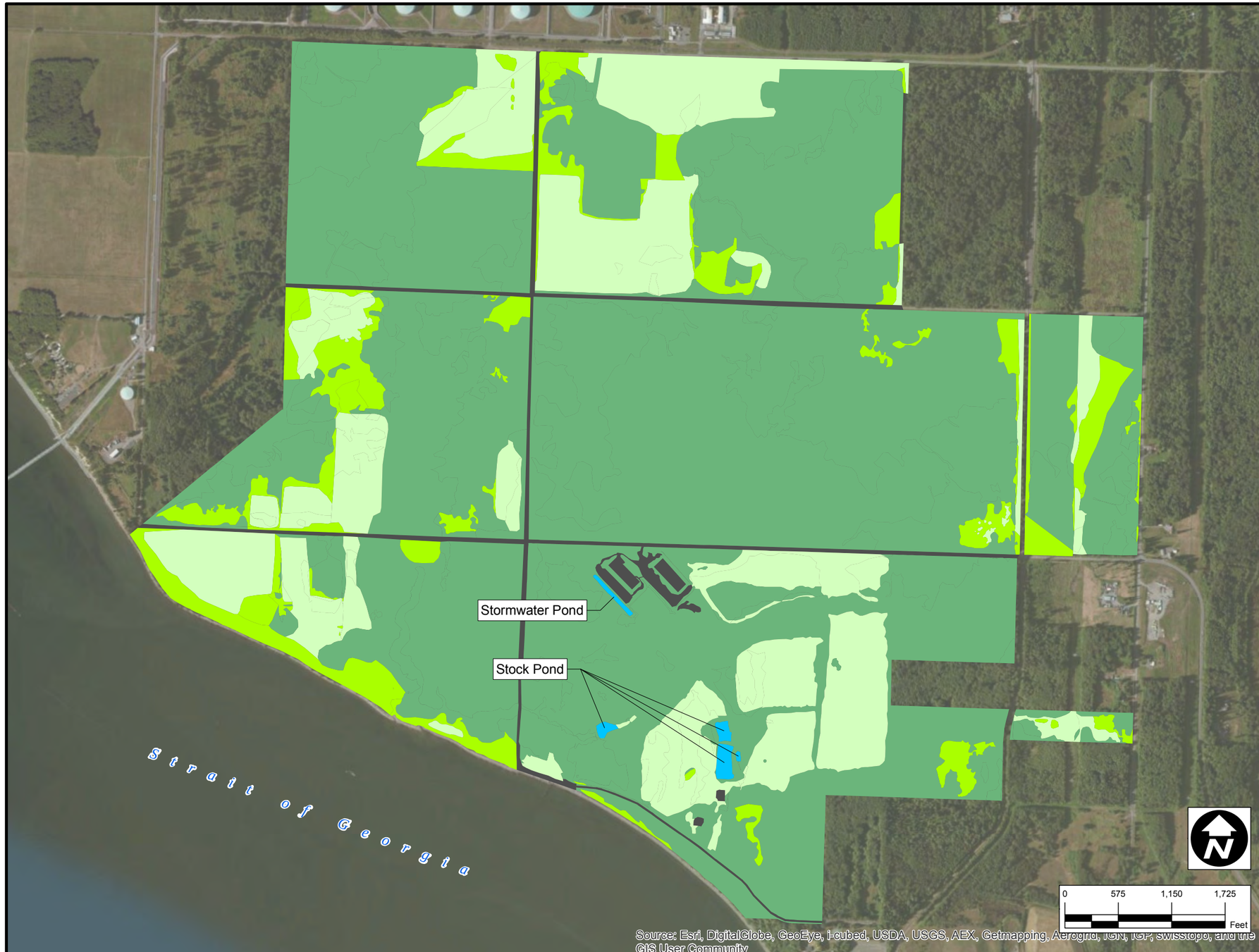
Detailed information about geologic conditions in the project area, including underlying formations, are presented in the 2012 Hydrologic and Hydrogeologic Investigation Report (AMEC 2013a). In general,

the report describes an upper zone that consists of weathered Bellingham glaciomarine drift that extends approximately 25 feet below the ground surface. Tests were performed that show the hydraulic conductivity rates are on the order of 0.1 foot/day. Beneath this zone lies fine-grained clay ranging in depth from 25 to 80 feet, with hydraulic conductivity rates ranging from 1.0×10^{-3} foot/day to 3.2×10^{-3} foot/day.

The Natural Resources Conservation Service (NRCS) has mapped several soil series in the project area (Figure 6). Soil series present in the project area include Birchbay silt loam (0 to 3 percent slopes and 3 to 8 percent slopes), Clipper silt loam, Kickerville silt loam, Neptune very gravelly sandy loam, Whatcom silt loam, and Whitehorn silt loam. Each soil series has a hydrologic soil group (HSG) assigned by the NRCS that classifies areas into four classes (A through D) based on an estimate of the soil's runoff/infiltration potential. Hydrologic soil group A soils have the highest infiltration rates and lowest runoff potential, while HSG D soils have the lowest infiltration rates and highest runoff potential. The soils on the site are predominately classified as HSG C and HSG D.

As stated earlier, MGSFlood was used to model surface flows. Representation of soils for hydrologic modeling using MGSFlood is limited to a few generalized soil categories selected to represent varied responses to rainfall. The soil categories used in the hydrologic model are limited to glacial outwash (highly permeable), glacial till (limited infiltration and seasonally high groundwater), saturated soils (frequent high groundwater with limited ability to infiltrate rainfall), and impervious cover (where infiltration of rainfall is negligible). The standard procedure when using MGSFlood to model soils in Western Washington is that HSG A soils are assigned to the outwash soil category in the model, HSG B soils are either till or outwash, HSG C soils are till, and HSG D soils are saturated (MGS 2009). Based on the soils and geologic data for the project area, non-wetland vegetated areas were typically categorized as glacial till, wetland areas were modeled as saturated soils, and paved areas were modeled as impervious.

According to the NRCS soil survey, glacial outwash soils are found in only very limited areas of the site (the Kickerville Silt Loam, see Figure 6). On-site investigations have confirmed this (AMEC 2013a). Furthermore, in the area where outwash soils were mapped, extensive grading is proposed in the future, which would alter the capacity of the upper soil layers to absorb rainfall. For these reasons, the areas shown in the soil survey as possible outwash soil areas were not categorized as such, but categorized more conservatively as glacial till for modeling purposes.



LEGEND:

LAND COVER TYPE:

- EMERGENT VEGETATION
- SHRUB VEGETATION
- FOREST VEGETATION
- IMPERVIOUS (PAVEMENT/GRAVEL/ROOF)
- OPEN WATER

NOTE: Emergent and Shrub vegetation is treated as "Pasture" for hydrologic modelling.

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CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

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Bothell, WA 98011

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DWN BY:	SD
CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,150 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: EXISTING LAND COVER TYPES

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 3

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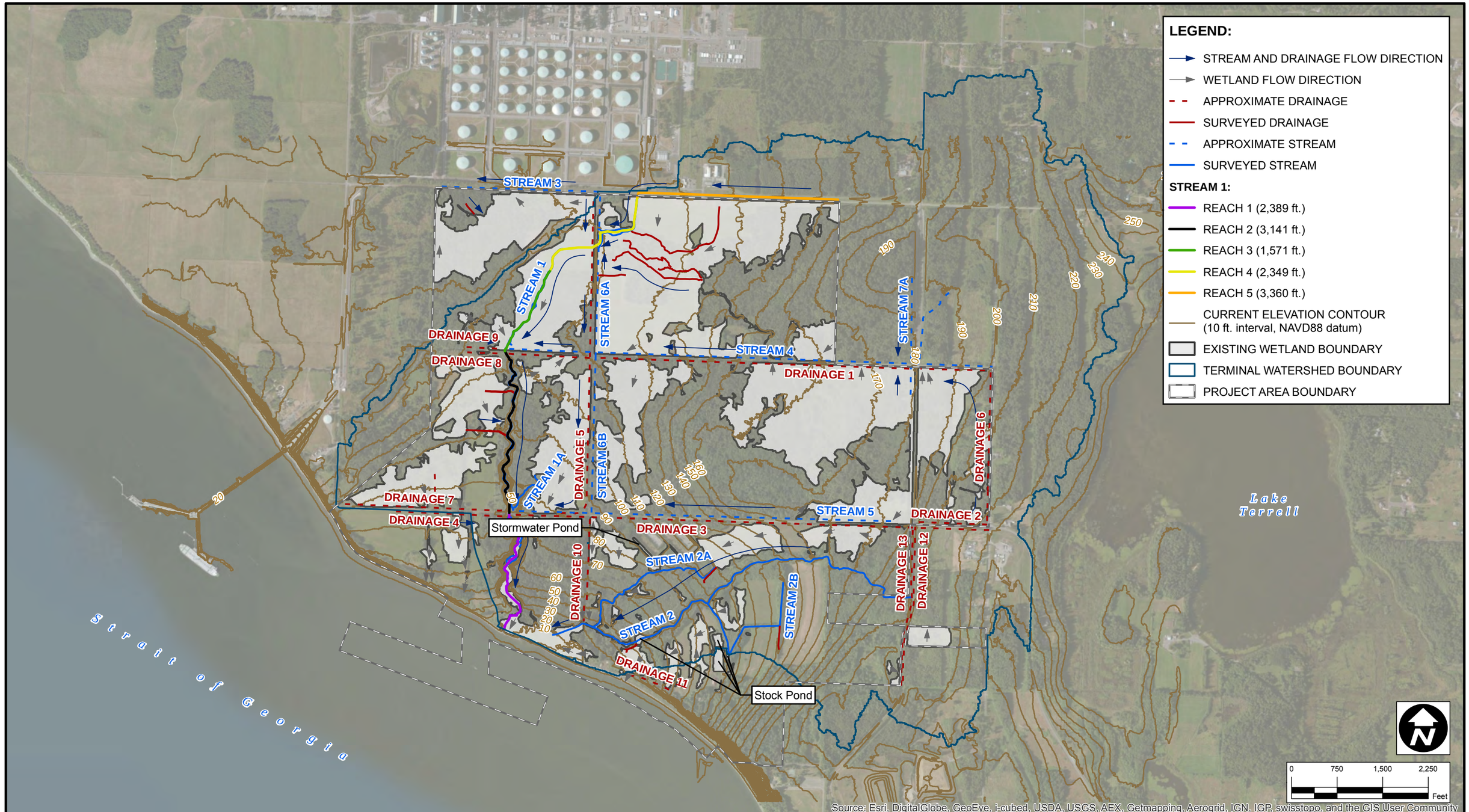

NOTE: Current Elevation Contours data derived from National Elevation Dataset product:
http://ned.usgs.gov/

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Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,500 feet

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: EXISTING TOPOGRAPHY WITH STREAM NETWORK, WETLANDS, AND HYDROLOGIC FLOW

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 4

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 4 - Existing Topography.mxd

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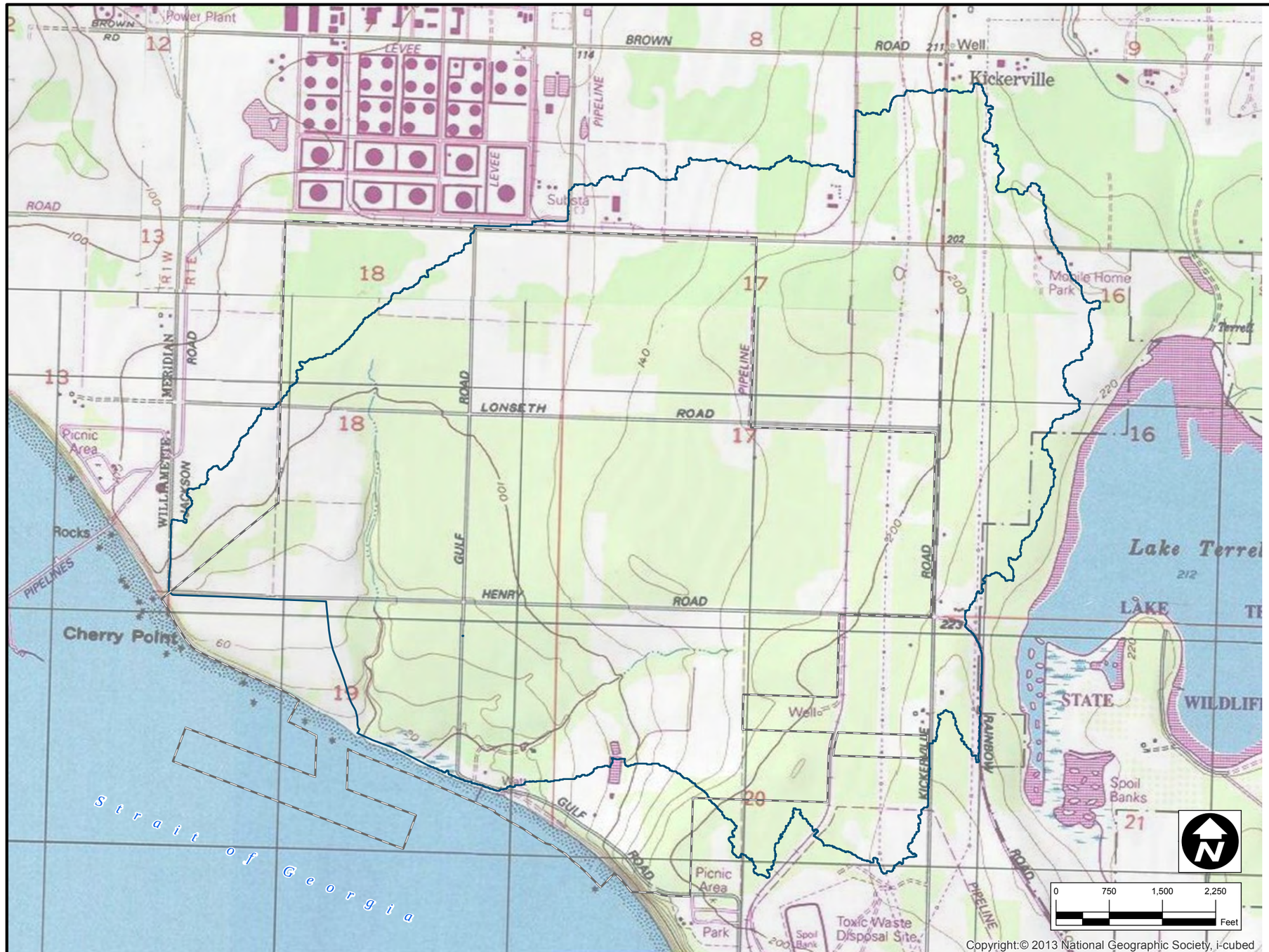

LEGEND:

- TERMINAL WATERSHED BOUNDARY
- PROJECT AREA BOUNDARY

ROAD CLASSIFICATION

- Primary highway, hard surface
- Light-duty road, hard or improved surface
- Secondary highway, hard surface
- Unimproved road
- Interstate Route
- U. S. Route
- State Route

CONTOUR INTERVAL 20 FEET
SUPPLEMENTARY CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY 6 FEET

Source:
NGS USA Topographic Maps provided by ArcGIS Map Service:
http://server.arcgisonline.com/v93
U.S. Geological Survey. Lummi Bay quadrangle, Washington.
1:24,000. Washington D.C.: USGS, 1973.

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amec

DWN BY:	SD
CHK'D BY:	KD
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,500 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: USGS TOPOGRAPHIC MAP

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 5

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 5 - USGS Topographic Map.mxd

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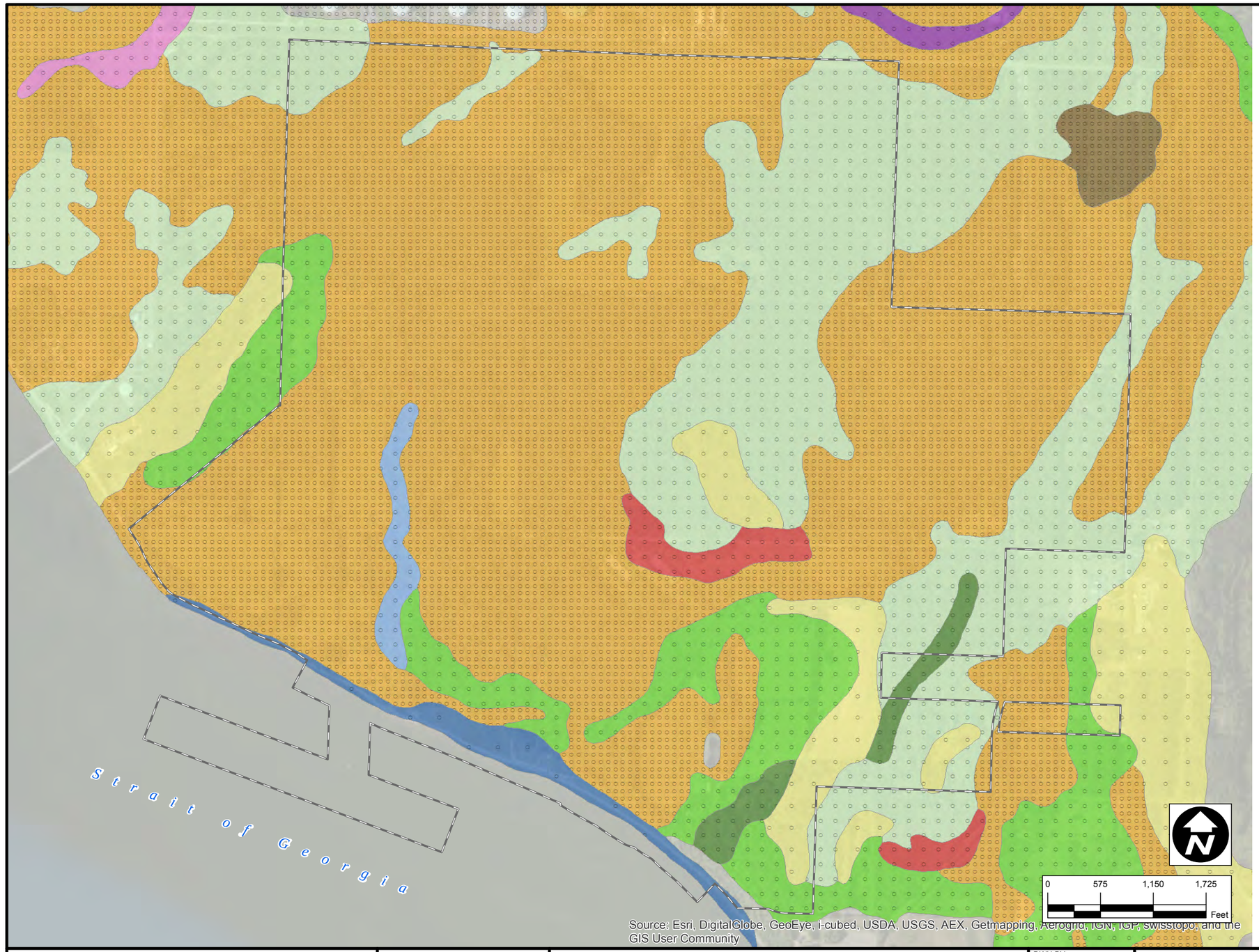

LEGEND:

SOIL CLASSIFICATION & HYDROLOGIC SOIL GROUP (HSG):

- BIRCHBAY SILT LOAM - HSG C (0 to 3 percent slopes)
- BIRCHBAY SILT LOAM - HSG C (3 to 8 percent slopes)
- BIRCHBAY SILT LOAM - HSG C 8 to 15 percent slopes)
- CLIPPER SILT LOAM - DRAINED - HSG C 0 to 2 percent slopes)
- EDMONDS-WOODLYN LOAMS - HSG D 0 to 2 percent slopes)
- HALE SILT LOAM - DRAINED - HSG C 0 to 2 percent slopes)
- KICKERVILLE SILT LOAM - HSG B (3 to 8 percent slopes)
- NEPTUNE VERY GRAVELLY SANDY LOAM - HSG A (0 to 3 percent slopes)
- TROMP LOAM - HSG C (0 to 2 percent slopes)
- WHATCOM SILT LOAM - HSG C (30 to 60 percent slopes)
- WHITEHORN SILT LOAM - HSG D (0 to 2 percent slopes)

HYDROLOGIC SOIL GROUP:

- HSG A
- HSG B
- HSG C
- HSG D
- PROJECT AREA BOUNDARY

Source:
Soil Classification data from U.S. Department of Agriculture:
http://SoilDataMart.nrcs.usda.gov

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DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,150 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: NATIONAL RESOURCES CONSERVATION SERVICE SOIL MAP

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 6

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 6 - NRCS Soil Map.mxd

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4.1.3 Precipitation

Historical climate data from the Bellingham International Airport were obtained from the Western Regional Climate Center (WRCC 2012) and used to compute the precipitation statistics herein. For the future, the project has a new meteorological tower on site which collects precipitation data.

Available data from the Bellingham airport covered the period from December 1, 1949, through April 30, 2012. During this period, average annual precipitation at the airport was 35.3 inches per year, while average annual snowfall was 13.7 inches per year. The 24-hour precipitation totals for selected recurrence storm intervals are shown in Table 1.

Table 1 24-Hour Precipitation for Storm Recurrence Intervals

Storm Recurrence Interval	24-Hour Precipitation (Inches)
6-month[1]	1.35
2-year	1.9
10-year	2.8
100-year	4.1

1. The 6-month storm was computed using 70.9 percent of the 2-year rainfall, based on the methods described in Section 2.3.1 of Volume III and the data for Bellingham in Appendix 1-B of Volume 1 of the *Stormwater Management Manual for Western Washington* (Ecology 2012).

4.1.4 Hydrology and Drainage

This section describes the watersheds and sub-watersheds, sub-basins and catchments existing in the project area, as well as other significant hydrologic features such as wetlands and outfalls. Site reconnaissance was performed in 2011 and 2013 to verify the delineation of catchments and the locations of existing drainage infrastructure, such as culverts and ditches.

4.1.4.1 Watersheds and Sub-watersheds

The project property lies within two watersheds: (1) the Birch Bay Watershed and (2) the Terminal Watershed. The watersheds and existing stream network in the project area are illustrated in Figure 4.

Approximately 68 acres of the northwest corner of the project area drains northwest to the Birch Bay Watershed. The Birch Bay watershed extends north and east from the project area. The watershed includes the BP Cherry Point Refinery and associated industries lying immediately north, as well as Lake Terrell and its natural area lying due east of the project area. Both the BP Refinery and Lake Terrell are notable features in the project vicinity. Located within the Birch Bay watershed, Stream 3 is located north of Aldergrove Road adjacent to BP property and flows due west in a deep ditch just

north of the northern perimeter of the project area and parallel to Aldergrove Road (Figure 4). From Aldergrove road, this water then flows out of the project area and eventually connects with the "Industrial Tributary to Terrell Creek" draining to Birch Bay. A single 6-inch culvert beneath Aldergrove Road was identified as providing surface water connection from the project area to Stream 3 only during high flow periods (AMEC 2008).

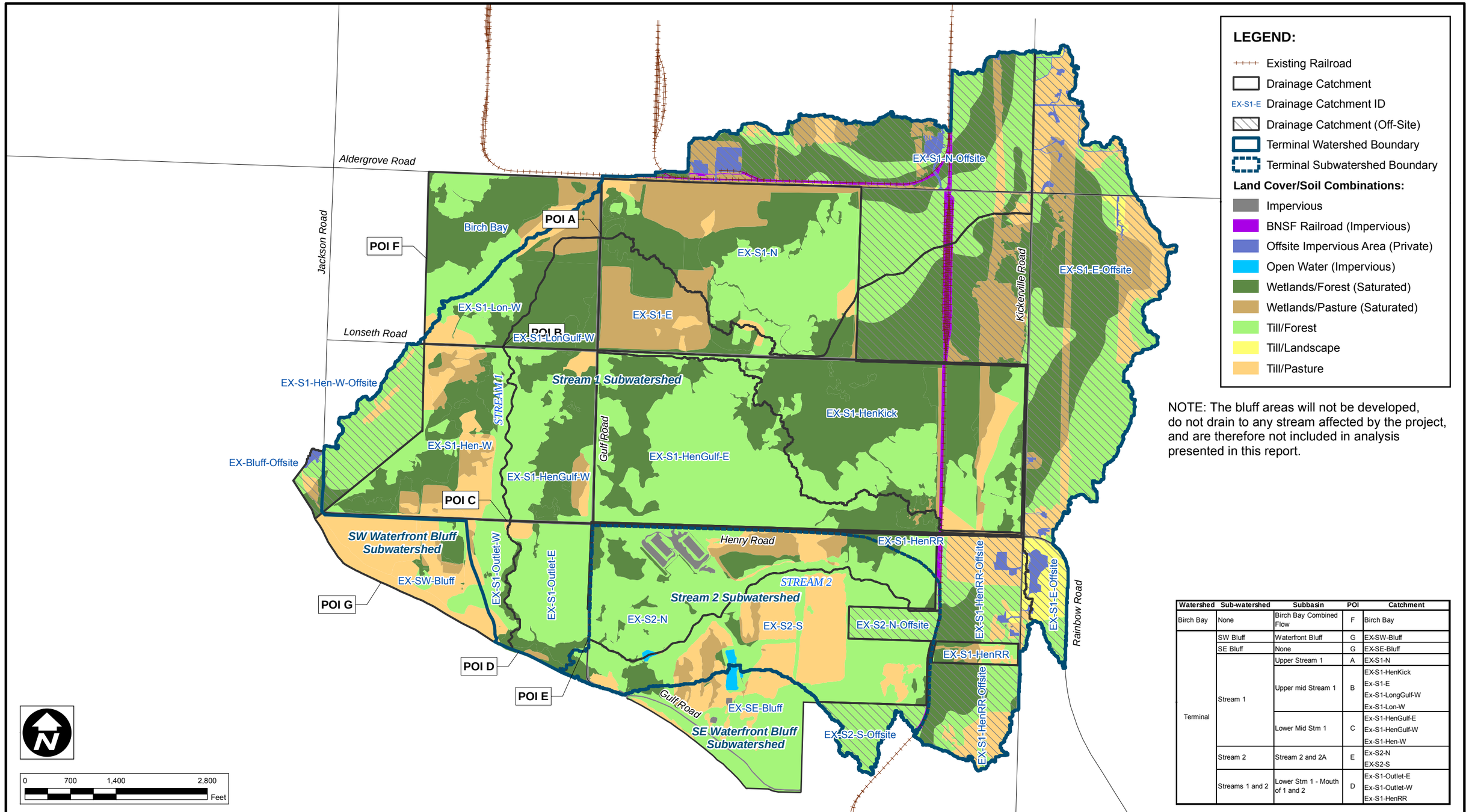
The proposed development area lies within an unnamed watershed (referred to as the Terminal watershed in this report) that drains via Streams 1 and 2.

For this study, the Terminal watershed was divided into four sub-watersheds for discussion and analyses:

- Stream 1 sub-watershed;
- Stream 2 sub-watershed;
- Southwest Waterfront Bluff sub-watershed; and
- Southeast Waterfront Bluff sub-watershed.

Figure 7 shows the existing catchments that comprise each of these sub-watersheds. The catchment names shown on Figure 7 indicate which subwatershed the catchment lies within. Watershed areas outside of the project area were included in the site analyses and are shown on Figure 7 because these areas were evaluated in the hydrologic modeling to estimate the proposed changes to flows in Streams 1 and 2.

The Southwest Waterfront Bluff sub-watershed drains via infiltration and unconcentrated surface flow toward the Strait of Georgia and does not drain to a stream or ditch. The Southeast Waterfront Bluff sub-watershed drains to Drainage 11, a ditch that discharges to the Strait of Georgia after passing through a road culvert beneath Gulf Road. Based on the site topographical mapping and site observations, the southernmost farm stockpond located north of the single family residence is within this subwatershed. Proposed development within this watershed is to provide public access along the existing road, at the edge of Georgia Strait and consists of a parking area that would be constructed in the property in the southeast vicinity and accessed by Gulf Road.



NOTE: The bluff areas will not be developed, do not drain to any stream affected by the project, and are therefore not included in analysis presented in this report.

Watershed	Sub-watershed	Subbasin	POI	Catchment
Birch Bay	None	Birch Bay Combined Flow	F	Birch Bay
Terminal	SW Bluff	Waterfront Bluff	G	EX-SW-Bluff
	SE Bluff	None	G	EX-SE-Bluff
	Stream 1	Upper Stream 1	A	EX-S1-N
		Upper mid Stream 1	B	EX-S1-HenKick Ex-S1-E Ex-S1-LongGulf-W Ex-S1-Lon-W
		Lower Mid Stm 1	C	Ex-S1-HenGulf-E Ex-S1-HenGulf-W Ex-S1-Hen-W
	Stream 2	Stream 2 and 2A	E	Ex-S2-N EX-S2-S
	Streams 1 and 2	Lower Stm 1 - Mouth of 1 and 2	D	Ex-S1-Outlet-E Ex-S1-Outlet-W Ex-S1-HenRR

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DWN BY: SD
CHK'D BY: BT
DATUM: NAD83
PROJECTION: WA SP North, Ft.
SCALE: 1 inch = 1,400 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: EXISTING CATCHMENTS AND LAND COVER

DATE: APRIL 2014
PROJECT NO.: 091515338C-02-04
REV. NO.: -
FIGURE NO.: FIGURE 7

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 7 - Existing Catchments and Land Cover.mxd

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The existing Stream 1 sub-watershed includes Stream 1 and its tributaries and includes approximately 1,008 acres of the site and 710 acres of off-site area. Stream 1 drains to the Strait of Georgia with its headwaters located offsite, north of Aldergrove Road. Stream 1A flows into Stream 1 just north of Henry Road. Streams 4, 5, 6, and 7 flow in roadside ditches to Stream 1. In addition, nine other tributary drainages occur as roadside ditches including Drainages 1 through 9, which drain the central and eastern project areas. Stream 1 sub-watershed also includes a section of the watershed lying on the southeastern perimeter (see Figure 8). This area is currently hydrologically connected by flows that flow in a roadside ditch along Henry Road. The existing Stream 2 sub-watershed includes Stream 2 and its tributaries and includes approximately 274 acres of the site and 37 acres of off-site area. Stream 2 drains the approximate southeast quarter of the project area south of Henry Road and east of Gulf Road. Stream 2 flows roughly south-southwesterly, and its headwaters are largely in the project area. Three tributaries (Streams 2A, 2B, and Drainage 10) flow into Stream 2 before Stream 2 drains to a coastal lagoon at the Strait of Georgia.

The Stream 2 sub-watershed also includes an area of abandoned industrial development, including two unused building foundations, abandoned stormwater conveyance pipes, and an unmaintained stormwater pond. A single family residence, hay barn, stock ponds, and a few small out-buildings are present in the southeastern portion of the Stream 2 sub-watershed.

4.1.4.2 Subbasins and Catchments

In the vicinity of the proposed development the Stream 1 and Stream 2 sub-watersheds were further subdivided into subbasins and catchments. These were delineated to facilitate the development of the hydrologic model scenarios and support the design of stormwater management facilities.

Catchments consist of areas that drain to a common discharge point. *Subbasins* are comprised of one or more catchments that drain to either a proposed stormwater pond location, or to a hydrologic POI, as described further in Section 4.1.5.1. See Figure 7 for the locations, soils, and land cover of the existing catchments. Table 2 shows the hierarchy of the catchments, subbasins, and subwatersheds.

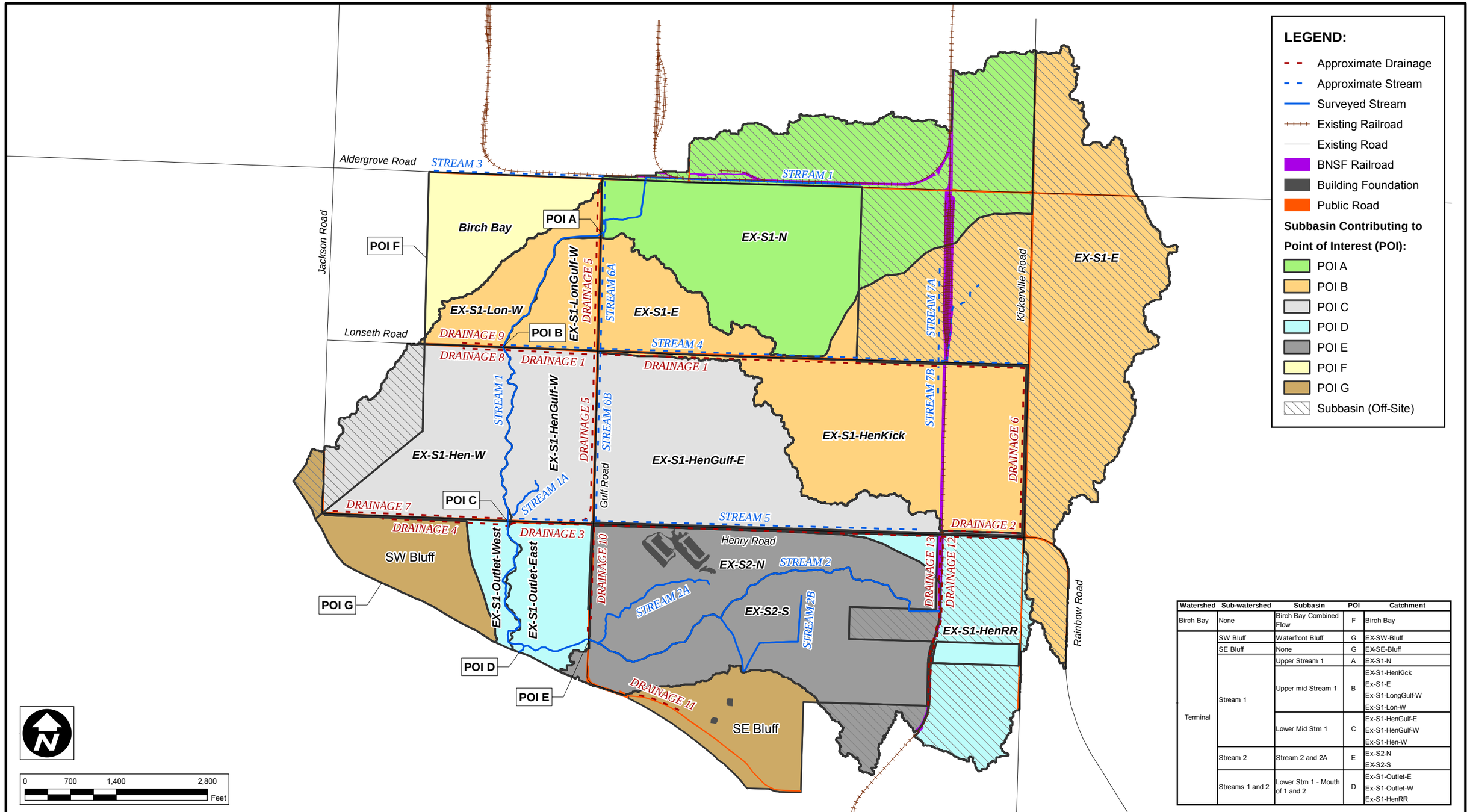
Catchments were delineated after reviewing drainage patterns for the existing conditions and for the proposed developed condition. These two scenarios were used as the basis of the catchment boundaries so that existing discharge points could be maintained to the extent practicable, and so that stormwater detention ponds could be designed and located at the low points where proposed stormwater would otherwise discharge from the project area.

Table 2 Watersheds, Subbasins, and Catchment Hierarchy for Existing Conditions

Watershed	Sub-watershed	Subbasin	POI	Catchment
Birch Bay	None	Birch Bay Combined Flow	F	Birch Bay
Terminal	SW Bluff	Waterfront Bluff	G	EX-SW-Bluff
	SE Bluff	None	G	EX-SE-Bluff
	Stream 1	Upper Stream 1	A	EX-S1-N
		Upper mid Stream 1	B	EX-S1-HenKick
				Ex-S1-E
				Ex-S1-LongGulf-W
				Ex-S1-Lon-W
		Lower Mid Stm 1	C	Ex-S1-HenGulf-E
				Ex-S1-HenGulf-W
				Ex-S1-Hen-W
	Stream 2	Stream 2 and 2A	E	Ex-S2-N
				EX-S2-S
	Streams 1 and 2	Lower Stm 1 - Mouth of 1 and 2	D	Ex-S1-Outlet-E
				Ex-S1-Outlet-W
				Ex-S1-HenRR

Separate catchments were delineated for on-site areas (owned by PI Terminals), off-site areas (typically upstream of the project with discharge flowing through the project to one of the streams discussed above), and County road right-of-way (for which stormwater runoff must be conveyed but is not subject to flow control or water quality treatment requirements unless it is vacated and within the project footprint).

Figure 7 shows the locations and soil/vegetation characteristics of the existing catchments as delineated within the entire Terminal watershed and also in that portion of Birch Bay watershed within the project area. Catchments areas were given an alpha-numeric sequence name to uniquely identify the polygon. An “EX” designator in a catchment name indicates that catchment extents are based on existing site conditions. Catchments with names that include the designator “S1” are located within the existing Stream 1 sub-watershed. Catchments with the designator “S2” are located within the existing Stream 2 sub-watershed. Catchments with “Offsite” in the catchment name contribute stormwater to either Stream 1 or Stream 2, and are located within the Terminal watershed, but outside of the project area.



Watershed	Sub-watershed	Subbasin	POI	Catchment
Birch Bay	None	Birch Bay Combined Flow	F	Birch Bay
Terminal	SW Bluff	Waterfront Bluff	G	EX-SW-Bluff
	SE Bluff	None	G	EX-SE-Bluff
	Stream 1	Upper Stream 1	A	EX-S1-N
		Upper mid Stream 1	B	EX-S1-HenKick Ex-S1-E Ex-S1-LongGulf-W Ex-S1-Lon-W
		Lower Mid Stm 1	C	Ex-S1-HenGulf-E Ex-S1-HenGulf-W Ex-S1-Hen-W
	Stream 2	Stream 2 and 2A	E	Ex-S2-N EX-S2-S
	Streams 1 and 2	Lower Stm 1 - Mouth of 1 and 2	D	Ex-S1-Outlet-E Ex-S1-Outlet-W Ex-S1-HenRR

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CHK'D BY: BT
DATUM: NAD83
PROJECTION: WA SP North, Ft.
SCALE: 1 inch = 1,400 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: EXISTING POINT OF INTEREST SUBBASINS

DATE: JUNE 2014
PROJECT NO.: 091515338C-02-04
REV. NO.: -
FIGURE NO.: FIGURE 8

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 8 - Existing Point of Interest Subbasins.mxd

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4.1.4.3 Hydrologic Features

This section describes the existing hydrologic features within the project area.

Existing Conveyances and Drainage Infrastructure

The locations of existing drainage ditches and streams are shown on Figure 3.

The existing stormwater pond and conveyances located near the abandoned building foundations south of Henry Road were likely built to provide flow control (see Figure 7 for location). Because this stormwater facility has been unmaintained for a number of years, any flow control potentially provided by this system was assumed to be minimal and we did not include this facility in the hydrologic model.

Three farm stock ponds are located north of the single family residence and farm located south of Henry Road, of which two are in the Stream 2 sub-watershed; these fill with surface runoff and groundwater, and overflow seasonally westward into the adjacent meadow areas where flows naturally disperse. The third, most southern stock pond, fills and discharges in a similar manner, except that the discharge flows southwesterly and this pond is in the Southeast Waterfront Bluff sub-watershed.

Within the main channel of Stream 2 is a man-made pond formed behind a weir and berm that span the channel. Inspection of the weir structure shows that discharge is presently over the top of the weir and berm, and the pond has been consistently full each time it has been observed by AMEC staff.

In the assessment of existing drainage patterns, some culverts were determined to be significant because they collect and concentrate flow to areas that may not have received concentrated flow in the predeveloped condition. The existing culverts that convey and directly affect the discharges from catchments at road intersections and railroad crossing locations include:

- Custer Spur rail line and Lonseth Road
- Lonseth Road and Gulf Road
- Henry Road and Gulf Road
- Aldergrove Road and Gulf Road
- Custer Spur rail line and Henry Road
- Henry Road and Kickerville Road
- Gulf Road at the Strait of Georgia.

Stream 1 and Stream 2 pass beneath roads in the project area via culverts located at:

- Aldergrove Road, where Stream 1 crosses south into the project area;
- Gulf Road, between Lonseth Road and Aldergrove Road, where Stream 1 crosses from east to west beneath Gulf Road;
- Lonseth Road, west of Gulf Road, where Stream 1 crosses from north to south beneath Lonseth Road;
- Henry Road, west of Gulf Road, where Stream 1 crosses from north to south beneath Henry Road; and
- Gulf Road, south of Henry Road, where Stream 2 crosses from east to west.

Wetlands

The presence, extent, and characteristics of existing wetlands have been described and documented in wetland reports for the project (AMEC 2008, 2011, and 2013b). Approximately 600 acres of the approximate 1,500-acre project area have been determined to be wetlands. Figure 4 shows that a number of the wetlands in the project area are bounded by roadside ditches.

Site observations of the existing wetlands have determined that within the areas mapped as wetlands, soils are saturated from October to May in most years, with drying occurring through the spring and summer months. The existing wetlands are located in pasture or forested areas. While within these wetlands generally there are small areas of surface ponding in the winter and spring, the wetlands typically lack constrained outlets that would create ponding, and they drain via shallow overland flow to streams or ditch drainages.

The only wetland areas that have the ponding depth needed to create an open water feature are the farm ponds. Thus, surface water storage within the existing wetlands is primarily within the soil matrix.

In conducting hydrologic modeling, the extent of saturated soils was assumed to correspond to the areas within wetland boundaries. Figure 7 shows saturated soils and wetlands solely for the purpose of establishing land surface conditions used in the stormwater runoff models, and may differ from the actual extent of jurisdictional wetlands considered in the permitting and environmental review processes.

Existing Storm Drain Pipe Discharge Locations

With the exception of the abandoned stormwater ponds in the Stream 2 sub-watershed, no storm drain pipe discharges currently exist in the project area. Existing roadside and agricultural drainage ditches discharge into streams.

The previously constructed storm drainage infrastructure located near the abandoned concrete foundations is not currently functional. The catch basins and manholes were installed with the tops (grates) above the surrounding unfinished grade, so the only water that is present in the pipes comes from groundwater. The pond itself is perpetually full, with the water level controlled by the overflow within the control structure. For these reasons, the abandoned existing system was not included in the hydrologic models.

4.1.5 Hydrologic and Hydrogeologic Modeling and Studies

This section discusses the development of the hydrologic models used to estimate surface runoff and size the proposed detention facilities. In addition to the modeling, hydrologic and hydrogeologic monitoring was conducted to characterize the groundwater and surface water flows in the project area. For additional details about hydrologic monitoring conducted within the project area, refer to the 2011 and 2012 Hydrologic and Hydrogeologic Investigation Reports (AMEC 2012 and 2013a). While surface water and groundwater flow data have been collected through the on-site monitoring and are available to calibrate future surface water model scenarios, these data were not used in the present development of the surface water hydrology model.

4.1.5.1 Hydrologic Points of Interest

In conducting the analyses of site hydrology, including stormwater runoff for the project area, hydrologic POIs were designated at seven locations and are designated POI A through POI G, as shown in Table 3. The total tributary areas contributing to each POI can be found in Table 4 as well as the breakdown of tributary areas found on the project property (on-site) and outside of the project area (off-site). The locations and contributing catchments for each POI are shown in Figures 7 and 8.

Note that for the POIs in Stream 1, the areas are cumulative from upstream to downstream, so that the total area tributary to POI subbasin B includes the POI A subbasin as well as the catchments that discharge to Stream 1 between POI A and POI B, and the total area tributary to POI C includes those areas tributary to POI A, POI B, and those catchments that discharge to Stream 1 between POI B and POI C. POI D includes all of the areas that are tributary to POI C and POI E, and the catchments that discharge to Stream 1 and Stream 2 between POIs C and D, and POIs E and D (POI E is upstream of POI D).

Table 3 Hydrologic Points of Interest

POI	Sub-Watershed(s)	Basin Position Within Sub-Watershed	Physical Location
A	Stream 1	Upper	Existing Gulf Road Stream 1 culvert. Existing Stream 6A discharge location to Stream 1.
B	Stream 1	Upper-Middle	Existing Lonseth Road culvert (to be removed). Existing Stream 4, Drainage 1, Drainage 8, and Drainage 9 discharge location to Stream 1.
C	Stream 1	Lower-Middle	Existing Henry Road culvert. Existing Stream 5 and Drainages 3, 4, 5, 6B, and 7 discharge locations.
D	Stream 1 & 2	Lower/Stream Outlet	Stream outlet to Strait of Georgia.
E	Stream 2	Lower	Existing Gulf Road culvert for Stream 2.
F	Birch Bay	Upper	Lowest topographic point in northwest corner of site.
G	Waterfront Bluff	not applicable	Bluffs above Strait of Georgia (unconcentrated flow and no point discharges).

POI = point of Interest

Table 4 Summary of Total Drainage Areas Contributing to Points of Interests

POI	Subbasin Description	Scenario	Total Contributing Area (acres) On-Site	Off-Site	Total
A	Upper Stream 1 Flow	Predeveloped	375.3	509.0	884.2
		Existing	170.8	199.0	369.8
		Proposed Development	210.4	567.5	777.9
B	Upper-mid Stream 1 Combined Flow	Predeveloped	475.7	509.0	984.7
		Existing	531.7	567.5	1,099.2
		Proposed Development	471.9	567.5	1,129.3
C	Lower-mid Stream 1 Combined Flow	Predeveloped	741.9	513.1	1,255.0
		Existing	907.4	610.6	1,517.9
		Proposed Development	810.2	610.6	1,420.8
D	Lower Stream 1 Combined Flow	Predeveloped	1,230.4	650.6	1,881.0
		Existing	1,282.4	746.1	2,028.5
		Proposed Development	1,287.6	744.5	2,032.1
E	Stream 2 & 2A Combined Flow	Predeveloped	346.7	135.6	482.3
		Existing	274.1	36.5	310.6
		Proposed Development	399.1	133.9	533.0
F	Birch Bay Combined Flow	Predeveloped	74.9	1.3	76.1
		Existing	74.9	1.3	76.1
		Proposed Development	74.9	1.3	76.1

Table 4 Summary of Total Drainage Areas Contributing to Points of Interests

POI	Subbasin Description	Scenario	Total Contributing Area (acres) On-Site	Off-Site	Total
G	Waterfront Bluff Combined Flow	Predeveloped	111.7	45.8	157.6
		Existing	62.1	6.8	68.8
		Proposed Development	62.1	6.8	68.8

POI = point of Interest

To evaluate effects of the project on stormwater runoff, the contributing drainage areas and the peak flow rates for each POI were evaluated and compared for three scenarios. Simulations were run for each of the scenarios described below:

- Predeveloped conditions (no roads or structures of any kind);
- Existing conditions;
- Proposed conditions with proposed Terminal land cover (with stormwater management).

Continuous hydrologic modeling using the MGSFlood software and climatic data applicable to the project area was used to simulate rainfall, runoff, and infiltration at each of the seven defined POIs from 1939 to 2097 (the standard period used in the MGSFlood software, which uses hypothetical rainfall for future dates in accordance with Ecology requirements).

The modeling results for the existing conditions are presented in this section. Results for the other scenarios are presented in Sections 4.2.5 and 5.4 of this report, which describe conditions under the other scenarios. Modeling methods and model parameters applied to the model are described in more detail in Appendix A.

4.1.5.2 Hydrologic Modeling of Existing Site Conditions

Numerical models were developed to simulate surface and groundwater within the project area. This section describes the methods and results of surface water simulation model MGSFlood and discusses the results from the separate groundwater modeling analyses.

Surface Water Modeling

Hydrologic models were developed for existing site conditions using MGSFlood software for the purpose of:

- Establishing baseline (existing) conditions for the project area to compare with the predeveloped and proposed site conditions.

- Estimating the existing flow rates at selected POIs in the project area.

Catchments were delineated for the existing conditions by using site topographic data and field reconnaissance data. Catchments were combined into subbasins, which contributed drainage to selected POIs on the project site (Figure 8).

Appendix A provides information about the modeling methods and assumptions used when preparing the hydrologic model scenarios. Table 5 summarizes the MGSflood simulated peak flow rates at each POI for the existing, post development and predevelopment scenarios.

These results indicate that in the existing scenario, flows in Stream 1 for the 2-year recurrence interval storm are estimated to be approximately 23 cubic feet per second (cfs) at POI A and go up to approximately 116 cfs at the end of Streams 1 and 2 (POI D). The 2-year storm is generally associated with stream stability and channel forming process.

Modeling results from existing and predeveloped scenarios provide quantification of estimated flows, showing road building, drainage, stream relocations, and clearing for agriculture may have altered the stream flows from predeveloped conditions. Comparing the estimated existing flow rates to the post developed flow rates predicts how flow rates may change as a result of development, as discussed in Section 5.4.3.

Groundwater Modeling

Conceptual and numerical groundwater models have been developed for the site (AMEC 2013a).

Groundwater modeling concluded that:

- Shallow groundwater flow is predominantly horizontal in the weathered Bellingham glaciomarine drift unit.
- There is downward vertical hydraulic gradient between the weathered Bellingham glaciomarine drift unit and underlying non-weathered Bellingham glaciomarine drift unit. However, downward groundwater flow into non-weathered Bellingham glaciomarine drift is expected to be minimal.
- The hydrogeologic system is characterized by high groundwater, with levels up to the ground surface during the wet period (October to May), and gradual groundwater level decline during the dry period (June to September).
- The wet period is characterized by groundwater at or near ground surface and flowing streams. The dominant hydrologic steps during the wet period are:

Table 5 Simulated Peak Flow Rates for Hydrologic Points of Interest

POI	Subbasin	Cumulative Total Contributing Area (acres) On-Site	Off-Site	Total	Scenario	Subbasin Peak Flow Rates (cfs)[1] 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	200-YR
A	Upper Stream 1 Combined Flow	375	509	884	Predeveloped	53	80	99	126	158	180	212
		171	199	370	Existing	23	35	44	54	67	75	93
		210	568	778	Post-Dev	49	75	94	118	141	157	192
B	Upper-Mid Stream 1 Combined Flow	476	509	985	Predeveloped	60	91	112	145	180	205	240
		532	568	1,099	Existing	75	114	140	171	217	246	295
		472	568	1,129	Post-Dev	70	106	130	163	200	224	269
C	Lower-Mid Stream 1 Combined Flow	742	513	1,255	Predeveloped	75	113	139	178	223	253	299
		907	611	1,518	Existing	95	146	180	223	279	316	384
		810	611	1421	Post-Dev	85	130	161	205	246	274	330
D	End of Streams 1 & 2 Combined Flow	1,230	651	1,881	Predeveloped	99	150	186	241	296	338	411
		1,282	746	2,029	Existing	116	181	227	283	345	391	486
		1,288	745	2032	Post-Dev [2]	112	173	218	279	327	365	449
E	Stream 2 Combined Flow	347	136	482	Predeveloped	18	29	36	50	56	64	86
		274	37	311	Existing	12	19	26	32	37	43	59
		399	134	533	Post-Dev	23	37	49	61	70	78	102
F	Birch Bay Combined Flow	75	1	76	Predeveloped	5	7	9	12	14	16	19
		75	1	76	Existing	75	1	76	75	1	76	75
		75	1	76	Post-Dev	75	1	76	75	1	76	75
G	Waterfront Bluff Combined Flow	112	46	158	Predeveloped	6	10	13	17	19	22	29
		62	7	69	Existing	3	5	6	8	9	10	14
		62	7	69	Post-Dev	3	5	6	8	9	10	14

1. Subbasin peak flow rates for different storm recurrence intervals simulated using MGSFlood software as described in text and in Appendix A.
2. The total area at the outfall (POI D) differs between existing and developed conditions because of how areas for subbasins adjacent to the shoreline were measured between earlier modeling of existing conditions and current modeling of proposed developed conditions; specific areas affected are the marine shoreline and the westernmost off-site areas that drain to Stream 1.
cfs=cubic feet per second
POI = Point of Interest
YR=years

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- Soil becomes saturated to the surface as groundwater elevation rises and surface runoff rates are low;
- Groundwater discharges to streams and drainages; and
- Surface runoff increases with continued precipitation, and precipitation more frequently becomes surface runoff and is collected by the streams and drainage ditches.

- The dry period is characterized by groundwater levels below the ground surface and mostly dry stream beds and drainages. The dominant hydrologic process is the removal of groundwater by evapotranspiration during the drying leg of the hydrologic curve. The type and density of vegetation appear to have an effect on the amount of evapotranspiration and the rate of groundwater level drop during the dry period.

Based on the modeling and site observations, groundwater contributes to surface water flows during the times of the year when significant rainfall events occur.

While the MGSFlood model that was used here to predict surface flows from the existing site takes into account shallow groundwater flow ("interflow"), the standard settings used in MGSFlood, such as model parameters for interflow and groundwater, are based on regional calibrations for typical Puget Sound basin soil types, and site-specific calibration of the groundwater portion of the MGSFlood models have not yet been performed.

4.2 Predeveloped Conditions

Ecology (2012) specifies criteria for controlling the hydrologic impacts of development and requires that stormwater management practices, including engineered flow control facilities, are to be implemented such that discharge from the developed site mimics discharge from the predeveloped site for those project areas where the proposed land cover is changed from the existing conditions. Section 6.1.1.2 details Ecology's flow control requirements. To understand what stormwater management practices may be necessary, predeveloped site conditions were evaluated. This section discusses the evaluation of predeveloped conditions.

While the Ecology requirement is to use the predeveloped land cover of a project site as the hydrologic basis to be achieved by flow control facilities, this is more restrictive than the criteria used by Whatcom County. Whatcom County uses peak runoff rates from the existing land cover as the performance standard for flow control facilities. By designing proposed flow control facilities to achieve the predeveloped hydrology ,peak flow rates and flow durations will be lower than for the existing hydrology, thus exceeding the Whatcom County performance standards .

Ecology defines the predevelopment site condition to be:

The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed conditions shall be assumed to be forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement (Ecology 2012).

4.2.1 Vegetation and Land Cover

The predeveloped vegetation of the propose project area was assumed to be forest growing in glacial till soils in upland or wetlands. This assumption is based on the Ecology requirement that predeveloped sites are considered to be forested unless it can be documented that another land cover was present. A map of the assumed predevelopment land cover is shown on Figure 9 .

4.2.2 Topography and Soils

Please see discussion in Section 4.1.2. for topography and soils details and Section 4.1.3 for a discussion of precipitation data and calculation of the storm recurrence interval. Predeveloped watershed, sub-watershed, and subbasin extents were estimated based on topographic information and our best professional judgment of the probable effects that construction of the existing infrastructure (e.g., public roads, drainage ditches, and other residential and agricultural improvements) had on the topography of the predevelopment landscape. Soil conditions were assumed to be the same as existing conditions.

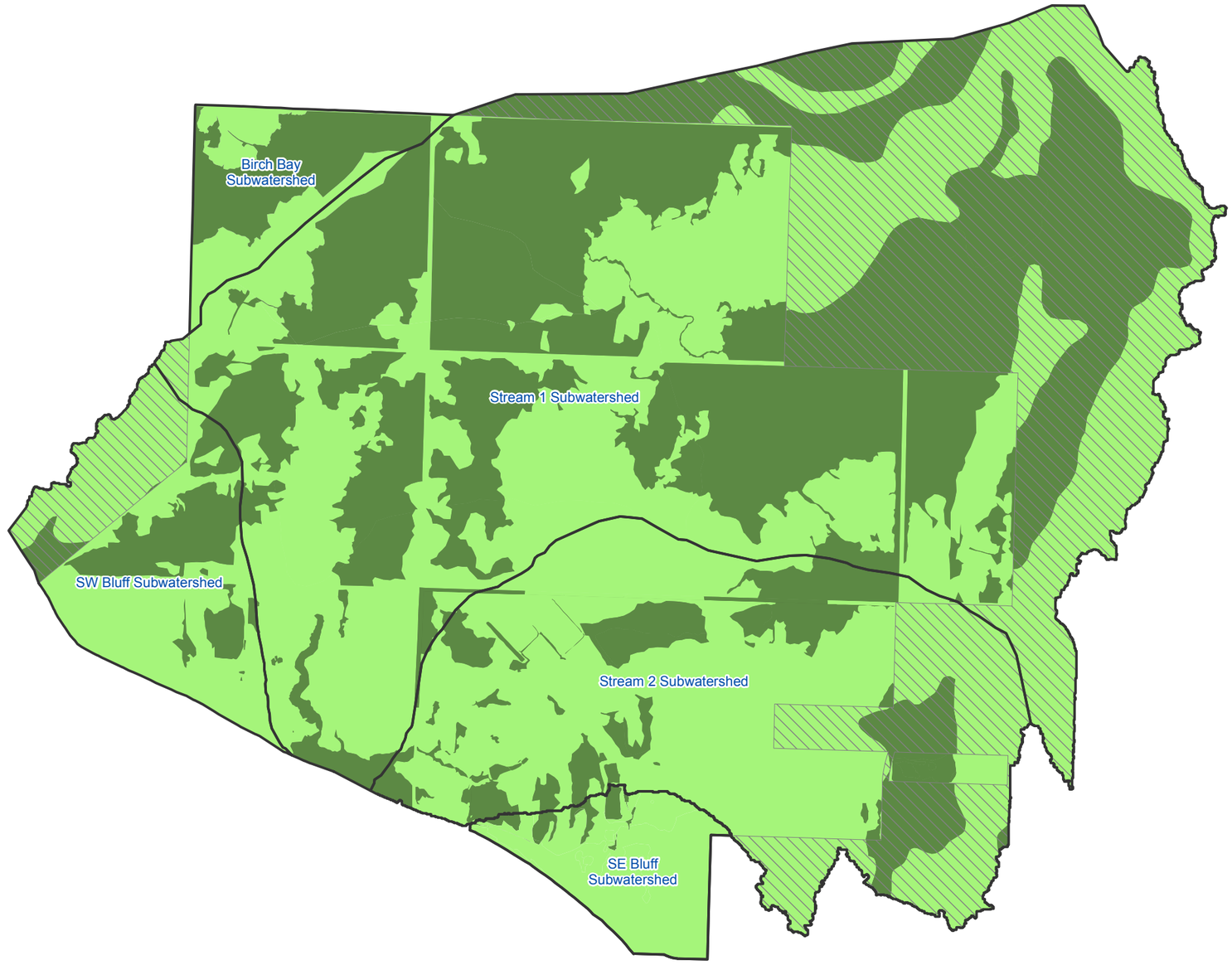
4.2.3 Hydrology and Drainage

This section presents an overview of the predevelopment hydrologic conditions that most likely existed in the project area.

4.2.3.1 Watersheds, Sub-Watersheds, and Subbasins

Figure 9 shows the likely predevelopment soils and land covers within the Terminal Watershed and portion of site in the Birch Bay Watershed, sub-watersheds for Stream 1, Stream 2, and the Waterfront Bluffs that extend beyond the project area boundary, including off-site areas that potentially contribute runoff to the project area.

Figure 10 shows the assumed predevelopment boundaries for subbasin areas that would have contributed to the seven hydrologic POIs considered in the stormwater analysis. The total contributing land area for each of these subbasins was previously shown in Table 4.



LEGEND:

- Sub-Watershed Basin
- Sub-Watershed Basin (Off-Site)
- Wetlands/Forest
- Till/Forest

NOTE: On-site wetland boundaries delineated in the field by AMEC staff (2006-2012)
Off-site wetland boundaries obtained from U.S. Department of Agriculture (not field verified):
http://SoilDataMart.nrcs.usda.gov

0 700 1,400 2,800 Feet

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DWN BY: SD
CHK'D BY: BT
DATUM: NAD83
PROJECTION: WA SP North, Ft.
SCALE: 1 inch = 1,400 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PREDEVELOPED SUB-WATERSHED BASINS AND LAND COVER

DATE: JUNE 2014
PROJECT NO.: 091515338C-02-04
REV. NO.: -
FIGURE NO.: FIGURE 9

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 9 - Predeveloped Sub-Watershed Basins and Land Cover.mxd

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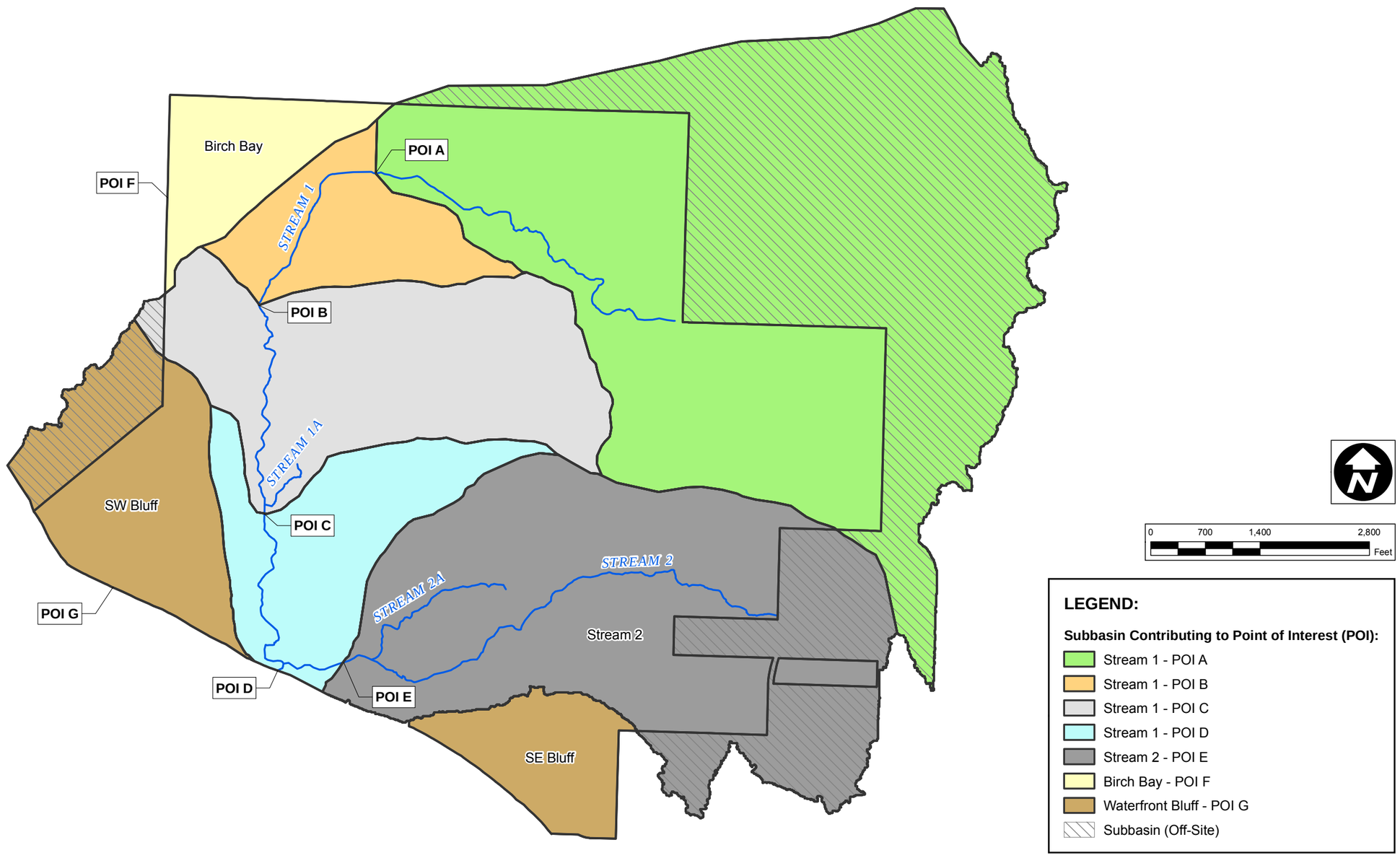

NOTE: Streams shown are at existing locations.

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PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PREDEVELOPED POINT OF INTEREST SUBBASINS

DATE: JUNE 2014
PROJECT NO.: 091515338C-02-04
REV. NO.: -
FIGURE NO.: FIGURE 10

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 10 - Predeveloped Point of Interest Subbasins.mxd

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4.2.3.2 Predeveloped Hydrologic Features

The predevelopment flow patterns within the project area were determined using topographic information, site observations, historical aerial photos, and professional judgment. The hydrologic features identified from this analysis are described in this section.

The predeveloped wetland extents and locations are assumed to be the same as those described for the existing conditions.

The predeveloped alignments of Stream 1, Stream 2, and Stream 2A are assumed to resemble the existing stream alignments, with the exception of the upper extents of Stream 1, where topographical evidence of a remnant channel has been observed. The remnant channel is located in the area currently bounded by Aldergrove Road, Lonseth Road, Gulf Road, and Kickerville Road. The assumption was made that Stream 1 would have followed this channel in the predevelopment scenario.

The other existing streams and drainages in the project area are roadside ditches that have been created as a result of site development. The topography of the project area indicates these streams intercept runoff that is no longer able to discharge directly into Stream 1, 2, or 2A. Therefore, it is assumed that none of these surface flows existed during predeveloped conditions.

4.2.4 Hydrologic Modeling

Numerical models were developed to simulate surface water flow within the project area under predeveloped conditions, as was done for the existing conditions (Section 4.1.5). This section describes the methods and results of surface water and groundwater modeling conducted to simulate hydrologic conditions under predevelopment conditions.

4.2.4.1 Surface Water Modeling

Hydrologic models were developed using MGSFlood software, as described in Appendix A, for predeveloped site conditions. The purposes of the modeling were to:

- Establish baseline conditions in the project area for comparison to the existing and proposed site conditions; and
- Identify the historic drainage patterns and flow rates at POIs in the project area.

The numerical modeling for the predeveloped conditions was conducted assuming the following:

- Land cover was assumed to be entirely forested.
- The predeveloped soil types were assumed to be the same as existing soil types.

- Wetland flow attenuation and surface water storage within existing wetlands were not included in this preliminary modeling due to there not being a standard approach to model sloped wetlands that do not have standing water.

A summary of the peak flow rates at each POI was previously shown in Table 5. Table 5 also shows the total contributing area in acres for each POI.

In examining the results of this analysis, it is clear that construction of roadways and roadside ditches in the past resulted in rerouting of some flows, thus contributing areas to POI that are different in the predeveloped and existing conditions. It appears that approximately 884 acres likely contributed surface runoff to POI A before Lonseth Road was constructed. However, following construction of roadways, the contributing area is approximately 370 acres. The flows currently in Drainage 1 and Stream 4 (Figure 8) served to capture flow from the catchment contributing to POI A and route it to the POI B. Our modeling estimated this alteration would have reduced the 2-year flow in Stream 1 between POI A and POI B by approximately 30 cfs from the predeveloped condition.

Table 5 also shows that the existing flows in the middle and lower reaches of Stream 1 (represented by POI B, POI C, and POI D) likely increased above predeveloped flow rates by as much as 20 cfs for the 2-year storm event as a result of construction of roads and roadside ditches.

4.2.4.2 Groundwater

The groundwater hydrology of the predeveloped site was likely similar to the existing conditions, because groundwater movement and perching of groundwater is controlled by the geologic deposits that underlie this site, as well as the precipitation patterns. Past construction of roadside ditches could have lowered the water table and reduced the amount of saturated soils in some areas, and raised the water table in other areas where roadfill obstructed drainage paths; there is insufficient evidence to know with certainty how the land use changes from predeveloped to existing conditions would have affected groundwater movement, the depth to the groundwater table, and the extent of seasonally saturated soils. For this study the extent of saturated soils (which is caused by the high water table) was assumed to be the same between predeveloped and existing conditions. The MGSFlood model does not distinguish vegetation types in areas of saturated soils, and the effect of past vegetation change has not been quantified.

5.0 STORMWATER EVALUATION FOR PROPOSED CONDITIONS

This section describes elements of the proposed project that are important with regard to evaluating possible effects on hydrology and options for stormwater management. The proposed project footprint is illustrated on Figure 2; the extent of earth disturbance and new construction within the project area is shown on Figure 11, together with existing topographic and drainage features.

5.1 Anticipated Construction Activities

The project is currently undergoing an environmental review and permitting process and has not yet reached the phase for final engineering design and construction specifications. This section presents a general summary of the anticipated construction activities.

5.1.1 Land Clearing

Prior to the initiation of any land clearing, appropriate sedimentation control and other water quantity and quality controls would be installed in approved locations to protect adjacent and downstream resources.

Excavation would likely be performed using mechanical excavators within delimited construction areas within the project area. Where possible, the excavated materials would be reused on site as fill. Construction staging, stockpiling, and materials laydown is anticipated to occur within the bounds of the rail loops in locations that would ultimately function as part of the commodity-handling infrastructure.

Within the construction footprint, vegetation would be cleared, topsoil and organic material would be removed, and the soil surface would be graded, compacted, and in some locations, preloaded with fill. Figure 11 identifies the approximate areas of cut and fill based on the current proposed design. Where practicable, rough grading for stormwater management ponds located downgradient of major grading areas would occur early in the sequence of construction. In this way the ponds could be used for temporary construction stormwater treatment facilities.

Existing topsoil and organic material present within areas of excavation would be stockpiled and stored during rough grading. Ecology (2012) requires that soil amendment be blended into disturbed pervious areas of a site. If possible, this material stockpiled during clearing would be managed as appropriate (composted or stored), distributed over pervious vegetated areas or integrated into the upper soil layers as a soil amendment during final grading to improve soil quality and enhance the capacity to absorb rainwater relative to the native, unamended subsurface soils. If it is not practical to stockpile existing on-site material, imported compost or other organic material may be used to amend soils.

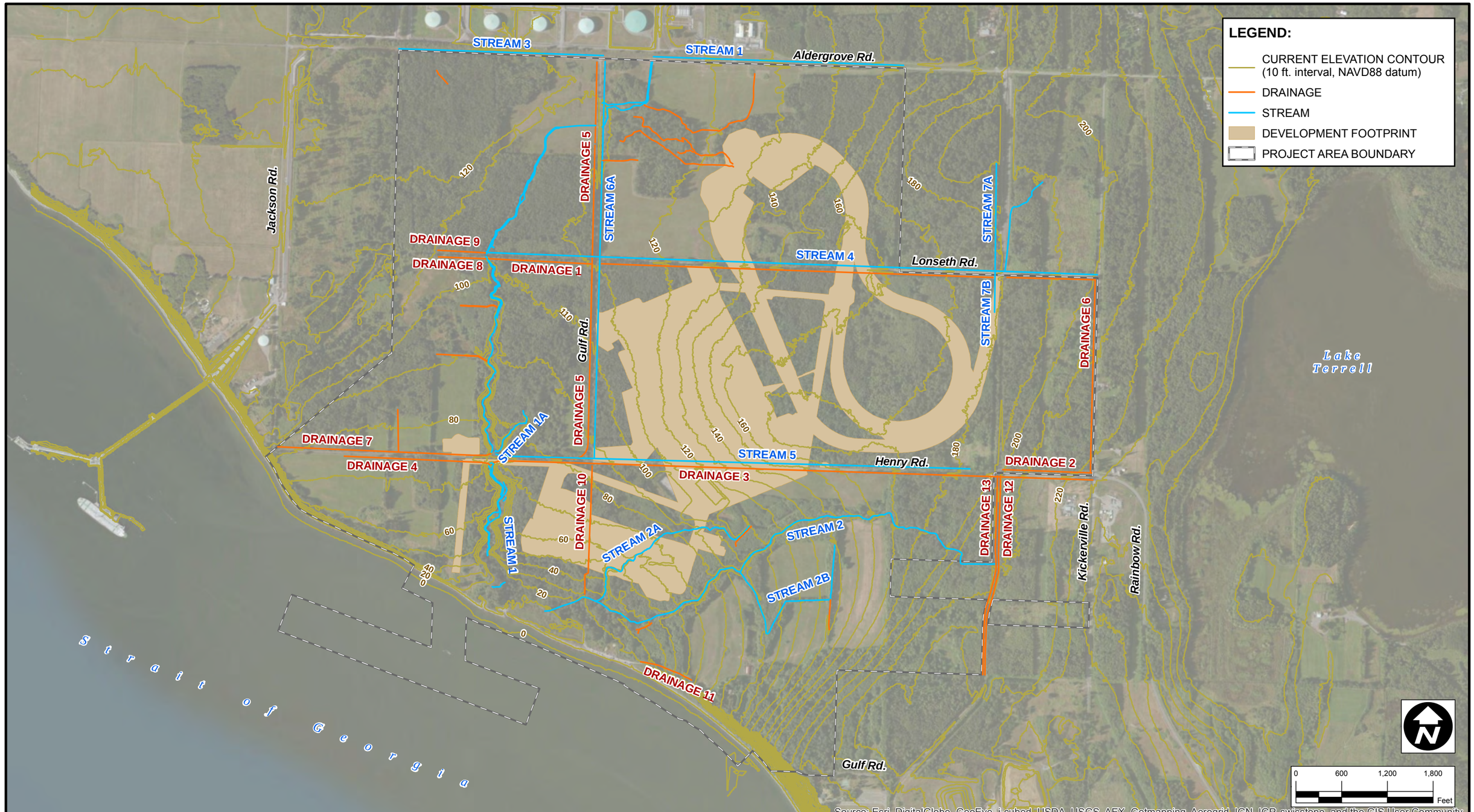
5.1.2 Construction Stormwater Management

Stormwater runoff during the construction phase would be managed to protect water quality in accordance with approved erosion and sedimentation control plans. Because the area of earth disturbance exceeds 1 acre, a Construction Stormwater Pollution Prevention Plan (SWPPP) would be required as part of the National Pollutant Discharge Elimination System (NPDES) permit. Discharges would meet the requirements for construction stormwater discharges under the Washington State NPDES requirements. Refer to Section 6.1.2 for additional information.

Stormwater BMPs would be employed and facilities would be built to protect water quality during the construction phase in accordance with Ecology's *Stormwater Management Manual for Western Washington* (the Ecology stormwater manual) (Ecology 2012) and Whatcom County requirements. Installation of the stormwater management system would be the first step in construction and would be completed before other bulk earthwork activities were initiated at the Terminal.

Stormwater sediment-trapping basins would be implemented during construction. Prior to construction, perimeter sediment-controlling geotextile fabric fences would be installed. The stormwater management basins would be excavated and would act primarily as the sediment trapping basin with internal finger dikes and orifice flow control outlets. The project's main construction drainage ditches, with erosion-resistant linings, would then be constructed to drain to the sediment trapping basins.

Basins used to trap sediment rely on gravity to settle particles from the water. Smaller particles take longer to settle, and require larger facilities. Because fine-grained soils, such as clays, underlie portions of the site, traditional settling ponds may not be able to meet the discharge standard for turbidity without additional treatment. If this occurs, treatment using flocculants or electrocoagulation may be considered to reduce the turbidity of construction runoff to allowable levels. Provisions would be incorporated into the construction documents so that an approved treatment system can be implemented if needed. It is anticipated that treatment systems would be designed to fit within the areas of the various stormwater ponds that are proposed. Specifically, it is anticipated that Stormwater Ponds (SWM Ponds) 1, 7, 9, 10, and 11 would be preferred locations to settle and treat construction stormwater runoff.



Source:
Current Elevation Contours data derived from National Elevation Dataset product:
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PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,200 feet

PROJECT:
GATEWAY PACIFIC TERMINAL

TITLE:
PROPOSED GRADING FOOTPRINT WITH EXISTING STREAM NETWORK

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 11

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Site preparation, including earthmoving, cutting, and filling activities, would be performed in a manner to minimize and manage stormwater runoff. Interim exposed disturbed areas would be stabilized with mulch or plastic covering, and permanent exposed cut surfaces would be vegetated as soon as practicable, including those portions of the ditches that do not require smooth hard surfaces to prevent erosion. Water trucks would routinely sprinkle dust-suppressing water spray over the site until disturbed soils are treated with mulch and revegetated. Spill-containment measures would be constructed and maintained around chemical and oil storage areas and equipment fueling areas, to supplement drip trays and other spill control practices during construction. Additional pollution control BMPs would be implemented as required to comply with local and state requirements and permit conditions.

5.2 Anticipated Site Water Use and Non-stormwater Discharges

Once the facility is operational, water would be used for health and sanitation facilities, fire suppression systems, cleaning and washdown, and dust suppression. Water may be needed for temporary irrigation following construction to establish vegetation in cleared areas and stormwater ponds. Some of the water used on site would be discharged after use, as described below. Industrial water would be supplied to the Terminal from the local public utility district.

5.2.1 Process Water

Future operations on the Terminal would require the use of water and would result in the generation of process wastewater. Process wastewater would be managed and treated separately from stormwater in accordance with Ecology and Whatcom County requirements.

Process water would be used and collected during the following facility operations:

- ***Dust suppression:*** Outdoor stockpiles would be misted during summer months to reduce airborne dust and risk of combustion. Sensors would be used to prevent over-misting. Surface runoff due to misting is not anticipated, but could occur occasionally and any runoff would be collected in sediment ponds. The source of this water is anticipated to be mainly industrial water.
- ***Materials exposed to rainfall:*** Open storage areas would receive direct rainfall. Based on other similar terminal facilities, surface runoff is not expected; nonetheless, if and when runoff would occur from the open storage area, it would be managed as process wastewater. Several sediment ponds have been located within the open storage area to collect and treat this wastewater. The source of this water is precipitation. Treated water from these ponds would be discharged to the watershed.

- ***Railcar wash:*** Railcar wash stations would be used to remove dust from railcars following unloading. The wash stations incorporate containment and a cleanout sump. The source of water would be industrial water. The wash wastewater would be collected, sediment would be removed, and the water would be recycled.
- ***Transfer tower washdown:*** At the transfer towers, where materials are transferred between conveyors, industrial water would be used to periodically to wash down accumulated dust and reduce risk of spontaneous combustion. In addition, transfer towers contain dry fogging systems to suppress dust generation. The source of water would be industrial water. Each transfer tower foundation includes a containment area and cleanout sump. The washdown water would be collected, sediment would be settled and removed, and the water would be recycled. This system would be independent of the site stormwater system and there would be no discharges to the stormwater system or surface waters.
- ***Berth washdown:*** Vessel berth areas would be washed down very infrequently. This water would not be collected. The source of this water would be industrial water.
- ***Shiploader washdown***: Each shiploader has a location on the wharf for lockdown and maintainance. This location has containment for water, and waters collected here would be piped to an onshore facility, treated and released to the watershed. The source of water would be stormwater and industrial water.

Table 6 shows the anticipated uses of process water and generation rates for process wastewater. It is anticipated that there would be discharges of treated process wastewater to stormwater management facilities, and ultimately process water would be released to on-site surface water bodies under NPDES discharge standards. No direct marine discharges are included in the project design, except for the occasional washdown water at the wharf.

It is anticipated that the facility would employ the following process water treatment practices:

- Fogging process water from transfer towers, if any, would be allowed to settle in sumps prior to being pumped to process water treatment ponds. All sumps are accessible by vehicle, and the sludge would be removed by front-end loaders or vactor trucks and recycled into stockpiles; and
- Process wastewater from coal storage areas would be collected and routed to sediment ponds. These ponds are designed to settle out coal and dust particles, and are designed to address 0.001-inch-diameter coal particles with a density of 87.4 pounds per cubic foot.

Table 6 Process and Sanitary Wastewater Summary

Type of Wastewater	Type of Discharge	Process	Maximum daily usage (gallons)	Estimated annual discharge (gallons)	Treatment	Comment
Sanitary	Continuous	Toilets, Showers, Sinks	8,000	2,922,000	On-site wastewater treatment plants	Wastewater treatment plants will be located at the Longshore Building and the Administrative/Maintenance Buildings.
Process	Continuous	Dust Suppression	360,000	15,000	Sediment Ponds	Assume applied 5 months/year, with 10% runoff forming
Process	Batch	Railcar Wash Stations	48,000	1,461,000	Sediment Ponds	Assume 2 hrs/day at two locations
Process	Batch	Transfer Tower Washdown	72,000	2,192,000	Sediment Ponds	Assume 6 hrs/day (total for site)
Process	Batch (rare)	Berth Washdown	100,000	200,000	none	Assume twice/year, not captured for treatment

The drawings in Appendix B show the sediment ponds. These are located upstream of Stormwater management (SWM) Pond 1. The discharge from the sediment facilities would be directed to this stormwater pond so that runoff from the uncovered storage area would be detained to meet the flow control standards for the site.

Discharge from the sediment ponds would be monitored to ensure discharge standards and permit benchmarks are met. Shut-off valves would be used to prevent discharge from the process water treatment ponds in the event that additional treatment is required to meet discharge standards and permit benchmarks.

5.2.2 Wastewater

Sanitary wastewater would be generated during day-to-day operation of the terminal facility. Once fully developed, the daily population for the site is anticipated to be 88 people over three work shifts and up to approximately 8,000 gallons per day of sanitary wastewater would be produced from showers, toilets, and faucets. Three buildings at the Terminal would have sanitary facilities that generate sanitary wastewater (the Administration Building, Maintenance Buildings, and Longshore building), which would be treated in two on-site wastewater treatment facilities.

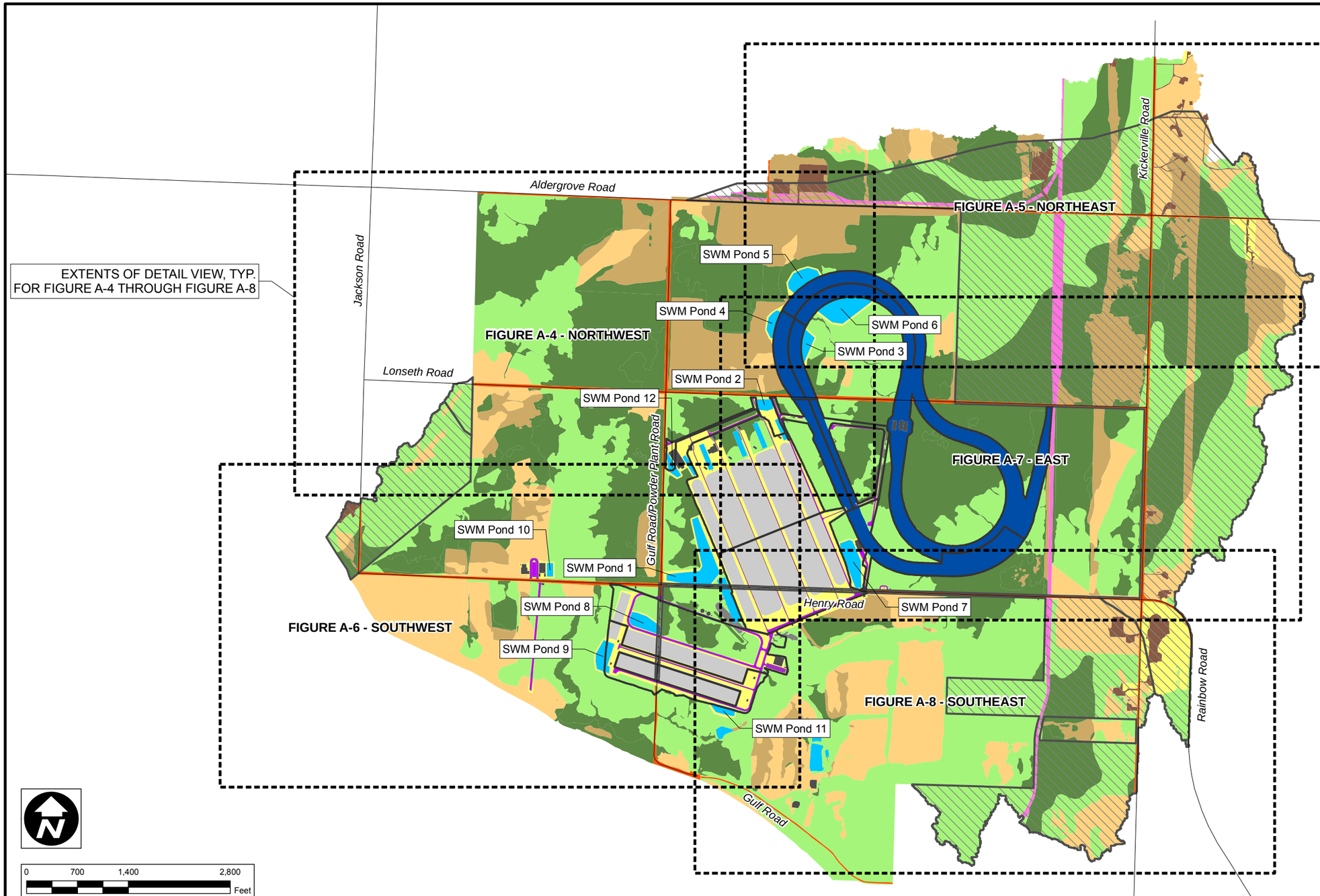
The wastewater treatment facilities would each have a 10,000-gallon tank (4,000 gallons for settling and 6,000 gallons for flow equalization) to collect and temporarily store wastewater before the wastewater is pumped into a 12,000-gallon tank. This second tank would be equipped with a proprietary treatment system, which would treat the sanitary wastewater to achieve Washington State discharge standards for biological oxygen demand, total suspended solids, and nitrogen. The exact discharge location for these treatment systems has not been identified; however, it is anticipated that once sanitary wastewater has been treated to meet state discharge standards, this water would be mixed with treated stormwater and discharged or infiltrated. Details of the sanitary wastewater system would be identified in future design documents. Table 6 shows the anticipated sanitary wastewater generation rate for the Terminal.

5.3 Proposed Hydrology and Drainage

Construction of the Terminal and the associated stormwater management system would create a revised hydrologic regime. This section describes the proposed hydrologic and drainage conditions based on the preliminary civil site design and the preliminary stormwater management design.

For this study, the preliminary site civil design was first analyzed to identify locations where stormwater would be collected and discharged, to identify where low-impact development practices could be applied, and to characterize the proposed land covers for tabulation and input into the hydrologic model. Following this, several iterations of proposed stormwater management facilities were considered to develop the preliminary stormwater design and to size stormwater facilities to meet stormwater flow control and treatment requirements. The draft conceptual stormwater management plan is described in Section 6.0. Preliminary Stormwater Drainage Plan drawings are presented in Appendix B.

The proposed site hydrologic conditions are described in this section and illustrated on Figure 12. Additional figures are provided in Appendix A that show each proposed catchment area and the land cover/soil complexes used in the hydrologic model. Figure 13 shows where stormwater management facilities would be constructed, and the subbasins that drain to each proposed facility. Figure 14 shows the proposed subbasins tributary to the hydrologic POIs. A list of the resulting sub-basins and catchments is presented in Table 7. See also Table 3, which listed the total areas contributing drainage at the seven POIs for the predeveloped, existing, and proposed conditions. In the figures, the “PR” designator in the catchment names indicates that catchment extents are based on proposed site conditions. Catchments with names that include the designator “S1” are located within the Stream 1 sub-watershed. Catchments with the designator “S2” are located within the Stream 2 sub-watershed. Those with “Offsite” in the catchment name contribute stormwater to either Stream 1 or Stream 2 in the watershed, but are outside the project area. Table 8 shows the hierarchy of the proposed catchments, subbasins, and subwatersheds.



LEGEND:

- Proposed Drainage Catchment
- EX-S1-E Drainage Catchment ID
- Proposed Drainage Catchment (Off-Site)

Impervious:

- Existing Road
- Building
- Gravel
- Stockpile
- Impervious Area (Private)
- Private Railroad (BNSF)
- Private Railroad (Terminal)
- Private Road (Terminal)
- Public Road
- Open Water

Saturated:

- WetlandForest
- Wetland/Pasture

Till:

- Till/Forest
- Till/Pasture
- Till/Landscape

NOTE: A preliminary list of stormwater management ponds and associated catchments and subbasins is presented in Table 9, along with a summary of key characteristics. Detailed catchment maps are provided in Appendix A.

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SCALE:	1 inch = 1,400 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PRELIMINARY PROPOSED CATCHMENTS KEY PLAN

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 12

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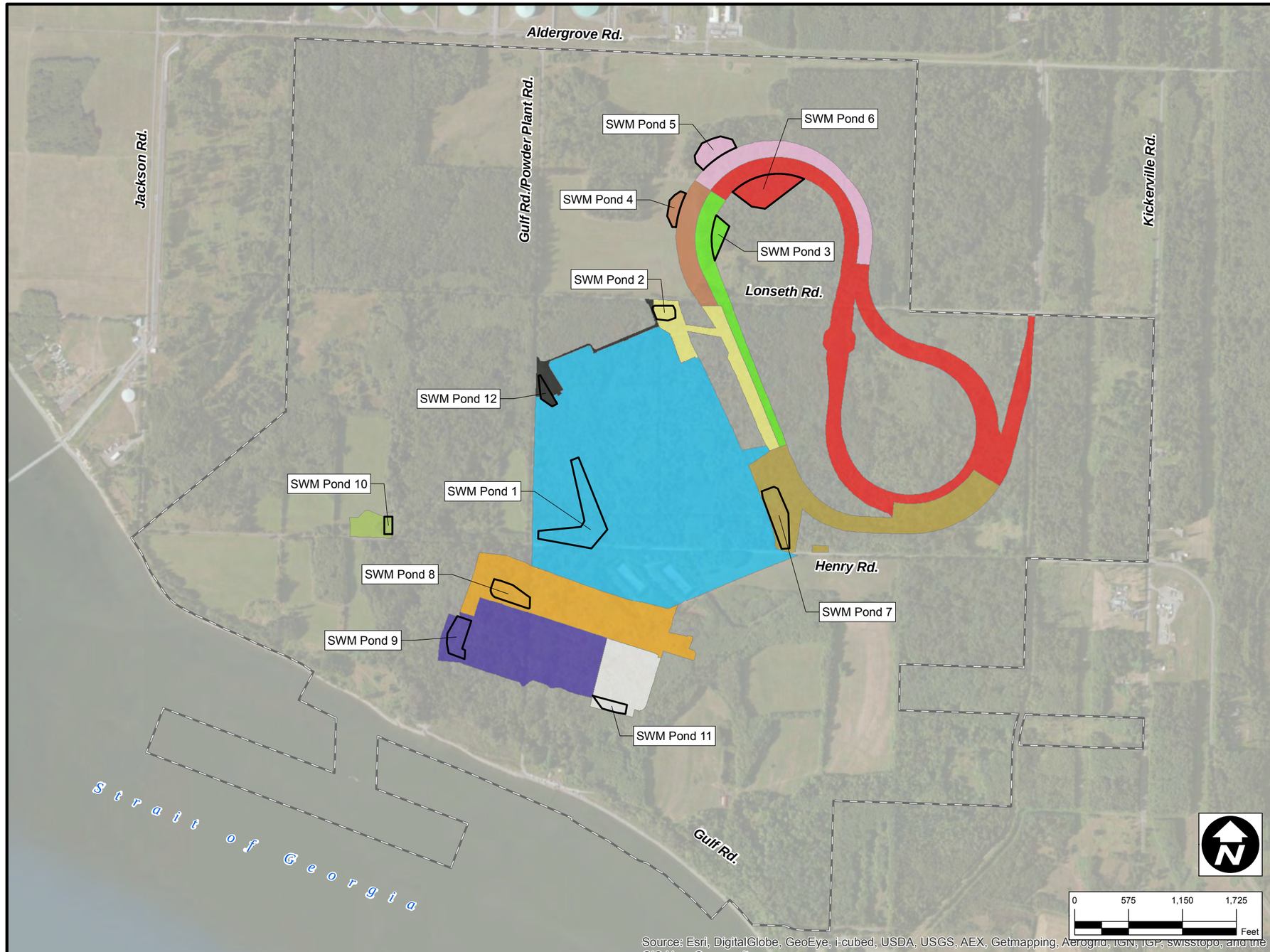

LEGEND:

- PROJECT AREA BOUNDARY
- PROPOSED STORMWATER POND

STORMWATER FACILITY TRIBUTARY SUBBASINS:

- SWM POND 1
- SWM POND 2
- SWM POND 3
- SWM POND 4
- SWM POND 5
- SWM POND 6
- SWM POND 7
- SWM POND 8
- SWM POND 9
- SWM POND 10
- SWM POND 11
- SWM POND 12

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PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,150 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER FACILITIES AND SUBBASIN AREAS

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 13

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 13 - Proposed Stormwater Facilities and Subbasin Areas.mxd

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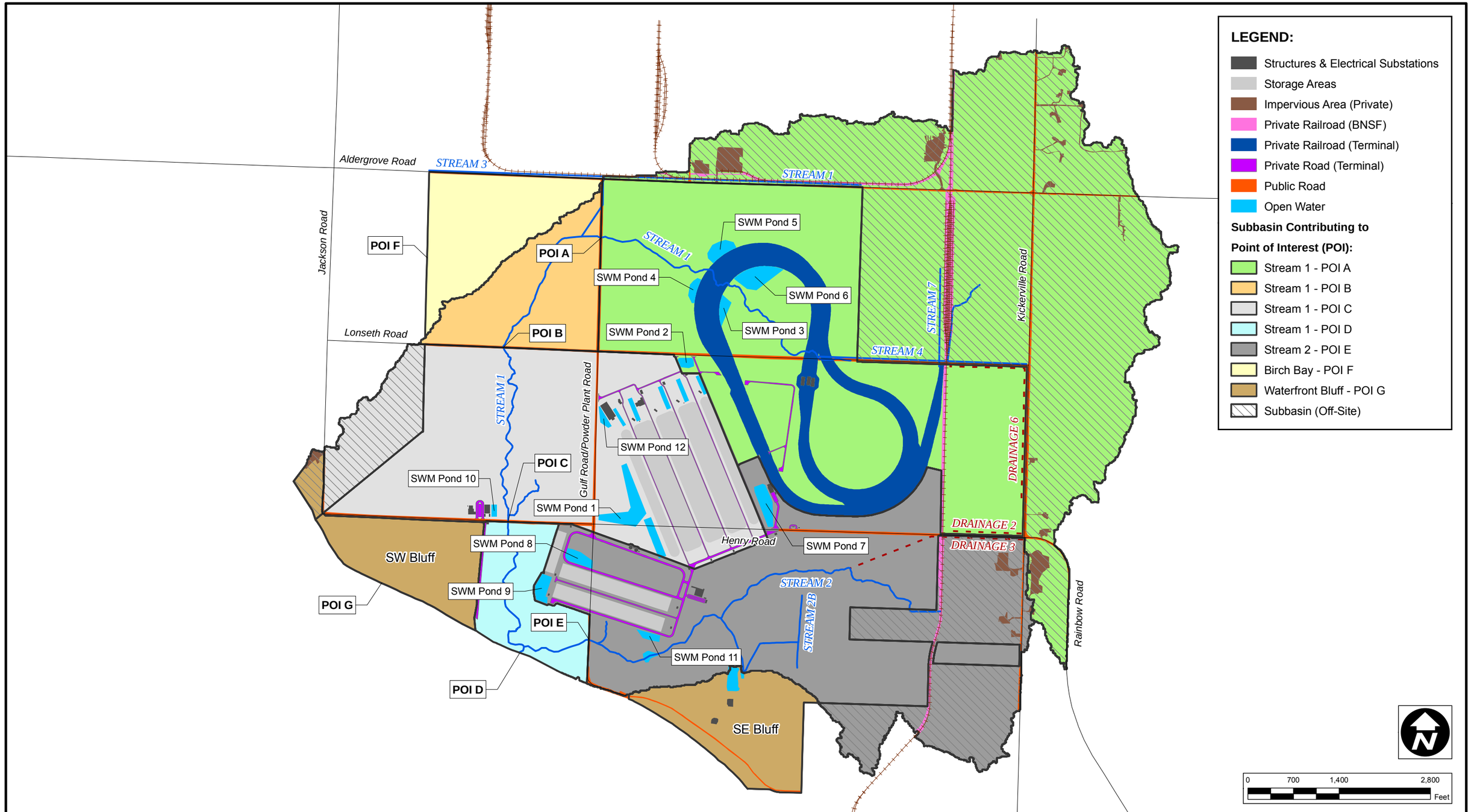

Pacific International Terminals.
A Carrix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,400 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: POINT OF INTEREST SUBBASINS

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE 14

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure 14 - Point of Interest Subbasins.mxd

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Table 7 List of Proposed Subbasins and Catchments

Subbasin Description	Catchments[1]	Stormwater Pond Name[2]
Open Storage Area	P1-N P1-S P1-W	SWM POND 1
West Railbed	B1 P-11	SWM POND 2
Interior West Railbed	B2 C2	SWM POND 3
Northwest Railbed	C1	SWM POND 4
North Railbed	D	SWM POND 5
East & Central Railbed	E	SWM POND 6
South Railbed	F P-14	SWM POND 7
North Closed Storage	P2-N	SWM POND 8
Southwest Closed Storage	P2-SW	SWM POND 9
Longshore Building	P-10	SWM POND 10
Southeast Closed Storage	P2-SE	SWM POND 11
Main Substation	A	SWM POND 12
SW Road to Trestle	Ex-Bluff Ex-S1-Outlet West	Flow dispersion[3]
Offshore – Trestle and Wharf	—	BMPs[4]

1. Refer to Appendix A for proposed catchment locations.
2. Refer to Figure 14 for proposed stormwater facilities and subbasin areas.
3. Flow dispersion to provide flow control and treatment for the new road between Henry Road and the trestle.
4. Drain inlet BMPs would be used to provide stormwater quality treatment for the trestle and wharf prior to discharge.

Table 8 Watersheds, Subbasins, and Catchment Hierarchy for Proposed Conditions

Watershed	Sub-watershed	Subbasin	POI	Catchments without flow control	Catchments draining to flow control facilities	Upstream Contributing POI subbasins
Birch Bay	None	Birch Bay Combined Flow	F	Birch Bay	—	—
Terminal	SW Bluff	Waterfront Bluff	G	EX-SW-Bluff	see note 1	—
	SE Bluff	None		EX-SE-Bluff	—	—
	Stream 1	Upper Stream 1 (undetained areas)	A	P-12	—	—
				P-13	—	
				P-15	—	
				P-16	—	
				P-18	—	
				P-21	—	
				P-23	—	
		SWM Pond 3	A	—	B2	
				—	C2	
		SWM Pond 4	A	—	C1	
		SWM Pond 5	A	—	D	
		SWM Pond 6	A	—	E	
		Upper mid Stream 1 (undetained areas)	B	Ex-S1-LongGulf-W	—	A
				Ex-S1-Lon-W	—	
		SWM Pond 2	B	—	B1	
				—	P-11	
		Lower Mid Stm 1 (undetained areas)	C	EX-S1-HenGulf-w	—	A, B
				P-19	—	
				P-20	—	
				P-26	—	
		SWM Pond 1	C	—	P1-N	
				—	P1-S	

Table 8 Watersheds, Subbasins, and Catchment Hierarchy for Proposed Conditions

Watershed	Sub-watershed	Subbasin	POI	Catchments without flow control	Catchments draining to flow control facilities	Upstream Contributing POI subbasins
				—	P1-W	
		SWM Pond 10	C	—	P-10	
		SWM Pond 12	C	—	A	
	Stream 2	Stream 2 and 2A (undetained areas)	E	EX-S1-HenGulf-E	—	—
				EX-S1-HenRR	—	
				EX-S2-S	—	
				P-17	—	
				P-24	—	
				P-25	—	
		SWM Pond 7	E	—	F	
				—	P-14	
		SWM Pond 8	E	—	P2-N	
		SWM Pond 9	E	—	P2-SW	
		SWM Pond 11	E	—	P2-SE	
	Streams 1 and 2	Lower Stm 1—Mouth of 1 and 2	D	Ex-S1-Outlet-E	—	A, B, C, E
				P-27	—	

1. Dispersion is proposed in lieu of flow control facility.

5.3.1 Proposed Watersheds and Subbasins

The proposed site grading and construction of the Terminal infrastructure would change land cover and stormwater runoff generation. To quantify these changes, the proposed land cover of the site was characterized and catchment areas were delineated based on the proposed Terminal layout. This information was used to develop a hydrologic model for the proposed Terminal development. One of the goals of the wetlands and stream mitigation plans for the project is to restore predeveloped drainage patterns where possible. Implementation of this goal is reflected in the site layout and proposed improvements by:

- Removing non-essential roads and drainage ditches that currently partition drainage basins;
- Restoring the historic alignment of Stream 1 into its remnant channel east of Gulf Road;
- Routing flow through culverts and drainage channels so that project runoff is released at historic discharge locations, where practicable; and
- Other changes to existing drainage patterns are discussed in Appendix C.

5.3.2 Proposed Hydrologic Features

This section describes key hydrologic features of the project area following development of the Terminal and summarizes the proposed drainage infrastructure. A more detailed description of the conceptual plan for the stormwater management system and mitigation of stormwater impacts is presented in Section 6.0. Drawings showing the Preliminary Stormwater Drainage Plan for the proposed stormwater management system are presented in Appendix B.

5.3.2.1 Wetlands

The proposed wetland areas comprise existing wetlands not affected by the project, compensatory mitigation wetlands created or enhanced by the project, and stormwater treatment wetlands (manmade treatment facilities). Refer to the Draft Conceptual Compensatory Mitigation Plan (AMEC 2014) for additional details about wetland areas and wetland mitigation measures.

Stormwater treatment wetlands would be integrated into stormwater management facilities shown on Figure 14 (SWM Ponds 2 – 12). These stormwater treatment wetlands are engineered, man-made facilities, and are described more fully in Section 6.2.4. Naturally-occurring wetlands would not be used for stormwater management.

5.3.2.2 Streams

A number of improvements would be made to the existing system of streams and drainage courses. These enhancements are discussed in Appendix C. These improvements are proposed to restore the

site to the predeveloped watershed conditions in locations, while accommodating the proposed development, and have been accounted for in the delineation of proposed subbasins and catchments.

5.3.3 Proposed Storm Drainage Infrastructure

The proposed storm drainage infrastructure consists of collection and conveyance systems, discharge systems, and stormwater management facilities to provide flow control and water quality treatment. Process water and sanitary wastewater treatment facilities also would be constructed but are not considered part of the storm drainage infrastructure; these facilities were discussed briefly in Section 5.2.

5.3.3.1 Collection and Conveyance Systems

Detailed conveyance plans and design calculations would be prepared as the design is further developed. The Preliminary Stormwater Drainage Plan (Appendix B) shows the conveyance concepts that enable stormwater runoff to be managed at the pond locations that are proposed.

Stormwater would be collected primarily in ditches and swales that intercept non-concentrated sheet flow from catchment areas. Culverts would be used to convey flow beneath roads and rails and embankment areas to stormwater management facilities. Catch basins, manholes, inlets, culverts, and storm drain pipes may be used in limited applications to reduce the extent of disturbance (such as the south edge of the covered storage area), where conveyance paths cross (such as where untreated stormwater from the rail beds would cross over natural stormwater), and where the presence of open channels would pose a safety hazard to site operations (such as where loaders would be operating). When the open ditches used for conveying stormwater are designed, channel stability would be evaluated, and channel linings would be selected based on allowable velocity or tractive shear stress methods (as described in the Federal Highway Administration *Hydraulic Engineering Circular* No. 15 (FHWA 2005).

To the extent practicable, a separate conveyance system would be used to collect natural stormwater from undisturbed areas of the property and vegetated areas not subject to industrial use. This system is also expected to collect groundwater where the groundwater table is intercepted on cut slopes as a result of the construction. This water would not be combined with industrial stormwater or process water, and would be conveyed to a downstream wetland or conveyance channel.

5.3.3.2 Discharge Systems

Wherever practicable, flow dispersion techniques would be used to discharge treated stormwater across pervious surfaces. Criteria specified by Ecology (2012) would be used to evaluate where flow dispersion is an appropriate option. Preliminary areas of flow dispersion are shown in the Preliminary Stormwater Drainage Plan (Appendix B).

When flow dispersion is not possible, pipe outfalls would be constructed where discharges from constructed storm drainage facilities or relocated drainages enter downstream channels, using rock pads or other energy dissipation techniques. Wherever possible, existing ditches and outfalls would be used.

Outfall locations may be further refined in future design revisions.

5.3.3.3 Stormwater Management Facilities

The stormwater management practices discussed in Section 6.0 include surface water ponds to provide stormwater detention and water quality treatment within the developed basins of the Terminal site. These facilities are further discussed in Section 6.2.4 and are shown with typical details in Appendix B.

5.4 Proposed Site Hydrologic Analysis

The proposed site hydrology was analyzed so that developed stormwater runoff rates and volumes could be quantified to evaluate potential impacts and enable future design of drainage infrastructure elements such as conveyance ditches and culverts. To accomplish this, the proposed site hydrologic characteristics were used to develop MGSFlood hydrologic models for the developed site conditions. A hydrologic model for the proposed Terminal without any stormwater management facilities was first run to determine the amount of stormwater that would need to be managed. After incorporating stormwater management faculties into the design, the model was re-run to determine if the stormwater facilities were sufficient based on these analyses, and stormwater detention facilities were identified, sized, and integrated into a post-developed, detained hydrologic model of the proposed Terminal development.

5.4.1 Wetlands

Wetland flow attenuation and surface water storage within wetlands was not quantified in the proposed site hydrologic models as part of the preliminary stormwater system design. Existing wetlands were modeled as saturated soils. See additional discussion in Section 4.1.5.

5.4.2 Groundwater

Groundwater was not modeled for the proposed developed site condition. An existing groundwater model has been developed for the site (see Section 4.1.5). A groundwater model for proposed conditions would be refined in the future to further evaluate the hydrology of proposed mitigation wetlands and to evaluate stream baseflow for stream mitigation elements of the project. At that time, the groundwater contribution to the proposed stormwater system would be accounted for in the design of the stormwater infrastructure and evaluation of stream reaches on the site. Generally, it is anticipated the system of using ditches to intercept natural stormwater from upgradient of the

improvements would also intercept groundwater that would otherwise enter into the drainage system designed to convey the on-site stormwater to the proposed SWM ponds; for this reason the proposed stormwater facility designs do not compensate for groundwater in the sizing of treatment and detention volumes and hydraulic analysis of control structures.

5.4.3 Surface Water Modeling

Stormwater runoff was simulated for proposed developed conditions using the MGSFlood software. First, the unmitigated conditions were modeled to quantify the change in runoff rates and volumes from project catchments and subbasins. Next, the proposed flow control facilities were sized based on the results of the unmitigated project conditions, and these facilities were added to the hydrologic models to simulate the proposed mitigated hydrology of the developed Terminal project area.

The hydrologic simulation methods used to estimate runoff generation and the procedures used to analyze and size stormwater detention facilities are discussed in Appendix A. The preliminary sizing and design of stormwater control facilities is discussed in Section 6.2.

Simulation modeling of the proposed hydrologic conditions was performed assuming the following:

- The proposed condition soil types were assumed to be the same as the existing soil types, except outwash soils were considered to be till soils. This assumption yields a conservatively high estimate of runoff rates because till soils have lower infiltration rates and generate more surface runoff than outwash soils.
- The land cover was a mix of forest, pasture, lawn, and impervious surfaces.
- Stockpile areas and areas immediately adjacent to stockpiles, which would be surfaced with gravel, were considered impervious. Based on anecdotal discussions of other similar terminal facilities, surface runoff is only infrequently observed from gravel surfaced stockpile yards, so this may be a conservative assumption.
- Railroad beds, which would be gravel on top and may employ soil-cement on the side slopes, are considered impervious.
- Five soil type/cover combinations were used in the models: till/forest, till/pasture, till/lawn, saturated soil/all cover groups, and impervious.
- Wetland flow attenuation and surface water storage within existing wetlands and streams were not included in the modeling.
- To the extent possible, flow between undisturbed areas and disturbed areas would be kept separate by constructing drainage ditches and berms, so that flow from undisturbed areas is not routed through proposed stormwater facilities.

5.4.4 Proposed Flow Rates

Table 5 shows the mitigated flow rates, which reflect the presence of the proposed stormwater management ponds, but do not reflect the incorporation of some LID features (e.g., bioretention for parking areas and building roof drainage) that would be integrated into future detailed design documents and would result in additional reductions in developed flow rates. Table 5 does not incorporate the effect of the wetland and stream mitigation area improvements that are associated with the project.

The data in Table 5 show that, when compared to existing flow rates, the proposed flow control measures have the net effect of maintaining or reducing peak flow rates in Stream 1 from existing conditions at the POIs. This would be expected to meet Whatcom County development standards criteria, and would act to reduce the stream erosion and scour potential from existing conditions, as well as reducing peak flow velocities, which could improve the accessibility of stream areas to fish.

Flow rates in the Birch Bay and Waterfront Bluff subbasins are not expected to change from existing conditions as a result of constructing the Terminal facilities. There may still be a change in runoff from the SW Bluff subbasin due to the proposed wetland mitigation site improvements, which were not modeled.

The analyses also show that, without further mitigation, Stream 2 flow rates (at POI E, the culvert crossing Gulf Road) would increase from both existing and predeveloped conditions. This is because the overall watershed area tributary to Stream 2 would increase when those catchments north of Henry Road and east of the BNSF railroad are hydraulically and hydrologically reconnected back to Stream 2. (The historic predeveloped point of discharge (immediately downstream of POI E) was disconnected from Stream 2 when Henry Road and the BNSF railroad were constructed, at which time surface runoff was redirected to Stream 1 (POI C) via roadside drainages. Figures 8, 10, and 13 show the existing, predeveloped, and proposed Stream 2 subbasins.

Due to the proposed grading, it would not be possible to precisely match the predeveloped Stream 2 subbasin area and corresponding peak flow rates at POI E. As part of the project stream and wetland mitigation, several improvements would mitigate the potential and impacts from increased flow in Stream 2. First, the increased flows are only expected in the lower reaches of Stream 2 between the confluence of Stream 2B and Gulf Road; in-stream habitat improvements in this reach are proposed as part of the mitigation plans that would provide large woody debris, bank stabilization, and engineered pools for fish use. Second, there is a wetland mitigation area proposed on the east side of Gulf Road that would be supplied water from Stream 2; a flow diversion structure would be engineered to direct a portion of the Stream 2 flow to this wetland complex. Future engineering and

analyses of this diversion structure would include refining the hydrologic model and design to prevent increases in flow at POI E that would impede fish passage or cause flooding at the Gulf Road culvert.

5.5 Proposed Site Water Quality and Pollution Potential

Without mitigation, pollutants could be discharged into existing drainages as a result of activities associated with the proposed development or existing site conditions that are not changed by the proposed development.

Limited investigations conducted in the project area under existing conditions have measured background levels of turbidity that exist in water courses within existing drainages in the project area. Future investigations and water quality sampling would be conducted to further characterize the existing background levels of regulated pollutants, such as turbidity, pH, metals, and sediment.

Water quality investigations were conducted in 2011 and 2012 to establish whether past site uses or activities have resulted in any residual contamination (AMEC 2012, 2013a). Results of water quality sampling conducted in 2011 showed no indication that groundwater or surface water on the Terminal property was impacted by semivolatile organic compounds (SVOCs) or petroleum hydrocarbons. Groundwater samples were collected from piezometers installed on the Terminal property. Surface water samples were collected from two locations in Stream 1 and one location in the coastal wetland. The samples were analyzed for SVOCs and petroleum hydrocarbons, along with major cation and anion species. No SVOCs or petroleum hydrocarbons were detected above their detection limits, except bis(2-ethylhexyl) phthalate (BEHP), which was detected in three groundwater samples and in two surface water samples during one sampling event. Because no other SVOCs were detected in these samples, or in any samples during the other sampling events, and because BEHP is a known common laboratory contaminant, the detections of BEHP is not believed to be indicative of existing contamination

Without mitigation and water quality control measures, the project could potentially release pollutants to drainage ditches and roadside streams, wetlands downgradient of flow dispersal systems, groundwater, streams, Birch Bay, and the Strait of Georgia. The potential pollutants that could be released from the project area include:

- Oil, grease, hydraulic fluid, and hydrocarbons from equipment leaks, drips, spills, and refueling operations in areas exposed to rainfall;
- Increased sediment and turbidity resulting from, for example, airborne deposition, traffic on unpaved site areas, erosion of landscape areas and conveyance ditches, and transport into the project area from off-site by vehicles or wind;

- Increased concentrations of metals such as copper and zinc from exposed metal surfaces, building materials, vehicle brakes and tires, hydraulic fluid, maintenance of vehicles and equipment, and airborne deposition from off-site sources;
- Dust and particulates from handling bulk commodities such as coal and grain, and from airborne deposition from off-site sources;
- Anti-dust control agents; and
- Nutrients (nitrogen, phosphorus) from landscaping soil amendments.

Because of the concern with these potential pollutants, the conceptual design incorporates source control measures to minimize the exposure of pollutants to stormwater, as well as the proposed stormwater treatment wetlands that would be integrated into SWM Ponds 2 through 12. These measures include:

- Using roofing materials, gutters, and drains that do not have exposed galvanizing, zinc, or copper;
- Using catch basin filter sacks in areas where sediment tracking may occur and where dust is observed to accumulate;
- Regular sweeping of paved surfaces with a regenerative vacuum sweeper;
- Using low phosphorus fertilizer or no fertilizer in landscape areas;
- Using spill control BMPs if outdoor maintenance or fueling occur;
- Incorporating spill control elbows / tees into drainage structures;
- Conducting maintenance indoor to the extent practicable; and
- Fully containing the conveyor systems.

6.0 STORMWATER MANAGEMENT

Previous sections of this report discussed the site hydrology and changes in land cover and surface runoff that would occur with construction of the project. This section identifies the minimum regulatory requirements that apply to stormwater management, and the strategies and methods proposed to achieve compliance with County and State requirements for stormwater discharges. This Draft Conceptual Stormwater Management Plan is deemed preliminary, as it is expected that the site layout may change as the overall project design is further developed. It is anticipated that some adjustments may be made to facility locations, and footprints may be altered to accommodate proposed grading and existing topographic constraints.

6.1 Summary of Minimum Requirements

This section outlines the stormwater management requirements of Whatcom County and Ecology that are expected to be applied to the project. A summary table comparing specific requirements is provided in Appendix D. Where a discrepancy in requirements occurs between Whatcom County and Ecology requirements, PI Terminals has voluntarily committed to achieving the more stringent of the County and Ecology (2012) standards for the Terminal. The requirements discussed below are those that were in effect in March 2012, when the project was vested in the County permitting process.

6.1.1 Requirements for New Site Development

Both Whatcom County and the Ecology specify permitting and operational requirements for new commercial and industrial facilities. This section briefly describes these County and Ecology requirements insofar as they affect stormwater management.

6.1.1.1 Whatcom County

Whatcom County requires permits for Land Disturbance, Major Projects , and Shoreline Substantial Development. Whatcom County Development Standards (Whatcom County 2002) adopt and apply the 1992 Ecology *Stormwater Management Manual for the Puget Sound Basin* (Ecology 1992).

The County requires that peak stormwater discharge rates for developed project areas (the proposed condition) are not to exceed the peak stormwater discharge rates of the existing project areas (the existing condition). Single-event hydrologic models (the Santa Barbara Urban Hydrograph Method) are accepted for use in analyzing site hydrology and sizing flow control facilities such as detention ponds.

The County applies thresholds and criteria for water quality treatment based on the 1992 stormwater manual (Ecology 1992). These criteria include using the 6-month, 24-hour storm event as the basis for determining runoff treatment volumes and rates.

Whatcom County identifies specific watersheds where additional stormwater controls apply on its website. No current watershed or basin-specific requirements would apply to this project.

The comparison of County and Ecology stormwater requirements provided in Appendix D shows that the Ecology requirements for flow control and water quality treatment (Ecology 2012) are more stringent than the County requirements. If the project meets the Ecology 2012 requirements, Whatcom County stormwater requirements would also likely be satisfied.

6.1.1.2 Ecology Stormwater Management Manual for Western Washington

Because the project would be required to operate under Ecology's NPDES requirements for industrial stormwater, and would require additional permits from Ecology for construction, the current (2012) Ecology stormwater manual requirements have been considered. Ecology's stormwater management requirements are more restrictive than those of Whatcom County, so the proposed stormwater management facilities and practices have been conceptually designed to meet requirements of the Ecology stormwater manual to the extent possible at this point in the conceptual design stage of the Terminal project. The 2012 Ecology stormwater manual establishes minimum requirements for new development projects in Western Washington that were considered in the development of this draft conceptual stormwater management plan.

Minimum Requirement #1: Preparation of Stormwater Site Plans

Ecology states that projects shall prepare a Stormwater Site Plan for local government review, and shall retain native vegetation and minimize impervious surfaces to the extent feasible. This plan and future reports would meet this requirement. Retaining native vegetation and minimizing both the project footprint and impervious surfaces were taken into account when developing the proposed site layout.

Minimum Requirement #2: Construction Stormwater Pollution Prevention Plan

Ecology requires new development and redevelopment projects of this size to prepare a SWPPP to prevent erosion and discharge of sediment and other pollutants during construction. This project would prepare such a detailed plan in the future, prior to any clearing or grading. Section 5.1.2 discusses some specific measures and practices that would be part of the construction SWPPP.

Minimum Requirement #3: Source Control of Pollution

Source controls are measures taken to reduce the generation of pollutants and minimize contact of pollutants with stormwater. Source control includes good housekeeping practices such as covering pollutant source areas, sweeping and clean-up, establishing specific areas on a site where activities involving potential pollutants are conducted, and other source control BMPs.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

The Ecology stormwater manual requires that projects maintain natural drainage patterns and discharge stormwater at the natural location, and presents the concept of "threshold discharge area." Ecology has defined threshold discharge area to clarify how sites with multiple discharge locations are to be analyzed and mitigation measures designed to meet the minimum requirements. Multiple discharges where flows combine within one-quarter mile downstream of natural discharge locations are considered to be in a single threshold discharge area. The development thresholds are evaluated and requirements are to be met (flow control, water quality treatment, discharge at natural locations, etc.) within each threshold discharge area where development is proposed.

While the existing locations of streams and wetlands on the property have been altered from the historic predeveloped condition by past development (roads, agriculture, and logging), this proposed project layout was developed to minimize, to the extent possible, additional impact to streams and wetlands from building the Terminal. Some changes in drainage patterns are unavoidable due to the size of the facilities needed for the Terminal. Mitigation plans for streams and wetlands affected by the project have been developed, and stormwater discharge points to receiving waters (Streams 1, 2, and the Strait of Georgia) have been selected to match existing or predeveloped discharge locations.

Minimum Requirement #5: On-site Stormwater Management

LID, also referred to as on-site stormwater management, will be used to the extent feasible to infiltrate, disperse, and retain stormwater runoff on-site, and the 2012 Ecology manual establishes numerical performance requirement to be achieved through on-site stormwater management for certain project types. LID practices typically involve the use of plants and soils to reduce stormwater runoff rates and volumes. LID promotes the disposal of stormwater through infiltration, evapotranspiration, or rainwater harvesting/re-use. Specific LID requirements include dispersing runoff across pervious vegetated surfaces to the extent practicable, and amending disturbed soils with organic compost to improve the post-developed capacity of the site to absorb rainfall before runoff is generated. The 2012 Ecology manual also includes a flow duration performance standard that targets discharges less than 50 percent of the predeveloped 2-year flows.

This project would implement LID practices where feasible and compatible with the planned site operations. Runoff dispersion and soil amendment would be implemented across the site. Due to the high groundwater and clayey soils, no suitable locations to infiltrate stormwater runoff were identified. Future detailed drainage design would incorporate bioretention areas to serve parking lots and rooftops where the presence of groundwater does not limit these practices. The proposed design would not achieve the numerical LID flow duration performance standard, because of the site constraints explained in this report.

Minimum Requirement #6: Runoff Treatment

Water quality treatment BMPs are typically required to remove pollutants from stormwater. The performance goal for basic water quality treatment is removal of suspended solids. Enhanced treatment is typically required for sites that have the potential to release metals into stormwater, and removal is targeted to suspended solids, zinc, and copper. Enhanced treatment is typically triggered by high vehicular use or the presence of leachable metals (zinc or copper) in building materials, particularly in roofing (including flashing and gutters). Treatment for phosphorus is typically required when a site drains to a lake or wetland that has been identified by the local agency as a phosphorus-sensitive system. Oil control is typically triggered by sites with potential release of hydrocarbons into stormwater, such as fueling stations or sites with large volumes of traffic/parking turnover. At a minimum, this project would apply enhanced treatment to runoff from areas with industrial activities, and basic treatment to administrative areas; the proposed design incorporates enhanced treatment for all new impervious surfaces except those areas from which runoff is to be dispersed.

Minimum Requirement #7: Flow Control

Flow control BMPs, such as detention or infiltration BMPs, are intended to protect streams and other water bodies sensitive to increased flows from development. Flow control is typically required for all development that drains to a stream or wetland. Sites that drain directly to major receiving bodies, such as Puget Sound and marine waters, are typically exempted from flow control requirements. The proposed Terminal would discharge to streams and wetlands, and therefore flow control would be needed.

Minimum Requirement #8: Wetlands Protection

Projects that discharge stormwater to wetlands, either directly or indirectly through a conveyance system, are to conduct hydrologic analyses of wetland receiving waters and avoid using wetland buffers for stormwater management facilities. This project acknowledges that direct wetland impacts would occur in some of the proposed construction areas. At this time, specific hydrologic analyses of wetlands downstream of the project have not been performed. The existing wetlands are not open water ponded areas, but rather consist of saturated, gently sloped areas where ponded water level fluctuations cannot be modeled effectively. Detailed wetland mitigation plans developed for the project include enhancements to previously impacted wetlands and construction of new wetlands.

Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual is required for proposed stormwater facilities and BMPs. A detailed operation and maintenance manual would be developed in the future as detailed drainage designs and the SWPPP for the facility are completed.

6.1.2 National Pollutant Discharge Elimination System

The US Environmental Protection Agency (EPA) has designated Ecology's Water Quality Program, as the state water pollution control agency, responsible for implementing all federal and state water pollution control laws and regulations. Wastewater and stormwater (construction stormwater and industrial stormwater) discharges are regulated primarily by wastewater discharge permits, which stipulate specific limits and conditions of allowable discharge. There are two types of NPDES permits: general and individual permits. General permits are designed to cover the majority of sites under typical conditions and include the Industrial Stormwater General Permit (ISWGP) or wastewater NPDES permit, and construction general permit. Individual permits are required for sites with wastewater discharge to surface waters or for sites with stormwater discharges that are more complex (high level of contaminants, certain industry types, or those that discharge to water bodies that are already severely impacted).

Because more than 1 acre of area would be disturbed, the requirements for the construction stormwater general permit would be triggered. It is possible that construction activities could be wrapped into an individual permit to cover all water discharges from the site. However, given that final detailed design of process water and wastewater treatment systems may not be completed until after construction begins, it is likely that the construction general permit would be sought. In either case, the construction stormwater requirements from the 2012 Ecology stormwater manual would apply.

Industrial stormwater discharges are defined as stormwater released to surface waters from certain types of facilities ("stormwater associated with industrial activity"). Facility types are identified by standard industrial classification codes. Based on the EPA list of industrial activities, Ecology considers rail and water transportation facilities (such as marine terminals, docks, and waterfront terminal operations) to be industrial facilities when those facilities have a vehicle maintenance shop, perform vehicle maintenance activities, perform equipment cleaning operations, conduct material handling, or perform airport deicing operations. EPA and Ecology categories for discharges to surface waters include nonprocess wastewater,[1] stormwater associated with industrial activity, and process wastewater,[2] each of which require different EPA permit application forms.

During preliminary discussions with Ecology, it was determined that water sprayed on stockpiled materials to control dust would be considered process wastewater (Hood 2011). Because vehicle maintenance and material handling are part of the project, and all of the stormwater and site process

1 The term *non-process wastewaters* means utility wastewaters (for example, water treatment residuals, boiler blowdown, and air pollution control wastewaters from heat recovery equipment); treated or untreated wastewaters from groundwater remediation systems; dewatering water for building foundations; and other wastewater streams not associated with a production process.

2 EPA Form 2E states "process wastewater is water that comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, waste product, or wastewater."

water would be discharged to surface water or groundwater, an NPDES ISWGP or Individual Wastewater Discharge Permit, or both, may be required for ongoing operations of the facility.

According to the Ecology rules, there is flexibility to determine whether a project should be permitted under the ISWGP or the individual permit, assuming the site is not excluded from the ISWGP or construction general permit by rule. A developer may elect to have only one individual permit rather than three permits (ISWGP, construction general permit, and wastewater NPDES permit). For sites with complex water quality issues, or combinations of industrial stormwater, process wastewater, and sanitary wastewater, Ecology has discretion to require individual permits in lieu of the general permits.

The NPDES permit structure for the operational site affects the design because the ISWGP has conditions that prohibit mingling of untreated process water with stormwater runoff, which affects where process water treatment ponds are located relative to stormwater treatment ponds.

Here, runoff from the large stockpile areas would likely be considered process water, but would also require detention facilities so that Ecology flow control requirements can be met for the overall project. The concepts and preliminary design information presented in this report take the approach of treating process water before it is allowed to mix with stormwater in the proposed detention ponds in order to meet the ISWGP conditions.

6.1.2.1 Requirements for the Industrial Stormwater General Permit

The ISWGP establishes requirements for discharge of stormwater from industrial sites. The permit does not cover discharge of process water or wastewater, so if the ISWGP is used to permit the site's proposed stormwater discharges, additional permits would be needed to cover process water and wastewater. As stated, the ISWGP cannot be used where untreated process water is mixed with stormwater.

The conditions of the ISWGP include the following:

- Prepare and maintain a SWPPP that identifies good housekeeping, operational, source control, and treatment BMPs to be employed on the site to prevent stormwater pollutant discharges;
- Develop and implement a sampling plan to measure concentrations of targeted pollutants in stormwater discharges;
- Develop and implement a spill prevention and control plan;
- Perform monthly visual inspections of stormwater control BMPs;
- Prepare and submit quarterly and annual stormwater reports to Ecology; and

- Develop procedures for corrective actions to be implemented if discharge concentrations exceed benchmark concentrations of targeted pollutants.

6.1.2.2 Requirements for Construction Permits

Similar to the ISWGP, the NPDES Construction Stormwater General Permit (CSWGP) is administered by Ecology on behalf of the EPA. The CSWGP establishes stormwater pollution control measures to be used during construction of projects larger than 1 acre. The CSWGP can be issued following a public notification and comment period, prior to the start of earth-disturbing activities.

The conditions of the CSWGP include the following:

- Prepare and maintain an SWPPP that identifies erosion and sedimentation control BMPs to be employed on the site during construction to prevent the release of sediment from construction areas;
- Develop and implement a spill prevention and control plan;
- Perform regular inspections of erosion and sedimentation control BMPs and spill control BMPs throughout construction; and
- Prepare and submit stormwater discharge reports to Ecology.

6.2 Proposed Stormwater Management Practices

This section describes the preliminary stormwater management practices and facilities proposed for the project. Figure 14 shows the preliminary plan for major stormwater facilities that are proposed, and the areas that are tributary to them. Preliminary engineering drawings are provided in Appendix B. Table 9 shows which catchments make up each subbasin that flows to a stormwater facility, and presents sizing information for each proposed stormwater pond.

6.2.1 Low-Impact Development Strategies

LID is used as a stormwater management tool to control stormwater discharges, and to mimic more natural hydrologic conditions. LID practices may be used for water quality treatment and control in what is referred to as an Integrated Management Practice. Over a very large site such as the project site, LID and Integrated Management Practice practices can be very valuable in their ability to provide stormwater mitigation at various scales and site locations. Evaluating each LID and Integrated Management Practice technology requires careful consideration of the proposed areas of development, site topography, and site maintenance requirements.

A number of LID technologies were evaluated for use on the site based on the ability of the technology to be integrated into site development, and the suitability of site conditions. These

technologies included bioretention (rain gardens) for shallow sloping areas of the site, amending soils to allow for better stormwater retention, permeable paving for areas of the site where pavement is required, vegetated roofs, rainwater collection systems such as cisterns, and runoff dispersion for stormwater conveyance and infiltration. Appendix E provides a more detailed discussion of each of the technologies that were evaluated.

Based on site constraints and the selected stormwater treatment technologies, LID technologies evaluated were screened based on the following criteria:

- *Compatibility with high groundwater and fine textured soils:* Seasonal high groundwater conditions and fine soils greatly limit the effectiveness of infiltration-based practices such as bioretention and permeable pavements.
- *Cost and effectiveness:* High implementation costs and relatively low effectiveness at achieving stormwater management requirements may limit the feasibility of vegetated roofs.
- *Impact on site operations:* Siting LID facilities such as bioretention and vegetated swales within areas of intensive industrial activity can lead to safety hazards for equipment operators, and would create ongoing maintenance concerns due to limited opportunities to safely access the facilities.
- *Catchment area:* Most LID practices are intended to serve small catchments, whereas substantial portions of the project area (the stockpiles) are graded and drained to provide a working surface appropriate for the equipment used to handle materials. These factors yield catchments much larger than appropriate for bioretention and flow dispersion practices.
- *Maintainability:* The proposed water quality treatment and detention facilities would require a substantial maintenance commitment to ensure proper operation. Adding numerous LID facilities that require additional maintenance to the site would substantially increase the maintenance burden for the facility operator and staff.

Table 9 Proposed Stormwater Management Facilities

Site Characteristics				Stormwater Ponds[2]				Stormwater Quality Treatment		
Subbasin Name	**Catchments[1]**	**Area (acres)**	**Facility**	**Stormwater Pond Name**	**Pond Top Area (ft^2)**	**Pond Bottom Area (ft^2)**	**Pond Volume (ft^3)**	**Water Quality Treatment Technology**	**Wetland Volume (ft^3)**	**Wetland Surface Area (ft^2)**
Open Storage Area	P1-N P1-S P1-W	132.3	Open storage	SWM POND 1	229,400	116,000	1,443,000	Settling Ponds	Settling Ponds[3]	Settling Ponds[3]
West Railbed	B1 P-11	6.6	Railbed, road	SWM POND 2	35,300	27,000	74,300	SWW	28,000	20,000
Interior West Railbed	B2 C2	8.2	Railbed	SWM POND 3	41,300	31,000	104,100	SWW	39,000	23,000
Northwest Railbed	C1	6.4	Railbed	SWM POND 4	41,500	35,000	55,200	SWW SWW	30,000	17,000
North Railbed	D	9.9	Railbed	SWM POND 5	86,500	75,000	157,300	SWW	47,000	27,000
East & Central Railbed	E	44.4	Railbed	SWM POND 6	154,600	129,000	555,700	SWW	211,000	108,000
South Railbed	F P-14	22.2	Railbed, Administrative building, parking	SWM POND 7	107,800	88,000	335,600	SWW	92,000	49,000
North Closed Storage	P2-N	26.4	Roads, silo area	SWM POND 8	70,500	57,000	185,200	SWW	74,000	27,000
Southwest Closed Storage	P2-SW	26.5	A-frame structures, roads	SWM POND 9	74,400	51,000	363,000	SWW	94,000	51,000
Longshore Building	P-10	2.5	Building, parking, substation	SWM POND 10	15,500	9,000	34,800	SWW	9,000	7,000
Southeast Closed Storage	P2-SE	9.7	Maintenance building and parking, roads, A-frame structures	SWM POND 11	32,600	20,000	123,800	SWW	33,000	19,000
Main Substation	A	2.9	Substation	SWM POND 12	27,600	23,000	24,300	SWW	9,000	6,000
SW Waterfront Bluff - New Rd	Ex-Bluff Ex-S1-Outlet-West	NA	Road, conveyor, trestle	Flow dispersion[4]				Flow dispersion[4]		

1. Refer to Appendix A for proposed catchment locations and land use types.
2. Refer to Figure 14 for graphic of a proposed stormwater facilities and subbasin areas.
3. Settling ponds would be used upstream of the detention pond to provide treatment of runoff from the open storage area that is collected and conveyed in drainage ditches to the settling pond locations shown in the drawings.
4. This catchment would utilize flow dispersion to provide flow control and treatment.

ft^2=square feet
ft^3=cubic feet
NA=Not Applicable
RR=Railroad
SWW=Stormwater Wetland

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Even with these limitations, several LID technologies passed screening and are proposed for use on the site:

- Flow dispersion technologies were selected based on the ability of the technology to reduce and treat stormwater flows from relatively isolated areas of the site (such as access road to the trestle). Additionally, flow dispersion trenches would be used to disperse the discharge from stormwater treatment systems, such as the wetlands designed for stormwater treatment. Flow dispersion technologies allow for non-erosive release of stormwater to vegetated, pervious areas of the site so that infiltration can occur and plants can evapotranspirate moisture from the soil.
- Soils would be amended in areas of disturbed and developed land, allowing for greater infiltration and retention of stormwater in pervious landscaped areas. The soil amendment would most likely consist of topsoils stockpiled during grading operation which would be worked into the upper 12 inches of finished graded pervious areas.
- Rainwater harvesting may be considered during future design development to offset the amount of off-site water needed to meet the process water demand, but this is subject to legal constraints, such as the need to secure water rights to use rainwater for a beneficial use.
- Bioretention facilities would be integrated with the final design of the proposed parking lots and to manage stormwater from the roofs of the Longshore building, Maintenance building, and Administrative building. These have not been considered as part of this conceptual plan.

Permeable pavement has been considered, but would have limited usefulness on this site due to the poor infiltration characteristics of the soils and seasonally high groundwater table. Permeable pavement would not function in the open storage area where particulates could clog the pores of the surface. Future design and geotechnical testing would evaluate the potential benefit of permeable pavements around the administrative areas of the site, where clogging concerns are less likely.

In addition to the engineered LID practices identified above, a substantial portion of the project area would be left undisturbed and vegetated. This would allow existing forest vegetation to continue to mature and forest to be naturally established on other areas which would increase the interception, infiltration and retention of rainfall. These areas may be used in conjunction with dispersion technologies to manage stormwater flows.

6.2.2 Pollution Source Control Best Management Practices

Detailed plans for implementing pollutant source control BMPs would be developed as part of the SWPPP that would be prepared in the future to meet NPDES permit requirements. Appropriate BMPs include, but are not limited to:

- Regular sweeping of paved areas;
- Isolating untreated process water and sanitary wastewater from storm drainage systems;
- Maintaining spill control kits throughout the site;
- Providing regular training on spill avoidance and management;
- Providing spill containment for stored liquids;
- Conducting vehicle maintenance under cover or indoors;
- Installation of “spike strips” or other measures to reduce bird roosting (which contributes bacteria to stormwater runoff);
- Installation of spill control tees, oil stop valves and/or oil/water separators in areas of vehicle fueling, motors, and transformers;
- Oil-water separators with in-line oil-stop valves would treat runoff from paved parking lot areas, fuel station areas, and transformer containment areas;
- Using dedicated equipment washing areas that are not allowed to discharge to the stormwater system;
- Covering equipment or parts of equipment stored outside; and
- Avoiding the use of uncoated or galvanized metal products in roofs, fences and other exterior fixtures/features to the extent possible.

These practices are not all shown on the Preliminary Stormwater Drainage Plan (Appendix B), but would be incorporated into the industrial SWPPP that would be developed for the project.

6.2.3 Flow Control Facilities

Flow control would be provided for upland areas of the project using the following structural practices:

- ***Runoff dispersion:*** This LID practice would disperse runoff from the shared access road (to the trestle) to adjacent pervious vegetated areas, and from some of the railroad embankments. Details are provided in the Preliminary Stormwater Drainage Plan (Appendix B).
- ***Stormwater detention ponds:*** The design includes 12 stormwater detention ponds with volumes ranging from 24,300 cubic feet for Pond 12 to 1.44 million cubic feet for Pond 1. The total volume of detention storage proposed for the project is approximately 3,456,000 cubic feet (79.35 acre-feet). Table 9 shows the size of each proposed stormwater pond. Because of the low vertical relief within the proposed project footprint, the assumed depth for detention

storage was typically limited to 4 feet or less; however, SWM Ponds 1 and 9 conceptually have greater depths because of the proposed grades in the vicinity of those ponds.

As stated, these stormwater detention ponds were sized using modeling with MGSFlood software and Ecology's flow duration control criteria (Appendix A). Figure 13 shows the locations and tributary subbasins for each of the facilities. Additional details regarding the layout of the stormwater detention ponds are presented in the Preliminary Stormwater Drainage Plan in Appendix B. Table 9 shows the sizes and catchment areas for each stormwater detention pond.

Water released from stormwater management facilities would be dispersed using flow spreaders wherever practicable. In those areas where dispersion trenches would not work, such as on steep slopes, pipes or stabilized open channels with energy dissipaters would be used to convey the water to the bottom of the valleys or steep slopes, to discharge in a non-erosive manner.

The proposed flow control facilities are designed to operate as gravity systems and no pumps or special operating procedures are anticipated. Maintenance of the proposed flow control BMPs would be in accordance with standardized maintenance checklists that would be prepared as part of the final Stormwater Design Report.

6.2.4 Water Quality Treatment Facilities

In determining the most appropriate stormwater treatment technologies for the site, several technologies that Ecology (2012) has approved were considered for enhanced treatment (removal of metals as well as total suspended solids and turbidity). This standard was applied because during operations the project is expected to comply with requirements of the NPDES ISWGP, which has specific benchmarks for copper, zinc, turbidity, pH, and oil/grease. The approved technologies that were considered included various types of treatment trains, including systems such as detention structures followed by a sand filter; stormwater treatment wetlands, proprietary filtration systems (Stormfilter™), dispersion, and media filter drains.

Stormwater treatment wetlands are proposed as the primary treatment method for most of the subbasins. The selection of this treatment technology was based on the site's flat topography, which means there is insufficient hydraulic head to rely on treatment through a filter. Bioswales were not considered because they are not an Ecology-approved option for enhanced treatment unless coupled with a filtration BMP, for which there is insufficient hydraulic head on this site. Dispersion is proposed as the BMP for treatment solely along the road to the trestle.

The wetlands were sized based on Ecology's procedures and constraints as specified in the 2012 Ecology stormwater manual (Ecology 2012). The manual specifies constraints such as minimal

length-to-width ratios for the wetland, minimum and maximum presettling cell depths in the wetlands, side slopes required, and overall volume ratios between the presettling cells and the wetland cells. It is understood that the specific configuration of each wetland, including features to extend the flow path during design treatment flows by creating meandering flow patterns, would be developed in detail in future designs.

The water quality volumes that require treatment were determined from MGSFlood modeling software. Based on the water quality volume and the constraints of the 2012 Ecology stormwater manual, several iterations were performed for each wetland to find appropriate dimensions. Table 9 shows the proposed sizes of the treatment wetlands (refer to the Preliminary Stormwater Drainage Plan in Appendix B for additional information). These stormwater treatment wetlands would be sited at the base of the stormwater detention ponds shown in Figure 14. Stormwater treatment wetlands include a forebay to promote settling and evenly distribute flow across areas of emergent vegetation.

Stormwater treatment wetlands will be maintained in accordance with Ecology and Whatcom County guidelines and requirements. Detailed maintenance checklists and plans would be developed as part of the Stormwater Design Report. Generally, the forebay area would be periodically inspected and accumulated sediments removed when the sediment depth exceeds the maintenance criteria. Planted areas will be inspected and replanted when necessary to ensure that the potential of vegetation to provide biofiltration of stormwater is maintained. The plant growth will be periodically inspected and harvesting of wetland vegetation may be performed if needed to maintain the design water quality treatment volume. Sediment and vegetation removed from the stormwater treatment wetlands would be tested and disposed of off-site in accordance with state and local waste regulations.

Areas that are affected by open storage would employ sediment ponds that use settling processes to provide water treatment of stormwater that contacts stored materials and commodities. The sediment ponds would be placed upstream of stormwater detention (SWM Pond 1). Treated process water from the sediment ponds would be conveyed into the stormwater facilities for flow control (detention), and conveyances would be designed to allow sampling of sediment pond discharge before it combines with any stormwater. Preliminary sizing of sediment ponds was performed to provide adequate settling time for runoff that may have been exposed to coal dust at the open storage area. Periodically, accumulated sediment would be removed from the sediment ponds, tested, and disposed of off-site in accordance with state and local waste regulations.

A detailed stormwater treatment plan for the access trestle and wharf would be developed during future detailed design development. A piped system to collect stormwater would be installed in areas on the access trestle and wharf where oils or fluids may be likely to accumulate, such as near the shiploaders. The industrial stormwater from these locations would be collected and transferred to a

treatment plant capable of removing oils and hydrocarbons. It is anticipated that stormwater from other portions of the access trestle and wharf that are minimally exposed to potential pollutants would be drained into the seawater.

The Preliminary Stormwater Drainage Plan (Appendix B) shows the approximate locations and sizes for water quality treatment facilities. Maintenance access roads for the ponds are not shown at this time, but access to pond bottoms, treatment wetland forebays, and outfall structures is planned and would be identified in future design revisions.

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7.0 COMPLIANCE STATUS OF PROPOSED PROJECT

This section discusses findings from the preliminary stormwater and hydrologic analyses performed in developing the Draft Conceptual Stormwater Management Plan presented in Section 6.0.

7.1 Annual Discharge Summary

Annual use of process water, wastewater generation, and stormwater runoff were estimated for the project. Process water estimates are based on the uses described in Section 5.2.1. Wastewater generation is based on the fully built-out facility. Annual stormwater runoff from the development area (the subbasins that drain to the proposed stormwater ponds) was estimated using the MGSFlood model results for a 158-year simulation. Losses due to evapotranspiration from stormwater facilities and wetlands were not quantified. Table 10 shows the anticipated average annual discharge volume associated with each of these types of discharges.

Table 10 Summary of Anticipated Site Discharges

Type of Discharge	Process	Estimated annual discharge (gallons)[1]
Sanitary Wastewater	Toilets, showers, sinks	2,922,000
Process Water	Dust suppression, railcar wash stations, transfer tower washdown, berth washdown	3,860,000
Stormwater	Storm runoff within project footprint	253,300,000 [2]

1. Estimated annual discharge is based on the completed built out facility.
2. Estimated using the MGSFlood model results for a 158-year simulation.

7.2 Compliance with Stormwater Regulations

This section evaluates the proposed compliance of the stormwater treatment system with Whatcom County and Ecology stormwater requirements. A comparison of Whatcom County and Ecology stormwater management requirements is presented in Appendix D.

7.2.1 Whatcom County Stormwater Requirements

As noted in Section 6.1.1.2, the stormwater management system for this project would meet or exceed Whatcom County requirements for stormwater flow control because this project would manage the developed stormwater peak rates and flow durations to match historic predeveloped site conditions, while the County requires the less stringent goal of reducing peak flow rates to not exceed existing conditions. Additionally, LID practices (which have not yet been quantified) would be employed, and those practices would act to reduce peak runoff rates beyond the level documented in this report. In addition to the requirements for flow control, water quality treatments, and construction stormwater controls, Whatcom County has requirements for conveyance design that would be applied when the conveyance elements of the project are engineered in the future.

7.2.2 Ecology Stormwater Requirements

As noted previously, Ecology requires that stormwater be discharged at the natural location. To meet the most literal interpretation of the Ecology stormwater manual for the threshold discharge area definition and the minimum requirements that are triggered for each threshold discharge area, the project would have to maintain at least 11 different discharge locations, and stormwater management infrastructure (flow control and water quality treatment) would need to be provided within the catchments draining to each discharge. Because of the large areas needed to manage the storage of the dry goods on the site, and because the project proposes to restore predevelopment flow patterns to the extent possible within the project area, this Draft Conceptual Stormwater Management Plan strives to meet the intent of the Ecology manual but does not apply the threshold discharge area definition precisely. This is because an alternative strategy was employed to restore historic drainage patterns rather than maintaining existing discharge locations, which are not the same as the predeveloped natural discharge locations. Proposed stormwater management facilities would achieve the flow control and treatment requirements within the subbasins that contribute to each stormwater facility, but discharge locations would change from the existing locations. This would enable the facilities to be constructed in space available within the project footprint. Maintaining the existing discharge locations, would require changes to the facility layout and actually increase the overall footprint of the proposed development. Key points of interests within Streams 1 and 2 are analyzed in Section 5.4.4 so that reviewers can evaluate the net effect of this approach.

Stormwater facilities were sized using the MGSFlood program to meet the 2012 Ecology stormwater manual flow control requirements for areas tributary to the ponds. Proposed condition storm flows would be detained and released at predevelopment flow rates for those catchments that drain to each pond. Stormwater detention ponds of the sizes presented achieve the flow duration standard for flows from half of the 2-year to the 50-year flow rate. The proposed stormwater controls do not achieve the LID performance standard.

Stormwater treatment wetlands were sized to provide treatment volumes that meet or exceed the basic water quality treatment volume calculated with the MGSFlood program for the subbasins tributary to the ponds. LID practices that are compatible with the site soils and land covers have been incorporated into this Draft Conceptual Stormwater Management Plan and would be expanded upon in future design.

This stormwater management plan substantially meets the requirements of the Ecology stormwater manual, which was the basis for selecting BMPs and establishing the design criteria used for the preliminary engineering of the proposed stormwater facilities. Stormwater management provisions for several relatively small areas of the site would be addressed during future design development. These areas consist of the fuel station along Henry Road, for which spill containment and oil control devices

would be designed, and the details of containment BMPs used during maintenance of equipment on the wharf.

7.2.3 NPDES Compliance

Section 6.1.2 outlined a strategy for complying with NPDES permits administered by Ecology. NPDES permits and supporting documents required under the CSWGP and ISWGP, such as SWPPPs, would be developed in the future. These documents would further refine the BMPs and other site improvements needed to comply with NPDES requirements.

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8.0 CONCLUSIONS

The studies and analyses conducted for and included in this Draft Conceptual Stormwater Management Plan provide the following understanding of the site hydrology and stormwater:

- There are two watersheds (Birch Bay and the Terminal watershed) on the project site. The project area lies within the Streams 1 and 2 sub-watershed areas. Existing land cover includes pastures, second growth forests, emergent wetlands, and County roads.
- Ecology and Whatcom County have minimum requirements for stormwater management that would apply to the proposed development. Ecology has more stringent methods of analysis and more restrictive assumptions about predevelopment conditions than Whatcom County. Controlling discharges to meet Ecology minimum requirements for proposed site hydrology mimics predeveloped runoff conditions (those of old-growth forest).
- Stormwater detention facilities sized to meet Ecology flow control requirements can be accommodated on the site. Open water detention and treatment ponds are proposed that would incorporate enhanced stormwater treatment within the footprint of the pond.
- Sanitary wastewater, process wastewater, industrial stormwater, and natural stormwater would be managed separately. Separate water quality treatment systems would be used for sanitary wastewater, process wastewater, and industrial stormwater. Industrial stormwater would be treated using approved enhanced treatment practices. Natural stormwater generated outside of the proposed development footprint would be conveyed in separate, dedicated systems of ditches and culverts.
- LID practices incorporated into the proposed conceptual design include flow dispersion of runoff from some of the proposed access roads and using flow dispersion trenches for discharges from proposed ponds where feasible. Additional LID elements (bioretention) serving administrative areas (parking and buildings) would be incorporated into future design revisions.
- Implementation of the proposed stormwater plan would reduce surface runoff rates from existing flow rates, to predevelopment levels, for those areas that would be developed.
- Peak flow rates in Stream 1 would be reduced from existing conditions.
- Peak flow rates in Stream 2 would increase in a portion of the lower reach, and would be mitigated by in-stream improvements to provide additional stabilization of the stream bed and banks, and by using water from Stream 2 to support wetland mitigation sites located along the lower Stream 2 corridor.

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9.0 LIMITATIONS

This report was prepared exclusively for PI Terminals by AMEC.

The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and is based on: (i) information available at the time of preparation; (ii) data supplied by outside sources; and (iii) the assumptions, conditions, and qualifications set forth in this report. The project is subject to change in response to environmental review processes, permit conditions, and Client preferences. This report is intended to be used by the Client for the Terminal project only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third party. Should additional parties require reliance on this report, written authorization from AMEC will be required. With respect to third parties, AMEC has no liability or responsibility for losses of any kind whatsoever, including direct or consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

In evaluating the project site, AMEC has relied in good faith on information provided by third parties, including but not limited to site survey information, aerial photographs, and preliminary engineering drawings developed by Ausenco. AMEC has assumed that the information provided is factual and accurate. AMEC accepts no responsibility for any deficiency, misstatement, or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

The findings contained herein are relevant to the conditions at the time this report was written and our understanding of conditions at later dates. With respect to regulatory compliance issues and stormwater permit requirements, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

The analyses and findings reported here are solely for the purpose of establishing baseline conditions for proposed stormwater improvements, and to quantify the expected changes from the existing and predeveloped site conditions to the proposed site conditions. The modeling conducted with the MGSFlood model used regional calibration parameters and was not calibrated to the specific conditions of the site. Groundwater was not included in the stormwater models. Attenuation and storage of runoff within wetlands was not calculated for this report. Actual flow rates of streams and conveyances, and runoff volumes, may differ from the values reported herein.

AMEC makes no guarantees, explicit or implied, that implementation of the proposed improvements will fully mitigate changes in site hydrology or achieve benchmarks established in the current or future ISWGP. On-site pilot-testing of treatment technologies discussed herein is recommended prior to further design and implementation. Depending on the results of the pilot-testing, recommendations and conclusions expressed in this report are subject to change.

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APPENDIX A

Surface Water Modeling Methods

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APPENDIX A: SURFACE WATER MODELING

Gateway Pacific Terminal
Whatcom County, Washington

OVERVIEW

Hydrologic models for the project were developed and MGSFlood version 4.34 was used to estimate flow rates in watersheds affected by the project and to size stormwater detention ponds. This appendix provides detailed information describing the model development process used to estimate the flow to the hydrologic points of interest (POIs). The appendix presents hydrologic modeling methods and results, as well as the computations performed to size the proposed detention ponds shown in the preliminary stormwater drainage plan (which can be found in Appendix B). The attached model results show that the proposed stormwater pond designs for the project "pass" the flow duration standard criteria established by the Washington State Department of Ecology (Ecology).

Three land use scenarios were modeled:

- Predeveloped conditions (prior to construction of roads, rail lines, homes, agricultural infrastructure, or any other structures);
- Current existing conditions (2013);
- Proposed developed conditions with proposed Terminal land cover (with stormwater management).

SUMMARY OF PROCESS

The process used to develop the models and size detention facilities generally consisted of characterizing areas of the site for each land use scenario, using those data as input to the hydrology model, using the model to estimate flow rates and size detention ponds, and applying the model results to develop the preliminary stormwater drainage plan presented in Appendix B. In detail, the steps consisted of:

1. For each scenario, subbasins and catchments were delineated based on topography and observed site conditions such as roadside drainage and culvert locations. Proposed pond subbasins were determined based on the conceptual stormwater conveyance routing and proposed grade elevations of the site so that runoff from developed areas would be intercepted and detained prior to discharging to receiving waters. Then the areas of each

combination of soil types and land covers were tabulated within each catchment and subbasin using Geographic Information System (GIS) software.

2. For the predeveloped and existing condition scenarios, GIS areas were input to the hydrologic models to estimate flow rates at the POIs. Figures A-1 and A-2 are model schematics of the predeveloped and existing scenarios, respectively. The Modeling Methodology section of this appendix presents details about the parameters used in the analyses.

3. For the proposed land use scenario, catchments were identified, areas were aggregated by the land cover types, and total areas of subbasins draining to the proposed ponds were calculated (note that a pond subbasin may contain several different catchments). Within each pond subbasin, GIS software (ESRI ArcGIS 10.1) was used to tabulate the predeveloped and proposed land covers and soils. Tables A-1 and A-2 show land use in acres for the predeveloped and proposed conditions for each proposed catchment shown in Figures A4 through A8. Table A-2 also presents the land cover/soils for the undetained catchments that contribute runoff to each of the POIs (undetained catchments are those areas that contribute runoff to the POI but whose runoff is not routed through one of the proposed ponds). A total of 13 models were then developed: one model for the POI analysis, and 12 models for the pond sizing analyses.

4. Separate MGS Flood models were developed for each subbasin catchment area and respective proposed pond (for example, the Pond 1 model simulates only the Pond 1 subbasin for predeveloped and proposed developed scenarios). Pond detention volumes were sized to control stormwater discharge at the predeveloped flow rates and durations within the corresponding subbasin extents. Proposed pond depths were based on the topography at each proposed pond location. The proposed pond layout shapes were selected to account for proposed grades, existing grades, and discharge locations, and were not necessarily rectilinear. The ponds were sized using the automated routine within the MGS Flood software.

5. For the proposed developed condition scenario, the proposed ponds sized in Step 4, the developed land uses within the project extents, and the existing land uses outside of the project extents were incorporated into a proposed hydrologic model for the project that was then used to estimate the peak flow rates at each hydrologic POI. Refer to Figure A-3 for model schematic and Table A-2 for the catchment area breakdown.

6. The pond bottom areas calculated through the sizing computations in Step 4 were used to establish the minimum pond size and to lay out the ponds in the preliminary stormwater drainage plan (Appendix B). The proposed pond top areas shown in Appendix B were

determined from the interior side slopes, the depth of detention storage, and the freeboard depth. The total pond volume was determined from the preliminary stormwater drainage plan and verified to meet or exceed the pond volume determined through the MGS Flood sizing analysis. The model output reports from the pond sizing computations can be found in Attachment 1 to this Appendix.

MODELING METHODOLOGY

MGSFlood is a general, continuous, rainfall-runoff computer model developed specifically for analysis and design of stormwater management facilities in the lowlands of Western Washington. The program uses the Hydrological Simulation Program-Fortran (HSPF) routine to simulate runoff based on specified rainfall data. HSPF uses multi-year inputs of hourly precipitation and evaporation, keeps a running account of the moisture within the soil column and in groundwater storage, and simulates a multi-year (annual) time series or hourly runoff.

The program includes the following subroutines to simulate features associated with stormwater runoff:

- A routing routine that uses a stage-storage-discharge rating table to define a stormwater retention/detention facility or reservoir;
- Routines for computing stream flow magnitude-frequency and duration statistics; and
- Graphics routines for plotting hydrographs and stream flow frequency and duration characteristics.

The program meets the requirements of the *Stormwater Management Manual for Western Washington* (Ecology, 2012).

The MGSFlood model allows the user to select one of four soil types for each subbasin within the modeled area: glacial till, glacial outwash, saturated, and impervious. These soil types generally correspond to the Natural Resource Conservation Service (NRCS) hydrologic soils groups, which are general classifications (A, B, C, or D) assigned by NRCS to reflect the overall capacity of a mapped soil unit to infiltrate water.

The land covers found on the existing project site, and anticipated for the proposed conditions, are a mix of forest, pasture, lawn/landscape, and impervious. Seven soil type/cover combinations were used in the models: till/forest, till/pasture, till/lawn, outwash/forest, outwash/pasture, saturated soil/all cover groups, and impervious.

Subbasins and catchments areas were delineated by AMEC for the predeveloped, existing, and proposed conditions as described above and in the Draft Conceptual Stormwater Management Plan. The catchments were combined into subbasins, which subsequently contributed to selected POIs on the project site. MGSFlood models were then created to simulate predeveloped, existing, and proposed conditions for the following watersheds:

1. Stream 1 & 2 Watershed (includes POIs A through E);
2. Birch Bay Watershed (includes POI F); and
3. Waterfront Bluff Watershed (includes POI G).

In general, the default MGSFlood model parameters were used for the model runs. The following user input characteristics were selected:

- Precipitation data set used in analysis: Extended time series (produces most accurate results by using a combination of historic data and a statistically-based data set for future precipitation rates developed by the software provider and approved by Ecology).
- Climate region: Region 16, Puget East 44 in the Mean Annual Precipitation menu.
- Mean annual precipitation from isopluvial maps embedded in the software: 45.5 inches/year.
- Simulation time span: October 1, 1939, to October 1, 2097.
- Computational time step: 1 hour.

DETENTION POND SIZING RESULTS

Once hydrologic models for the predeveloped and proposed conditions were created, detention ponds were sized using the MGSFlood software. The preliminary sizing of detention ponds followed the flow duration standard, which seeks to maintain predevelopment levels in both the magnitude and duration of stream flow for those flows that exceed the threshold for bedload movement. As specified in the *Stormwater Management Manual for Western Washington* (Ecology, 2012), the threshold for bedload movement is assumed to be 50 percent of the 2-year flow computed for the predeveloped conditions. The intent of this standard is to prevent increases in the rate of stream-channel erosion over that which occurs under predeveloped conditions.

Ecology (2012) requires the following flow duration standard:

- Stormwater discharges shall match developed discharge duration and predeveloped durations for the range of predeveloped discharge rates from 50-percent of the 2-year peak flow, up to the full 50-year peak flow.

Ecology specifies the following tolerance criteria for matching development flow duration curves to predevelopment levels:

1. The exceedance probability of developed flow duration values must not exceed the predeveloped values for discharge rates between one-half of the 2-year discharge and the 2-year discharge.
2. The exceedance probability of developed flow duration values must not exceed the predeveloped exceedance probability by more than 10 percent for the 2-year and 50-year discharges.
3. No more than 50 percent of the developed flow duration values can be greater than the predeveloped values for discharges between one-half of the 2-year discharge and the 50-year discharge.

All three criteria must be met for the ponds to meet the flow duration standard. The attached model output reports show that the proposed ponds each pass the flow duration standard criteria.

MODELING ASSUMPTIONS AND DESIGN CRITERIA

The developed conditions and stormwater detention analysis were conducted based on the following assumptions and design criteria:

Assumptions

- The developed conditions soil types were assumed to be the same as the existing soil types. Open storage areas and areas immediately adjacent (gravel) are considered impervious.
- Railbeds are considered impervious.
- Given the high water table and underlying clay soils for much of the project site, hydraulic conductivity was set at 0 inches per hour (no infiltration) in the stormwater models.

Design Criteria

- The land cover was a mix of forest, pasture, lawn, and impervious.
- Five soil type/cover combinations were used in the models: till/forest, till/pasture, till/lawn, saturated soil/all cover groups, and impervious.
- Wetland flow attenuation and surface water storage within existing wetlands were not included in the preliminary design modeling.
- Conveyance and hydraulic routing of flows in streams and drainages was not modeled.

- Where possible, flows between undisturbed areas and disturbed areas were separated by the inclusion of drainage ditches. These ditches will minimize the required size of stormwater facilities.
- Detention ponds are not designed to detain runoff from existing public roads, or the existing BNSF railroad, unless these areas would be redeveloped through the planned improvements.
- Detention ponds were sized using the “Full Optimization” option for preliminary analysis. Ponds typically have multiple orifices and a riser structure at the outfall.
- Interior side slopes of detention ponds were assumed to be 3 horizontal to 1 vertical (3H:1V).
- The length-to-width ratio of detention ponds was considered to be 2:1 in the models, although the proposed pond layouts shown on the drawings may have varied dimensions due to space limitations.
- 1.0 foot of freeboard would be provided for detention ponds except for the largest pond, which would have a minimum of 1.5 foot freeboard to account for waves and wind fetch.
- The point of compliance for sizing flow control facilities is at the outfall. In other words, compliance with the flow control standard was assessed on a subbasin-by-subbasin basis.

REFERENCES

MGS Software LLC. 2009. MGS Flood – Proprietary Version Users Manual, Version 4. December 31.

Washington State Department of Ecology (Ecology). 2012. *Stormwater Management Manual for Western Washington*. Washington State Department of Ecology, Water Quality Program, Publication Number 05-10-030. August.

FIGURES

Note: See MGS Flood Project Report for input file '2014 Main Site Pre-Dev vs. EX.fld' for detailed input and model results.

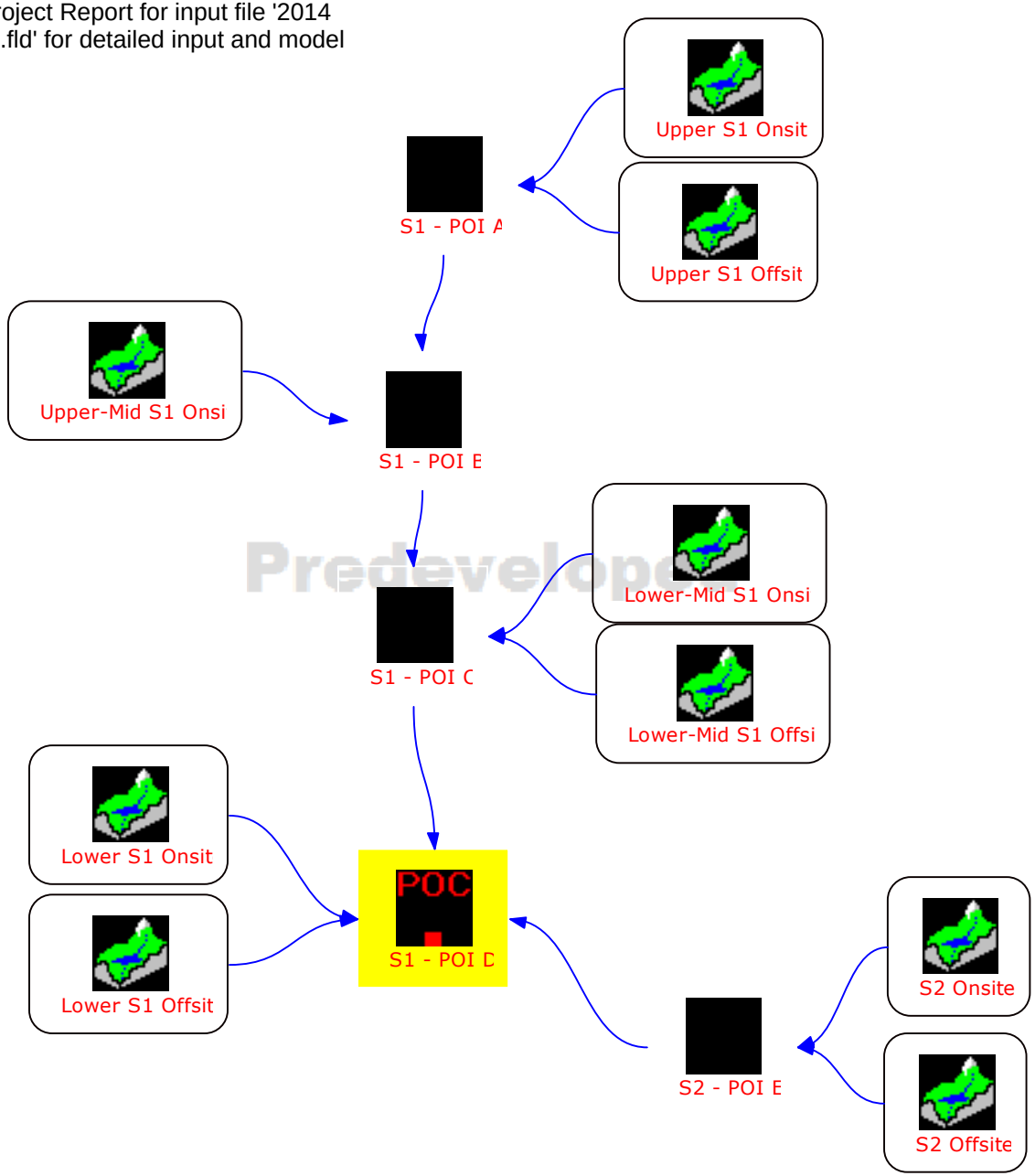


FIGURE A-1: HYDROLOGY MODEL SCHEMATIC FOR PREDEVELOPED HISTORIC CONDITIONS

Note: See MGS Flood Project Report for input file '2014 Main Site Pre-Dev vs. EX.fld' for detailed input and model results.

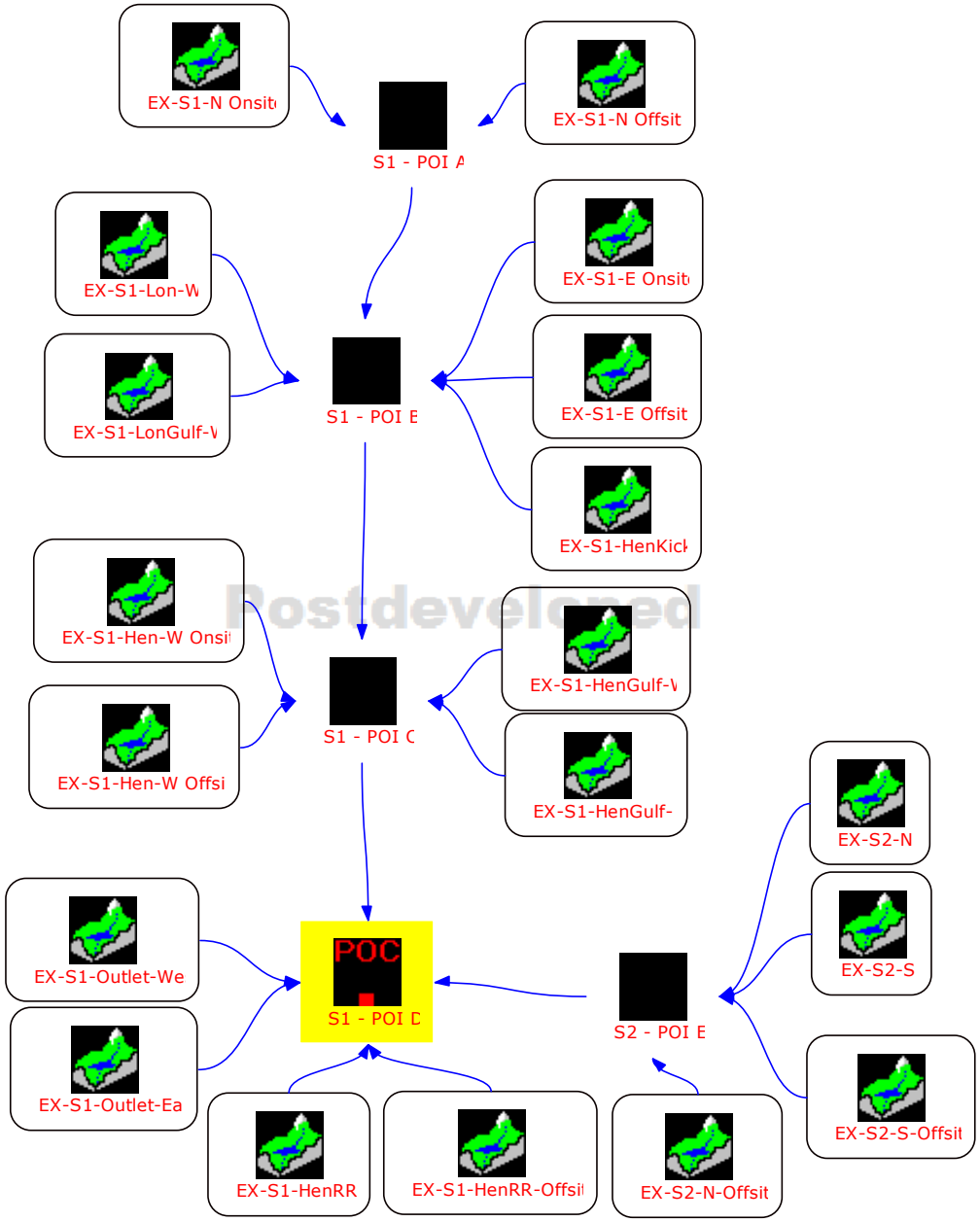


FIGURE A-2: HYDROLOGY MODEL SCHEMATIC FOR EXISTING (2013) CONDITIONS

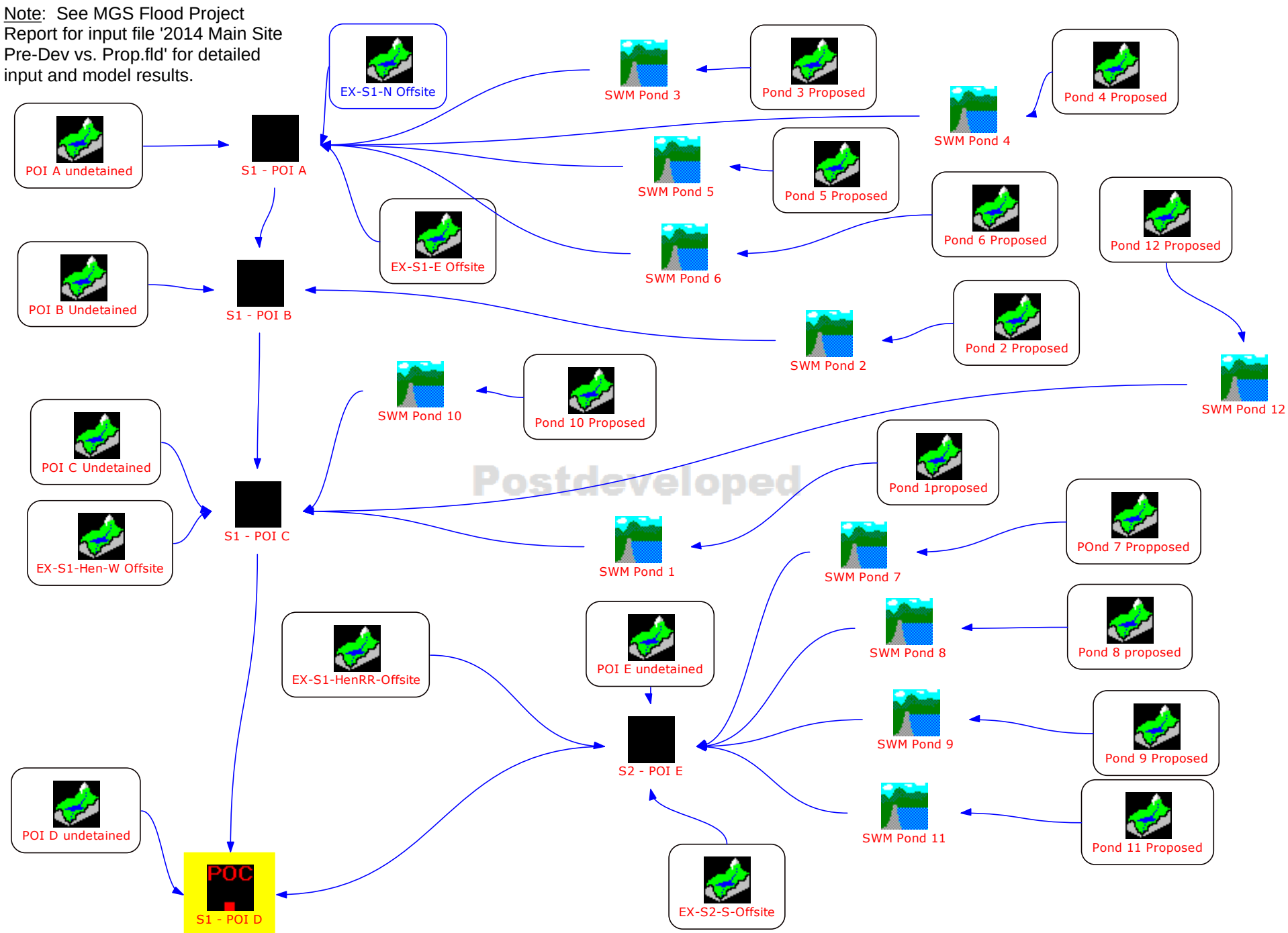
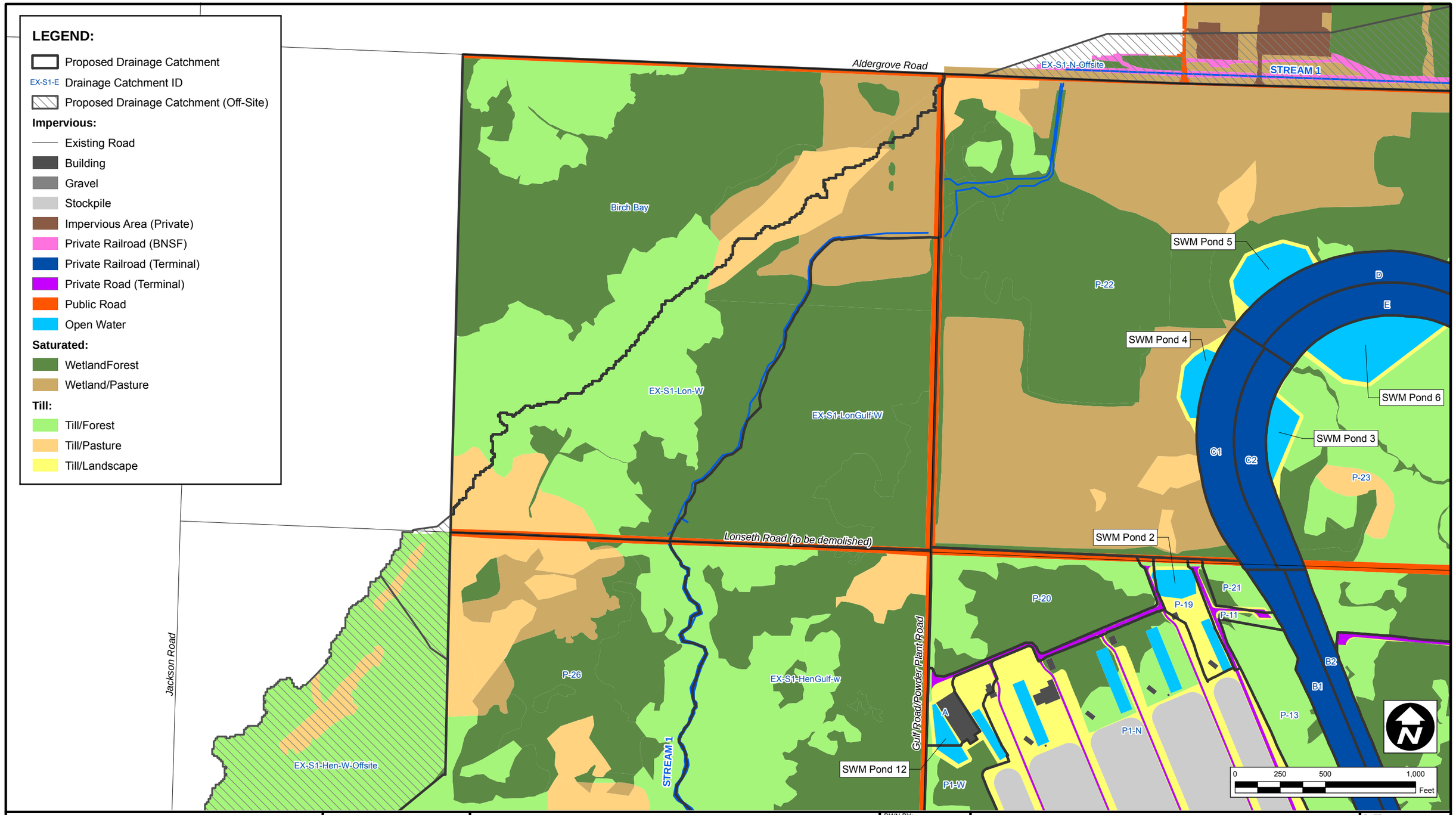


FIGURE A-3: HYDROLOGY MODEL SCHEMATIC FOR PROPOSED DEVELOPED CONDITIONS



NOTE: 1. A preliminary list of stormwater management ponds and associated catchments and subbasins is presented in Table 7 along with a summary of their key characteristics.

2. A list of the sub-watersheds and the associated catchments is presented in Table 6.

3. Existing road alignments were modeled as impervious surfaces but do not appear as roads on this figure due to map scale, symbology and labels.

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AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 500 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PRELIMINARY PROPOSED CATCHMENTS AND LAND TYPES: NORTHWEST

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE A-4

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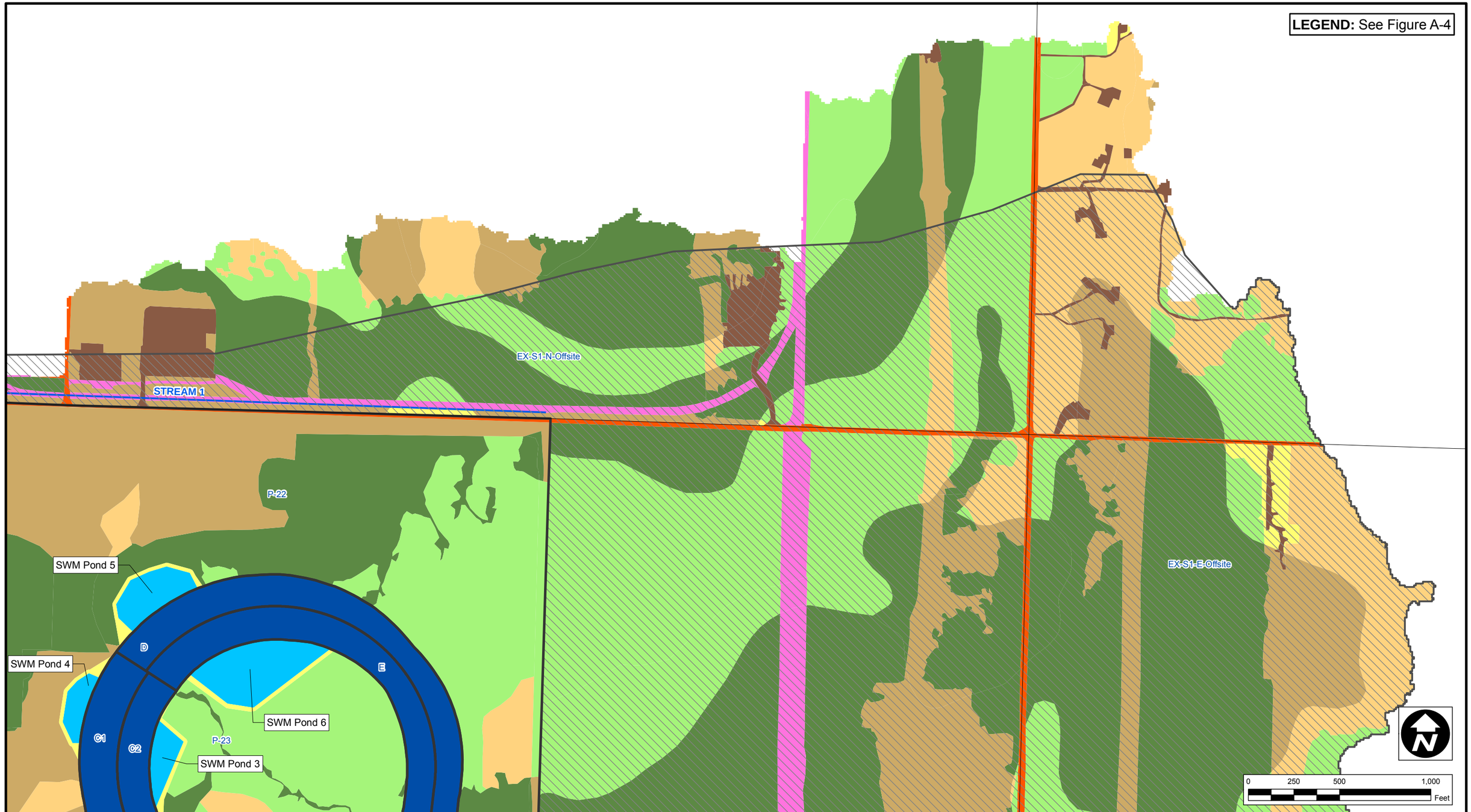

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PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 500 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PRELIMINARY PROPOSED CATCHMENTS AND LAND TYPES: NORTHEAST

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE A-5

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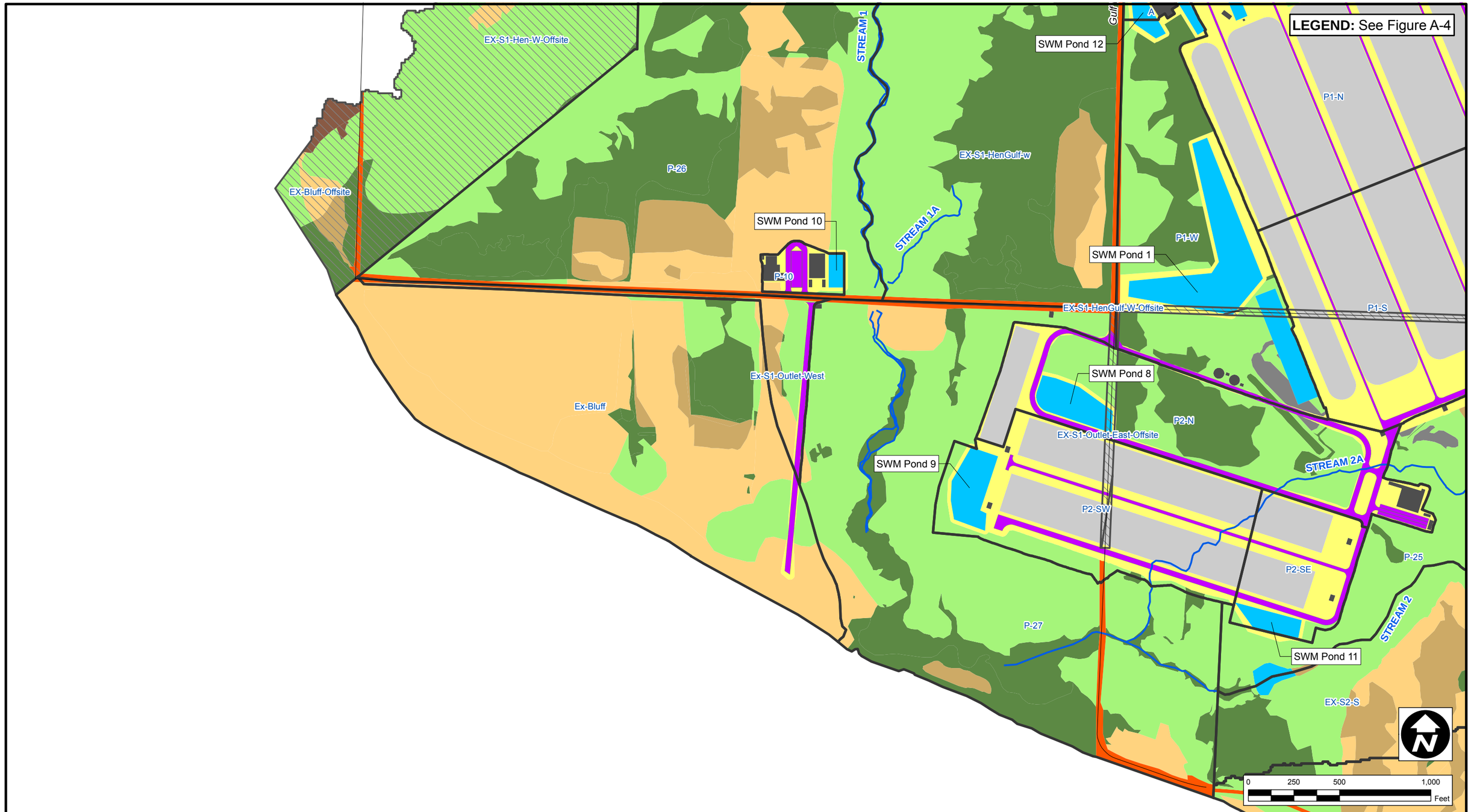

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TITLE: PRELIMINARY PROPOSED CATCHMENTS AND LAND TYPES: SOUTHWEST

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE A-6

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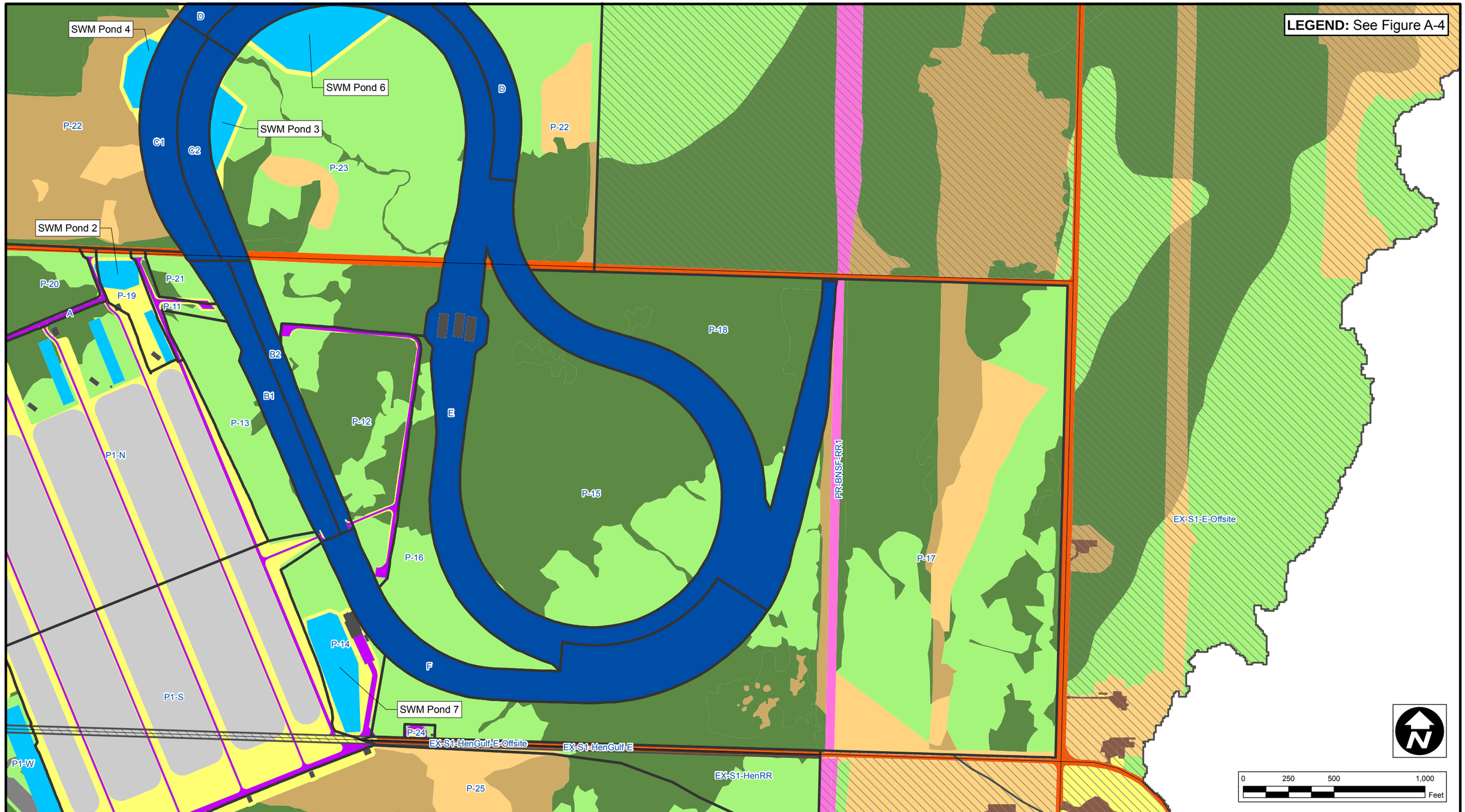

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PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 500 feet

PROJECT:
PROPOSED GATEWAY PACIFIC TERMINAL

TITLE:
PRELIMINARY PROPOSED CATCHMENTS AND LAND TYPES: EAST

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE A-7

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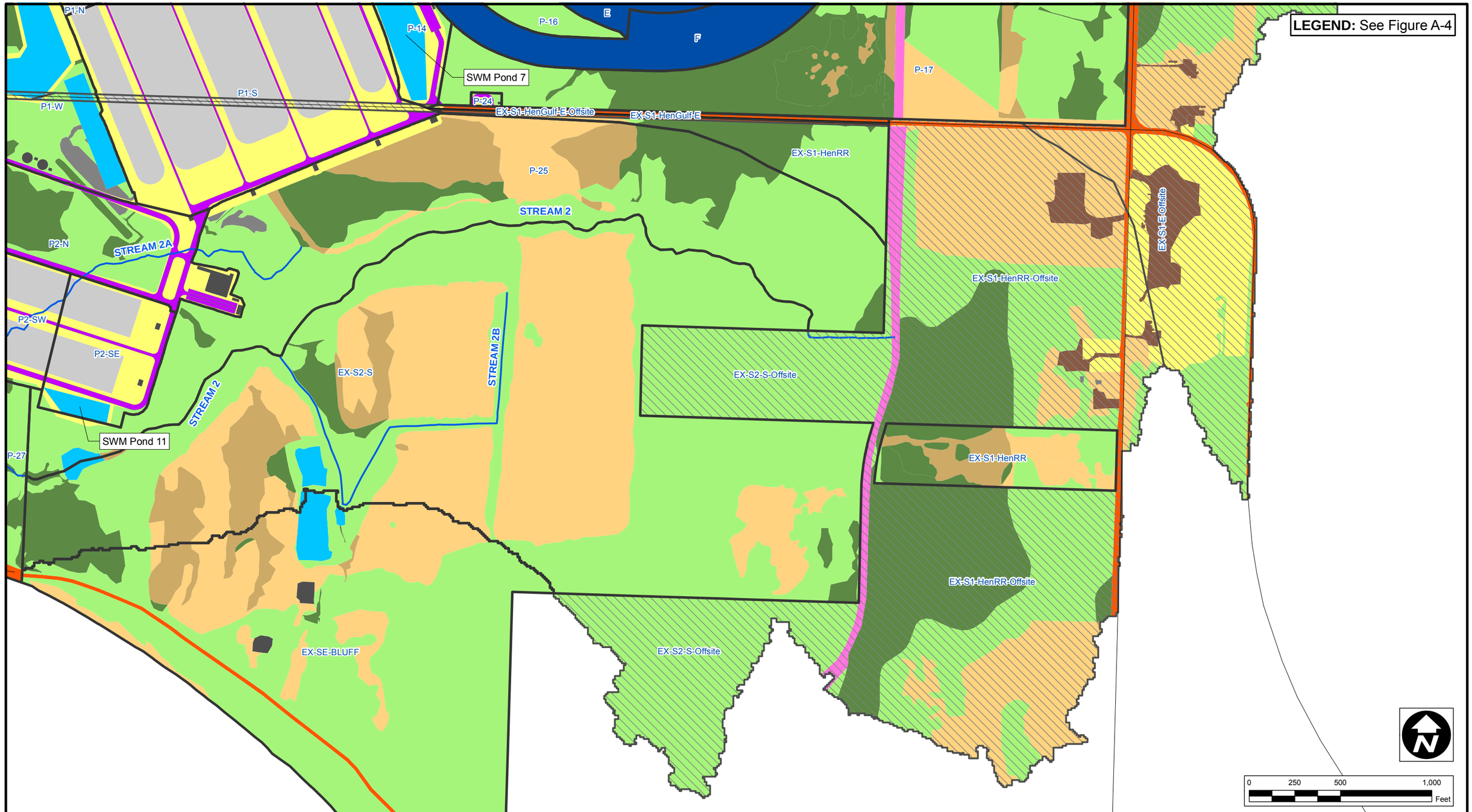

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CHK'D BY:	BT
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 500 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: PRELIMINARY PROPOSED CATCHMENTS AND LAND TYPES: SOUTHEAST

DATE:	JUNE 2014
PROJECT NO.:	091515338C-02-04
REV. NO.:	-
FIGURE NO.:	FIGURE A-8

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-02-04 - Stormwater Report\dwg_Revised_November_2013\Figure A-4-8 Mapbook - Preliminary Proposed Catchments and Land Cover.mxd

TABLES

TABLE A-1:
LAND USE IN PROPOSED CATCHMENT AREAS FOR PREDEVELOPED CONDITIONS

ALL AREAS IN ACRES

	Land Use / Soil for Model, areas in acres		
Catchment Name	**Unsaturated Till Forest**	**Saturated Forest**	**Total Area**
A	2.065	0.863	2.929
B1	2.992	2.331	5.323
B2	1.962	1.383	3.345
Birch Bay	31.129	45.038	76.168
C1	0.663	5.721	6.385
C2	2.301	2.555	4.856
D	7.132	2.731	9.863
E	22.986	21.395	44.381
Ex-Bluff	57.036	4.781	61.818
EX-S1-HenGulf-E	0.665	0.757	1.422
EX-S1-HenGulf-w	41.419	40.669	82.089
EX-S1-HenRR	10.383	8.526	18.909
EX-S1-LonGulf-W	7.682	31.224	38.907
EX-S1-Lon-W	25.310	21.194	46.504
Ex-S1-Outlet-West	5.691	0.037	5.728
EX-S2-S	112.940	15.377	128.316
EX-SE-BLUFF	65.237	5.667	70.904
F	10.634	4.659	15.294
P-10	2.482		2.482
P-11	0.733	0.532	1.265
P-12	5.019	9.116	14.135
P-13	8.038	0.297	8.335
P-14	6.859		6.859
P-15	10.539	31.875	42.414
P-16	6.996	2.663	9.658
P-17	51.331	49.898	101.229
P-18	0.446	17.857	18.303
P-19	1.478	1.413	2.891
P1-N	37.345	15.139	52.485
P1-S	43.881	2.599	46.480
P1-W	21.771	11.485	33.256
P-20	5.667	8.738	14.405
P-21	1.275	0.338	1.614
P-22	37.069	132.395	169.463
P-23	37.948	9.190	47.138
P-24	0.287		0.287
P-25	43.291	21.651	64.942
P-26	47.948	53.271	101.219
P-27	55.435	17.147	72.582
P2-N	19.415	6.946	26.360
P2-SE	9.134	0.549	9.683
P2-SW	25.398	1.106	26.504
Grand Total	**888.016**	**609.113**	**1,497.129**

TABLE A-2: LAND USE FOR PROPOSED SITE CONDITIONS

ALL AREAS IN ACRES

SUBBASIN/ CATCHMENT	Impervious							Impervious Total	Saturated		Saturated Total	Till/Forest	Till/Lawn	Till/Pasture	Water	Grand Total
	Building	Gravel	Impervious Area Not Requiring Water Quality Treatment (BNSF Railroad)	Impervious Area Not Requiring Water Quality Treatment (Public)	Impervious Area Requiring Water Quality Treatment (GPT Railroad)	Impervious Area Requiring Water Quality Treatment (Industrial)	Impervious Area Requiring Water Quality Treatment (Private)		Saturated Soils with Forest	Saturated Soils with Pasture						
POI A			**0.003**	**1.494**			**1.110**	**2.607**	**70.353**	**0.001**	**70.354**	**60.614**	**0.469**	**1.697**	**5.855**	**141.597**
P-12							1.079	1.079	8.213		8.213	4.434	0.409			14.135
P-13									0.297		0.297	8.038				8.335
P-15				0.050				0.050	31.875		31.875	10.489				42.414
P-16									2.663		2.663	6.996				9.658
P-18			0.003					0.003	17.856	0.001	17.857	0.443				18.303
P-21				0.129			0.031	0.160	0.322		0.322	1.072	0.060			1.614
P-23				1.315				1.315	9.127		9.127	29.143		1.697	5.855	47.138
POI B				**6.113**				**6.113**	**111.442**	**77.271**	**188.713**	**42.822**		**15.265**	**1.957**	**254.870**
EX-S1-LonGulf-W				1.777				1.777	33.768	3.361	37.130					38.907
EX-S1-Lon-W				1.228				1.228	13.986	7.137	21.123	16.581		7.569		46.502
P-22				3.108				3.108	63.687	66.772	130.460	26.241		7.696	1.957	169.462
POI C	**0.053**			**6.309**				**6.362**	**88.265**	**18.191**	**106.456**	**60.103**	**0.014**	**26.497**	**1.167**	**200.599**
EX-S1-HenGulf-w				3.132				3.132	39.998	3.482	43.480	31.426		4.050		82.088
P-19	0.053			0.123				0.176	0.967		0.967	0.567	0.014		1.167	2.891
P-20				1.013				1.013	8.738		8.738	4.654	0.000			14.405
P-26				2.042				2.042	38.562	14.709	53.271	23.456		22.447		101.216
POI D	**0.042**			**3.536**			**0.817**	**4.395**	**16.800**	**1.290**	**18.090**	**48.738**	**0.203**	**6.940**		**78.367**
Ex-S1-Outlet-West				0.962			0.661	1.622	0.094	0.623	0.717	1.619	0.185	1.586		5.728
P-27	0.042			2.574			0.157	2.773	16.706	0.667	17.373	47.120	0.019	5.355		72.639
POI E	**0.104**	**0.585**	**2.969**	**2.339**			**0.106**	**6.104**	**65.251**	**27.988**	**93.239**	**142.308**	**0.198**	**71.298**	**1.278**	**314.424**
EX-S1-HenGulf-E				1.388			0.003	1.392					0.031			1.422
EX-S1-HenRR				0.884				0.884	5.573	2.441	8.014	7.280	0.013	2.718		18.909
EX-S2-S									6.780	7.938	14.717	59.900		52.660	0.965	128.242
P-17			2.969	0.060			0.012	3.042	41.439	8.459	49.898	37.443		10.846		101.229
P-24	0.014			0.005			0.091	0.110				0.097	0.079			0.287
P-25	0.090	0.585						0.676	11.460	9.150	20.610	37.588	0.075	5.074	0.312	64.334
POI F				**1.242**				**1.242**	**39.150**	**5.893**	**45.043**	**25.587**		**4.284**		**76.157**
Birch Bay				1.242				1.242	39.150	5.893	45.043	25.587		4.284		76.157
POI G	**0.445**			**1.453**			**0.370**	**2.268**	**5.723**	**4.977**	**10.700**	**55.767**	**0.249**	**62.276**	**1.481**	**132.741**
Ex-Bluff				0.018			0.370	0.388	4.427	2.087	6.514	7.350	0.249	47.336		61.837
EX-SE-BLUFF	0.445			1.435				1.879	1.297	2.889	4.186	48.417		14.941	1.481	70.904
SWM Pond 1	**0.742**	**0.007**		**0.554**		**60.118**	**5.785**	**67.207**	**3.653**	**0.003**	**3.656**	**5.482**	**42.530**	**0.002**	**13.381**	**132.257**
P1-N	0.550					30.770	2.174	33.494	2.592		2.592	2.595	12.116		1.724	52.521
P1-S	0.004	0.007		0.000		29.348	3.026	32.386		0.003	0.003	0.319	13.771	0.002		46.480
P1-W	0.188			0.554			0.585	1.327	1.061		1.061	2.568	16.643		11.656	33.256
SWM Pond 10	**0.578**			**0.002**			**0.699**	**1.280**				**0.167**	**0.549**	**0.121**	**0.365**	**2.482**
P-10	0.578			0.002			0.699	1.280				0.167	0.549	0.121	0.365	2.482
SWM Pond 11	**0.042**					**3.906**	**0.997**	**4.944**	**0.040**		**0.040**	**0.278**	**3.431**		**0.991**	**9.683**
P2-SE	0.042					3.906	0.997	4.944	0.040		0.040	0.278	3.431		0.991	9.683
SWM Pond 12	**0.760**			**0.102**			**0.727**	**1.589**	**0.048**		**0.048**	**0.910**	**0.382**		**0.000**	**2.929**
A	0.760			0.102			0.727	1.589	0.048		0.048	0.910	0.382		0.000	2.929
SWM Pond 2				**0.049**	**5.299**		**0.390**	**5.738**	**0.195**		**0.195**	**0.373**	**0.282**		**0.000**	**6.588**
B1					5.299		0.015	5.313					0.010			5.323
P-11				0.049			0.376	0.425	0.195		0.195	0.373	0.272		0.000	1.265
SWM Pond 3					**8.174**		**0.019**	**8.193**					**0.008**			**8.201**
B2					3.318		0.019	3.336					0.008			3.345
C2					4.856			4.856								4.856
SWM Pond 4					**6.385**			**6.385**								**6.385**
C1					6.385			6.385								6.385
SWM Pond 5					**9.863**			**9.863**								**9.863**
D					9.863			9.863								9.863
SWM Pond 6	**0.497**				**43.884**			**44.381**	**0.000**		**0.000**	**0.000**				**44.381**
E	0.497				43.884			44.381	0.000		0.000	0.000				44.381
SWM Pond 7	**0.226**			**0.000**	**15.294**		**0.541**	**16.061**				**3.077**	**0.651**		**2.364**	**22.153**
F					15.294			15.294								15.294
P-14	0.226			0.000			0.541	0.767				3.077	0.651		2.364	6.859
SWM Pond 8	**0.452**	**0.088**		**0.169**		**2.071**	**3.436**	**6.215**	**4.613**		**4.613**	**6.503**	**2.930**		**6.100**	**26.360**
P2-N	0.452	0.088		0.169		2.071	3.436	6.215	4.613		4.613	6.503	2.930		6.100	26.360
SWM Pond 9	**0.042**			**0.073**		**13.370**	**1.628**	**15.112**	**0.090**		**0.090**	**1.904**	**6.630**		**2.769**	**26.504**
P2-SW	0.042			0.073		13.370	1.628	15.112	0.090		0.090	1.904	6.630		2.769	26.504
Grand Total	**3.982**	**0.681**	**2.972**	**23.434**	**88.898**	**79.464**	**16.625**	**216.057**	**405.622**	**135.613**	**541.235**	**454.635**	**58.527**	**188.381**	**37.708**	**1,496.542**

UNDETAINED CATCHMENTS

DETAINED CATCHMENTS

ATTACHMENT 1

MGS Flood Model Output

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/11/2014 2:12 PM

Input File Name: 2014 Main Site Pre-Dev vs. EX.fld
Project Name: GPT - Main Site Pre-Dev vs. Existing
Analysis Title: Ecology (Pre-Developed vs. Existing)
Comments: MGR - 11/7/12; Updated April 2014 BLT

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9

---------- Subbasin : Upper S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	159.750
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	215.520
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 375.270

---------- Subbasin : Upper S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	240.460
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	268.500
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	508.960

---------- Subbasin : Upper-Mid S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	22.100
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	78.340
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	100.440

---------- Subbasin : Lower-Mid S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	4.160
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	4.160

---------- Subbasin : Lower-Mid S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	148.110
Till Pasture	0.000

Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	118.070
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	266.180

---------- Subbasin : Lower S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	107.220
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.520
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	141.740

---------- Subbasin : S2 Onsite ----------

	-------Area(Acres) --------
Till Forest	275.080
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	71.650
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	346.730

---------- Subbasin : S2 Offsite ----------

	-------Area(Acres) --------
Till Forest	101.230
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.380
Green Roof	0.000
User	0.000

Impervious	0.000
Subbasin Total	135.610

---------- Subbasin : Lower S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.910
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	1.910

----------SCENARIO: EXISTING

Number of Subbasins: 19

---------- Subbasin : EX-S1-N Onsite ----------

	-------Area(Acres) --------
Till Forest	76.350
Till Pasture	2.030
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	90.550
Green Roof	0.000
User	0.000
Impervious	1.880
Subbasin Total	170.810

---------- Subbasin : EX-S1-N Offsite ----------

	-------Area(Acres) --------
Till Forest	80.130
Till Pasture	35.510
Till Grass	0.400
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	62.640
Green Roof	0.000
User	0.000
Impervious	20.300
Subbasin Total	198.980

```
 ---------- Subbasin : EX-S1-Lon-W ----------
                        -------Area(Acres) --------
Till Forest                 21.320
Till Pasture                2.830
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     21.130
Green Roof                  0.000
User                        0.000
Impervious                  0.480
---------------------------------------------
Subbasin Total              45.760


 ---------- Subbasin : EX-S1-HenGulf-W ----------
                        -------Area(Acres) --------
Till Forest                 36.740
Till Pasture                1.570
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     40.610
Green Roof                  0.000
User                        0.000
Impervious                  0.930
---------------------------------------------
Subbasin Total              79.850


 ---------- Subbasin : EX-S1-Hen-W Onsite ----------
                        -------Area(Acres) --------
Till Forest                 38.700
Till Pasture                17.520
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     45.310
Green Roof                  0.000
User                        0.000
Impervious                  0.930
---------------------------------------------
Subbasin Total              102.460


 ---------- Subbasin : EX-S1-Outlet-West ----------
                        -------Area(Acres) --------
Till Forest                 15.830
Till Pasture                2.550
Till Grass                  0.000
Outwash Forest              0.050
```

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.630
Green Roof	0.000
User	0.000
Impervious	0.650
Subbasin Total	22.710

---------- Subbasin : EX-S2-N ----------

	-------Area(Acres) --------
Till Forest	89.490
Till Pasture	9.400
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	32.110
Green Roof	0.000
User	0.000
Impervious	2.790
Subbasin Total	133.790

---------- Subbasin : EX-S2-N-Offsite ----------

	-------Area(Acres) --------
Till Forest	1.350
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.310
Subbasin Total	1.660

---------- Subbasin : EX-S1-Outlet-East ----------

	-------Area(Acres) --------
Till Forest	46.770
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	3.690
Outwash Pasture	0.670
Outwash Grass	0.000
Wetland	8.380
Green Roof	0.000
User	0.000
Impervious	0.280

Subbasin Total	59.790

---------- Subbasin : EX-S1-LonGulf-W ----------

	-------Area(Acres) --------
Till Forest	5.890
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	31.240
Green Roof	0.000
User	0.000
Impervious	0.730
Subbasin Total	37.860

---------- Subbasin : EX-S1-E Onsite ----------

	-------Area(Acres) --------
Till Forest	3.380
Till Pasture	2.690
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	60.130
Green Roof	0.000
User	0.000
Impervious	1.310
Subbasin Total	67.510

---------- Subbasin : EX-S1-HenKick ----------

	-------Area(Acres) --------
Till Forest	76.680
Till Pasture	0.510
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	127.650
Green Roof	0.000
User	0.000
Impervious	4.950
Subbasin Total	209.790

---------- Subbasin : EX-S1-E Offsite ----------

	-------Area(Acres) --------
Till Forest	94.720
Till Pasture	50.540

Till Grass	14.450
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	188.800
Green Roof	0.000
User	0.000
Impervious	20.000
Subbasin Total	368.510

---------- Subbasin : EX-S1-Hen-W Offsite ----------

	-------Area(Acres) --------
Till Forest	38.020
Till Pasture	2.580
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.000
Green Roof	0.000
User	0.000
Impervious	0.460
Subbasin Total	43.060

---------- Subbasin : EX-S1-HenGulf-E ----------

	-------Area(Acres) --------
Till Forest	131.390
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	59.650
Green Roof	0.000
User	0.000
Impervious	2.290
Subbasin Total	193.330

---------- Subbasin : EX-S1-HenRR ----------

	-------Area(Acres) --------
Till Forest	7.590
Till Pasture	2.810
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	8.040
Green Roof	0.000
User	0.000

Impervious	0.000
Subbasin Total	18.440

---------- Subbasin : EX-S2-S ----------

	-------Area(Acres) --------
Till Forest	66.710
Till Pasture	54.600
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	18.310
Green Roof	0.000
User	0.000
Impervious	0.650
Subbasin Total	140.270

---------- Subbasin : EX-S2-S-Offsite ----------

	-------Area(Acres) --------
Till Forest	33.780
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.090
Subbasin Total	34.870

---------- Subbasin : EX-S1-HenRR-Offsite ----------

	-------Area(Acres) --------
Till Forest	29.480
Till Pasture	31.250
Till Grass	2.230
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	27.120
Green Roof	0.000
User	0.000
Impervious	8.930
Subbasin Total	99.010

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

********** **LINK DATA** **********

----------SCENARIO: EXISTING
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C

Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9
Number of Links: 5

********** **Subbasin: Upper S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.988
5-Year	34.852
10-Year	42.792
25-Year	55.261
50-Year	68.844
100-Year	78.256
200-Year	91.824

********** **Subbasin: Upper S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	29.806
5-Year	45.065
10-Year	55.791
25-Year	70.969
50-Year	88.801
100-Year	101.073
200-Year	120.007

********** **Subbasin: Upper-Mid S1 Onsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.580
5-Year	11.074
10-Year	13.784
25-Year	18.193
50-Year	22.391
100-Year	25.339
200-Year	28.507

********** **Subbasin: Lower-Mid S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.172
10-Year	0.229
25-Year	0.286
50-Year	0.341
100-Year	0.383
200-Year	0.571

********** **Subbasin: Lower-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.141
5-Year	21.423
10-Year	26.531
25-Year	34.326
50-Year	42.151
100-Year	48.105
200-Year	58.509

********** **Subbasin: Lower S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.509
5-Year	8.787
10-Year	11.116
25-Year	15.089
50-Year	17.003
100-Year	19.584
200-Year	25.760

********** **Subbasin: S2 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.711
5-Year	20.228
10-Year	25.493
25-Year	35.088
50-Year	39.137
100-Year	45.187
200-Year	60.581

********** **Subbasin: S2 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.394
5-Year	8.484
10-Year	10.815
25-Year	14.630
50-Year	16.527
100-Year	19.025
200-Year	24.904

********** **Subbasin: Lower S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.174
5-Year	0.254
10-Year	0.321
25-Year	0.415
50-Year	0.506
100-Year	0.571
200-Year	0.622

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794

5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	99.103
5-Year	150.266
10-Year	186.185
25-Year	241.343
50-Year	295.666
100-Year	337.500
200-Year	411.276

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)

==========

2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

********** Link: S2 - POI E ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

----------SCENARIO: EXISTING

Number of Subbasins: 19

Number of Links: 5

********** **Subbasin: EX-S1-N Onsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	10.391
5-Year	15.710
10-Year	19.389
25-Year	24.380
50-Year	30.678
100-Year	34.844
200-Year	41.421

********** **Subbasin: EX-S1-N Offsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.561
5-Year	19.245
10-Year	24.733

25-Year	29.008
50-Year	35.791
100-Year	40.201
200-Year	51.537

********** **Subbasin: EX-S1-Lon-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.589
5-Year	3.948
10-Year	4.875
25-Year	6.231
50-Year	7.710
100-Year	8.770
200-Year	10.677

********** **Subbasin: EX-S1-HenGulf-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.775
5-Year	7.212
10-Year	8.882
25-Year	11.173
50-Year	14.057
100-Year	15.973
200-Year	19.111

********** **Subbasin: EX-S1-Hen-W Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.705
5-Year	8.932
10-Year	11.068
25-Year	14.113
50-Year	17.317
100-Year	19.695
200-Year	24.368

********** **Subbasin: EX-S1-Outlet-West** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.900
5-Year	1.424
10-Year	1.884
25-Year	2.341
50-Year	2.710
100-Year	3.106
200-Year	4.277

********** **Subbasin: EX-S2-N** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.754
5-Year	9.057
10-Year	11.610
25-Year	15.097
50-Year	17.413
100-Year	19.925
200-Year	26.322

********** **Subbasin: EX-S2-N-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.108
5-Year	0.147
10-Year	0.176
25-Year	0.219
50-Year	0.247
100-Year	0.273
200-Year	0.375

********** **Subbasin: EX-S1-Outlet-East** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.913
5-Year	3.042
10-Year	3.964
25-Year	5.237
50-Year	5.826
100-Year	6.747
200-Year	9.279

********** **Subbasin: EX-S1-LonGulf-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136
5-Year	4.577
10-Year	5.614
25-Year	7.312
50-Year	9.041
100-Year	10.199
200-Year	11.419

********** **Subbasin: EX-S1-E Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.917
5-Year	8.649
10-Year	10.662
25-Year	13.814
50-Year	17.092
100-Year	19.261
200-Year	21.427

********** **Subbasin: EX-S1-HenKick** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.288
5-Year	21.143
10-Year	26.282
25-Year	33.271
50-Year	41.732
100-Year	47.224
200-Year	55.098

********** **Subbasin: EX-S1-E Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	25.639
5-Year	39.603
10-Year	48.573

25-Year	59.241
50-Year	75.159
100-Year	84.953
200-Year	103.148

********** **Subbasin: EX-S1-Hen-W Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.271
5-Year	2.136
10-Year	2.757
25-Year	3.478
50-Year	4.108
100-Year	4.523
200-Year	6.666

********** **Subbasin: EX-S1-HenGulf-E** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	8.741
5-Year	13.641
10-Year	17.375
25-Year	22.778
50-Year	26.458
100-Year	30.277
200-Year	38.619

********** **Subbasin: EX-S1-HenRR** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.989
5-Year	1.536
10-Year	1.912
25-Year	2.468
50-Year	3.017
100-Year	3.439
200-Year	4.256

********** **Subbasin: EX-S2-S** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.182
5-Year	8.476
10-Year	11.299
25-Year	14.680
50-Year	16.655
100-Year	18.905
200-Year	27.243

********** **Subbasin: EX-S2-S-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028
5-Year	1.736
10-Year	2.185
25-Year	2.846
50-Year	3.245
100-Year	3.633
200-Year	5.308

********** **Subbasin: EX-S1-HenRR-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.095
5-Year	9.300
10-Year	12.023
25-Year	14.220
50-Year	17.509
100-Year	19.727
200-Year	25.940

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.783
5-Year	35.401
10-Year	44.118
25-Year	54.195
50-Year	66.469
100-Year	75.045
200-Year	92.958

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.783
5-Year	35.401
10-Year	44.118
25-Year	54.195
50-Year	66.469
100-Year	75.045
200-Year	92.958

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.883
5-Year	113.875
10-Year	140.353
25-Year	170.880
50-Year	217.202
100-Year	245.453
200-Year	294.727

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.883
5-Year	113.875
10-Year	140.353
25-Year	170.880
50-Year	217.202
100-Year	245.453
200-Year	294.727

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	94.681
5-Year	145.621
10-Year	180.303
25-Year	222.900
50-Year	278.856
100-Year	315.846
200-Year	383.466

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	94.681
5-Year	145.621
10-Year	180.303
25-Year	222.900
50-Year	278.856
100-Year	315.846
200-Year	383.466

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	115.684
5-Year	181.188
10-Year	226.541
25-Year	282.700
50-Year	344.906
100-Year	391.387
200-Year	486.396

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	11.996
5-Year	19.048
10-Year	25.876
25-Year	31.841
50-Year	37.039

100-Year	42.523
200-Year	59.178

********** Link: S2 - POI E ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	11.996
5-Year	19.048
10-Year	25.876
25-Year	31.841
50-Year	37.039
100-Year	42.523
200-Year	59.178

*************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: Upper S1 Onsite	79209.340
Subbasin: Upper S1 Offsite	106602.400
Subbasin: Upper-Mid S1 Onsite	21916.450
Subbasin: Lower-Mid S1 Offsite	795.220
Subbasin: Lower-Mid S1 Onsite	54976.730
Subbasin: Lower S1 Onsite	28291.810
Subbasin: S2 Onsite	68764.910
Subbasin: S2 Offsite	27115.160
Subbasin: Lower S1 Offsite	431.343
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable
Link: S2 - POI E	Not Applicable
Total:	388103.400

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: EX-S1-N Onsite	35428.230
Subbasin: EX-S1-N Offsite	36232.660
Subbasin: EX-S1-Lon-W	9382.697
Subbasin: EX-S1-HenGulf-W	16491.270
Subbasin: EX-S1-Hen-W Onsite	20944.460
Subbasin: EX-S1-Outlet-West	4343.835
Subbasin: EX-S2-N	26136.420
Subbasin: EX-S2-N-Offsite	258.064

Subbasin: EX-S1-Outlet-East	12248.760	
Subbasin: EX-S1-LonGulf-W		8180.980
Subbasin: EX-S1-E Onsite		14734.360
Subbasin: EX-S1-HenKick		43582.230
Subbasin: EX-S1-E Offsite	72175.780	
Subbasin: EX-S1-Hen-W Offsite		8207.551
Subbasin: EX-S1-HenGulf-E		38587.330
Subbasin: EX-S1-HenRR		3798.140
Subbasin: EX-S2-S	27215.350	
Subbasin: EX-S2-S-Offsite	6457.336	
Subbasin: EX-S1-HenRR-Offsite		17960.070
Link: S1 - POI A	Not Applicable	
Link: S1 - POI B	Not Applicable	
Link: S1 - POI C	Not Applicable	
Link: S1 - POI D	Not Applicable	
Link: S2 - POI E	Not Applicable	
Total:		402365.500

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2456.351 ac-ft/year, Post Developed: 2546.617 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 5

----------SCENARIO: EXISTING

Number of Links: 5

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: S1 - POI D
Scenario Existing Compliance Link: S1 - POI D

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	99.103	2-Year	115.684
5-Year	150.266	5-Year	181.188
10-Year	186.185	10-Year	226.541
25-Year	241.343	25-Year	282.700
50-Year	295.666	50-Year	344.906
100-Year	337.500	100-Year	391.387
200-Year	411.276	200-Year	486.396

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	44.9%	FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	65.4%	FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	100.0%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/14/2014 10:27 AM

Input File Name: 2014 Main Site Pre-Dev vs. Prop.fld
Project Name: GPT - Main Site Pre-Dev vs. Proposed
Analysis Title: POI Flow Calc (PreDev and Proposed)
Comments: MGR - 11/7/12; Updated April 2014 BLT

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9

---------- Subbasin : Upper S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	159.750
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	215.520
Green Roof	0.000
User	0.000
Impervious	0.000

```
---------------------------------------------
Subbasin Total              375.270


 ---------- Subbasin : Upper S1 Offsite ----------
                        -------Area(Acres) --------
Till Forest                 240.460
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     268.500
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              508.960


 ---------- Subbasin : Upper-Mid S1 Onsite ----------
                        -------Area(Acres) --------
Till Forest                 22.100
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     78.340
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              100.440


 ---------- Subbasin : Lower-Mid S1 Offsite ----------
                        -------Area(Acres) --------
Till Forest                 4.160
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              4.160


 ---------- Subbasin : Lower-Mid S1 Onsite ----------
```

```
                        -------Area(Acres) --------
Till Forest                     148.110
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         118.070
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  266.180


 ---------- Subbasin : Lower S1 Onsite ----------
                        -------Area(Acres) --------
Till Forest                     107.220
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         34.520
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  141.740


 ---------- Subbasin : S2 Onsite ----------
                        -------Area(Acres) --------
Till Forest                     275.080
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         71.650
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  346.730


 ---------- Subbasin : S2 Offsite ----------
                        -------Area(Acres) --------
Till Forest                     101.230
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
```

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.380
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	135.610

---------- Subbasin : Lower S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.910
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	1.910

----------SCENARIO: PROPOSED
Number of Subbasins: 22

---------- Subbasin : POI A undetained ----------

	-------Area(Acres) --------
Till Forest	60.614
Till Pasture	1.697
Till Grass	0.469
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	70.354
Green Roof	0.000
User	0.000
Impervious	8.462
Subbasin Total	141.596

---------- Subbasin : EX-S1-N Offsite ----------

	-------Area(Acres) --------
Till Forest	80.130
Till Pasture	35.510
Till Grass	0.400
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000

```
Wetland                 62.640
Green Roof              0.000
User                    0.000
Impervious              20.300
---------------------------------------------
Subbasin Total          198.980


 ---------- Subbasin : POI B Undetained ----------
                       -------Area(Acres) --------
Till Forest             42.822
Till Pasture            15.265
Till Grass              0.000
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 188.713
Green Roof              0.000
User                    0.000
Impervious              8.070
---------------------------------------------
Subbasin Total          254.870


 ---------- Subbasin : POI C Undetained ----------
                       -------Area(Acres) --------
Till Forest             60.103
Till Pasture            26.497
Till Grass              0.014
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 106.456
Green Roof              0.000
User                    0.000
Impervious              7.529
---------------------------------------------
Subbasin Total          200.599


 ---------- Subbasin : POI D undetained ----------
                       -------Area(Acres) --------
Till Forest             48.738
Till Pasture            6.940
Till Grass              0.203
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 18.090
Green Roof              0.000
User                    0.000
Impervious              4.395
---------------------------------------------
```

```
Subbasin Total              78.366

 ---------- Subbasin : POI E undetained ----------
                       -------Area(Acres) --------
Till Forest                 142.308
Till Pasture                71.298
Till Grass                  0.198
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     93.239
Green Roof                  0.000
User                        0.000
Impervious                  7.382
---------------------------------------------
Subbasin Total              314.425

 ---------- Subbasin : EX-S1-E Offsite ----------
                       -------Area(Acres) --------
Till Forest                 94.720
Till Pasture                50.540
Till Grass                  14.450
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     188.800
Green Roof                  0.000
User                        0.000
Impervious                  20.000
---------------------------------------------
Subbasin Total              368.510

 ---------- Subbasin : EX-S1-Hen-W Offsite ----------
                       -------Area(Acres) --------
Till Forest                 38.020
Till Pasture                2.580
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     2.000
Green Roof                  0.000
User                        0.000
Impervious                  0.460
---------------------------------------------
Subbasin Total              43.060

 ---------- Subbasin : EX-S2-S-Offsite ----------
                       -------Area(Acres) --------
```

Till Forest	33.780
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.090
Subbasin Total	34.870

---------- Subbasin : EX-S1-HenRR-Offsite ----------

	-------Area(Acres) --------
Till Forest	29.480
Till Pasture	31.250
Till Grass	2.230
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	27.120
Green Roof	0.000
User	0.000
Impervious	8.930
Subbasin Total	99.010

---------- Subbasin : Pond 1proposed ----------

	-------Area(Acres) --------
Till Forest	5.482
Till Pasture	0.000
Till Grass	42.530
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.656
Green Roof	0.000
User	0.000
Impervious	80.588
Subbasin Total	132.256

---------- Subbasin : Pond 2 Proposed ----------

	-------Area(Acres) --------
Till Forest	0.373
Till Pasture	0.000
Till Grass	0.282
Outwash Forest	0.000

```
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.195
Green Roof               0.000
User                     0.000
Impervious               5.738
---------------------------------------------
Subbasin Total           6.588

 ---------- Subbasin : Pond 3 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.008
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
Impervious               8.193
---------------------------------------------
Subbasin Total           8.201

 ---------- Subbasin : Pond 4 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.000
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
Impervious               6.385
---------------------------------------------
Subbasin Total           6.385

 ---------- Subbasin : Pond 5 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.000
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
```

```
Impervious                  9.863
----------------------------------------------
Subbasin Total              9.863


 ---------- Subbasin : Pond 6 Proposed ----------
                       -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  44.381
----------------------------------------------
Subbasin Total              44.381


 ---------- Subbasin : POnd 7 Propposed ----------
                       -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  3.728
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  18.421
----------------------------------------------
Subbasin Total              22.149


 ---------- Subbasin : Pond 8 proposed ----------
                       -------Area(Acres) --------
Till Forest                 6.503
Till Pasture                0.000
Till Grass                  2.930
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     4.613
Green Roof                  0.000
User                        0.000
Impervious                  12.315
----------------------------------------------
Subbasin Total              26.361
```

```
---------- Subbasin : Pond 9 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 1.904
Till Pasture                0.000
Till Grass                  6.630
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.090
Green Roof                  0.000
User                        0.000
Impervious                  17.881
----------------------------------------------
Subbasin Total              26.505

---------- Subbasin : Pond 10 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  0.837
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  1.645
----------------------------------------------
Subbasin Total              2.482

---------- Subbasin : Pond 11 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.278
Till Pasture                0.000
Till Grass                  3.431
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.040
Green Roof                  0.000
User                        0.000
Impervious                  5.935
----------------------------------------------
Subbasin Total              9.684

---------- Subbasin : Pond 12 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.910
Till Pasture                0.000
Till Grass                  0.382
```

Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.048
Green Roof	0.000
User	0.000
Impervious	1.589
Subbasin Total	2.929

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

********** **LINK DATA** **********

----------SCENARIO: PROPOSED
Number of Links: 17

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: SWM Pond 1
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 88.00
Riser Crest Elevation (ft) : 98.00
Max Pond Elevation (ft) : 99.50
Storage Depth (ft) : 10.00
Pond Bottom Length (ft) : 760.6
Pond Bottom Width (ft) : 152.1
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 115687.
Area at Riser Crest El (sq-ft) : 174,049.
(acres) : 3.996
Volume at Riser Crest (cu-ft) : 1,442,681.
(ac-ft) : 33.119
Area at Max Elevation (sq-ft) : 183425.
(acres) : 4.211
Vol at Max Elevation (cu-ft) : 1,745,577.
(ac-ft) : 40.073

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 54.00
Common Length (ft) : 0.310
Riser Crest Elevation : 98.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 88.00
Diameter (in) : 6.11
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 93.94
Length (in) : 3.76
Height (in) : 48.74
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 2
Link Type: Structure
Downstream Link Name: S1 - POI B

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 126.00
Riser Crest Elevation (ft) : 128.50
Max Pond Elevation (ft) : 129.00
Storage Depth (ft) : 2.50
Pond Bottom Length (ft) : 283.6
Pond Bottom Width (ft) : 94.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 26800.
Area at Riser Crest El (sq-ft) : 32,697.
(acres) : 0.751
Volume at Riser Crest (cu-ft) : 74,277.
(ac-ft) : 1.705
Area at Max Elevation (sq-ft) : 33930.
(acres) : 0.779

Vol at Max Elevation (cu-ft) : 94,203.
(ac-ft) : 2.163

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.180
Riser Crest Elevation : 128.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 126.00
Diameter (in) : 2.30
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 127.46
Length (in) : 2.11
Height (in) : 12.45
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 3
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 134.00
Riser Crest Elevation (ft) : 137.00
Max Pond Elevation (ft) : 138.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 304.6
Pond Bottom Width (ft) : 101.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 30917.
Area at Riser Crest El (sq-ft) : 38,551.
(acres) : 0.885
Volume at Riser Crest (cu-ft) : 104,039.
(ac-ft) : 2.388

Area at Max Elevation (sq-ft) : 41239.
(acres) : 0.947
Vol at Max Elevation (cu-ft) : 147,783.
(ac-ft) : 3.393

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.190
Riser Crest Elevation : 137.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 134.00
Diameter (in) : 2.52
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 135.78
Length (in) : 2.22
Height (in) : 14.61
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 4
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.50
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 1.50
Pond Bottom Length (ft) : 323.1
Pond Bottom Width (ft) : 107.7
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 34798.
Area at Riser Crest El (sq-ft) : 38,756.
(acres) : 0.890

Volume at Riser Crest (cu-ft) : 55,145.
(ac-ft) : 1.266
Area at Max Elevation (sq-ft) : 41485.
(acres) : 0.952
Vol at Max Elevation (cu-ft) : 99,135.
(ac-ft) : 2.276

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 180.00
Common Length (ft) : 0.560
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 123.50
Diameter (in) : 3.26
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.36
Length (in) : 6.72
Height (in) : 7.65
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 5
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.00
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 473.6
Pond Bottom Width (ft) : 157.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 74781.

Area at Riser Crest El (sq-ft) : 82,503.
(acres) : 1.894
Volume at Riser Crest (cu-ft) : 157,237.
(ac-ft) : 3.610
Area at Max Elevation (sq-ft) : 86472.
(acres) : 1.985
Vol at Max Elevation (cu-ft) : 249,969.
(ac-ft) : 5.739

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.270
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 123.00
Diameter (in) : 2.63
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.23
Length (in) : 3.22
Height (in) : 9.27
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 6
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 135.00
Riser Crest Elevation (ft) : 139.00
Max Pond Elevation (ft) : 140.00
Storage Depth (ft) : 4.00
Pond Bottom Length (ft) : 621.5
Pond Bottom Width (ft) : 207.2

Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 128775.
Area at Riser Crest El (sq-ft) : 149,240.
(acres) : 3.426
Volume at Riser Crest (cu-ft) : 555,645.
(ac-ft) : 12.756
Area at Max Elevation (sq-ft) : 154536.
(acres) : 3.548
Vol at Max Elevation (cu-ft) : 722,450.
(ac-ft) : 16.585

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 42.00
Common Length (ft) : 0.640
Riser Crest Elevation : 139.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 135.00
Diameter (in) : 5.45
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 137.40
Length (in) : 7.67
Height (in) : 19.17
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 7
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 145.00
Riser Crest Elevation (ft) : 148.50
Max Pond Elevation (ft) : 149.50
Storage Depth (ft) : 3.50

Pond Bottom Length (ft) : 515.3
Pond Bottom Width (ft) : 171.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 88529.
Area at Riser Crest El (sq-ft) : 103,399.
(acres) : 2.374
Volume at Riser Crest (cu-ft) : 335,615.
(ac-ft) : 7.705
Area at Max Elevation (sq-ft) : 107809.
(acres) : 2.475
Vol at Max Elevation (cu-ft) : 451,553.
(ac-ft) : 10.366

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.270
Riser Crest Elevation : 148.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 145.00
Diameter (in) : 3.24
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 147.08
Length (in) : 3.19
Height (in) : 17.10
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 8
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 66.00
Riser Crest Elevation (ft) : 69.00

Max Pond Elevation (ft) : 70.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 412.3
Pond Bottom Width (ft) : 137.4
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 56650.
Area at Riser Crest El (sq-ft) : 66,869.
(acres) : 1.535
Volume at Riser Crest (cu-ft) : 185,116.
(ac-ft) : 4.250
Area at Max Elevation (sq-ft) : 70419.
(acres) : 1.617
Vol at Max Elevation (cu-ft) : 260,441.
(ac-ft) : 5.979

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.290
Riser Crest Elevation : 69.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 66.00
Diameter (in) : 4.06
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 67.46
Length (in) : 3.50
Height (in) : 18.48
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 9
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 42.00
Riser Crest Elevation (ft) : 48.00
Max Pond Elevation (ft) : 49.00
Storage Depth (ft) : 6.00
Pond Bottom Length (ft) : 390.0
Pond Bottom Width (ft) : 130.0
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 50700.
Area at Riser Crest El (sq-ft) : 70,716.
(acres) : 1.623
Volume at Riser Crest (cu-ft) : 362,952.
(ac-ft) : 8.332
Area at Max Elevation (sq-ft) : 74304.
(acres) : 1.706
Vol at Max Elevation (cu-ft) : 442,528.
(ac-ft) : 10.159

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.100
Riser Crest Elevation : 48.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 42.00
Diameter (in) : 2.68
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Horizontal Rectangular Orifice
Control Elevation (ft) : 45.44
Length (in) : 1.19
Height (in) : 30.73
Orientation : Horizontal
Elbow : Yes

Link Name: SWM Pond 10
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 71.00
Riser Crest Elevation (ft) : 74.00
Max Pond Elevation (ft) : 75.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 168.5
Pond Bottom Width (ft) : 56.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 9470.
Area at Riser Crest El (sq-ft) : 13,838.
(acres) : 0.318
Volume at Riser Crest (cu-ft) : 34,800.
(ac-ft) : 0.799
Area at Max Elevation (sq-ft) : 15439.
(acres) : 0.354
Vol at Max Elevation (cu-ft) : 50,816.
(ac-ft) : 1.167

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.030
Riser Crest Elevation : 74.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 71.00
Diameter (in) : 0.94
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 72.76
Length (in) : 0.33
Height (in) : 14.89
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 11

Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 52.00
Riser Crest Elevation (ft) : 57.00
Max Pond Elevation (ft) : 58.00
Storage Depth (ft) : 5.00
Pond Bottom Length (ft) : 242.5
Pond Bottom Width (ft) : 80.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 19594.
Area at Riser Crest El (sq-ft) : 30,193.
(acres) : 0.693
Volume at Riser Crest (cu-ft) : 123,717.
(ac-ft) : 2.840
Area at Max Elevation (sq-ft) : 32529.
(acres) : 0.747
Vol at Max Elevation (cu-ft) : 158,092.
(ac-ft) : 3.629

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.050
Riser Crest Elevation : 57.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 52.00
Diameter (in) : 1.71
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 54.90
Length (in) : 0.59
Height (in) : 25.25
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 12
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 101.00
Max Pond Elevation (ft) : 102.00
Storage Depth (ft) : 1.00
Pond Bottom Length (ft) : 263.7
Pond Bottom Width (ft) : 87.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 23179.
Area at Riser Crest El (sq-ft) : 25,325.
(acres) : 0.581
Volume at Riser Crest (cu-ft) : 24,246.
(ac-ft) : 0.557
Area at Max Elevation (sq-ft) : 27542.
(acres) : 0.632
Vol at Max Elevation (cu-ft) : 53,206.
(ac-ft) : 1.221

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.220
Riser Crest Elevation : 101.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.78
Orientation : Horizontal
Elbow : Yes

--- Device Number 2 ---
Device Type : Horizontal Rectangular Orifice
Control Elevation (ft) : 100.52
Length (in) : 2.58
Height (in) : 5.76
Orientation : Horizontal
Elbow : Yes

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9
Number of Links: 5

********** **Subbasin: Upper S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.988
5-Year	34.852
10-Year	42.792
25-Year	55.261
50-Year	68.844
100-Year	78.256
200-Year	91.824

********** **Subbasin: Upper S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	29.806
5-Year	45.065
10-Year	55.791
25-Year	70.969
50-Year	88.801
100-Year	101.073
200-Year	120.007

********** **Subbasin: Upper-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.580
5-Year	11.074
10-Year	13.784
25-Year	18.193
50-Year	22.391
100-Year	25.339
200-Year	28.507

********** **Subbasin: Lower-Mid S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.172
10-Year	0.229
25-Year	0.286
50-Year	0.341
100-Year	0.383
200-Year	0.571

********** **Subbasin: Lower-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.141
5-Year	21.423
10-Year	26.531
25-Year	34.326
50-Year	42.151
100-Year	48.105
200-Year	58.509

********** **Subbasin: Lower S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.509
5-Year	8.787
10-Year	11.116
25-Year	15.089
50-Year	17.003
100-Year	19.584
200-Year	25.760

********** **Subbasin: S2 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.711
5-Year	20.228

10-Year	25.493
25-Year	35.088
50-Year	39.137
100-Year	45.187
200-Year	60.581

********** **Subbasin: S2 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.394
5-Year	8.484
10-Year	10.815
25-Year	14.630
50-Year	16.527
100-Year	19.025
200-Year	24.904

********** **Subbasin: Lower S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.174
5-Year	0.254
10-Year	0.321
25-Year	0.415
50-Year	0.506
100-Year	0.571
200-Year	0.622

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI C ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI D ********** Link Inflow

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	99.103
5-Year	150.266
10-Year	186.185
25-Year	241.343
50-Year	295.666
100-Year	337.500
200-Year	411.276

********** Link: S2 - POI E ********** Link Inflow

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308

25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

********** Link: S2 - POI E ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

----------SCENARIO: PROPOSED
Number of Subbasins: 22
Number of Links: 17

********** **Subbasin: POI A undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	9.558
5-Year	14.308
10-Year	17.738
25-Year	21.556
50-Year	27.176
100-Year	30.659
200-Year	36.851

********** **Subbasin: EX-S1-N Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.561
5-Year	19.245
10-Year	24.733
25-Year	29.008
50-Year	35.791

100-Year	40.201
200-Year	51.537

********** **Subbasin: POI B Undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	20.269
5-Year	29.758
10-Year	36.491
25-Year	46.689
50-Year	58.567
100-Year	66.034
200-Year	75.513

********** **Subbasin: POI C Undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	13.391
5-Year	20.358
10-Year	25.085
25-Year	30.844
50-Year	39.099
100-Year	44.183
200-Year	53.174

********** **Subbasin: POI D undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.804
5-Year	6.012
10-Year	7.758
25-Year	9.425
50-Year	11.187
100-Year	12.700
200-Year	16.766

********** **Subbasin: POI E undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	15.107
5-Year	24.263
10-Year	31.832
25-Year	39.456
50-Year	46.840
100-Year	53.342
200-Year	69.704

********** **Subbasin: EX-S1-E Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	25.639
5-Year	39.603
10-Year	48.573
25-Year	59.241
50-Year	75.159
100-Year	84.953
200-Year	103.148

********** **Subbasin: EX-S1-Hen-W Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.271
5-Year	2.136
10-Year	2.757
25-Year	3.478
50-Year	4.108
100-Year	4.523
200-Year	6.666

********** **Subbasin: EX-S2-S-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028
5-Year	1.736
10-Year	2.185
25-Year	2.846
50-Year	3.245
100-Year	3.633

200-Year	5.308

********** **Subbasin: EX-S1-HenRR-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.095
5-Year	9.300
10-Year	12.023
25-Year	14.220
50-Year	17.509
100-Year	19.727
200-Year	25.940

********** **Subbasin: Pond 1proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	26.628
5-Year	33.409
10-Year	39.811
25-Year	47.876
50-Year	52.816
100-Year	54.616
200-Year	68.782

********** **Subbasin: Pond 2 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.714
5-Year	2.138
10-Year	2.521
25-Year	2.876
50-Year	3.043
100-Year	3.350
200-Year	3.887

********** **Subbasin: Pond 3 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)

==========

2-Year	2.361
5-Year	2.971
10-Year	3.513
25-Year	3.950
50-Year	4.276
100-Year	4.702
200-Year	5.286

********** **Subbasin: Pond 4 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.840
5-Year	2.315
10-Year	2.736
25-Year	3.076
50-Year	3.332
100-Year	3.663
200-Year	4.118

********** **Subbasin: Pond 5 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.842
5-Year	3.576
10-Year	4.226
25-Year	4.752
50-Year	5.147
100-Year	5.658
200-Year	6.360

********** **Subbasin: Pond 6 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.788
5-Year	16.090
10-Year	19.017
25-Year	21.384
50-Year	23.158
100-Year	25.461
200-Year	28.620

********** **Subbasin: POnd 7 Propposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.663
5-Year	7.129
10-Year	8.384
25-Year	9.705
50-Year	10.418
100-Year	11.298
200-Year	13.228

********** **Subbasin: Pond 8 proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.040
5-Year	5.150
10-Year	5.977
25-Year	7.479
50-Year	7.968
100-Year	8.614
200-Year	11.061

********** **Subbasin: Pond 9 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.700
5-Year	7.153
10-Year	8.399
25-Year	10.022
50-Year	10.983
100-Year	11.563
200-Year	14.155

********** **Subbasin: Pond 10 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs) Flood Peak (cfs)

2-Year	0.539
5-Year	0.675
10-Year	0.792
25-Year	0.960
50-Year	1.061
100-Year	1.108
200-Year	1.364

********** **Subbasin: Pond 11 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.973
5-Year	2.467
10-Year	2.940
25-Year	3.553
50-Year	3.949
100-Year	4.078
200-Year	5.108

********** **Subbasin: Pond 12 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.504
5-Year	0.630
10-Year	0.744
25-Year	0.889
50-Year	0.960
100-Year	0.990
200-Year	1.271

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	48.659
5-Year	75.123
10-Year	94.205
25-Year	118.025
50-Year	140.735
100-Year	157.393
200-Year	192.922

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	48.659
5-Year	75.123
10-Year	94.205
25-Year	118.025
50-Year	140.735
100-Year	157.393
200-Year	192.922

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	69.616
5-Year	105.483
10-Year	130.255
25-Year	162.698
50-Year	199.532
100-Year	223.568
200-Year	268.560

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	69.616
5-Year	105.483
10-Year	130.255
25-Year	162.698
50-Year	199.532
100-Year	223.568
200-Year	268.560

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	85.385
5-Year	129.514
10-Year	160.526
25-Year	205.336
50-Year	245.948
100-Year	274.243
200-Year	330.181

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	85.385
5-Year	129.514
10-Year	160.526
25-Year	205.336
50-Year	245.948
100-Year	274.243
200-Year	330.181

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	112.185
5-Year	173.091
10-Year	218.214
25-Year	278.816
50-Year	327.107
100-Year	364.675
200-Year	448.866

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	23.268

5-Year	36.769
10-Year	48.467
25-Year	60.747
50-Year	69.972
100-Year	77.732
200-Year	101.920

********** Link: S2 - POI E ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	23.268
5-Year	36.769
10-Year	48.467
25-Year	60.747
50-Year	69.972
100-Year	77.732
200-Year	101.920

********** Link: SWM Pond 1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	26.628
5-Year	33.409
10-Year	39.811
25-Year	47.876
50-Year	52.816
100-Year	54.616
200-Year	68.782

********** Link: SWM Pond 1 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.353
5-Year	4.118
10-Year	6.320
25-Year	8.229
50-Year	9.455
100-Year	10.965

200-Year	13.928

********** Link: SWM Pond 1 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	91.258
1.11-Year	91.695
1.25-Year	92.219
2.00-Year	93.577
3.33-Year	94.611
5-Year	95.361
10-Year	96.502
25-Year	97.188
50-Year	97.802
100-Year	98.064

********** Link: SWM Pond 2 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.714
5-Year	2.138
10-Year	2.521
25-Year	2.876
50-Year	3.043
100-Year	3.350
200-Year	3.887

********** Link: SWM Pond 2 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.167
5-Year	0.292
10-Year	0.446
25-Year	0.612
50-Year	0.691
100-Year	0.843
200-Year	0.968

********** Link: SWM Pond 2 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	126.827
1.11-Year	126.947
1.25-Year	127.058
2.00-Year	127.405
3.33-Year	127.592
5-Year	127.821
10-Year	128.105
25-Year	128.299
50-Year	128.461
100-Year	128.533

********** Link: SWM Pond 3 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.361
5-Year	2.971
10-Year	3.513
25-Year	3.950
50-Year	4.276
100-Year	4.702
200-Year	5.286

********** Link: SWM Pond 3 ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.221
5-Year	0.385
10-Year	0.588
25-Year	0.795
50-Year	0.903
100-Year	1.173
200-Year	1.329

********** Link: SWM Pond 3 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	135.013
1.11-Year	135.151
1.25-Year	135.300
2.00-Year	135.695
3.33-Year	135.922
5-Year	136.200
10-Year	136.531
25-Year	136.785
50-Year	136.936
100-Year	137.040

********** Link: SWM Pond 4 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.840
5-Year	2.315
10-Year	2.736
25-Year	3.076
50-Year	3.332
100-Year	3.663
200-Year	4.118

********** Link: SWM Pond 4 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.263
5-Year	0.520
10-Year	0.676
25-Year	1.006
50-Year	1.067
100-Year	1.272
200-Year	1.481

********** Link: SWM Pond 4 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	124.003
1.11-Year	124.122
1.25-Year	124.215
2.00-Year	124.360
3.33-Year	124.523
5-Year	124.616
10-Year	124.726
25-Year	124.902
50-Year	124.977
100-Year	125.008

********** Link: SWM Pond 5 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.842
5-Year	3.576
10-Year	4.226
25-Year	4.752
50-Year	5.147
100-Year	5.658
200-Year	6.360

********** Link: SWM Pond 5 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.191
5-Year	0.306
10-Year	0.490
25-Year	0.619
50-Year	0.703
100-Year	0.737
200-Year	1.276

********** Link: SWM Pond 5 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	123.667
1.11-Year	123.746
1.25-Year	123.849
2.00-Year	124.075
3.33-Year	124.291
5-Year	124.462
10-Year	124.722
25-Year	124.835
50-Year	124.959
100-Year	124.993

********** Link: SWM Pond 6 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.788
5-Year	16.090
10-Year	19.017
25-Year	21.384
50-Year	23.158
100-Year	25.461
200-Year	28.620

********** Link: SWM Pond 6 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.192
5-Year	2.084
10-Year	3.188
25-Year	4.320
50-Year	4.932
100-Year	6.505
200-Year	7.233

********** Link: SWM Pond 6 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)

1.05-Year	136.347
1.11-Year	136.529
1.25-Year	136.725
2.00-Year	137.261
3.33-Year	137.573
5-Year	137.952
10-Year	138.412
25-Year	138.761
50-Year	138.971
100-Year	139.100

********** Link: SWM Pond 7 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.663
5-Year	7.129
10-Year	8.384
25-Year	9.705
50-Year	10.418
100-Year	11.298
200-Year	13.228

********** Link: SWM Pond 7 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.385
5-Year	0.624
10-Year	1.061
25-Year	1.347
50-Year	1.473
100-Year	1.550
200-Year	2.418

********** Link: SWM Pond 7 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	146.140
1.11-Year	146.263

1.25-Year	146.426
2.00-Year	146.890
3.33-Year	147.231
5-Year	147.485
10-Year	147.954
25-Year	148.136
50-Year	148.307
100-Year	148.368

********** Link: SWM Pond 8 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.040
5-Year	5.150
10-Year	5.977
25-Year	7.479
50-Year	7.968
100-Year	8.614
200-Year	11.061

********** Link: SWM Pond 8 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.546
5-Year	0.869
10-Year	1.424
25-Year	2.091
50-Year	2.207
100-Year	2.403
200-Year	2.620

********** Link: SWM Pond 8 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	66.811
1.11-Year	66.928
1.25-Year	67.076
2.00-Year	67.498

3.33-Year	67.750
5-Year	67.931
10-Year	68.428
25-Year	68.587
50-Year	68.974
100-Year	69.030

********** Link: SWM Pond 9 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.700
5-Year	7.153
10-Year	8.399
25-Year	10.022
50-Year	10.983
100-Year	11.563
200-Year	14.155

********** Link: SWM Pond 9 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.664
5-Year	1.232
10-Year	1.604
25-Year	1.939
50-Year	2.010
100-Year	2.111
200-Year	2.186

********** Link: SWM Pond 9 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	44.172
1.11-Year	44.333
1.25-Year	44.704
2.00-Year	45.508
3.33-Year	45.807
5-Year	45.958

10-Year	46.471
25-Year	46.903
50-Year	47.216
100-Year	47.428

********** Link: SWM Pond 10 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.539
5-Year	0.675
10-Year	0.792
25-Year	0.960
50-Year	1.061
100-Year	1.108
200-Year	1.364

********** Link: SWM Pond 10 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.544E-02
5-Year	7.121E-02
10-Year	0.102
25-Year	0.126
50-Year	0.148
100-Year	0.182
200-Year	0.345

********** Link: SWM Pond 10 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	72.167
1.11-Year	72.224
1.25-Year	72.420
2.00-Year	72.880
3.33-Year	73.139
5-Year	73.371
10-Year	73.673
25-Year	73.833

50-Year	73.995
100-Year	74.018

********** Link: SWM Pond 11 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.973
5-Year	2.467
10-Year	2.940
25-Year	3.553
50-Year	3.949
100-Year	4.078
200-Year	5.108

********** Link: SWM Pond 11 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.142
5-Year	0.267
10-Year	0.400
25-Year	0.510
50-Year	0.560
100-Year	0.571
200-Year	1.095

********** Link: SWM Pond 11 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	53.834
1.11-Year	53.988
1.25-Year	54.288
2.00-Year	55.028
3.33-Year	55.481
5-Year	55.815
10-Year	56.388
25-Year	56.640
50-Year	56.956
100-Year	56.994

********** Link: SWM Pond 12 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.504
5-Year	0.630
10-Year	0.744
25-Year	0.889
50-Year	0.960
100-Year	0.990
200-Year	1.271

********** Link: SWM Pond 12 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.765E-02
5-Year	0.177
10-Year	0.240
25-Year	0.290
50-Year	0.327
100-Year	0.332
200-Year	0.349

********** Link: SWM Pond 12 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.289
1.11-Year	100.323
1.25-Year	100.374
2.00-Year	100.515
3.33-Year	100.552
5-Year	100.579
10-Year	100.655
25-Year	100.723
50-Year	100.803
100-Year	100.814

*************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: Upper S1 Onsite	79209.340
Subbasin: Upper S1 Offsite	106602.400
Subbasin: Upper-Mid S1 Onsite	21916.450
Subbasin: Lower-Mid S1 Offsite	795.220
Subbasin: Lower-Mid S1 Onsite	54976.730
Subbasin: Lower S1 Onsite	28291.810
Subbasin: S2 Onsite	68764.910
Subbasin: S2 Offsite	27115.160
Subbasin: Lower S1 Offsite	431.343
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable
Link: S2 - POI E	Not Applicable
Total:	388103.400

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: POI A undetained	27856.960
Subbasin: EX-S1-N Offsite	36232.660
Subbasin: POI B Undetained	53691.150
Subbasin: POI C Undetained	40544.590
Subbasin: POI D undetained	14741.090
Subbasin: POI E undetained	61772.320
Subbasin: EX-S1-E Offsite	72175.780
Subbasin: EX-S1-Hen-W Offsite	8207.551
Subbasin: EX-S2-S-Offsite	6457.336
Subbasin: EX-S1-HenRR-Offsite	17960.070
Subbasin: Pond 1proposed	7382.208
Subbasin: Pond 2 Proposed	151.865
Subbasin: Pond 3 Proposed	1.036
Subbasin: Pond 4 Proposed	0.000
Subbasin: Pond 5 Proposed	0.000
Subbasin: Pond 6 Proposed	0.000
Subbasin: POnd 7 Propposed	482.863
Subbasin: Pond 8 proposed	2664.380
Subbasin: Pond 9 Proposed	1243.031
Subbasin: Pond 10 Proposed	108.411
Subbasin: Pond 11 Proposed	506.570
Subbasin: Pond 12 Proposed	234.272
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable

Link:	S2 - POI E	Not Applicable
Link:	SWM Pond 1	0.000
Link:	SWM Pond 2	0.000
Link:	SWM Pond 3	0.000
Link:	SWM Pond 4	0.000
Link:	SWM Pond 5	0.000
Link:	SWM Pond 6	0.000
Link:	SWM Pond 7	0.000
Link:	SWM Pond 8	0.000
Link:	SWM Pond 9	0.000
Link:	SWM Pond 10	0.000
Link:	SWM Pond 11	0.000
Link:	SWM Pond 12	0.000
Total:		352414.200

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2456.351 ac-ft/year, Post Developed: 2230.469 ac-ft/year

**************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 5

----------SCENARIO: PROPOSED

Number of Links: 17

********** Link: SWM Pond 1 **********

Basic Wet Pond Volume (91% Exceedance): 444359. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 666539. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 51290.82
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 2 **********

Basic Wet Pond Volume (91% Exceedance): 27928. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 41893. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 2972.31
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%

```
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 3                                          **********

 Basic Wet Pond Volume (91% Exceedance):   38954. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   58431. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   4054.10
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 4                                          **********

 Basic Wet Pond Volume (91% Exceedance):   30351. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   45527. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   3157.93
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 5                                          **********

 Basic Wet Pond Volume (91% Exceedance):   46884. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   70327. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   4878.11
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 6                                          **********

 Basic Wet Pond Volume (91% Exceedance):   210968. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   316452. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   21950.24
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 7                                          **********
```

Basic Wet Pond Volume (91% Exceedance): 91718. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 137577. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 10021.27
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 8 **********

Basic Wet Pond Volume (91% Exceedance): 73711. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 110567. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 8076.28
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 9 **********

Basic Wet Pond Volume (91% Exceedance): 94422. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 141633. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 10701.77
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 10 **********

Basic Wet Pond Volume (91% Exceedance): 8841. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13261. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 1018.02
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 11 **********

Basic Wet Pond Volume (91% Exceedance): 32834. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 49250. cu-ft

Infiltration/Filtration Statistics----------

Total Runoff Volume (ac-ft): 3811.03
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 12 **********

Basic Wet Pond Volume (91% Exceedance): 8781. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13171. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 993.86
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: S1 - POI D
Scenario Proposed Compliance Link: S1 - POI D

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	99.103	2-Year	112.185
5-Year	150.266	5-Year	173.091
10-Year	186.185	10-Year	218.214
25-Year	241.343	25-Year	278.816
50-Year	295.666	50-Year	327.107
100-Year	337.500	100-Year	364.675
200-Year	411.276	200-Year	448.866

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 52.6% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 61.8% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/11/2014 5:16 PM

Input File Name: Pond_1.fld
Project Name: GPT Pond 1
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 1 predev """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	102.997
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	29.223
Green Roof	0.000
User	0.000
Impervious	0.000

"""

Subbasin Total	132.220

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 1 Proposed """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	5.482
Till Pasture	0.000
Till Grass	42.530
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.656
Green Roof	0.000
User	0.000
Impervious	80.588

"""

Subbasin Total 132.256

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 1
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	88.00
Riser Crest Elevation (ft)	:	98.00
Max Pond Elevation (ft)	:	99.50
Storage Depth (ft)	:	10.00
Pond Bottom Length (ft)	:	760.6
Pond Bottom Width (ft)	:	152.1
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	115711.
Area at Riser Crest El (sq"ft)	:	174,076.
(acres)	:	3.996
Volume at Riser Crest (cu"ft)	:	1,442,936.
(ac"ft)	:	33.125
Area at Max Elevation (sq"ft)	:	183452.
(acres)	:	4.211
Vol at Max Elevation (cu"ft)	:	1,745,878.
(ac"ft)	:	40.080

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 54.00
Common Length (ft) : 0.313
Riser Crest Elevation : 98.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 88.00
Diameter (in) : 6.11
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 93.94
Length (in) : 3.76
Height (in) : 48.74
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** **Subbasin: Pond 1 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2"Year	26.628
5"Year	33.409
10"Year	39.811
25"Year	47.876
50"Year	52.816
100"Year	54.616

200"Year	68.782

********** Link: Pond 1 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2"Year	26.628
5"Year	33.409
10"Year	39.811
25"Year	47.876
50"Year	52.816
100"Year	54.616
200"Year	68.782

********** Link: Pond 1 ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	91.259
1.11"Year	91.696
1.25"Year	92.219
2.00"Year	93.578
3.33"Year	94.613
5"Year	95.360
10"Year	96.502
25"Year	97.189
50"Year	97.802
100"Year	98.063

**********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: Pond 1 predev	26288.310
Total:	26288.310

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 1 Proposed	7382.208
Link: Pond 1	0.000
Total:	7382.208

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 166.382 ac-ft/year, Post Developed: 46.723 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 1 **********

Basic Wet Pond Volume (91% Exceedance): 444359. cu"ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 666539. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 51290.82
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Pond 1 predev

Scenario Postdeveloped Compliance Link: Pond 1

***** 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	4.924	2"Year	2.352
5"Year	7.918	5"Year	4.118
10"Year	9.974	10"Year	6.321
25"Year	13.651	25"Year	8.230
50"Year	15.289	50"Year	9.458
100"Year	17.635	100"Year	10.954
200"Year	23.463	200"Year	13.930

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): "8.1% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): "3.6% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 7.6% PASS

Percent Excursion from Q2 to Q50 (Must be less than 50%): 13.9% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 4:02 PM

Input File Name: Pond_2.fld
Project Name: GPT Pond 2
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 1 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	3.726
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.862
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 6.588

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 2 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.373
Till Pasture	0.000
Till Grass	0.282
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.195
Green Roof	0.000
User	0.000
Impervious	5.738

""
Subbasin Total 6.588

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 2
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 126.00
Riser Crest Elevation (ft) : 128.50
Max Pond Elevation (ft) : 129.00
Storage Depth (ft) : 2.50
Pond Bottom Length (ft) : 283.6
Pond Bottom Width (ft) : 94.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 26808.
Area at Riser Crest El (sq"ft) : 32,705.
(acres) : 0.751
Volume at Riser Crest (cu"ft) : 74,297.

	(ac"ft)	:	1.706
Area at Max Elevation	(sq"ft)	:	33938.
	(acres)	:	0.779
Vol at Max Elevation	(cu"ft)	:	94,227.
	(ac"ft)	:	2.163

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.176
Riser Crest Elevation : 128.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 126.00
Diameter (in) : 2.30
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 127.46
Length (in) : 2.11
Height (in) : 12.45
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 2 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	126.828
1.11"Year	126.948
1.25"Year	127.061
2.00"Year	127.406
3.33"Year	127.596
5"Year	127.822
10"Year	128.108
25"Year	128.300
50"Year	128.464
100"Year	128.534

*************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: Pond 1 predev	1358.594
Total:	1358.594

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 2 Proposed	151.865
Link: Pond 2	0.000
Total:	151.865

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 8.599 ac-ft/year, Post Developed: 0.961 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 2 **********

Basic Wet Pond Volume (91% Exceedance): 27928. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 41893. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""""""
Total Runoff Volume (ac"ft):   2972.31
Total Runoff Infiltrated (ac"ft):   0.00,   0.00%
Total Runoff Filtered (ac"ft):   0.00,   0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 1 predev

Scenario Postdeveloped Compliance Link: Pond 2

***** 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	0.346	2"Year	0.167
5"Year	0.524	5"Year	0.291
10"Year	0.650	10"Year	0.445
25"Year	0.843	25"Year	0.611
50"Year	1.032	50"Year	0.690
100"Year	1.178	100"Year	0.849
200"Year	1.437	200"Year	0.973

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"17.3%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"2.6%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	5.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	10.2%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 5:15 PM

Input File Name: Pond_3.fld
Project Name: GPT Pond 3
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 3 predev """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	4.263
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.938
Green Roof	0.000
User	0.000
Impervious	0.000

"""

Subbasin Total	8.201

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 3 Proposed """""""""""""""

	"""""""""Area(Acres) """"""""""
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	8.193

"""

Subbasin Total	8.201

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 3
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	134.00
Riser Crest Elevation (ft)	:	137.00
Max Pond Elevation (ft)	:	138.00
Storage Depth (ft)	:	3.00
Pond Bottom Length (ft)	:	304.6
Pond Bottom Width (ft)	:	101.5
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	30932.
Area at Riser Crest El (sq"ft)	:	38,567.
(acres)	:	0.885
Volume at Riser Crest (cu"ft)	:	104,087.
(ac"ft)	:	2.390
Area at Max Elevation (sq"ft)	:	41256.
(acres)	:	0.947
Vol at Max Elevation (cu"ft)	:	147,849.
(ac"ft)	:	3.394

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.190
Riser Crest Elevation : 137.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 134.00
Diameter (in) : 2.52
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 135.78
Length (in) : 2.22
Height (in) : 14.61
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 3 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	135.015
1.11"Year	135.152
1.25"Year	135.301
2.00"Year	135.695
3.33"Year	135.922

5"Year	136.201
10"Year	136.532
25"Year	136.785
50"Year	136.936
100"Year	137.041

*************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: Pond 3 predev	1704.244
Total:	1704.244

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 3 Proposed	1.036
Link: Pond 3	0.000
Total:	1.036

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 10.786 ac-ft/year, Post Developed: 0.007 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 3 **********

Basic Wet Pond Volume (91% Exceedance): 38954. cu"ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 58431. cu"ft

Infiltration/Filtration Statistics
Total Runoff Volume (ac"ft): 4054.10
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Pond 3 predev

Scenario Postdeveloped Compliance Link: Pond 3

***** 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	0.458	2"Year	0.220
5"Year	0.688	5"Year	0.386
10"Year	0.852	10"Year	0.589
25"Year	1.090	25"Year	0.795
50"Year	1.356	50"Year	0.904
100"Year	1.546	100"Year	1.177
200"Year	1.860	200"Year	1.330

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"13.2%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		"0.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	7.7%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	13.3%	PASS	

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 5:31 PM

Input File Name: Pond_4.fld
Project Name: GPT Pond 4
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 4 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.663
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	5.721
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 6.384

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 4 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	6.385

""
Subbasin Total 6.385

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 4
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	123.50
Riser Crest Elevation (ft)	:	125.00
Max Pond Elevation (ft)	:	126.00
Storage Depth (ft)	:	1.50
Pond Bottom Length (ft)	:	323.1
Pond Bottom Width (ft)	:	107.7
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	34805.
Area at Riser Crest El (sq"ft)	:	38,764.
(acres)	:	0.890
Volume at Riser Crest (cu"ft)	:	55,157.

	(ac"ft)	:	1.266
Area at Max Elevation	(sq"ft)	:	41493.
	(acres)	:	0.953
Vol at Max Elevation	(cu"ft)	:	99,156.
	(ac"ft)	:	2.276

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.560
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 123.50
Diameter (in) : 3.26
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.36
Length (in) : 6.72
Height (in) : 7.65
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 4 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	124.003
1.11"Year	124.121
1.25"Year	124.214
2.00"Year	124.359
3.33"Year	124.522
5"Year	124.614
10"Year	124.726
25"Year	124.901
50"Year	124.976
100"Year	125.013

*************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: Pond 4 predev	1418.735
Total:	1418.735

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 4 Proposed	0.000
Link: Pond 4	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 8.979 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 4 **********

Basic Wet Pond Volume (91% Exceedance): 30351. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 45527. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 3157.93
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 4 predev

Scenario Postdeveloped Compliance Link: Pond 4

*** 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	0.536	2"Year	0.263
5"Year	0.780	5"Year	0.518
10"Year	0.980	10"Year	0.675
25"Year	1.278	25"Year	1.006
50"Year	1.566	50"Year	1.066
100"Year	1.768	100"Year	1.157
200"Year	1.953	200"Year	1.325

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"18.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"7.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	6.5%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	2.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 6:15 PM

Input File Name: Pond_5.fld
Project Name: GPT Pond 4
Analysis Title: Ecology (Proposed vs. Pre#Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939#10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 4 predev ########
######Area(Acres) ######

Till Forest	7.132
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.731
Green Roof	0.000
User	0.000
Impervious	0.000

##
Subbasin Total 9.863

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 5 Proposed ########
######Area(Acres) #######

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	9.863

##
Subbasin Total 9.863

********** **LINK DATA** **********

##################SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

##################SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 5
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.00
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 473.6
Pond Bottom Width (ft) : 157.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq#ft) : 74767.
Area at Riser Crest El (sq#ft) : 82,489.
(acres) : 1.894
Volume at Riser Crest (cu#ft) : 157,208.

	(ac#ft)	:	3.609
Area at Max Elevation	(sq#ft)	:	86458.
	(acres)	:	1.985
Vol at Max Elevation	(cu#ft)	:	249,924.
	(ac#ft)	:	5.737

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio#Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.270
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

##Device Number 1 ##
Device Type : Circular Orifice
Control Elevation (ft) : 123.00
Diameter (in) : 2.63
Orientation : Horizontal
Elbow : No

##Device Number 2 ##
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.23
Length (in) : 3.22
Height (in) : 9.27
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 5 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05#Year	123.667
1.11#Year	123.746
1.25#Year	123.849
2.00#Year	124.075
3.33#Year	124.291
5#Year	124.461
10#Year	124.721
25#Year	124.834
50#Year	124.958
100#Year	124.992

*************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: Pond 4 predev	1980.096
Total:	1980.096

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac#ft)
Subbasin: Pond 5 Proposed	0.000
Link: Pond 5	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 12.532 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 5 **********

Basic Wet Pond Volume (91% Exceedance): 46884. cu#ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 70327. cu#ft

Infiltration/Filtration Statistics################
Total Runoff Volume (ac#ft): 4878.11
Total Runoff Infiltrated (ac#ft): 0.00, 0.00%
Total Runoff Filtered (ac#ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Pond 4 predev

Scenario Postdeveloped Compliance Link: Pond 5

*** 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	0.409	2#Year	0.191
5#Year	0.634	5#Year	0.306
10#Year	0.817	10#Year	0.491
25#Year	1.096	25#Year	0.620
50#Year	1.246	50#Year	0.704
100#Year	1.433	100#Year	0.738
200#Year	1.855	200#Year	1.279

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	#10.5%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		#4.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1.5%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.2%	PASS	

##
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
##

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 7:58 AM

Input File Name: Pond_6.fld
Project Name: GPT Pond 6
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 6 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	22.986
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	21.395
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 44.381

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 6 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	44.381

""
Subbasin Total 44.381

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 6
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 135.00
Riser Crest Elevation (ft) : 139.00
Max Pond Elevation (ft) : 140.00
Storage Depth (ft) : 4.00
Pond Bottom Length (ft) : 621.5
Pond Bottom Width (ft) : 207.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 128765.
Area at Riser Crest El (sq"ft) : 149,230.
(acres) : 3.426
Volume at Riser Crest (cu"ft) : 555,606.

(ac"ft) : 12.755
Area at Max Elevation (sq"ft) : 154526.
(acres) : 3.547
Vol at Max Elevation (cu"ft) : 722,401.
(ac"ft) : 16.584

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 42.00
Common Length (ft) : 0.639
Riser Crest Elevation : 139.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 135.00
Diameter (in) : 5.45
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 137.40
Length (in) : 7.67
Height (in) : 19.17
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 6 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	136.347
1.11"Year	136.528
1.25"Year	136.724
2.00"Year	137.260
3.33"Year	137.571
5"Year	137.952
10"Year	138.413
25"Year	138.761
50"Year	138.972
100"Year	139.100

*************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: Pond 6 predev	9225.690
Total:	9225.690

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 6 Proposed	0.000
Link: Pond 6	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 58.390 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 6 **********

Basic Wet Pond Volume (91% Exceedance): 210968. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 316452. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 21950.24
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 6 predev

Scenario Postdeveloped Compliance Link: Pond 6

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2"Year	2.483	2"Year	1.193
5"Year	3.734	5"Year	2.081
10"Year	4.622	10"Year	3.185
25"Year	5.906	25"Year	4.317
50"Year	7.356	50"Year	4.930
100"Year	8.384	100"Year	6.500
200"Year	10.080	200"Year	7.235

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"15.4%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"3.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	9.9%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 10:15 AM

Input File Name: Pond_7.fld
Project Name: GPT Pond 7
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 7 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	17.493
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	4.659
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 22.152

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 7 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	3.728
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	18.421

""
Subbasin Total 22.149

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 7
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 145.00
Riser Crest Elevation (ft) : 148.50
Max Pond Elevation (ft) : 149.50
Storage Depth (ft) : 3.50
Pond Bottom Length (ft) : 515.3
Pond Bottom Width (ft) : 171.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 88499.
Area at Riser Crest El (sq"ft) : 103,368.
(acres) : 2.373
Volume at Riser Crest (cu"ft) : 335,511.

	(ac"ft)	:	7.702
Area at Max Elevation	(sq"ft)	:	107778.
	(acres)	:	2.474
Vol at Max Elevation	(cu"ft)	:	451,414.
	(ac"ft)	:	10.363

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.266
Riser Crest Elevation : 148.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 145.00
Diameter (in) : 3.24
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 147.08
Length (in) : 3.19
Height (in) : 17.10
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 7 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	146.142
1.11"Year	146.265
1.25"Year	146.428
2.00"Year	146.892
3.33"Year	147.233
5"Year	147.488
10"Year	147.953
25"Year	148.134
50"Year	148.307
100"Year	148.367

*************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: Pond 7 predev	4396.098
Total:	4396.098

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 7 Proposed	482.863
Link: Pond 7	0.000
Total:	482.863

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 27.823 ac-ft/year, Post Developed: 3.056 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 7 **********

Basic Wet Pond Volume (91% Exceedance): 91718. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 137577. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 10021.27
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 7 predev

Scenario Postdeveloped Compliance Link: Pond 7

***** 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	0.817	2"Year	0.384
5"Year	1.301	5"Year	0.628
10"Year	1.639	10"Year	1.064
25"Year	2.253	25"Year	1.353
50"Year	2.516	50"Year	1.477
100"Year	2.904	100"Year	1.554
200"Year	3.886	200"Year	2.426

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"15.6%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"5.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	7.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	6.3%	PASS

""
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
""

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 1:30 PM

Input File Name: Pond_8.fld
Project Name: GPT Pond 8
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 8 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	19.415
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	6.946
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 26.361

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 8 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	6.503
Till Pasture	0.000
Till Grass	2.930
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	4.613
Green Roof	0.000
User	0.000
Impervious	12.315

""
Subbasin Total 26.361

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 8
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	66.00
Riser Crest Elevation (ft)	:	69.00
Max Pond Elevation (ft)	:	70.00
Storage Depth (ft)	:	3.00
Pond Bottom Length (ft)	:	412.3
Pond Bottom Width (ft)	:	137.4
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	56668.
Area at Riser Crest El (sq"ft)	:	66,887.
(acres)	:	1.536
Volume at Riser Crest (cu"ft)	:	185,171.

	(ac"ft)	:	4.251
Area at Max Elevation	(sq"ft)	:	70438.
	(acres)	:	1.617
Vol at Max Elevation	(cu"ft)	:	260,516.
	(ac"ft)	:	5.981

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.290
Riser Crest Elevation : 69.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 66.00
Diameter (in) : 4.06
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 67.46
Length (in) : 3.50
Height (in) : 18.48
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 8 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	66.809
1.11"Year	66.928
1.25"Year	67.075
2.00"Year	67.496
3.33"Year	67.749
5"Year	67.930
10"Year	68.427
25"Year	68.585
50"Year	68.972
100"Year	69.029

*************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: Pond 8 predev	5279.987
Total:	5279.987

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 8 Proposed	2664.380
Link: Pond 8	0.000
Total:	2664.380

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 33.418 ac-ft/year, Post Developed: 16.863 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 8 **********

Basic Wet Pond Volume (91% Exceedance): 73711. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 110567. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 8076.28
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 8 predev

Scenario Postdeveloped Compliance Link: Pond 8

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2"Year	1.070	2"Year	0.546
5"Year	1.664	5"Year	0.868
10"Year	2.137	10"Year	1.424
25"Year	2.881	25"Year	2.091
50"Year	3.263	50"Year	2.206
100"Year	3.754	100"Year	2.397
200"Year	4.891	200"Year	2.612

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"1.4%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"1.4%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	2.3%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	4.9%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 2:18 PM

Input File Name: Pond_9.fld
Project Name: GPT Pond 9
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 9 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	25.398
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.106
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 26.504

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 9 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	1.904
Till Pasture	0.000
Till Grass	6.630
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.090
Green Roof	0.000
User	0.000
Impervious	17.881

""
Subbasin Total 26.505

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 9
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 42.00
Riser Crest Elevation (ft) : 48.00
Max Pond Elevation (ft) : 49.00
Storage Depth (ft) : 6.00
Pond Bottom Length (ft) : 390.0
Pond Bottom Width (ft) : 130.0
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 50700.
Area at Riser Crest El (sq"ft) : 70,716.
(acres) : 1.623
Volume at Riser Crest (cu"ft) : 362,952.

	(ac"ft)	:	8.332
Area at Max Elevation	(sq"ft)	:	74304.
	(acres)	:	1.706
Vol at Max Elevation	(cu"ft)	:	442,528.
	(ac"ft)	:	10.159

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.100
Riser Crest Elevation : 48.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 42.00
Diameter (in) : 2.68
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 45.44
Length (in) : 1.19
Height (in) : 30.73
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 9 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	44.174
1.11"Year	44.335
1.25"Year	44.706
2.00"Year	45.562
3.33"Year	46.126
5"Year	46.598
10"Year	47.262
25"Year	47.579
50"Year	47.924
100"Year	47.983

*************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: Pond 9 predev	5104.818
Total:	5104.818

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 9 Proposed	1243.031
Link: Pond 9	0.000
Total:	1243.031

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 32.309 ac-ft/year, Post Developed: 7.867 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 9 **********

Basic Wet Pond Volume (91% Exceedance): 94422. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 141633. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 10701.77
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Pond 9 predev

Scenario Postdeveloped Compliance Link: Pond 9

***** 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	0.712	2"Year	0.373
5"Year	1.183	5"Year	0.739
10"Year	1.533	10"Year	1.086
25"Year	1.991	25"Year	1.357
50"Year	2.340	50"Year	1.500
100"Year	2.573	100"Year	1.539
200"Year	3.815	200"Year	3.046

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"10.5%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"5.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.4%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 2:03 PM

Input File Name: Pond_10.fld
Project Name: GPT Pond 10
Analysis Title: Ecology (Proposed vs. Pre#Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939#10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 10 predev ########
######Area(Acres) ######

Till Forest	2.482
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

##
Subbasin Total 2.482

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 10 Proposed ########
######Area(Acres) #######

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.837
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.645

##
Subbasin Total 2.482

********** **LINK DATA** **********

##################SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

##################SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 10
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 71.00
Riser Crest Elevation (ft) : 74.00
Max Pond Elevation (ft) : 75.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 168.5
Pond Bottom Width (ft) : 56.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq#ft) : 9459.
Area at Riser Crest El (sq#ft) : 13,826.
(acres) : 0.317
Volume at Riser Crest (cu#ft) : 34,766.

	(ac#ft)	:	0.798
Area at Max Elevation	(sq#ft)	:	15426.
	(acres)	:	0.354
Vol at Max Elevation	(cu#ft)	:	50,768.
	(ac#ft)	:	1.165

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio#Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.030
Riser Crest Elevation : 74.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

##Device Number 1 ##
Device Type : Circular Orifice
Control Elevation (ft) : 71.00
Diameter (in) : 0.94
Orientation : Horizontal
Elbow : No

##Device Number 2 ##
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 72.76
Length (in) : 0.33
Height (in) : 14.89
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 10 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05#Year	72.174
1.11#Year	72.231
1.25#Year	72.427
2.00#Year	72.887
3.33#Year	73.143
5#Year	73.377
10#Year	73.680
25#Year	73.841
50#Year	74.001
100#Year	74.021

*************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: Pond 10 predev	474.456
Total:	474.456

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac#ft)
Subbasin: Pond 10 Proposed	108.411
Link: Pond 10	0.000
Total:	108.411

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 3.003 ac-ft/year, Post Developed: 0.686 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 10 **********

Basic Wet Pond Volume (91% Exceedance): 8841. cu#ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 13261. cu#ft

Infiltration/Filtration Statistics################
Total Runoff Volume (ac#ft): 1018.02
Total Runoff Infiltrated (ac#ft): 0.00, 0.00%
Total Runoff Filtered (ac#ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Pond 10 predev

Scenario Postdeveloped Compliance Link: Pond 10

*** 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	6.265E#02	2#Year	3.553E#02
5#Year	0.103	5#Year	7.113E#02
10#Year	0.137	10#Year	0.102
25#Year	0.171	25#Year	0.126
50#Year	0.204	50#Year	0.151
100#Year	0.229	100#Year	0.195
200#Year	0.341	200#Year	0.351

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	#5.7%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		#1.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.0%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	25.4%	PASS	

##
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
##

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 3:03 PM

Input File Name: Pond_11.fld
Project Name: GPT Pond 11
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 11 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	9.134
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.549
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 9.683

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 11 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.278
Till Pasture	0.000
Till Grass	3.431
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.040
Green Roof	0.000
User	0.000
Impervious	5.935

""
Subbasin Total 9.684

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 11
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 52.00
Riser Crest Elevation (ft) : 57.00
Max Pond Elevation (ft) : 58.00
Storage Depth (ft) : 5.00
Pond Bottom Length (ft) : 242.5
Pond Bottom Width (ft) : 80.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 19595.
Area at Riser Crest El (sq"ft) : 30,193.
(acres) : 0.693
Volume at Riser Crest (cu"ft) : 123,719.

```
                              (ac"ft)   :      2.840
Area at Max Elevation   (sq"ft)   :      32529.
                              (acres)  :       0.747
Vol at Max Elevation   (cu"ft)    :    158,093.
                              (ac"ft)   :      3.629

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr)     :   0.00
Depth to Water Table (ft)                    : 100.00
Bio"Fouling Potential                : Low
Maintenance                          : Average or Better

Riser Geometry
Riser Structure Type                 : Circular
Riser Diameter (in)                  : 18.00
Common Length (ft)                   : 0.050
Riser Crest Elevation                : 57.00 ft

 Hydraulic Structure Geometry

Number of Devices:      2

        """Device Number     1 """
Device Type                 :   Circular Orifice
Control Elevation (ft)      :   52.00
Diameter (in)               :   1.71
Orientation                 : Horizontal
Elbow                       : No

        """ Device Number     2 """
Device Type                 : Vertical Rectangular Orifice
Control Elevation (ft)      :   54.90
Length (in)                 :     0.59
Height (in)                 :     25.25
Orientation                 : Vertical
Elbow                       : No
```

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 11 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	53.833
1.11"Year	53.987
1.25"Year	54.288
2.00"Year	55.027
3.33"Year	55.480
5"Year	55.813
10"Year	56.388
25"Year	56.641
50"Year	56.958
100"Year	56.995

*************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: Pond 11 predev	1870.025
Total:	1870.025

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 11 Proposed	506.570
Link: Pond 11	0.000
Total:	506.570

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 11.836 ac-ft/year, Post Developed: 3.206 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 11 **********

Basic Wet Pond Volume (91% Exceedance): 32834. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 49250. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 3811.03
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 11 predev

Scenario Postdeveloped Compliance Link: Pond 11

***** 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	0.268	2"Year	0.142
5"Year	0.444	5"Year	0.267
10"Year	0.576	10"Year	0.399
25"Year	0.751	25"Year	0.509
50"Year	0.878	50"Year	0.558
100"Year	0.957	100"Year	0.569
200"Year	1.417	200"Year	1.094

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"5.8%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"2.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.2%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	6.7%	PASS

""
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
""

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 3:25 PM

Input File Name: Pond_12.fld
Project Name: GPT Pond 12 (aka Pond A)
Analysis Title: Ecology (Proposed vs. Pre%Developed)
Comments: December 2013 preferred C1rev [BLT]. Catchment renambed from 'A' to 'Pond 12'.

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939%10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) ***************

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

%%%%%%%%%%Subbasin : Pond 12 predev %%%%%%%%%%
%%%%%%%Area(Acres) %%%%%%%%
Till Forest 2.065
Till Pasture 0.000
Till Grass 0.000
Outwash Forest 0.000
Outwash Pasture 0.000
Outwash Grass 0.000
Wetland 0.863
Green Roof 0.000
User 0.000

Impervious 0.000
%%
Subbasin Total 2.928

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

%%%%%%%%%%%Subbasin : Pond 12 Proposed %%%%%%%%%%%
%%%%%%%%Area(Acres) %%%%%%%%

Till Forest	0.910
Till Pasture	0.000
Till Grass	0.382
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.048
Green Roof	0.000
User	0.000
Impervious	1.589

%%
Subbasin Total 2.929

************************* **LINK DATA** *******************************

%%%%%%%%%%%%%%%%%%%%%%%%%%%SCENARIO: PREDEVELOPED
Number of Links: 0

************************* **LINK DATA** *******************************

%%%%%%%%%%%%%%%%%%%%%%%%%%%SCENARIO: POSTDEVELOPED
Number of Links: 1

--
Link Name: Pond 12
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 101.00
Max Pond Elevation (ft) : 102.00
Storage Depth (ft) : 1.00
Pond Bottom Length (ft) : 263.7
Pond Bottom Width (ft) : 87.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq%ft) : 23178.
Area at Riser Crest El (sq%ft) : 25,324.
(acres) : 0.581

Volume at Riser Crest (cu%ft) : 24,245.
(ac%ft) : 0.557
Area at Max Elevation (sq%ft) : 27541.
(acres) : 0.632
Vol at Max Elevation (cu%ft) : 53,204.
(ac%ft) : 1.221

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio%Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.220
Riser Crest Elevation : 101.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

%%%Device Number 1 %%%
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.78
Orientation : Horizontal
Elbow : No

%%%Device Number 2 %%%
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 100.52
Length (in) : 2.58
Height (in) : 5.76
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 12 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05%/year	100.278
1.11%/year	100.312
1.25%/year	100.365
2.00%/year	100.498
3.33%/year	100.584
5%/year	100.649
10%/year	100.791
25%/year	100.858
50%/year	100.947
100%/year	100.966

*************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: Pond 12 predev	589.637
Total:	589.637

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Pond 12 Proposed	234.272
Link: Pond 12	0.000
Total:	234.272

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 3.732 ac-ft/year, Post Developed: 1.483 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 12 **********

Basic Wet Pond Volume (91% Exceedance): 8781. cu%ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13171. cu%ft

Infiltration/Filtration Statistics%%%%%%%%%%%%%%%%%%%%
Total Runoff Volume (ac%ft): 993.86
Total Runoff Infiltrated (ac%ft): 0.00, 0.00%
Total Runoff Filtered (ac%ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 12 predev

Scenario Postdeveloped Compliance Link: Pond 12

*** **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	0.124	2%Year	5.994E%02
5%Year	0.193	5%Year	9.787E%02
10%Year	0.248	10%Year	0.156
25%Year	0.331	25%Year	0.221
50%Year	0.380	50%Year	0.242
100%Year	0.436	100%Year	0.254
200%Year	0.561	200%Year	0.257

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** **Flow Duration Performance** ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	%15.2%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	%3.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	%4.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

%%%
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
%%%

Note: See MGS Flood Project Report for input file '2014 Main Site Pre-Dev vs. EX.fld' for detailed input and model results.

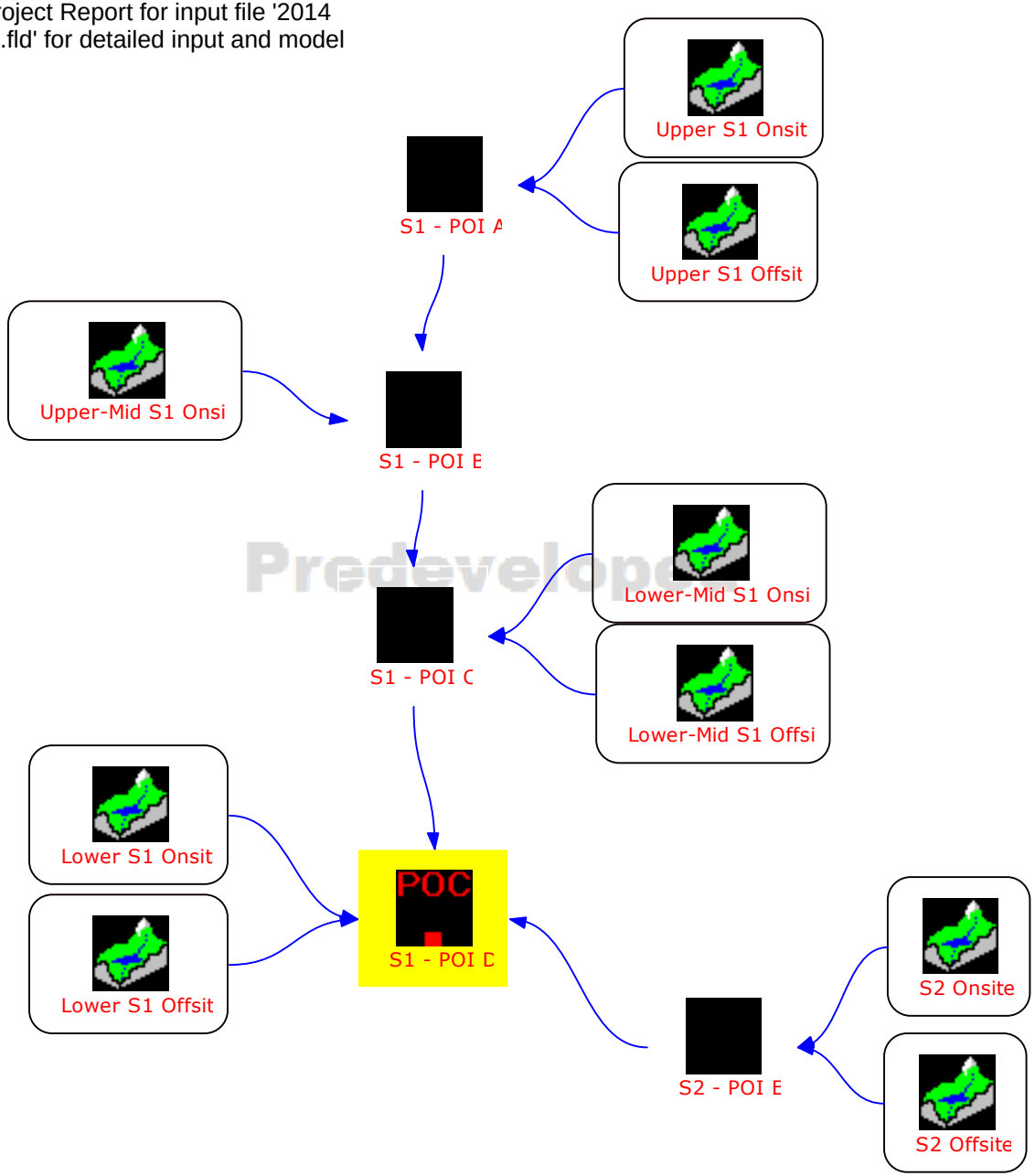

FIGURE A-1: HYDROLOGY MODEL SCHEMATIC FOR PREDEVELOPED HISTORIC CONDITIONS

Note: See MGS Flood Project Report for input file '2014 Main Site Pre-Dev vs. EX.fld' for detailed input and model results.

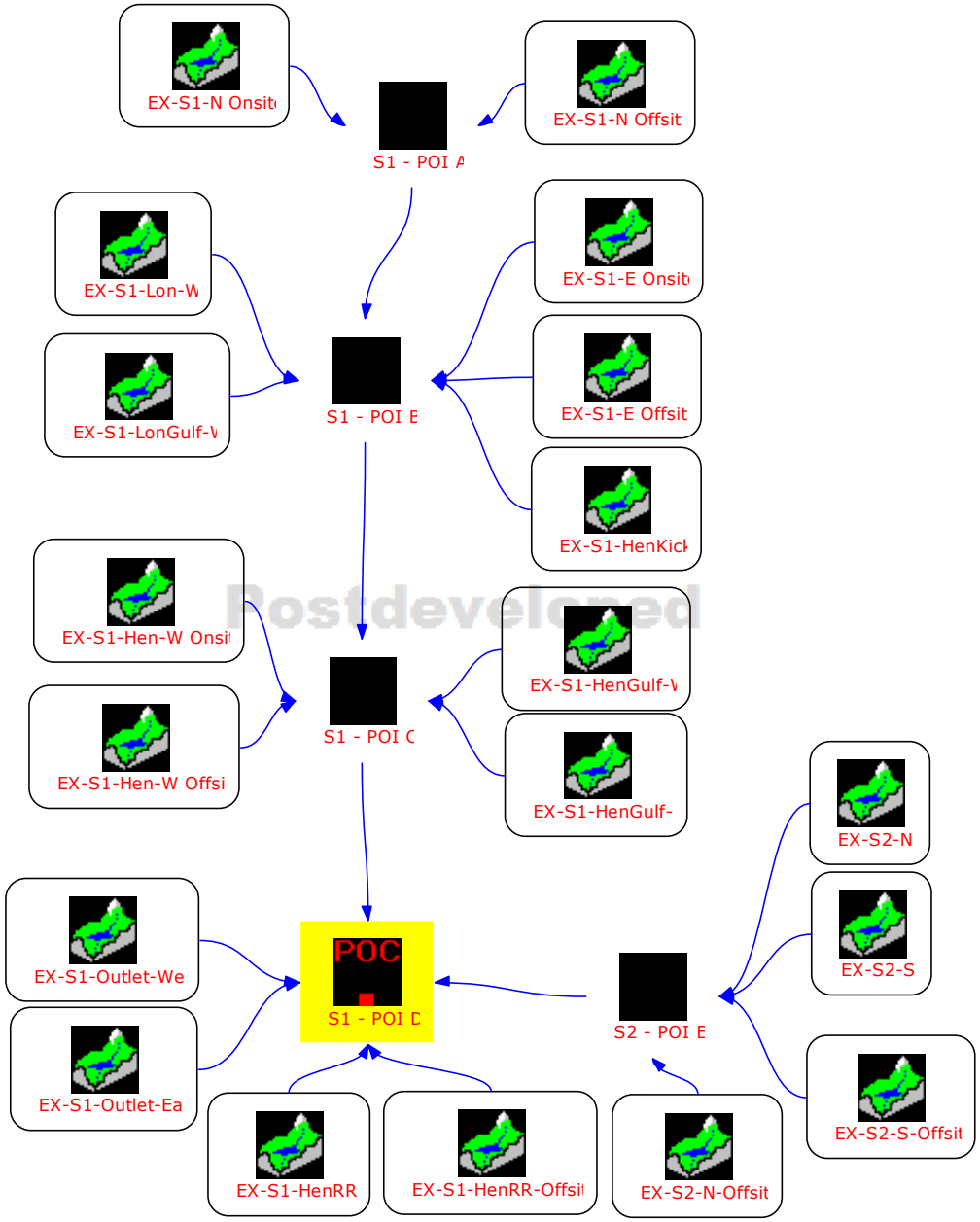

FIGURE A-2: HYDROLOGY MODEL SCHEMATIC FOR EXISTING (2013) CONDITIONS

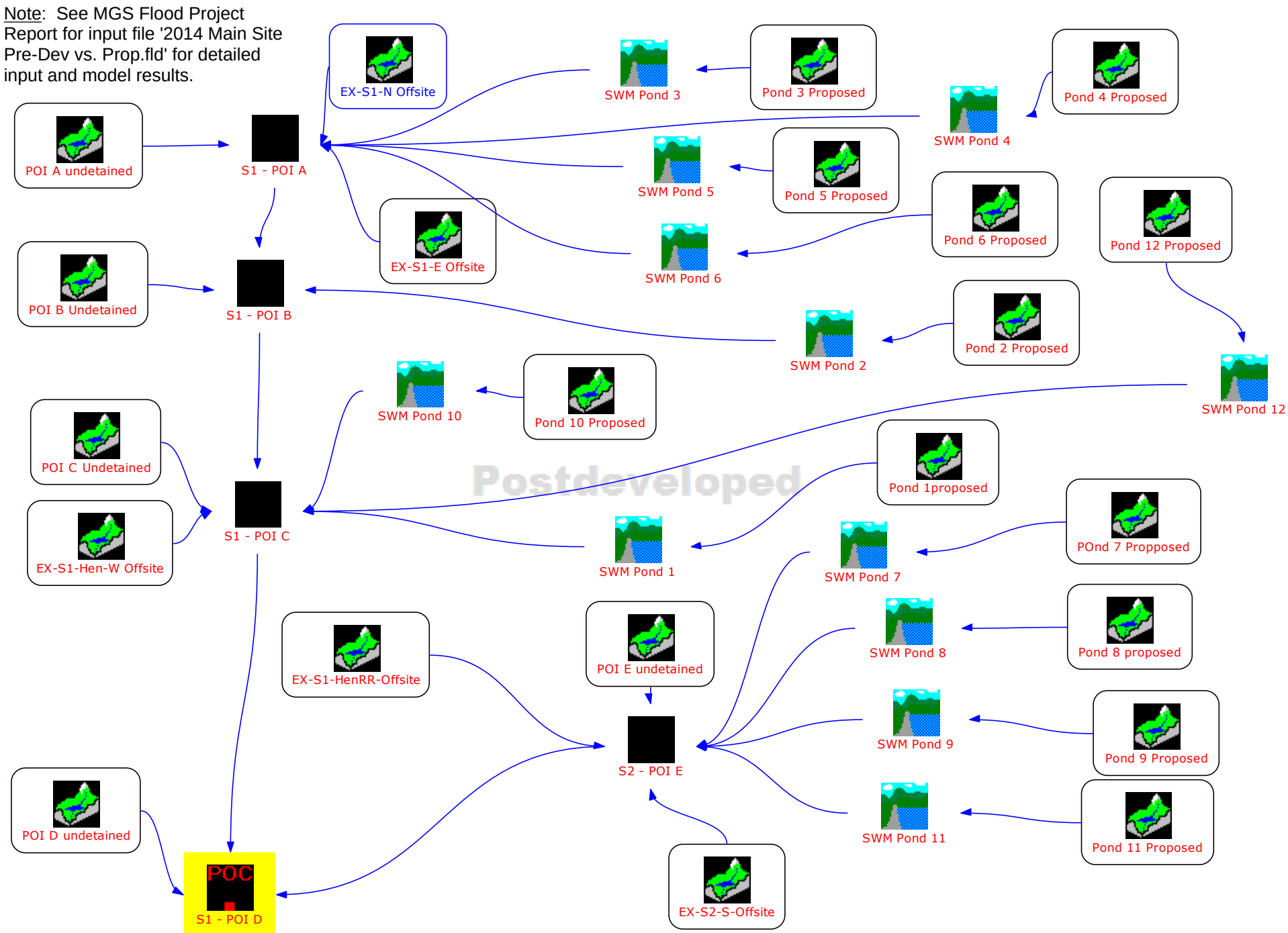

FIGURE A-3: HYDROLOGY MODEL SCHEMATIC FOR PROPOSED DEVELOPED CONDITIONS

TABLE A-1:
LAND USE IN PROPOSED CATCHMENT AREAS FOR PREDEVELOPED CONDITIONS

ALL AREAS IN ACRES

	Land Use / Soil for Model, areas in acres		
Catchment Name	**Unsaturated Till Forest**	**Saturated Forest**	**Total Area**
A	2.065	0.863	2.929
B1	2.992	2.331	5.323
B2	1.962	1.383	3.345
Birch Bay	31.129	45.038	76.168
C1	0.663	5.721	6.385
C2	2.301	2.555	4.856
D	7.132	2.731	9.863
E	22.986	21.395	44.381
Ex-Bluff	57.036	4.781	61.818
EX-S1-HenGulf-E	0.665	0.757	1.422
EX-S1-HenGulf-w	41.419	40.669	82.089
EX-S1-HenRR	10.383	8.526	18.909
EX-S1-LonGulf-W	7.682	31.224	38.907
EX-S1-Lon-W	25.310	21.194	46.504
Ex-S1-Outlet-West	5.691	0.037	5.728
EX-S2-S	112.940	15.377	128.316
EX-SE-BLUFF	65.237	5.667	70.904
F	10.634	4.659	15.294
P-10	2.482		2.482
P-11	0.733	0.532	1.265
P-12	5.019	9.116	14.135
P-13	8.038	0.297	8.335
P-14	6.859		6.859
P-15	10.539	31.875	42.414
P-16	6.996	2.663	9.658
P-17	51.331	49.898	101.229
P-18	0.446	17.857	18.303
P-19	1.478	1.413	2.891
P1-N	37.345	15.139	52.485
P1-S	43.881	2.599	46.480
P1-W	21.771	11.485	33.256
P-20	5.667	8.738	14.405
P-21	1.275	0.338	1.614
P-22	37.069	132.395	169.463
P-23	37.948	9.190	47.138
P-24	0.287		0.287
P-25	43.291	21.651	64.942
P-26	47.948	53.271	101.219
P-27	55.435	17.147	72.582
P2-N	19.415	6.946	26.360
P2-SE	9.134	0.549	9.683
P2-SW	25.398	1.106	26.504
Grand Total	**888.016**	**609.113**	**1,497.129**

TABLE A-2: LAND USE FOR PROPOSED SITE CONDITIONS

ALL AREAS IN ACRES

SUBBASIN/ CATCHMENT	Impervious							Impervious Total	Saturated		Saturated Total	Till/Forest	Till/Lawn	Till/Pasture	Water	Grand Total
	Building	Gravel	Impervious Area Not Requiring Water Quality Treatment (BNSF Railroad)	Impervious Area Not Requiring Water Quality Treatment (Public)	Impervious Area Requiring Water Quality Treatment (GPT Railroad)	Impervious Area Requiring Water Quality Treatment (Industrial)	Impervious Area Requiring Water Quality Treatment (Private)		Saturated Soils with Forest	Saturated Soils with Pasture						
POI A			**0.003**	**1.494**			**1.110**	**2.607**	**70.353**	**0.001**	**70.354**	**60.614**	**0.469**	**1.697**	**5.855**	**141.597**
P-12							1.079	1.079	8.213		8.213	4.434	0.409			14.135
P-13									0.297		0.297	8.038				8.335
P-15				0.050				0.050	31.875		31.875	10.489				42.414
P-16									2.663		2.663	6.996				9.658
P-18			0.003					0.003	17.856	0.001	17.857	0.443				18.303
P-21				0.129			0.031	0.160	0.322		0.322	1.072	0.060			1.614
P-23				1.315				1.315	9.127		9.127	29.143		1.697	5.855	47.138
POI B				**6.113**				**6.113**	**111.442**	**77.271**	**188.713**	**42.822**		**15.265**	**1.957**	**254.870**
EX-S1-LonGulf-W				1.777				1.777	33.768	3.361	37.130					38.907
EX-S1-Lon-W				1.228				1.228	13.986	7.137	21.123	16.581		7.569		46.502
P-22				3.108				3.108	63.687	66.772	130.460	26.241		7.696	1.957	169.462
POI C	**0.053**			**6.309**				**6.362**	**88.265**	**18.191**	**106.456**	**60.103**	**0.014**	**26.497**	**1.167**	**200.599**
EX-S1-HenGulf-w				3.132				3.132	39.998	3.482	43.480	31.426		4.050		82.088
P-19	0.053			0.123				0.176	0.967		0.967	0.567	0.014		1.167	2.891
P-20				1.013				1.013	8.738		8.738	4.654	0.000			14.405
P-26				2.042				2.042	38.562	14.709	53.271	23.456		22.447		101.216
POI D	**0.042**			**3.536**			**0.817**	**4.395**	**16.800**	**1.290**	**18.090**	**48.738**	**0.203**	**6.940**		**78.367**
Ex-S1-Outlet-West				0.962			0.661	1.622	0.094	0.623	0.717	1.619	0.185	1.586		5.728
P-27	0.042			2.574			0.157	2.773	16.706	0.667	17.373	47.120	0.019	5.355		72.639
POI E	**0.104**	**0.585**	**2.969**	**2.339**			**0.106**	**6.104**	**65.251**	**27.988**	**93.239**	**142.308**	**0.198**	**71.298**	**1.278**	**314.424**
EX-S1-HenGulf-E				1.388			0.003	1.392					0.031			1.422
EX-S1-HenRR				0.884				0.884	5.573	2.441	8.014	7.280	0.013	2.718		18.909
EX-S2-S									6.780	7.938	14.717	59.900		52.660	0.965	128.242
P-17			2.969	0.060			0.012	3.042	41.439	8.459	49.898	37.443		10.846		101.229
P-24	0.014			0.005			0.091	0.110				0.097	0.079			0.287
P-25	0.090	0.585						0.676	11.460	9.150	20.610	37.588	0.075	5.074	0.312	64.334
POI F				**1.242**				**1.242**	**39.150**	**5.893**	**45.043**	**25.587**		**4.284**		**76.157**
Birch Bay				1.242				1.242	39.150	5.893	45.043	25.587		4.284		76.157
POI G	**0.445**			**1.453**			**0.370**	**2.268**	**5.723**	**4.977**	**10.700**	**55.767**	**0.249**	**62.276**	**1.481**	**132.741**
Ex-Bluff				0.018			0.370	0.388	4.427	2.087	6.514	7.350	0.249	47.336		61.837
EX-SE-BLUFF	0.445			1.435				1.879	1.297	2.889	4.186	48.417		14.941	1.481	70.904
SWM Pond 1	**0.742**	**0.007**		**0.554**		**60.118**	**5.785**	**67.207**	**3.653**	**0.003**	**3.656**	**5.482**	**42.530**	**0.002**	**13.381**	**132.257**
P1-N	0.550					30.770	2.174	33.494	2.592		2.592	2.595	12.116		1.724	52.521
P1-S	0.004	0.007		0.000		29.348	3.026	32.386		0.003	0.003	0.319	13.771	0.002		46.480
P1-W	0.188			0.554			0.585	1.327	1.061		1.061	2.568	16.643		11.656	33.256
SWM Pond 10	**0.578**			**0.002**			**0.699**	**1.280**				**0.167**	**0.549**	**0.121**	**0.365**	**2.482**
P-10	0.578			0.002			0.699	1.280				0.167	0.549	0.121	0.365	2.482
SWM Pond 11	**0.042**					**3.906**	**0.997**	**4.944**	**0.040**		**0.040**	**0.278**	**3.431**		**0.991**	**9.683**
P2-SE	0.042					3.906	0.997	4.944	0.040		0.040	0.278	3.431		0.991	9.683
SWM Pond 12	**0.760**			**0.102**			**0.727**	**1.589**	**0.048**		**0.048**	**0.910**	**0.382**		**0.000**	**2.929**
A	0.760			0.102			0.727	1.589	0.048		0.048	0.910	0.382		0.000	2.929
SWM Pond 2				**0.049**	**5.299**		**0.390**	**5.738**	**0.195**		**0.195**	**0.373**	**0.282**		**0.000**	**6.588**
B1					5.299		0.015	5.313					0.010			5.323
P-11				0.049			0.376	0.425	0.195		0.195	0.373	0.272		0.000	1.265
SWM Pond 3					**8.174**		**0.019**	**8.193**					**0.008**			**8.201**
B2					3.318		0.019	3.336					0.008			3.345
C2					4.856			4.856								4.856
SWM Pond 4					**6.385**			**6.385**								**6.385**
C1					6.385			6.385								6.385
SWM Pond 5					**9.863**			**9.863**								**9.863**
D					9.863			9.863								9.863
SWM Pond 6	**0.497**				**43.884**			**44.381**	**0.000**		**0.000**	**0.000**				**44.381**
E	0.497				43.884			44.381	0.000		0.000	0.000				44.381
SWM Pond 7	**0.226**			**0.000**	**15.294**		**0.541**	**16.061**				**3.077**	**0.651**		**2.364**	**22.153**
F					15.294			15.294								15.294
P-14	0.226			0.000			0.541	0.767				3.077	0.651		2.364	6.859
SWM Pond 8	**0.452**	**0.088**		**0.169**		**2.071**	**3.436**	**6.215**	**4.613**		**4.613**	**6.503**	**2.930**		**6.100**	**26.360**
P2-N	0.452	0.088		0.169		2.071	3.436	6.215	4.613		4.613	6.503	2.930		6.100	26.360
SWM Pond 9	**0.042**			**0.073**		**13.370**	**1.628**	**15.112**	**0.090**		**0.090**	**1.904**	**6.630**		**2.769**	**26.504**
P2-SW	0.042			0.073		13.370	1.628	15.112	0.090		0.090	1.904	6.630		2.769	26.504
Grand Total	**3.982**	**0.681**	**2.972**	**23.434**	**88.898**	**79.464**	**16.625**	**216.057**	**405.622**	**135.613**	**541.235**	**454.635**	**58.527**	**188.381**	**37.708**	**1,496.542**

UNDETAINED CATCHMENTS

DETAINED CATCHMENTS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/11/2014 2:12 PM

Input File Name: 2014 Main Site Pre-Dev vs. EX.fld
Project Name: GPT - Main Site Pre-Dev vs. Existing
Analysis Title: Ecology (Pre-Developed vs. Existing)
Comments: MGR - 11/7/12; Updated April 2014 BLT

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9

---------- Subbasin : Upper S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	159.750
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	215.520
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 375.270

---------- Subbasin : Upper S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	240.460
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	268.500
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	508.960

---------- Subbasin : Upper-Mid S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	22.100
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	78.340
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	100.440

---------- Subbasin : Lower-Mid S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	4.160
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	4.160

---------- Subbasin : Lower-Mid S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	148.110
Till Pasture	0.000

Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	118.070
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	266.180

---------- Subbasin : Lower S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	107.220
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.520
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	141.740

---------- Subbasin : S2 Onsite ----------

	-------Area(Acres) --------
Till Forest	275.080
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	71.650
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	346.730

---------- Subbasin : S2 Offsite ----------

	-------Area(Acres) --------
Till Forest	101.230
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.380
Green Roof	0.000
User	0.000

Impervious	0.000
Subbasin Total	135.610

---------- Subbasin : Lower S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.910
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	1.910

----------SCENARIO: EXISTING

Number of Subbasins: 19

---------- Subbasin : EX-S1-N Onsite ----------

	-------Area(Acres) --------
Till Forest	76.350
Till Pasture	2.030
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	90.550
Green Roof	0.000
User	0.000
Impervious	1.880
Subbasin Total	170.810

---------- Subbasin : EX-S1-N Offsite ----------

	-------Area(Acres) --------
Till Forest	80.130
Till Pasture	35.510
Till Grass	0.400
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	62.640
Green Roof	0.000
User	0.000
Impervious	20.300
Subbasin Total	198.980

```
 ---------- Subbasin : EX-S1-Lon-W ----------
                        -------Area(Acres) --------
Till Forest                 21.320
Till Pasture                2.830
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     21.130
Green Roof                  0.000
User                        0.000
Impervious                  0.480
---------------------------------------------
Subbasin Total              45.760


 ---------- Subbasin : EX-S1-HenGulf-W ----------
                        -------Area(Acres) --------
Till Forest                 36.740
Till Pasture                1.570
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     40.610
Green Roof                  0.000
User                        0.000
Impervious                  0.930
---------------------------------------------
Subbasin Total              79.850


 ---------- Subbasin : EX-S1-Hen-W Onsite ----------
                        -------Area(Acres) --------
Till Forest                 38.700
Till Pasture                17.520
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     45.310
Green Roof                  0.000
User                        0.000
Impervious                  0.930
---------------------------------------------
Subbasin Total              102.460


 ---------- Subbasin : EX-S1-Outlet-West ----------
                        -------Area(Acres) --------
Till Forest                 15.830
Till Pasture                2.550
Till Grass                  0.000
Outwash Forest              0.050
```

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.630
Green Roof	0.000
User	0.000
Impervious	0.650
Subbasin Total	22.710

---------- Subbasin : EX-S2-N ----------

	-------Area(Acres) --------
Till Forest	89.490
Till Pasture	9.400
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	32.110
Green Roof	0.000
User	0.000
Impervious	2.790
Subbasin Total	133.790

---------- Subbasin : EX-S2-N-Offsite ----------

	-------Area(Acres) --------
Till Forest	1.350
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.310
Subbasin Total	1.660

---------- Subbasin : EX-S1-Outlet-East ----------

	-------Area(Acres) --------
Till Forest	46.770
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	3.690
Outwash Pasture	0.670
Outwash Grass	0.000
Wetland	8.380
Green Roof	0.000
User	0.000
Impervious	0.280

Subbasin Total	59.790

---------- Subbasin : EX-S1-LonGulf-W ----------

	-------Area(Acres) --------
Till Forest	5.890
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	31.240
Green Roof	0.000
User	0.000
Impervious	0.730
Subbasin Total	37.860

---------- Subbasin : EX-S1-E Onsite ----------

	-------Area(Acres) --------
Till Forest	3.380
Till Pasture	2.690
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	60.130
Green Roof	0.000
User	0.000
Impervious	1.310
Subbasin Total	67.510

---------- Subbasin : EX-S1-HenKick ----------

	-------Area(Acres) --------
Till Forest	76.680
Till Pasture	0.510
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	127.650
Green Roof	0.000
User	0.000
Impervious	4.950
Subbasin Total	209.790

---------- Subbasin : EX-S1-E Offsite ----------

	-------Area(Acres) --------
Till Forest	94.720
Till Pasture	50.540

Till Grass	14.450
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	188.800
Green Roof	0.000
User	0.000
Impervious	20.000
Subbasin Total	368.510

---------- Subbasin : EX-S1-Hen-W Offsite ----------

	-------Area(Acres) --------
Till Forest	38.020
Till Pasture	2.580
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.000
Green Roof	0.000
User	0.000
Impervious	0.460
Subbasin Total	43.060

---------- Subbasin : EX-S1-HenGulf-E ----------

	-------Area(Acres) --------
Till Forest	131.390
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	59.650
Green Roof	0.000
User	0.000
Impervious	2.290
Subbasin Total	193.330

---------- Subbasin : EX-S1-HenRR ----------

	-------Area(Acres) --------
Till Forest	7.590
Till Pasture	2.810
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	8.040
Green Roof	0.000
User	0.000

Impervious	0.000
Subbasin Total	18.440

---------- Subbasin : EX-S2-S ----------

	-------Area(Acres) --------
Till Forest	66.710
Till Pasture	54.600
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	18.310
Green Roof	0.000
User	0.000
Impervious	0.650
Subbasin Total	140.270

---------- Subbasin : EX-S2-S-Offsite ----------

	-------Area(Acres) --------
Till Forest	33.780
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.090
Subbasin Total	34.870

---------- Subbasin : EX-S1-HenRR-Offsite ----------

	-------Area(Acres) --------
Till Forest	29.480
Till Pasture	31.250
Till Grass	2.230
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	27.120
Green Roof	0.000
User	0.000
Impervious	8.930
Subbasin Total	99.010

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

********** **LINK DATA** **********

----------SCENARIO: EXISTING
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C

Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9
Number of Links: 5

********** **Subbasin: Upper S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.988
5-Year	34.852
10-Year	42.792
25-Year	55.261
50-Year	68.844
100-Year	78.256
200-Year	91.824

********** **Subbasin: Upper S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	29.806
5-Year	45.065
10-Year	55.791
25-Year	70.969
50-Year	88.801
100-Year	101.073
200-Year	120.007

********** **Subbasin: Upper-Mid S1 Onsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.580
5-Year	11.074
10-Year	13.784
25-Year	18.193
50-Year	22.391
100-Year	25.339
200-Year	28.507

********** **Subbasin: Lower-Mid S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.172
10-Year	0.229
25-Year	0.286
50-Year	0.341
100-Year	0.383
200-Year	0.571

********** **Subbasin: Lower-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.141
5-Year	21.423
10-Year	26.531
25-Year	34.326
50-Year	42.151
100-Year	48.105
200-Year	58.509

********** **Subbasin: Lower S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.509
5-Year	8.787
10-Year	11.116
25-Year	15.089
50-Year	17.003
100-Year	19.584
200-Year	25.760

********** **Subbasin: S2 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.711
5-Year	20.228
10-Year	25.493
25-Year	35.088
50-Year	39.137
100-Year	45.187
200-Year	60.581

********** **Subbasin: S2 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.394
5-Year	8.484
10-Year	10.815
25-Year	14.630
50-Year	16.527
100-Year	19.025
200-Year	24.904

********** **Subbasin: Lower S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.174
5-Year	0.254
10-Year	0.321
25-Year	0.415
50-Year	0.506
100-Year	0.571
200-Year	0.622

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794

5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	99.103
5-Year	150.266
10-Year	186.185
25-Year	241.343
50-Year	295.666
100-Year	337.500
200-Year	411.276

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)

==========

2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

********** Link: S2 - POI E ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

----------SCENARIO: EXISTING

Number of Subbasins: 19

Number of Links: 5

********** **Subbasin: EX-S1-N Onsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	10.391
5-Year	15.710
10-Year	19.389
25-Year	24.380
50-Year	30.678
100-Year	34.844
200-Year	41.421

********** **Subbasin: EX-S1-N Offsite** **********

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.561
5-Year	19.245
10-Year	24.733

25-Year	29.008
50-Year	35.791
100-Year	40.201
200-Year	51.537

********** **Subbasin: EX-S1-Lon-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.589
5-Year	3.948
10-Year	4.875
25-Year	6.231
50-Year	7.710
100-Year	8.770
200-Year	10.677

********** **Subbasin: EX-S1-HenGulf-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.775
5-Year	7.212
10-Year	8.882
25-Year	11.173
50-Year	14.057
100-Year	15.973
200-Year	19.111

********** **Subbasin: EX-S1-Hen-W Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.705
5-Year	8.932
10-Year	11.068
25-Year	14.113
50-Year	17.317
100-Year	19.695
200-Year	24.368

********** **Subbasin: EX-S1-Outlet-West** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.900
5-Year	1.424
10-Year	1.884
25-Year	2.341
50-Year	2.710
100-Year	3.106
200-Year	4.277

********** **Subbasin: EX-S2-N** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.754
5-Year	9.057
10-Year	11.610
25-Year	15.097
50-Year	17.413
100-Year	19.925
200-Year	26.322

********** **Subbasin: EX-S2-N-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.108
5-Year	0.147
10-Year	0.176
25-Year	0.219
50-Year	0.247
100-Year	0.273
200-Year	0.375

********** **Subbasin: EX-S1-Outlet-East** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.913
5-Year	3.042
10-Year	3.964
25-Year	5.237
50-Year	5.826
100-Year	6.747
200-Year	9.279

********** **Subbasin: EX-S1-LonGulf-W** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136
5-Year	4.577
10-Year	5.614
25-Year	7.312
50-Year	9.041
100-Year	10.199
200-Year	11.419

********** **Subbasin: EX-S1-E Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.917
5-Year	8.649
10-Year	10.662
25-Year	13.814
50-Year	17.092
100-Year	19.261
200-Year	21.427

********** **Subbasin: EX-S1-HenKick** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.288
5-Year	21.143
10-Year	26.282
25-Year	33.271
50-Year	41.732
100-Year	47.224
200-Year	55.098

********** **Subbasin: EX-S1-E Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	25.639
5-Year	39.603
10-Year	48.573

25-Year	59.241
50-Year	75.159
100-Year	84.953
200-Year	103.148

********** **Subbasin: EX-S1-Hen-W Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.271
5-Year	2.136
10-Year	2.757
25-Year	3.478
50-Year	4.108
100-Year	4.523
200-Year	6.666

********** **Subbasin: EX-S1-HenGulf-E** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	8.741
5-Year	13.641
10-Year	17.375
25-Year	22.778
50-Year	26.458
100-Year	30.277
200-Year	38.619

********** **Subbasin: EX-S1-HenRR** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.989
5-Year	1.536
10-Year	1.912
25-Year	2.468
50-Year	3.017
100-Year	3.439
200-Year	4.256

********** **Subbasin: EX-S2-S** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.182
5-Year	8.476
10-Year	11.299
25-Year	14.680
50-Year	16.655
100-Year	18.905
200-Year	27.243

********** **Subbasin: EX-S2-S-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028
5-Year	1.736
10-Year	2.185
25-Year	2.846
50-Year	3.245
100-Year	3.633
200-Year	5.308

********** **Subbasin: EX-S1-HenRR-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.095
5-Year	9.300
10-Year	12.023
25-Year	14.220
50-Year	17.509
100-Year	19.727
200-Year	25.940

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.783
5-Year	35.401
10-Year	44.118
25-Year	54.195
50-Year	66.469
100-Year	75.045
200-Year	92.958

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.783
5-Year	35.401
10-Year	44.118
25-Year	54.195
50-Year	66.469
100-Year	75.045
200-Year	92.958

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.883
5-Year	113.875
10-Year	140.353
25-Year	170.880
50-Year	217.202
100-Year	245.453
200-Year	294.727

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.883
5-Year	113.875
10-Year	140.353
25-Year	170.880
50-Year	217.202
100-Year	245.453
200-Year	294.727

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	94.681
5-Year	145.621
10-Year	180.303
25-Year	222.900
50-Year	278.856
100-Year	315.846
200-Year	383.466

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	94.681
5-Year	145.621
10-Year	180.303
25-Year	222.900
50-Year	278.856
100-Year	315.846
200-Year	383.466

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	115.684
5-Year	181.188
10-Year	226.541
25-Year	282.700
50-Year	344.906
100-Year	391.387
200-Year	486.396

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	11.996
5-Year	19.048
10-Year	25.876
25-Year	31.841
50-Year	37.039

100-Year	42.523
200-Year	59.178

********** Link: S2 - POI E ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	11.996
5-Year	19.048
10-Year	25.876
25-Year	31.841
50-Year	37.039
100-Year	42.523
200-Year	59.178

*************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: Upper S1 Onsite	79209.340
Subbasin: Upper S1 Offsite	106602.400
Subbasin: Upper-Mid S1 Onsite	21916.450
Subbasin: Lower-Mid S1 Offsite	795.220
Subbasin: Lower-Mid S1 Onsite	54976.730
Subbasin: Lower S1 Onsite	28291.810
Subbasin: S2 Onsite	68764.910
Subbasin: S2 Offsite	27115.160
Subbasin: Lower S1 Offsite	431.343
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable
Link: S2 - POI E	Not Applicable
Total:	388103.400

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: EX-S1-N Onsite	35428.230
Subbasin: EX-S1-N Offsite	36232.660
Subbasin: EX-S1-Lon-W	9382.697
Subbasin: EX-S1-HenGulf-W	16491.270
Subbasin: EX-S1-Hen-W Onsite	20944.460
Subbasin: EX-S1-Outlet-West	4343.835
Subbasin: EX-S2-N	26136.420
Subbasin: EX-S2-N-Offsite	258.064

Subbasin: EX-S1-Outlet-East	12248.760	
Subbasin: EX-S1-LonGulf-W		8180.980
Subbasin: EX-S1-E Onsite		14734.360
Subbasin: EX-S1-HenKick		43582.230
Subbasin: EX-S1-E Offsite	72175.780	
Subbasin: EX-S1-Hen-W Offsite		8207.551
Subbasin: EX-S1-HenGulf-E		38587.330
Subbasin: EX-S1-HenRR		3798.140
Subbasin: EX-S2-S	27215.350	
Subbasin: EX-S2-S-Offsite	6457.336	
Subbasin: EX-S1-HenRR-Offsite		17960.070
Link: S1 - POI A	Not Applicable	
Link: S1 - POI B	Not Applicable	
Link: S1 - POI C	Not Applicable	
Link: S1 - POI D	Not Applicable	
Link: S2 - POI E	Not Applicable	
Total:		402365.500

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2456.351 ac-ft/year, Post Developed: 2546.617 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 5

----------SCENARIO: EXISTING

Number of Links: 5

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: S1 - POI D
Scenario Existing Compliance Link: S1 - POI D

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	99.103	2-Year	115.684
5-Year	150.266	5-Year	181.188
10-Year	186.185	10-Year	226.541
25-Year	241.343	25-Year	282.700
50-Year	295.666	50-Year	344.906
100-Year	337.500	100-Year	391.387
200-Year	411.276	200-Year	486.396

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	44.9%	FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	65.4%	FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	100.0%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/14/2014 10:27 AM

Input File Name: 2014 Main Site Pre-Dev vs. Prop.fld
Project Name: GPT - Main Site Pre-Dev vs. Proposed
Analysis Title: POI Flow Calc (PreDev and Proposed)
Comments: MGR - 11/7/12; Updated April 2014 BLT

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9

---------- Subbasin : Upper S1 Onsite ----------

	-------Area(Acres) --------
Till Forest	159.750
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	215.520
Green Roof	0.000
User	0.000
Impervious	0.000

```
---------------------------------------------
Subbasin Total              375.270


 ---------- Subbasin : Upper S1 Offsite ----------
                        -------Area(Acres) --------
Till Forest                 240.460
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     268.500
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              508.960


 ---------- Subbasin : Upper-Mid S1 Onsite ----------
                        -------Area(Acres) --------
Till Forest                 22.100
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     78.340
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              100.440


 ---------- Subbasin : Lower-Mid S1 Offsite ----------
                        -------Area(Acres) --------
Till Forest                 4.160
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  0.000
---------------------------------------------
Subbasin Total              4.160


 ---------- Subbasin : Lower-Mid S1 Onsite ----------
```

```
                        -------Area(Acres) --------
Till Forest                     148.110
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         118.070
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  266.180


 ---------- Subbasin : Lower S1 Onsite ----------
                        -------Area(Acres) --------
Till Forest                     107.220
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         34.520
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  141.740


 ---------- Subbasin : S2 Onsite ----------
                        -------Area(Acres) --------
Till Forest                     275.080
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
Outwash Pasture                 0.000
Outwash Grass                   0.000
Wetland                         71.650
Green Roof                      0.000
User                            0.000
Impervious                      0.000
---------------------------------------------
Subbasin Total                  346.730


 ---------- Subbasin : S2 Offsite ----------
                        -------Area(Acres) --------
Till Forest                     101.230
Till Pasture                    0.000
Till Grass                      0.000
Outwash Forest                  0.000
```

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	34.380
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	135.610

---------- Subbasin : Lower S1 Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.910
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	1.910

----------SCENARIO: PROPOSED
Number of Subbasins: 22

---------- Subbasin : POI A undetained ----------

	-------Area(Acres) --------
Till Forest	60.614
Till Pasture	1.697
Till Grass	0.469
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	70.354
Green Roof	0.000
User	0.000
Impervious	8.462
Subbasin Total	141.596

---------- Subbasin : EX-S1-N Offsite ----------

	-------Area(Acres) --------
Till Forest	80.130
Till Pasture	35.510
Till Grass	0.400
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000

```
Wetland                 62.640
Green Roof              0.000
User                    0.000
Impervious              20.300
---------------------------------------------
Subbasin Total          198.980


 ---------- Subbasin : POI B Undetained ----------
                       -------Area(Acres) --------
Till Forest             42.822
Till Pasture            15.265
Till Grass              0.000
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 188.713
Green Roof              0.000
User                    0.000
Impervious              8.070
---------------------------------------------
Subbasin Total          254.870


 ---------- Subbasin : POI C Undetained ----------
                       -------Area(Acres) --------
Till Forest             60.103
Till Pasture            26.497
Till Grass              0.014
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 106.456
Green Roof              0.000
User                    0.000
Impervious              7.529
---------------------------------------------
Subbasin Total          200.599


 ---------- Subbasin : POI D undetained ----------
                       -------Area(Acres) --------
Till Forest             48.738
Till Pasture            6.940
Till Grass              0.203
Outwash Forest          0.000
Outwash Pasture         0.000
Outwash Grass           0.000
Wetland                 18.090
Green Roof              0.000
User                    0.000
Impervious              4.395
---------------------------------------------
```

```
Subbasin Total              78.366

 ---------- Subbasin : POI E undetained ----------
                       -------Area(Acres) --------
Till Forest                 142.308
Till Pasture                71.298
Till Grass                  0.198
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     93.239
Green Roof                  0.000
User                        0.000
Impervious                  7.382
---------------------------------------------
Subbasin Total              314.425

 ---------- Subbasin : EX-S1-E Offsite ----------
                       -------Area(Acres) --------
Till Forest                 94.720
Till Pasture                50.540
Till Grass                  14.450
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     188.800
Green Roof                  0.000
User                        0.000
Impervious                  20.000
---------------------------------------------
Subbasin Total              368.510

 ---------- Subbasin : EX-S1-Hen-W Offsite ----------
                       -------Area(Acres) --------
Till Forest                 38.020
Till Pasture                2.580
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     2.000
Green Roof                  0.000
User                        0.000
Impervious                  0.460
---------------------------------------------
Subbasin Total              43.060

 ---------- Subbasin : EX-S2-S-Offsite ----------
                       -------Area(Acres) --------
```

Till Forest	33.780
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.090
Subbasin Total	34.870

---------- Subbasin : EX-S1-HenRR-Offsite ----------

	-------Area(Acres) --------
Till Forest	29.480
Till Pasture	31.250
Till Grass	2.230
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	27.120
Green Roof	0.000
User	0.000
Impervious	8.930
Subbasin Total	99.010

---------- Subbasin : Pond 1proposed ----------

	-------Area(Acres) --------
Till Forest	5.482
Till Pasture	0.000
Till Grass	42.530
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.656
Green Roof	0.000
User	0.000
Impervious	80.588
Subbasin Total	132.256

---------- Subbasin : Pond 2 Proposed ----------

	-------Area(Acres) --------
Till Forest	0.373
Till Pasture	0.000
Till Grass	0.282
Outwash Forest	0.000

```
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.195
Green Roof               0.000
User                     0.000
Impervious               5.738
---------------------------------------------
Subbasin Total           6.588

 ---------- Subbasin : Pond 3 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.008
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
Impervious               8.193
---------------------------------------------
Subbasin Total           8.201

 ---------- Subbasin : Pond 4 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.000
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
Impervious               6.385
---------------------------------------------
Subbasin Total           6.385

 ---------- Subbasin : Pond 5 Proposed ----------
                       -------Area(Acres) --------
Till Forest              0.000
Till Pasture             0.000
Till Grass               0.000
Outwash Forest           0.000
Outwash Pasture          0.000
Outwash Grass            0.000
Wetland                  0.000
Green Roof               0.000
User                     0.000
```

```
Impervious                  9.863
----------------------------------------------
Subbasin Total              9.863


 ---------- Subbasin : Pond 6 Proposed ----------
                       -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  0.000
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  44.381
----------------------------------------------
Subbasin Total              44.381


 ---------- Subbasin : POnd 7 Propposed ----------
                       -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  3.728
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  18.421
----------------------------------------------
Subbasin Total              22.149


 ---------- Subbasin : Pond 8 proposed ----------
                       -------Area(Acres) --------
Till Forest                 6.503
Till Pasture                0.000
Till Grass                  2.930
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     4.613
Green Roof                  0.000
User                        0.000
Impervious                  12.315
----------------------------------------------
Subbasin Total              26.361
```

```
---------- Subbasin : Pond 9 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 1.904
Till Pasture                0.000
Till Grass                  6.630
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.090
Green Roof                  0.000
User                        0.000
Impervious                  17.881
----------------------------------------------
Subbasin Total              26.505

---------- Subbasin : Pond 10 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.000
Till Pasture                0.000
Till Grass                  0.837
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.000
Green Roof                  0.000
User                        0.000
Impervious                  1.645
----------------------------------------------
Subbasin Total              2.482

---------- Subbasin : Pond 11 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.278
Till Pasture                0.000
Till Grass                  3.431
Outwash Forest              0.000
Outwash Pasture             0.000
Outwash Grass               0.000
Wetland                     0.040
Green Roof                  0.000
User                        0.000
Impervious                  5.935
----------------------------------------------
Subbasin Total              9.684

---------- Subbasin : Pond 12 Proposed ----------
                        -------Area(Acres) --------
Till Forest                 0.910
Till Pasture                0.000
Till Grass                  0.382
```

Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.048
Green Roof	0.000
User	0.000
Impervious	1.589
Subbasin Total	2.929

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 5

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

********** **LINK DATA** **********

----------SCENARIO: PROPOSED
Number of Links: 17

Link Name: S1 - POI A
Link Type: Copy
Downstream Link Name: S1 - POI B

Link Name: S1 - POI B
Link Type: Copy
Downstream Link Name: S1 - POI C

Link Name: S1 - POI C
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: S1 - POI D
Link Type: Copy
Downstream Link: None

Link Name: S2 - POI E
Link Type: Copy
Downstream Link Name: S1 - POI D

Link Name: SWM Pond 1
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 88.00
Riser Crest Elevation (ft) : 98.00
Max Pond Elevation (ft) : 99.50
Storage Depth (ft) : 10.00
Pond Bottom Length (ft) : 760.6
Pond Bottom Width (ft) : 152.1
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 115687.
Area at Riser Crest El (sq-ft) : 174,049.
(acres) : 3.996
Volume at Riser Crest (cu-ft) : 1,442,681.
(ac-ft) : 33.119
Area at Max Elevation (sq-ft) : 183425.
(acres) : 4.211
Vol at Max Elevation (cu-ft) : 1,745,577.
(ac-ft) : 40.073

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 54.00
Common Length (ft) : 0.310
Riser Crest Elevation : 98.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 88.00
Diameter (in) : 6.11
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 93.94
Length (in) : 3.76
Height (in) : 48.74
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 2
Link Type: Structure
Downstream Link Name: S1 - POI B

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 126.00
Riser Crest Elevation (ft) : 128.50
Max Pond Elevation (ft) : 129.00
Storage Depth (ft) : 2.50
Pond Bottom Length (ft) : 283.6
Pond Bottom Width (ft) : 94.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 26800.
Area at Riser Crest El (sq-ft) : 32,697.
(acres) : 0.751
Volume at Riser Crest (cu-ft) : 74,277.
(ac-ft) : 1.705
Area at Max Elevation (sq-ft) : 33930.
(acres) : 0.779

Vol at Max Elevation (cu-ft) : 94,203.
(ac-ft) : 2.163

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.180
Riser Crest Elevation : 128.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 126.00
Diameter (in) : 2.30
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 127.46
Length (in) : 2.11
Height (in) : 12.45
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 3
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 134.00
Riser Crest Elevation (ft) : 137.00
Max Pond Elevation (ft) : 138.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 304.6
Pond Bottom Width (ft) : 101.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 30917.
Area at Riser Crest El (sq-ft) : 38,551.
(acres) : 0.885
Volume at Riser Crest (cu-ft) : 104,039.
(ac-ft) : 2.388

Area at Max Elevation (sq-ft) : 41239.
(acres) : 0.947
Vol at Max Elevation (cu-ft) : 147,783.
(ac-ft) : 3.393

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.190
Riser Crest Elevation : 137.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 134.00
Diameter (in) : 2.52
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 135.78
Length (in) : 2.22
Height (in) : 14.61
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 4
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.50
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 1.50
Pond Bottom Length (ft) : 323.1
Pond Bottom Width (ft) : 107.7
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 34798.
Area at Riser Crest El (sq-ft) : 38,756.
(acres) : 0.890

Volume at Riser Crest (cu-ft) : 55,145.
(ac-ft) : 1.266
Area at Max Elevation (sq-ft) : 41485.
(acres) : 0.952
Vol at Max Elevation (cu-ft) : 99,135.
(ac-ft) : 2.276

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 180.00
Common Length (ft) : 0.560
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 123.50
Diameter (in) : 3.26
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.36
Length (in) : 6.72
Height (in) : 7.65
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 5
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.00
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 473.6
Pond Bottom Width (ft) : 157.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 74781.

Area at Riser Crest El (sq-ft) : 82,503.
(acres) : 1.894
Volume at Riser Crest (cu-ft) : 157,237.
(ac-ft) : 3.610
Area at Max Elevation (sq-ft) : 86472.
(acres) : 1.985
Vol at Max Elevation (cu-ft) : 249,969.
(ac-ft) : 5.739

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.270
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 123.00
Diameter (in) : 2.63
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.23
Length (in) : 3.22
Height (in) : 9.27
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 6
Link Type: Structure
Downstream Link Name: S1 - POI A

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 135.00
Riser Crest Elevation (ft) : 139.00
Max Pond Elevation (ft) : 140.00
Storage Depth (ft) : 4.00
Pond Bottom Length (ft) : 621.5
Pond Bottom Width (ft) : 207.2

Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 128775.
Area at Riser Crest El (sq-ft) : 149,240.
(acres) : 3.426
Volume at Riser Crest (cu-ft) : 555,645.
(ac-ft) : 12.756
Area at Max Elevation (sq-ft) : 154536.
(acres) : 3.548
Vol at Max Elevation (cu-ft) : 722,450.
(ac-ft) : 16.585

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 42.00
Common Length (ft) : 0.640
Riser Crest Elevation : 139.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 135.00
Diameter (in) : 5.45
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 137.40
Length (in) : 7.67
Height (in) : 19.17
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 7
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 145.00
Riser Crest Elevation (ft) : 148.50
Max Pond Elevation (ft) : 149.50
Storage Depth (ft) : 3.50

Pond Bottom Length (ft) : 515.3
Pond Bottom Width (ft) : 171.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 88529.
Area at Riser Crest El (sq-ft) : 103,399.
(acres) : 2.374
Volume at Riser Crest (cu-ft) : 335,615.
(ac-ft) : 7.705
Area at Max Elevation (sq-ft) : 107809.
(acres) : 2.475
Vol at Max Elevation (cu-ft) : 451,553.
(ac-ft) : 10.366

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.270
Riser Crest Elevation : 148.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 145.00
Diameter (in) : 3.24
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 147.08
Length (in) : 3.19
Height (in) : 17.10
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 8
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 66.00
Riser Crest Elevation (ft) : 69.00

Max Pond Elevation (ft) : 70.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 412.3
Pond Bottom Width (ft) : 137.4
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 56650.
Area at Riser Crest El (sq-ft) : 66,869.
(acres) : 1.535
Volume at Riser Crest (cu-ft) : 185,116.
(ac-ft) : 4.250
Area at Max Elevation (sq-ft) : 70419.
(acres) : 1.617
Vol at Max Elevation (cu-ft) : 260,441.
(ac-ft) : 5.979

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.290
Riser Crest Elevation : 69.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 66.00
Diameter (in) : 4.06
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 67.46
Length (in) : 3.50
Height (in) : 18.48
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 9
Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 42.00
Riser Crest Elevation (ft) : 48.00
Max Pond Elevation (ft) : 49.00
Storage Depth (ft) : 6.00
Pond Bottom Length (ft) : 390.0
Pond Bottom Width (ft) : 130.0
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 50700.
Area at Riser Crest El (sq-ft) : 70,716.
(acres) : 1.623
Volume at Riser Crest (cu-ft) : 362,952.
(ac-ft) : 8.332
Area at Max Elevation (sq-ft) : 74304.
(acres) : 1.706
Vol at Max Elevation (cu-ft) : 442,528.
(ac-ft) : 10.159

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.100
Riser Crest Elevation : 48.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 42.00
Diameter (in) : 2.68
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Horizontal Rectangular Orifice
Control Elevation (ft) : 45.44
Length (in) : 1.19
Height (in) : 30.73
Orientation : Horizontal
Elbow : Yes

Link Name: SWM Pond 10
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 71.00
Riser Crest Elevation (ft) : 74.00
Max Pond Elevation (ft) : 75.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 168.5
Pond Bottom Width (ft) : 56.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 9470.
Area at Riser Crest El (sq-ft) : 13,838.
(acres) : 0.318
Volume at Riser Crest (cu-ft) : 34,800.
(ac-ft) : 0.799
Area at Max Elevation (sq-ft) : 15439.
(acres) : 0.354
Vol at Max Elevation (cu-ft) : 50,816.
(ac-ft) : 1.167

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.030
Riser Crest Elevation : 74.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 71.00
Diameter (in) : 0.94
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 72.76
Length (in) : 0.33
Height (in) : 14.89
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 11

Link Type: Structure
Downstream Link Name: S2 - POI E

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 52.00
Riser Crest Elevation (ft) : 57.00
Max Pond Elevation (ft) : 58.00
Storage Depth (ft) : 5.00
Pond Bottom Length (ft) : 242.5
Pond Bottom Width (ft) : 80.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 19594.
Area at Riser Crest El (sq-ft) : 30,193.
(acres) : 0.693
Volume at Riser Crest (cu-ft) : 123,717.
(ac-ft) : 2.840
Area at Max Elevation (sq-ft) : 32529.
(acres) : 0.747
Vol at Max Elevation (cu-ft) : 158,092.
(ac-ft) : 3.629

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.050
Riser Crest Elevation : 57.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 52.00
Diameter (in) : 1.71
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 54.90
Length (in) : 0.59
Height (in) : 25.25
Orientation : Vertical
Elbow : No

Link Name: SWM Pond 12
Link Type: Structure
Downstream Link Name: S1 - POI C

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 101.00
Max Pond Elevation (ft) : 102.00
Storage Depth (ft) : 1.00
Pond Bottom Length (ft) : 263.7
Pond Bottom Width (ft) : 87.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 23179.
Area at Riser Crest El (sq-ft) : 25,325.
(acres) : 0.581
Volume at Riser Crest (cu-ft) : 24,246.
(ac-ft) : 0.557
Area at Max Elevation (sq-ft) : 27542.
(acres) : 0.632
Vol at Max Elevation (cu-ft) : 53,206.
(ac-ft) : 1.221

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.220
Riser Crest Elevation : 101.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.78
Orientation : Horizontal
Elbow : Yes

--- Device Number 2 ---
Device Type : Horizontal Rectangular Orifice
Control Elevation (ft) : 100.52
Length (in) : 2.58
Height (in) : 5.76
Orientation : Horizontal
Elbow : Yes

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 9
Number of Links: 5

********** **Subbasin: Upper S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	22.988
5-Year	34.852
10-Year	42.792
25-Year	55.261
50-Year	68.844
100-Year	78.256
200-Year	91.824

********** **Subbasin: Upper S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	29.806
5-Year	45.065
10-Year	55.791
25-Year	70.969
50-Year	88.801
100-Year	101.073
200-Year	120.007

********** **Subbasin: Upper-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.580
5-Year	11.074
10-Year	13.784
25-Year	18.193
50-Year	22.391
100-Year	25.339
200-Year	28.507

********** **Subbasin: Lower-Mid S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.172
10-Year	0.229
25-Year	0.286
50-Year	0.341
100-Year	0.383
200-Year	0.571

********** **Subbasin: Lower-Mid S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	14.141
5-Year	21.423
10-Year	26.531
25-Year	34.326
50-Year	42.151
100-Year	48.105
200-Year	58.509

********** **Subbasin: Lower S1 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.509
5-Year	8.787
10-Year	11.116
25-Year	15.089
50-Year	17.003
100-Year	19.584
200-Year	25.760

********** **Subbasin: S2 Onsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.711
5-Year	20.228

10-Year	25.493
25-Year	35.088
50-Year	39.137
100-Year	45.187
200-Year	60.581

********** **Subbasin: S2 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.394
5-Year	8.484
10-Year	10.815
25-Year	14.630
50-Year	16.527
100-Year	19.025
200-Year	24.904

********** **Subbasin: Lower S1 Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.174
5-Year	0.254
10-Year	0.321
25-Year	0.415
50-Year	0.506
100-Year	0.571
200-Year	0.622

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	52.794
5-Year	79.997
10-Year	98.576
25-Year	126.230
50-Year	157.645
100-Year	179.329
200-Year	211.831

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	60.136
5-Year	91.196
10-Year	111.966
25-Year	144.473
50-Year	180.037
100-Year	204.668
200-Year	240.338

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI C ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	74.554
5-Year	112.905
10-Year	139.296
25-Year	178.065
50-Year	222.492
100-Year	253.132
200-Year	299.410

********** Link: S1 - POI D ********** Link Inflow

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	99.103
5-Year	150.266
10-Year	186.185
25-Year	241.343
50-Year	295.666
100-Year	337.500
200-Year	411.276

********** Link: S2 - POI E ********** Link Inflow

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308

25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

********** Link: S2 - POI E ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	17.950
5-Year	28.822
10-Year	36.308
25-Year	49.718
50-Year	55.664
100-Year	64.212
200-Year	85.484

----------SCENARIO: PROPOSED
Number of Subbasins: 22
Number of Links: 17

********** **Subbasin: POI A undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	9.558
5-Year	14.308
10-Year	17.738
25-Year	21.556
50-Year	27.176
100-Year	30.659
200-Year	36.851

********** **Subbasin: EX-S1-N Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.561
5-Year	19.245
10-Year	24.733
25-Year	29.008
50-Year	35.791

100-Year	40.201
200-Year	51.537

********** **Subbasin: POI B Undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	20.269
5-Year	29.758
10-Year	36.491
25-Year	46.689
50-Year	58.567
100-Year	66.034
200-Year	75.513

********** **Subbasin: POI C Undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	13.391
5-Year	20.358
10-Year	25.085
25-Year	30.844
50-Year	39.099
100-Year	44.183
200-Year	53.174

********** **Subbasin: POI D undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.804
5-Year	6.012
10-Year	7.758
25-Year	9.425
50-Year	11.187
100-Year	12.700
200-Year	16.766

********** **Subbasin: POI E undetained** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	15.107
5-Year	24.263
10-Year	31.832
25-Year	39.456
50-Year	46.840
100-Year	53.342
200-Year	69.704

********** **Subbasin: EX-S1-E Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	25.639
5-Year	39.603
10-Year	48.573
25-Year	59.241
50-Year	75.159
100-Year	84.953
200-Year	103.148

********** **Subbasin: EX-S1-Hen-W Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.271
5-Year	2.136
10-Year	2.757
25-Year	3.478
50-Year	4.108
100-Year	4.523
200-Year	6.666

********** **Subbasin: EX-S2-S-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028
5-Year	1.736
10-Year	2.185
25-Year	2.846
50-Year	3.245
100-Year	3.633

200-Year	5.308

********** **Subbasin: EX-S1-HenRR-Offsite** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.095
5-Year	9.300
10-Year	12.023
25-Year	14.220
50-Year	17.509
100-Year	19.727
200-Year	25.940

********** **Subbasin: Pond 1proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	26.628
5-Year	33.409
10-Year	39.811
25-Year	47.876
50-Year	52.816
100-Year	54.616
200-Year	68.782

********** **Subbasin: Pond 2 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.714
5-Year	2.138
10-Year	2.521
25-Year	2.876
50-Year	3.043
100-Year	3.350
200-Year	3.887

********** **Subbasin: Pond 3 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)

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2-Year	2.361
5-Year	2.971
10-Year	3.513
25-Year	3.950
50-Year	4.276
100-Year	4.702
200-Year	5.286

********** **Subbasin: Pond 4 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.840
5-Year	2.315
10-Year	2.736
25-Year	3.076
50-Year	3.332
100-Year	3.663
200-Year	4.118

********** **Subbasin: Pond 5 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.842
5-Year	3.576
10-Year	4.226
25-Year	4.752
50-Year	5.147
100-Year	5.658
200-Year	6.360

********** **Subbasin: Pond 6 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.788
5-Year	16.090
10-Year	19.017
25-Year	21.384
50-Year	23.158
100-Year	25.461
200-Year	28.620

********** **Subbasin: POnd 7 Propposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.663
5-Year	7.129
10-Year	8.384
25-Year	9.705
50-Year	10.418
100-Year	11.298
200-Year	13.228

********** **Subbasin: Pond 8 proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.040
5-Year	5.150
10-Year	5.977
25-Year	7.479
50-Year	7.968
100-Year	8.614
200-Year	11.061

********** **Subbasin: Pond 9 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.700
5-Year	7.153
10-Year	8.399
25-Year	10.022
50-Year	10.983
100-Year	11.563
200-Year	14.155

********** **Subbasin: Pond 10 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs) Flood Peak (cfs)

2-Year	0.539
5-Year	0.675
10-Year	0.792
25-Year	0.960
50-Year	1.061
100-Year	1.108
200-Year	1.364

********** **Subbasin: Pond 11 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.973
5-Year	2.467
10-Year	2.940
25-Year	3.553
50-Year	3.949
100-Year	4.078
200-Year	5.108

********** **Subbasin: Pond 12 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.504
5-Year	0.630
10-Year	0.744
25-Year	0.889
50-Year	0.960
100-Year	0.990
200-Year	1.271

********** Link: S1 - POI A ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	48.659
5-Year	75.123
10-Year	94.205
25-Year	118.025
50-Year	140.735
100-Year	157.393
200-Year	192.922

********** Link: S1 - POI A ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	48.659
5-Year	75.123
10-Year	94.205
25-Year	118.025
50-Year	140.735
100-Year	157.393
200-Year	192.922

********** Link: S1 - POI B ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	69.616
5-Year	105.483
10-Year	130.255
25-Year	162.698
50-Year	199.532
100-Year	223.568
200-Year	268.560

********** Link: S1 - POI B ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	69.616
5-Year	105.483
10-Year	130.255
25-Year	162.698
50-Year	199.532
100-Year	223.568
200-Year	268.560

********** Link: S1 - POI C ********** Link Inflow
Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	85.385
5-Year	129.514
10-Year	160.526
25-Year	205.336
50-Year	245.948
100-Year	274.243
200-Year	330.181

********** Link: S1 - POI C ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	85.385
5-Year	129.514
10-Year	160.526
25-Year	205.336
50-Year	245.948
100-Year	274.243
200-Year	330.181

********** Link: S1 - POI D ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	112.185
5-Year	173.091
10-Year	218.214
25-Year	278.816
50-Year	327.107
100-Year	364.675
200-Year	448.866

********** Link: S2 - POI E ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	23.268

5-Year	36.769
10-Year	48.467
25-Year	60.747
50-Year	69.972
100-Year	77.732
200-Year	101.920

********** Link: S2 - POI E ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	23.268
5-Year	36.769
10-Year	48.467
25-Year	60.747
50-Year	69.972
100-Year	77.732
200-Year	101.920

********** Link: SWM Pond 1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	26.628
5-Year	33.409
10-Year	39.811
25-Year	47.876
50-Year	52.816
100-Year	54.616
200-Year	68.782

********** Link: SWM Pond 1 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.353
5-Year	4.118
10-Year	6.320
25-Year	8.229
50-Year	9.455
100-Year	10.965

200-Year	13.928

********** Link: SWM Pond 1 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	91.258
1.11-Year	91.695
1.25-Year	92.219
2.00-Year	93.577
3.33-Year	94.611
5-Year	95.361
10-Year	96.502
25-Year	97.188
50-Year	97.802
100-Year	98.064

********** Link: SWM Pond 2 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.714
5-Year	2.138
10-Year	2.521
25-Year	2.876
50-Year	3.043
100-Year	3.350
200-Year	3.887

********** Link: SWM Pond 2 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.167
5-Year	0.292
10-Year	0.446
25-Year	0.612
50-Year	0.691
100-Year	0.843
200-Year	0.968

********** Link: SWM Pond 2 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	126.827
1.11-Year	126.947
1.25-Year	127.058
2.00-Year	127.405
3.33-Year	127.592
5-Year	127.821
10-Year	128.105
25-Year	128.299
50-Year	128.461
100-Year	128.533

********** Link: SWM Pond 3 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.361
5-Year	2.971
10-Year	3.513
25-Year	3.950
50-Year	4.276
100-Year	4.702
200-Year	5.286

********** Link: SWM Pond 3 ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.221
5-Year	0.385
10-Year	0.588
25-Year	0.795
50-Year	0.903
100-Year	1.173
200-Year	1.329

********** Link: SWM Pond 3 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	135.013
1.11-Year	135.151
1.25-Year	135.300
2.00-Year	135.695
3.33-Year	135.922
5-Year	136.200
10-Year	136.531
25-Year	136.785
50-Year	136.936
100-Year	137.040

********** Link: SWM Pond 4 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.840
5-Year	2.315
10-Year	2.736
25-Year	3.076
50-Year	3.332
100-Year	3.663
200-Year	4.118

********** Link: SWM Pond 4 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.263
5-Year	0.520
10-Year	0.676
25-Year	1.006
50-Year	1.067
100-Year	1.272
200-Year	1.481

********** Link: SWM Pond 4 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	124.003
1.11-Year	124.122
1.25-Year	124.215
2.00-Year	124.360
3.33-Year	124.523
5-Year	124.616
10-Year	124.726
25-Year	124.902
50-Year	124.977
100-Year	125.008

********** Link: SWM Pond 5 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.842
5-Year	3.576
10-Year	4.226
25-Year	4.752
50-Year	5.147
100-Year	5.658
200-Year	6.360

********** Link: SWM Pond 5 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.191
5-Year	0.306
10-Year	0.490
25-Year	0.619
50-Year	0.703
100-Year	0.737
200-Year	1.276

********** Link: SWM Pond 5 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	123.667
1.11-Year	123.746
1.25-Year	123.849
2.00-Year	124.075
3.33-Year	124.291
5-Year	124.462
10-Year	124.722
25-Year	124.835
50-Year	124.959
100-Year	124.993

********** Link: SWM Pond 6 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	12.788
5-Year	16.090
10-Year	19.017
25-Year	21.384
50-Year	23.158
100-Year	25.461
200-Year	28.620

********** Link: SWM Pond 6 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.192
5-Year	2.084
10-Year	3.188
25-Year	4.320
50-Year	4.932
100-Year	6.505
200-Year	7.233

********** Link: SWM Pond 6 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)

1.05-Year	136.347
1.11-Year	136.529
1.25-Year	136.725
2.00-Year	137.261
3.33-Year	137.573
5-Year	137.952
10-Year	138.412
25-Year	138.761
50-Year	138.971
100-Year	139.100

********** Link: SWM Pond 7 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.663
5-Year	7.129
10-Year	8.384
25-Year	9.705
50-Year	10.418
100-Year	11.298
200-Year	13.228

********** Link: SWM Pond 7 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.385
5-Year	0.624
10-Year	1.061
25-Year	1.347
50-Year	1.473
100-Year	1.550
200-Year	2.418

********** Link: SWM Pond 7 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	146.140
1.11-Year	146.263

1.25-Year	146.426
2.00-Year	146.890
3.33-Year	147.231
5-Year	147.485
10-Year	147.954
25-Year	148.136
50-Year	148.307
100-Year	148.368

********** Link: SWM Pond 8 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.040
5-Year	5.150
10-Year	5.977
25-Year	7.479
50-Year	7.968
100-Year	8.614
200-Year	11.061

********** Link: SWM Pond 8 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.546
5-Year	0.869
10-Year	1.424
25-Year	2.091
50-Year	2.207
100-Year	2.403
200-Year	2.620

********** Link: SWM Pond 8 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	66.811
1.11-Year	66.928
1.25-Year	67.076
2.00-Year	67.498

3.33-Year	67.750
5-Year	67.931
10-Year	68.428
25-Year	68.587
50-Year	68.974
100-Year	69.030

********** Link: SWM Pond 9 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.700
5-Year	7.153
10-Year	8.399
25-Year	10.022
50-Year	10.983
100-Year	11.563
200-Year	14.155

********** Link: SWM Pond 9 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.664
5-Year	1.232
10-Year	1.604
25-Year	1.939
50-Year	2.010
100-Year	2.111
200-Year	2.186

********** Link: SWM Pond 9 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	44.172
1.11-Year	44.333
1.25-Year	44.704
2.00-Year	45.508
3.33-Year	45.807
5-Year	45.958

10-Year	46.471
25-Year	46.903
50-Year	47.216
100-Year	47.428

********** Link: SWM Pond 10 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.539
5-Year	0.675
10-Year	0.792
25-Year	0.960
50-Year	1.061
100-Year	1.108
200-Year	1.364

********** Link: SWM Pond 10 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.544E-02
5-Year	7.121E-02
10-Year	0.102
25-Year	0.126
50-Year	0.148
100-Year	0.182
200-Year	0.345

********** Link: SWM Pond 10 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	72.167
1.11-Year	72.224
1.25-Year	72.420
2.00-Year	72.880
3.33-Year	73.139
5-Year	73.371
10-Year	73.673
25-Year	73.833

50-Year	73.995
100-Year	74.018

********** Link: SWM Pond 11 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.973
5-Year	2.467
10-Year	2.940
25-Year	3.553
50-Year	3.949
100-Year	4.078
200-Year	5.108

********** Link: SWM Pond 11 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.142
5-Year	0.267
10-Year	0.400
25-Year	0.510
50-Year	0.560
100-Year	0.571
200-Year	1.095

********** Link: SWM Pond 11 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	53.834
1.11-Year	53.988
1.25-Year	54.288
2.00-Year	55.028
3.33-Year	55.481
5-Year	55.815
10-Year	56.388
25-Year	56.640
50-Year	56.956
100-Year	56.994

********** Link: SWM Pond 12 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.504
5-Year	0.630
10-Year	0.744
25-Year	0.889
50-Year	0.960
100-Year	0.990
200-Year	1.271

********** Link: SWM Pond 12 ********** Link Outflow
1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.765E-02
5-Year	0.177
10-Year	0.240
25-Year	0.290
50-Year	0.327
100-Year	0.332
200-Year	0.349

********** Link: SWM Pond 12 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.289
1.11-Year	100.323
1.25-Year	100.374
2.00-Year	100.515
3.33-Year	100.552
5-Year	100.579
10-Year	100.655
25-Year	100.723
50-Year	100.803
100-Year	100.814

*************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: Upper S1 Onsite	79209.340
Subbasin: Upper S1 Offsite	106602.400
Subbasin: Upper-Mid S1 Onsite	21916.450
Subbasin: Lower-Mid S1 Offsite	795.220
Subbasin: Lower-Mid S1 Onsite	54976.730
Subbasin: Lower S1 Onsite	28291.810
Subbasin: S2 Onsite	68764.910
Subbasin: S2 Offsite	27115.160
Subbasin: Lower S1 Offsite	431.343
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable
Link: S2 - POI E	Not Applicable
Total:	388103.400

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: POI A undetained	27856.960
Subbasin: EX-S1-N Offsite	36232.660
Subbasin: POI B Undetained	53691.150
Subbasin: POI C Undetained	40544.590
Subbasin: POI D undetained	14741.090
Subbasin: POI E undetained	61772.320
Subbasin: EX-S1-E Offsite	72175.780
Subbasin: EX-S1-Hen-W Offsite	8207.551
Subbasin: EX-S2-S-Offsite	6457.336
Subbasin: EX-S1-HenRR-Offsite	17960.070
Subbasin: Pond 1proposed	7382.208
Subbasin: Pond 2 Proposed	151.865
Subbasin: Pond 3 Proposed	1.036
Subbasin: Pond 4 Proposed	0.000
Subbasin: Pond 5 Proposed	0.000
Subbasin: Pond 6 Proposed	0.000
Subbasin: POnd 7 Propposed	482.863
Subbasin: Pond 8 proposed	2664.380
Subbasin: Pond 9 Proposed	1243.031
Subbasin: Pond 10 Proposed	108.411
Subbasin: Pond 11 Proposed	506.570
Subbasin: Pond 12 Proposed	234.272
Link: S1 - POI A	Not Applicable
Link: S1 - POI B	Not Applicable
Link: S1 - POI C	Not Applicable
Link: S1 - POI D	Not Applicable

Link:	S2 - POI E	Not Applicable
Link:	SWM Pond 1	0.000
Link:	SWM Pond 2	0.000
Link:	SWM Pond 3	0.000
Link:	SWM Pond 4	0.000
Link:	SWM Pond 5	0.000
Link:	SWM Pond 6	0.000
Link:	SWM Pond 7	0.000
Link:	SWM Pond 8	0.000
Link:	SWM Pond 9	0.000
Link:	SWM Pond 10	0.000
Link:	SWM Pond 11	0.000
Link:	SWM Pond 12	0.000
Total:		352414.200

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2456.351 ac-ft/year, Post Developed: 2230.469 ac-ft/year

**************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 5

----------SCENARIO: PROPOSED

Number of Links: 17

********** Link: SWM Pond 1 **********

Basic Wet Pond Volume (91% Exceedance): 444359. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 666539. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 51290.82
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 2 **********

Basic Wet Pond Volume (91% Exceedance): 27928. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 41893. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 2972.31
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%

```
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 3                                          **********

 Basic Wet Pond Volume (91% Exceedance):   38954. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   58431. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   4054.10
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 4                                          **********

 Basic Wet Pond Volume (91% Exceedance):   30351. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   45527. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   3157.93
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 5                                          **********

 Basic Wet Pond Volume (91% Exceedance):   46884. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   70327. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   4878.11
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 6                                          **********

 Basic Wet Pond Volume (91% Exceedance):   210968. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   316452. cu-ft


 Infiltration/Filtration Statistics--------------------
 Total Runoff Volume (ac-ft):   21950.24
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 7                                          **********
```

Basic Wet Pond Volume (91% Exceedance): 91718. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 137577. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 10021.27
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 8 **********

Basic Wet Pond Volume (91% Exceedance): 73711. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 110567. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 8076.28
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 9 **********

Basic Wet Pond Volume (91% Exceedance): 94422. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 141633. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 10701.77
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 10 **********

Basic Wet Pond Volume (91% Exceedance): 8841. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13261. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 1018.02
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 11 **********

Basic Wet Pond Volume (91% Exceedance): 32834. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 49250. cu-ft

Infiltration/Filtration Statistics----------

Total Runoff Volume (ac-ft): 3811.03
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: SWM Pond 12 **********

Basic Wet Pond Volume (91% Exceedance): 8781. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13171. cu-ft

Infiltration/Filtration Statistics----------
Total Runoff Volume (ac-ft): 993.86
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: S1 - POI D
Scenario Proposed Compliance Link: S1 - POI D

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	99.103	2-Year	112.185
5-Year	150.266	5-Year	173.091
10-Year	186.185	10-Year	218.214
25-Year	241.343	25-Year	278.816
50-Year	295.666	50-Year	327.107
100-Year	337.500	100-Year	364.675
200-Year	411.276	200-Year	448.866

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 52.6% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 61.8% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.34
Program License Number: 201210003
Run Date: 04/11/2014 5:16 PM

Input File Name: Pond_1.fld
Project Name: GPT Pond 1
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 1 predev """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	102.997
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	29.223
Green Roof	0.000
User	0.000
Impervious	0.000

"""

Subbasin Total	132.220

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 1 Proposed """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	5.482
Till Pasture	0.000
Till Grass	42.530
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.656
Green Roof	0.000
User	0.000
Impervious	80.588

"""

Subbasin Total 132.256

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 1
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	88.00
Riser Crest Elevation (ft)	:	98.00
Max Pond Elevation (ft)	:	99.50
Storage Depth (ft)	:	10.00
Pond Bottom Length (ft)	:	760.6
Pond Bottom Width (ft)	:	152.1
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	115711.
Area at Riser Crest El (sq"ft)	:	174,076.
(acres)	:	3.996
Volume at Riser Crest (cu"ft)	:	1,442,936.
(ac"ft)	:	33.125
Area at Max Elevation (sq"ft)	:	183452.
(acres)	:	4.211
Vol at Max Elevation (cu"ft)	:	1,745,878.
(ac"ft)	:	40.080

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 54.00
Common Length (ft) : 0.313
Riser Crest Elevation : 98.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 88.00
Diameter (in) : 6.11
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 93.94
Length (in) : 3.76
Height (in) : 48.74
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** **Subbasin: Pond 1 Proposed** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2"Year	26.628
5"Year	33.409
10"Year	39.811
25"Year	47.876
50"Year	52.816
100"Year	54.616

200"Year	68.782

********** Link: Pond 1 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2"Year	26.628
5"Year	33.409
10"Year	39.811
25"Year	47.876
50"Year	52.816
100"Year	54.616
200"Year	68.782

********** Link: Pond 1 ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	91.259
1.11"Year	91.696
1.25"Year	92.219
2.00"Year	93.578
3.33"Year	94.613
5"Year	95.360
10"Year	96.502
25"Year	97.189
50"Year	97.802
100"Year	98.063

**********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: Pond 1 predev	26288.310
Total:	26288.310

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 1 Proposed	7382.208
Link: Pond 1	0.000
Total:	7382.208

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 166.382 ac-ft/year, Post Developed: 46.723 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 1 **********

Basic Wet Pond Volume (91% Exceedance): 444359. cu"ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 666539. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 51290.82
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Pond 1 predev

Scenario Postdeveloped Compliance Link: Pond 1

***** 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	4.924	2"Year	2.352
5"Year	7.918	5"Year	4.118
10"Year	9.974	10"Year	6.321
25"Year	13.651	25"Year	8.230
50"Year	15.289	50"Year	9.458
100"Year	17.635	100"Year	10.954
200"Year	23.463	200"Year	13.930

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): "8.1% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): "3.6% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 7.6% PASS

Percent Excursion from Q2 to Q50 (Must be less than 50%): 13.9% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 4:02 PM

Input File Name: Pond_2.fld
Project Name: GPT Pond 2
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 1 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	3.726
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.862
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 6.588

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 2 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.373
Till Pasture	0.000
Till Grass	0.282
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.195
Green Roof	0.000
User	0.000
Impervious	5.738

""
Subbasin Total 6.588

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 2
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 126.00
Riser Crest Elevation (ft) : 128.50
Max Pond Elevation (ft) : 129.00
Storage Depth (ft) : 2.50
Pond Bottom Length (ft) : 283.6
Pond Bottom Width (ft) : 94.5
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 26808.
Area at Riser Crest El (sq"ft) : 32,705.
(acres) : 0.751
Volume at Riser Crest (cu"ft) : 74,297.

	(ac"ft)	:	1.706
Area at Max Elevation	(sq"ft)	:	33938.
	(acres)	:	0.779
Vol at Max Elevation	(cu"ft)	:	94,227.
	(ac"ft)	:	2.163

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.176
Riser Crest Elevation : 128.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 126.00
Diameter (in) : 2.30
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 127.46
Length (in) : 2.11
Height (in) : 12.45
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 2 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	126.828
1.11"Year	126.948
1.25"Year	127.061
2.00"Year	127.406
3.33"Year	127.596
5"Year	127.822
10"Year	128.108
25"Year	128.300
50"Year	128.464
100"Year	128.534

*************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: Pond 1 predev	1358.594
Total:	1358.594

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 2 Proposed	151.865
Link: Pond 2	0.000
Total:	151.865

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 8.599 ac-ft/year, Post Developed: 0.961 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 2 **********

Basic Wet Pond Volume (91% Exceedance): 27928. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 41893. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 2972.31
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*********** **Compliance Point Results** *************

Scenario Predeveloped Compliance Subbasin: Pond 1 predev

Scenario Postdeveloped Compliance Link: Pond 2

*** **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	0.346	2"Year	0.167
5"Year	0.524	5"Year	0.291
10"Year	0.650	10"Year	0.445
25"Year	0.843	25"Year	0.611
50"Year	1.032	50"Year	0.690
100"Year	1.178	100"Year	0.849
200"Year	1.437	200"Year	0.973

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** **Flow Duration Performance** ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"17.3%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"2.6%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	5.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	10.2%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 5:15 PM

Input File Name: Pond_3.fld
Project Name: GPT Pond 3
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 3 predev """""""""""""""
"""""""""Area(Acres) """""""""""

Till Forest	4.263
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	3.938
Green Roof	0.000
User	0.000
Impervious	0.000

"""

Subbasin Total	8.201

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

"""""""""""""" Subbasin : Pond 3 Proposed """""""""""""""

	"""""""""Area(Acres) """"""""""
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	8.193

"""

Subbasin Total	8.201

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

"""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 3
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	134.00
Riser Crest Elevation (ft)	:	137.00
Max Pond Elevation (ft)	:	138.00
Storage Depth (ft)	:	3.00
Pond Bottom Length (ft)	:	304.6
Pond Bottom Width (ft)	:	101.5
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	30932.
Area at Riser Crest El (sq"ft)	:	38,567.
(acres)	:	0.885
Volume at Riser Crest (cu"ft)	:	104,087.
(ac"ft)	:	2.390
Area at Max Elevation (sq"ft)	:	41256.
(acres)	:	0.947
Vol at Max Elevation (cu"ft)	:	147,849.
(ac"ft)	:	3.394

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.190
Riser Crest Elevation : 137.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 134.00
Diameter (in) : 2.52
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 135.78
Length (in) : 2.22
Height (in) : 14.61
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 3 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	135.015
1.11"Year	135.152
1.25"Year	135.301
2.00"Year	135.695
3.33"Year	135.922

5"Year	136.201
10"Year	136.532
25"Year	136.785
50"Year	136.936
100"Year	137.041

*************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: Pond 3 predev	1704.244
Total:	1704.244

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 3 Proposed	1.036
Link: Pond 3	0.000
Total:	1.036

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 10.786 ac-ft/year, Post Developed: 0.007 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 3 **********

Basic Wet Pond Volume (91% Exceedance): 38954. cu"ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 58431. cu"ft

Infiltration/Filtration Statistics
Total Runoff Volume (ac"ft): 4054.10
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Pond 3 predev

Scenario Postdeveloped Compliance Link: Pond 3

***** 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	0.458	2"Year	0.220
5"Year	0.688	5"Year	0.386
10"Year	0.852	10"Year	0.589
25"Year	1.090	25"Year	0.795
50"Year	1.356	50"Year	0.904
100"Year	1.546	100"Year	1.177
200"Year	1.860	200"Year	1.330

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"13.2%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		"0.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	7.7%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	13.3%	PASS	

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 5:31 PM

Input File Name: Pond_4.fld
Project Name: GPT Pond 4
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 4 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.663
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	5.721
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 6.384

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 4 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	6.385

""
Subbasin Total 6.385

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 4
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	123.50
Riser Crest Elevation (ft)	:	125.00
Max Pond Elevation (ft)	:	126.00
Storage Depth (ft)	:	1.50
Pond Bottom Length (ft)	:	323.1
Pond Bottom Width (ft)	:	107.7
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	34805.
Area at Riser Crest El (sq"ft)	:	38,764.
(acres)	:	0.890
Volume at Riser Crest (cu"ft)	:	55,157.

	(ac"ft)	:	1.266
Area at Max Elevation	(sq"ft)	:	41493.
	(acres)	:	0.953
Vol at Max Elevation	(cu"ft)	:	99,156.
	(ac"ft)	:	2.276

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.560
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 123.50
Diameter (in) : 3.26
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.36
Length (in) : 6.72
Height (in) : 7.65
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 4 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	124.003
1.11"Year	124.121
1.25"Year	124.214
2.00"Year	124.359
3.33"Year	124.522
5"Year	124.614
10"Year	124.726
25"Year	124.901
50"Year	124.976
100"Year	125.013

*************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: Pond 4 predev	1418.735
Total:	1418.735

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 4 Proposed	0.000
Link: Pond 4	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 8.979 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 4 **********

Basic Wet Pond Volume (91% Exceedance): 30351. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 45527. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 3157.93
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 4 predev

Scenario Postdeveloped Compliance Link: Pond 4

*** 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	0.536	2"Year	0.263
5"Year	0.780	5"Year	0.518
10"Year	0.980	10"Year	0.675
25"Year	1.278	25"Year	1.006
50"Year	1.566	50"Year	1.066
100"Year	1.768	100"Year	1.157
200"Year	1.953	200"Year	1.325

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"18.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"7.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	6.5%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	2.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/23/2013 6:15 PM

Input File Name: Pond_5.fld
Project Name: GPT Pond 4
Analysis Title: Ecology (Proposed vs. Pre#Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939#10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 4 predev ########
######Area(Acres) ######

Till Forest	7.132
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	2.731
Green Roof	0.000
User	0.000
Impervious	0.000

##
Subbasin Total 9.863

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 5 Proposed ########
######Area(Acres) #######

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	9.863

##
Subbasin Total 9.863

********** **LINK DATA** **********

##################SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

##################SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 5
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 123.00
Riser Crest Elevation (ft) : 125.00
Max Pond Elevation (ft) : 126.00
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 473.6
Pond Bottom Width (ft) : 157.9
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq#ft) : 74767.
Area at Riser Crest El (sq#ft) : 82,489.
(acres) : 1.894
Volume at Riser Crest (cu#ft) : 157,208.

	(ac#ft)	:	3.609
Area at Max Elevation	(sq#ft)	:	86458.
	(acres)	:	1.985
Vol at Max Elevation	(cu#ft)	:	249,924.
	(ac#ft)	:	5.737

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio#Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.270
Riser Crest Elevation : 125.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

##Device Number 1 ##
Device Type : Circular Orifice
Control Elevation (ft) : 123.00
Diameter (in) : 2.63
Orientation : Horizontal
Elbow : No

##Device Number 2 ##
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 124.23
Length (in) : 3.22
Height (in) : 9.27
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 5 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05#Year	123.667
1.11#Year	123.746
1.25#Year	123.849
2.00#Year	124.075
3.33#Year	124.291
5#Year	124.461
10#Year	124.721
25#Year	124.834
50#Year	124.958
100#Year	124.992

*************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: Pond 4 predev	1980.096
Total:	1980.096

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac#ft)
Subbasin: Pond 5 Proposed	0.000
Link: Pond 5	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 12.532 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 5 **********

Basic Wet Pond Volume (91% Exceedance): 46884. cu#ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 70327. cu#ft

Infiltration/Filtration Statistics################
Total Runoff Volume (ac#ft): 4878.11
Total Runoff Infiltrated (ac#ft): 0.00, 0.00%
Total Runoff Filtered (ac#ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Pond 4 predev

Scenario Postdeveloped Compliance Link: Pond 5

*** 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	0.409	2#Year	0.191
5#Year	0.634	5#Year	0.306
10#Year	0.817	10#Year	0.491
25#Year	1.096	25#Year	0.620
50#Year	1.246	50#Year	0.704
100#Year	1.433	100#Year	0.738
200#Year	1.855	200#Year	1.279

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	#10.5%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		#4.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1.5%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.2%	PASS	

##
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
##

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 7:58 AM

Input File Name: Pond_6.fld
Project Name: GPT Pond 6
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 6 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	22.986
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	21.395
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 44.381

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 6 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	44.381

""
Subbasin Total 44.381

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 6
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 135.00
Riser Crest Elevation (ft) : 139.00
Max Pond Elevation (ft) : 140.00
Storage Depth (ft) : 4.00
Pond Bottom Length (ft) : 621.5
Pond Bottom Width (ft) : 207.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 128765.
Area at Riser Crest El (sq"ft) : 149,230.
(acres) : 3.426
Volume at Riser Crest (cu"ft) : 555,606.

(ac"ft) : 12.755
Area at Max Elevation (sq"ft) : 154526.
(acres) : 3.547
Vol at Max Elevation (cu"ft) : 722,401.
(ac"ft) : 16.584

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 42.00
Common Length (ft) : 0.639
Riser Crest Elevation : 139.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 135.00
Diameter (in) : 5.45
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 137.40
Length (in) : 7.67
Height (in) : 19.17
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 6 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	136.347
1.11"Year	136.528
1.25"Year	136.724
2.00"Year	137.260
3.33"Year	137.571
5"Year	137.952
10"Year	138.413
25"Year	138.761
50"Year	138.972
100"Year	139.100

*************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: Pond 6 predev	9225.690
Total:	9225.690

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 6 Proposed	0.000
Link: Pond 6	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 58.390 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 6 **********

Basic Wet Pond Volume (91% Exceedance): 210968. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 316452. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 21950.24
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 6 predev

Scenario Postdeveloped Compliance Link: Pond 6

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2"Year	2.483	2"Year	1.193
5"Year	3.734	5"Year	2.081
10"Year	4.622	10"Year	3.185
25"Year	5.906	25"Year	4.317
50"Year	7.356	50"Year	4.930
100"Year	8.384	100"Year	6.500
200"Year	10.080	200"Year	7.235

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"15.4%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"3.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	9.9%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 10:15 AM

Input File Name: Pond_7.fld
Project Name: GPT Pond 7
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 7 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	17.493
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	4.659
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 22.152

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 7 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.000
Till Pasture	0.000
Till Grass	3.728
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	18.421

""
Subbasin Total 22.149

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 7
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 145.00
Riser Crest Elevation (ft) : 148.50
Max Pond Elevation (ft) : 149.50
Storage Depth (ft) : 3.50
Pond Bottom Length (ft) : 515.3
Pond Bottom Width (ft) : 171.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 88499.
Area at Riser Crest El (sq"ft) : 103,368.
(acres) : 2.373
Volume at Riser Crest (cu"ft) : 335,511.

	(ac"ft)	:	7.702
Area at Max Elevation	(sq"ft)	:	107778.
	(acres)	:	2.474
Vol at Max Elevation	(cu"ft)	:	451,414.
	(ac"ft)	:	10.363

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.266
Riser Crest Elevation : 148.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 145.00
Diameter (in) : 3.24
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 147.08
Length (in) : 3.19
Height (in) : 17.10
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 7 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	146.142
1.11"Year	146.265
1.25"Year	146.428
2.00"Year	146.892
3.33"Year	147.233
5"Year	147.488
10"Year	147.953
25"Year	148.134
50"Year	148.307
100"Year	148.367

*************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: Pond 7 predev	4396.098
Total:	4396.098

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 7 Proposed	482.863
Link: Pond 7	0.000
Total:	482.863

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 27.823 ac-ft/year, Post Developed: 3.056 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 7 **********

Basic Wet Pond Volume (91% Exceedance): 91718. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 137577. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 10021.27
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 7 predev

Scenario Postdeveloped Compliance Link: Pond 7

*** 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	0.817	2"Year	0.384
5"Year	1.301	5"Year	0.628
10"Year	1.639	10"Year	1.064
25"Year	2.253	25"Year	1.353
50"Year	2.516	50"Year	1.477
100"Year	2.904	100"Year	1.554
200"Year	3.886	200"Year	2.426

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"15.6%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"5.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	7.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	6.3%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 1:30 PM

Input File Name: Pond_8.fld
Project Name: GPT Pond 8
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 8 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	19.415
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	6.946
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 26.361

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 8 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	6.503
Till Pasture	0.000
Till Grass	2.930
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	4.613
Green Roof	0.000
User	0.000
Impervious	12.315

""
Subbasin Total 26.361

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 8
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	66.00
Riser Crest Elevation (ft)	:	69.00
Max Pond Elevation (ft)	:	70.00
Storage Depth (ft)	:	3.00
Pond Bottom Length (ft)	:	412.3
Pond Bottom Width (ft)	:	137.4
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft)	:	56668.
Area at Riser Crest El (sq"ft)	:	66,887.
(acres)	:	1.536
Volume at Riser Crest (cu"ft)	:	185,171.

	(ac"ft)	:	4.251
Area at Max Elevation	(sq"ft)	:	70438.
	(acres)	:	1.617
Vol at Max Elevation	(cu"ft)	:	260,516.
	(ac"ft)	:	5.981

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.290
Riser Crest Elevation : 69.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 66.00
Diameter (in) : 4.06
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 67.46
Length (in) : 3.50
Height (in) : 18.48
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 8 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	66.809
1.11"Year	66.928
1.25"Year	67.075
2.00"Year	67.496
3.33"Year	67.749
5"Year	67.930
10"Year	68.427
25"Year	68.585
50"Year	68.972
100"Year	69.029

*************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: Pond 8 predev	5279.987
Total:	5279.987

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 8 Proposed	2664.380
Link: Pond 8	0.000
Total:	2664.380

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 33.418 ac-ft/year, Post Developed: 16.863 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 8 **********

Basic Wet Pond Volume (91% Exceedance): 73711. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 110567. cu"ft

Infiltration/Filtration Statistics"""""""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 8076.28
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 8 predev

Scenario Postdeveloped Compliance Link: Pond 8

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2"Year	1.070	2"Year	0.546
5"Year	1.664	5"Year	0.868
10"Year	2.137	10"Year	1.424
25"Year	2.881	25"Year	2.091
50"Year	3.263	50"Year	2.206
100"Year	3.754	100"Year	2.397
200"Year	4.891	200"Year	2.612

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"1.4%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"1.4%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	2.3%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	4.9%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 2:18 PM

Input File Name: Pond_9.fld
Project Name: GPT Pond 9
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 9 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	25.398
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	1.106
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 26.504

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 9 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	1.904
Till Pasture	0.000
Till Grass	6.630
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.090
Green Roof	0.000
User	0.000
Impervious	17.881

""
Subbasin Total 26.505

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 9
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 42.00
Riser Crest Elevation (ft) : 48.00
Max Pond Elevation (ft) : 49.00
Storage Depth (ft) : 6.00
Pond Bottom Length (ft) : 390.0
Pond Bottom Width (ft) : 130.0
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 50700.
Area at Riser Crest El (sq"ft) : 70,716.
(acres) : 1.623
Volume at Riser Crest (cu"ft) : 362,952.

	(ac"ft)	:	8.332
Area at Max Elevation	(sq"ft)	:	74304.
	(acres)	:	1.706
Vol at Max Elevation	(cu"ft)	:	442,528.
	(ac"ft)	:	10.159

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio"Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 30.00
Common Length (ft) : 0.100
Riser Crest Elevation : 48.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

"""Device Number 1 """
Device Type : Circular Orifice
Control Elevation (ft) : 42.00
Diameter (in) : 2.68
Orientation : Horizontal
Elbow : No

""" Device Number 2 """
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 45.44
Length (in) : 1.19
Height (in) : 30.73
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 9 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	44.174
1.11"Year	44.335
1.25"Year	44.706
2.00"Year	45.562
3.33"Year	46.126
5"Year	46.598
10"Year	47.262
25"Year	47.579
50"Year	47.924
100"Year	47.983

*************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: Pond 9 predev	5104.818
Total:	5104.818

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 9 Proposed	1243.031
Link: Pond 9	0.000
Total:	1243.031

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 32.309 ac-ft/year, Post Developed: 7.867 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 9 **********

Basic Wet Pond Volume (91% Exceedance): 94422. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 141633. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""
Total Runoff Volume (ac"ft): 10701.77
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 9 predev

Scenario Postdeveloped Compliance Link: Pond 9

***** 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	0.712	2"Year	0.373
5"Year	1.183	5"Year	0.739
10"Year	1.533	10"Year	1.086
25"Year	1.991	25"Year	1.357
50"Year	2.340	50"Year	1.500
100"Year	2.573	100"Year	1.539
200"Year	3.815	200"Year	3.046

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"10.5%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"5.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.4%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 2:03 PM

Input File Name: Pond_10.fld
Project Name: GPT Pond 10
Analysis Title: Ecology (Proposed vs. Pre#Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939#10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 10 predev ########
######Area(Acres) ######

Till Forest	2.482
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

##
Subbasin Total 2.482

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

########Subbasin : Pond 10 Proposed ########
######Area(Acres) #######

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.837
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	1.645

##
Subbasin Total 2.482

********** **LINK DATA** **********

##################SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

##################SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 10
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 71.00
Riser Crest Elevation (ft) : 74.00
Max Pond Elevation (ft) : 75.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 168.5
Pond Bottom Width (ft) : 56.2
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq#ft) : 9459.
Area at Riser Crest El (sq#ft) : 13,826.
(acres) : 0.317
Volume at Riser Crest (cu#ft) : 34,766.

	(ac#ft)	:	0.798
Area at Max Elevation	(sq#ft)	:	15426.
	(acres)	:	0.354
Vol at Max Elevation	(cu#ft)	:	50,768.
	(ac#ft)	:	1.165

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio#Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.030
Riser Crest Elevation : 74.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

##Device Number 1 ##
Device Type : Circular Orifice
Control Elevation (ft) : 71.00
Diameter (in) : 0.94
Orientation : Horizontal
Elbow : No

##Device Number 2 ##
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 72.76
Length (in) : 0.33
Height (in) : 14.89
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 10 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05#Year	72.174
1.11#Year	72.231
1.25#Year	72.427
2.00#Year	72.887
3.33#Year	73.143
5#Year	73.377
10#Year	73.680
25#Year	73.841
50#Year	74.001
100#Year	74.021

*************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: Pond 10 predev	474.456
Total:	474.456

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac#ft)
Subbasin: Pond 10 Proposed	108.411
Link: Pond 10	0.000
Total:	108.411

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 3.003 ac-ft/year, Post Developed: 0.686 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 10 **********

Basic Wet Pond Volume (91% Exceedance): 8841. cu#ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 13261. cu#ft

Infiltration/Filtration Statistics################
Total Runoff Volume (ac#ft): 1018.02
Total Runoff Infiltrated (ac#ft): 0.00, 0.00%
Total Runoff Filtered (ac#ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Pond 10 predev

Scenario Postdeveloped Compliance Link: Pond 10

*** 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	6.265E#02	2#Year	3.553E#02
5#Year	0.103	5#Year	7.113E#02
10#Year	0.137	10#Year	0.102
25#Year	0.171	25#Year	0.126
50#Year	0.204	50#Year	0.151
100#Year	0.229	100#Year	0.195
200#Year	0.341	200#Year	0.351

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	#5.7%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):		#1.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.0%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	25.4%	PASS	

##
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
##

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 3:03 PM

Input File Name: Pond_11.fld
Project Name: GPT Pond 11
Analysis Title: Ecology (Proposed vs. Pre"Developed)
Comments: December 2013 preferred C1rev [BLT]

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939"10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 11 predev """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	9.134
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.549
Green Roof	0.000
User	0.000
Impervious	0.000

""
Subbasin Total 9.683

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

""""""""""""" Subbasin : Pond 11 Proposed """""""""""""
""""""""Area(Acres) """""""""""

Till Forest	0.278
Till Pasture	0.000
Till Grass	3.431
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.040
Green Roof	0.000
User	0.000
Impervious	5.935

""
Subbasin Total 9.684

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

""""""""""""""""""""""""""""SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Pond 11
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 52.00
Riser Crest Elevation (ft) : 57.00
Max Pond Elevation (ft) : 58.00
Storage Depth (ft) : 5.00
Pond Bottom Length (ft) : 242.5
Pond Bottom Width (ft) : 80.8
Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq"ft) : 19595.
Area at Riser Crest El (sq"ft) : 30,193.
(acres) : 0.693
Volume at Riser Crest (cu"ft) : 123,719.

```
                              (ac"ft)   :      2.840
Area at Max Elevation   (sq"ft)   :      32529.
                              (acres)  :       0.747
Vol at Max Elevation   (cu"ft)    :    158,093.
                              (ac"ft)   :      3.629

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr)     :   0.00
Depth to Water Table (ft)                    : 100.00
Bio"Fouling Potential                : Low
Maintenance                          : Average or Better

Riser Geometry
Riser Structure Type                 : Circular
Riser Diameter (in)                  : 18.00
Common Length (ft)                   : 0.050
Riser Crest Elevation                : 57.00 ft

 Hydraulic Structure Geometry

Number of Devices:      2

        """Device Number     1 """
Device Type                 :   Circular Orifice
Control Elevation (ft)      :   52.00
Diameter (in)               :   1.71
Orientation                 : Horizontal
Elbow                       : No

        """ Device Number     2 """
Device Type                 : Vertical Rectangular Orifice
Control Elevation (ft)      :   54.90
Length (in)                 :     0.59
Height (in)                 :     25.25
Orientation                 : Vertical
Elbow                       : No
```

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 11 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05"Year	53.833
1.11"Year	53.987
1.25"Year	54.288
2.00"Year	55.027
3.33"Year	55.480
5"Year	55.813
10"Year	56.388
25"Year	56.641
50"Year	56.958
100"Year	56.995

*************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: Pond 11 predev	1870.025
Total:	1870.025

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac"ft)
Subbasin: Pond 11 Proposed	506.570
Link: Pond 11	0.000
Total:	506.570

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 11.836 ac-ft/year, Post Developed: 3.206 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 11 **********

Basic Wet Pond Volume (91% Exceedance): 32834. cu"ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 49250. cu"ft

Infiltration/Filtration Statistics""""""""""""""""""""""""""""
Total Runoff Volume (ac"ft): 3811.03
Total Runoff Infiltrated (ac"ft): 0.00, 0.00%
Total Runoff Filtered (ac"ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 11 predev

Scenario Postdeveloped Compliance Link: Pond 11

*** 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	0.268	2"Year	0.142
5"Year	0.444	5"Year	0.267
10"Year	0.576	10"Year	0.399
25"Year	0.751	25"Year	0.509
50"Year	0.878	50"Year	0.558
100"Year	0.957	100"Year	0.569
200"Year	1.417	200"Year	1.094

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	"5.8%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	"2.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	4.2%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	6.7%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.33
Program License Number: 201210003
Run Date: 12/24/2013 3:25 PM

Input File Name: Pond_12.fld
Project Name: GPT Pond 12 (aka Pond A)
Analysis Title: Ecology (Proposed vs. Pre%Developed)
Comments: December 2013 preferred C1rev [BLT]. Catchment renambed from 'A' to 'Pond 12'.

——————————————— PRECIPITATION INPUT ———————————————

Computational Time Step (Minutes): 60

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939%10/01/2097
Evaporation Station : 961044 Puget East 44 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) ***************

********** **WATERSHED DEFINITION** **********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

%%%%%%%%%%Subbasin : Pond 12 predev %%%%%%%%%%
%%%%%%%Area(Acres) %%%%%%%%
Till Forest 2.065
Till Pasture 0.000
Till Grass 0.000
Outwash Forest 0.000
Outwash Pasture 0.000
Outwash Grass 0.000
Wetland 0.863
Green Roof 0.000
User 0.000

Impervious 0.000
%%
Subbasin Total 2.929

----------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

%%%%%%%%%%Subbasin : Pond 12 Proposed %%%%%%%%%%
%%%%%%Area(Acres) %%%%%%%

Till Forest	0.910
Till Pasture	0.000
Till Grass	0.382
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.048
Green Roof	0.000
User	0.000
Impervious	1.589

%%
Subbasin Total 2.929

*************************** **LINK DATA** *********************************

%%%%%%%%%%%%%%%%%%%%%SCENARIO: PREDEVELOPED
Number of Links: 0

*************************** **LINK DATA** *********************************

%%%%%%%%%%%%%%%%%%%%%SCENARIO: POSTDEVELOPED
Number of Links: 1

--
Link Name: Pond 12
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	101.00
Max Pond Elevation (ft)	:	102.00
Storage Depth (ft)	:	1.00
Pond Bottom Length (ft)	:	263.7
Pond Bottom Width (ft)	:	87.9
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq%ft)	:	23178.
Area at Riser Crest El (sq%ft)	:	25,324.
(acres)	:	0.581

Volume at Riser Crest (cu%ft) : 24,245.
(ac%ft) : 0.557
Area at Max Elevation (sq%ft) : 27541.
(acres) : 0.632
Vol at Max Elevation (cu%ft) : 53,204.
(ac%ft) : 1.221

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio%Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.220
Riser Crest Elevation : 101.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

%%%Device Number 1 %%%
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.78
Orientation : Horizontal
Elbow : No

%%%Device Number 2 %%%
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 100.52
Length (in) : 2.58
Height (in) : 5.76
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Pond 12 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05%/year	100.278
1.11%/year	100.312
1.25%/year	100.365
2.00%/year	100.498
3.33%/year	100.584
5%/year	100.649
10%/year	100.791
25%/year	100.858
50%/year	100.947
100%/year	100.966

*************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: Pond 12 predev	589.637
Total:	589.637

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Pond 12 Proposed	234.272
Link: Pond 12	0.000
Total:	234.272

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 3.732 ac-ft/year, Post Developed: 1.483 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Pond 12 **********

Basic Wet Pond Volume (91% Exceedance): 8781. cu%ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 13171. cu%ft

Infiltration/Filtration Statistics%%%%%%%%%%%%%%%%%%%%
Total Runoff Volume (ac%ft): 993.86
Total Runoff Infiltrated (ac%ft): 0.00, 0.00%
Total Runoff Filtered (ac%ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: Pond 12 predev

Scenario Postdeveloped Compliance Link: Pond 12

*** 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	0.124	2%Year	5.994E%02
5%Year	0.193	5%Year	9.787E%02
10%Year	0.248	10%Year	0.156
25%Year	0.331	25%Year	0.221
50%Year	0.380	50%Year	0.242
100%Year	0.436	100%Year	0.254
200%Year	0.561	200%Year	0.257

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	%15.2%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	%3.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	%4.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

%%
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
%%

APPENDIX B

Preliminary Stormwater Drainage Plan

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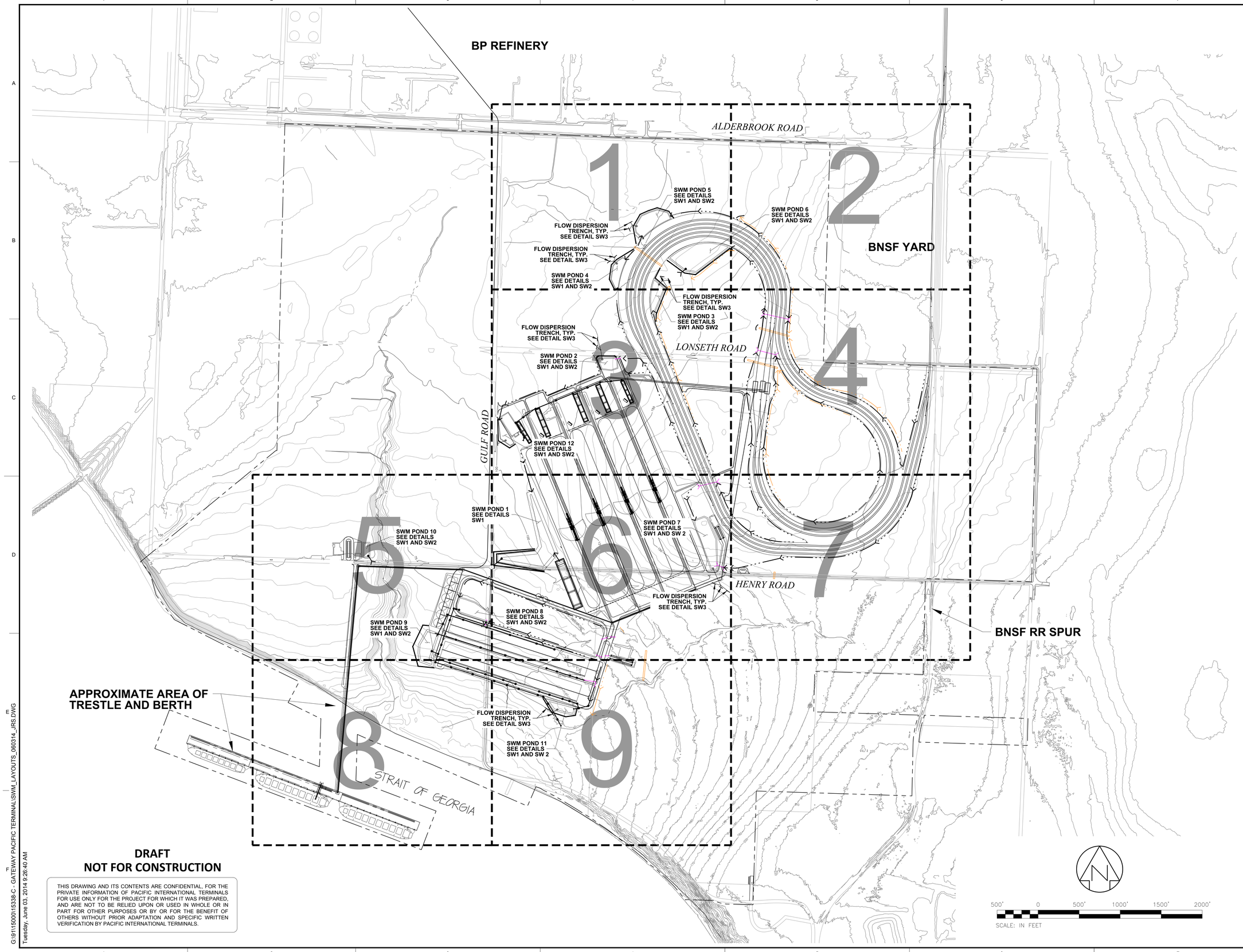

DWG. No.	REFERENCE	REF No.

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

GENERAL NOTES

1. ALL DRAWINGS ARE FOR PRELIMINARY STORMWATER DETENTION PONDS AND STORMWATER TREATMENT LAYOUT CONCEPTS ONLY. DRAWINGS ARE NOT FOR CONSTRUCTION PURPOSES.
2. DRAWINGS HAVE BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. THE ENGINEER CANNOT ASSURE ITS ACCURACY AND AS SUCH ALL RECORD DRAWINGS SHOULD BE VERIFIED INDEPENDENTLY.
3. ALL EXISTING CONDITIONS AND HORIZONTAL AND VERTICAL CONTROL SHALL BE VERIFIED PRIOR TO CONSTRUCTION.
4. CONTRACTOR SHALL PROVIDE CONTINUAL CLEAN-UP OF ALL CONSTRUCTION DEBRIS IN AND AROUND AREA OF WORK AND PROVIDE SAFE WORKING CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR TEMPORARY EROSION CONTROL MEASURES AND FOR REMOVAL OF ALL WASTE MATERIALS GENERATED ON THIS PROJECT.
5. CONTRACTOR MAY USE STORMWATER PONDS AS PART OF THEIR REQUIRED TEMPORARY CONSTRUCTION STORMWATER TREATMENT DURING GRADING OF THE SITE. STORMWATER FACILITIES MUST BE RE-GRADED AND RESTORED TO CONFORM TO STORMWATER PLAN DRAWINGS AND SPECIFICATIONS UPON COMPLETION OF GRADING AND EARTHWORK.
6. STORMWATER TREATMENT WETLANDS ARE TO BE LINED TO PREVENT INFILTRATION. THE EXISTING SUBSURFACE CLAY SOILS ARE ASSUMED TO BE ADEQUATE FOR STORMWATER FACILITY LINING. A GEOTECHNICAL REPORT PREPARED BY A WASHINGTON STATE LICENSED GEOTECHNICAL ENGINEER SHALL BE PREPARED DURING FINAL DESIGN TO DETERMINE THE SPECIFIC LINING REQUIREMENTS FOR EACH FACILITY.
7. EXCAVATION, GRADING AND SHORING REQUIRED TO CONSTRUCT STORMWATER FACILITIES AND DRAINAGE SYSTEMS SHALL BE IN ACCORDANCE WITH GEOTECHNICAL RECOMMENDATIONS OF A WASHINGTON STATE LICENSED GEOTECH ENGINEER.
8. CONTRACTOR SHALL DEVELOP AND IMPLEMENT A CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN IN ACCORDANCE WITH NPDES CONSTRUCTION STORMWATER GENERAL PERMIT AND OTHER PROJECT PERMIT CONDITIONS PRIOR TO EARTH DISTURBING CONSTRUCTION ACTIVITIES. THE PLAN SHALL INCLUDE TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES AND PROVISIONS FOR DEWATERING EXCAVATIONS AND TREATMENT OF WATER REMOVED FROM EXCAVATIONS TO MEET SITE DISCHARGE REQUIREMENTS.

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

DRAFT
NOT FOR CONSTRUCTION

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SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Gerlic Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN

DWG. NO. C0 REV

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Tuesday, June 03, 2014 9:26:40 AM

DWG. No.	REFERENCE	REF No.

100' 0 100' 200' 300' 400'

SCALE: IN FEET

ALDERBROOK ROAD

STREAM 1

APPROX LOCATION OF 20' DRAINAGE ESMT PER AF 519543 OVER TWIN 24" CULVERTS TO A NATURAL RAVINE TO THE SOUTH (#3)

EXISTING CULVERT

GULF ROAD

TOE OF BERM

MAX. WS WITH FREEBOARD

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

CULVERT FOR NATURAL STORMWATER

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 4 SEE DETAILS SW1 AND SW2

TOE OF BERM

MAX. WS WITH FREEBOARD

PERMANENT POOL WS

SWM POND 5 SEE DETAILS SW1 AND SW2

PERMANENT POOL WS

DITCH FOR RR STORMWATER (TYP)

RR TRACKS (TYP)

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 6 SEE DETAILS SW1 AND SW2

ROCK OUTFALL PROTECTION

PERMANENT POOL WS

MAX. WS WITH FREEBOARD

TOE OF BERM

SWM POND 3 SEE DETAILS SW1 AND SW2

MATCHLINE – SEE AREA 3

MATCHLINE – SEE AREA 2

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

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D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

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CLIENT: Pacific International Terminals. A Delta Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN AREA 1

DWG. NO. C1 REV

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DWG. No.	REFERENCE	REF No.

ALDERBROOK ROAD

MATCHLINE – SEE AREA 1

MATCHLINE – SEE AREA 4

175

ROCK CHECKDAM FLOW SPREADER FOR NATURAL STORMWATER

DITCH FOR NATURAL STORMWATER

RR TRACKS (TYP)

DITCH FOR RR STORMWATER (TYP)

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
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ABBREVIATIONS

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100' 0 100' 200' 300' 400'
SCALE: IN FEET

REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED	BLT	DRAWN	JRS
DATE	2/27/14	CHECK	
SCALE	AS SHOWN	DESIGN	BLT
D	143166	DES. CHK.	
		CAD FILE:	SWM_LAYOUTS_060314_JRS

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CLIENT
Pacific International Terminals.
A Delta Enterprise

PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
PROPOSED STORMWATER DRAINAGE PLAN
AREA 2

DWG. NO. C2 REV

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Tuesday, June 03, 2014 9:26:40 AM

MATCHLINE – SEE AREA 1

RR TRACKS (TYP)

SWM POND 3
SEE DETAILS
SW1 AND SW2

TOE OF BERM

MAX. WS WITH
FREEBOARD

PERMANENT POOL WS

PERMANENT POOL WS

MAX. WS WITH
FREEBOARD

TOE OF BERM

FLOW DISPERSION
TRENCH, TYP.
SEE DETAIL SW3

DITCH FOR RR STORMWATER (TYP)

DITCH FOR NATURAL STORMWATER (TYP)

EXISTING LONSETH ROAD

SWM POND 2
SEE DETAILS
SW1 AND SW2

SEDIMENT POND (TYP)

GULF ROAD

SD

SD

SD

SD

SD

105

150

100

SWM POND 12
SEE DETAILS
SW1 AND SW2

PERMANENT POOL WS

MAX. WS WITH
FREEBOARD

TOE OF BERM

MATCHLINE – SEE AREA 4

MATCHLINE – SEE AREA 6

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100' 0 100' 200' 300' 400'

SCALE: IN FEET

DWG. No.	REFERENCE	REF No.

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
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- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

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REV	BY	APP'D	DESCRIPTION	YR	MO	DA

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SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

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A Gerfin Enterprises

PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
PROPOSED STORMWATER DRAINAGE PLAN
AREA 3

DWG. NO. C3 REV

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DWG. No.	REFERENCE	REF No.

MATCHLINE – SEE AREA 2

MATCHLINE – SEE AREA 3

MATCHLINE – SEE AREA 7

CULVERT FOR RR STORMWATER (TYP)

CULVERT FOR NATURAL STORMWATER

ROCK FLOW SPREADER

EXISTING LONSETH ROAD

DITCH FOR RR STORMWATER (TYP)

DITCH FOR NATURAL STORMWATER (TYP)

RR TRACKS (TYP)

175

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

100' 0 100' 200' 300' 400'

SCALE: IN FEET

DRAFT
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REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED	BLT	DRAWN	JRS
DATE	2/27/14	CHECK	
SCALE	AS SHOWN	DESIGN	BLT
D	143166	DES. CHK.	
		CAD FILE:	SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Gavin Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN AREA 4

DWG. NO. C4 REV

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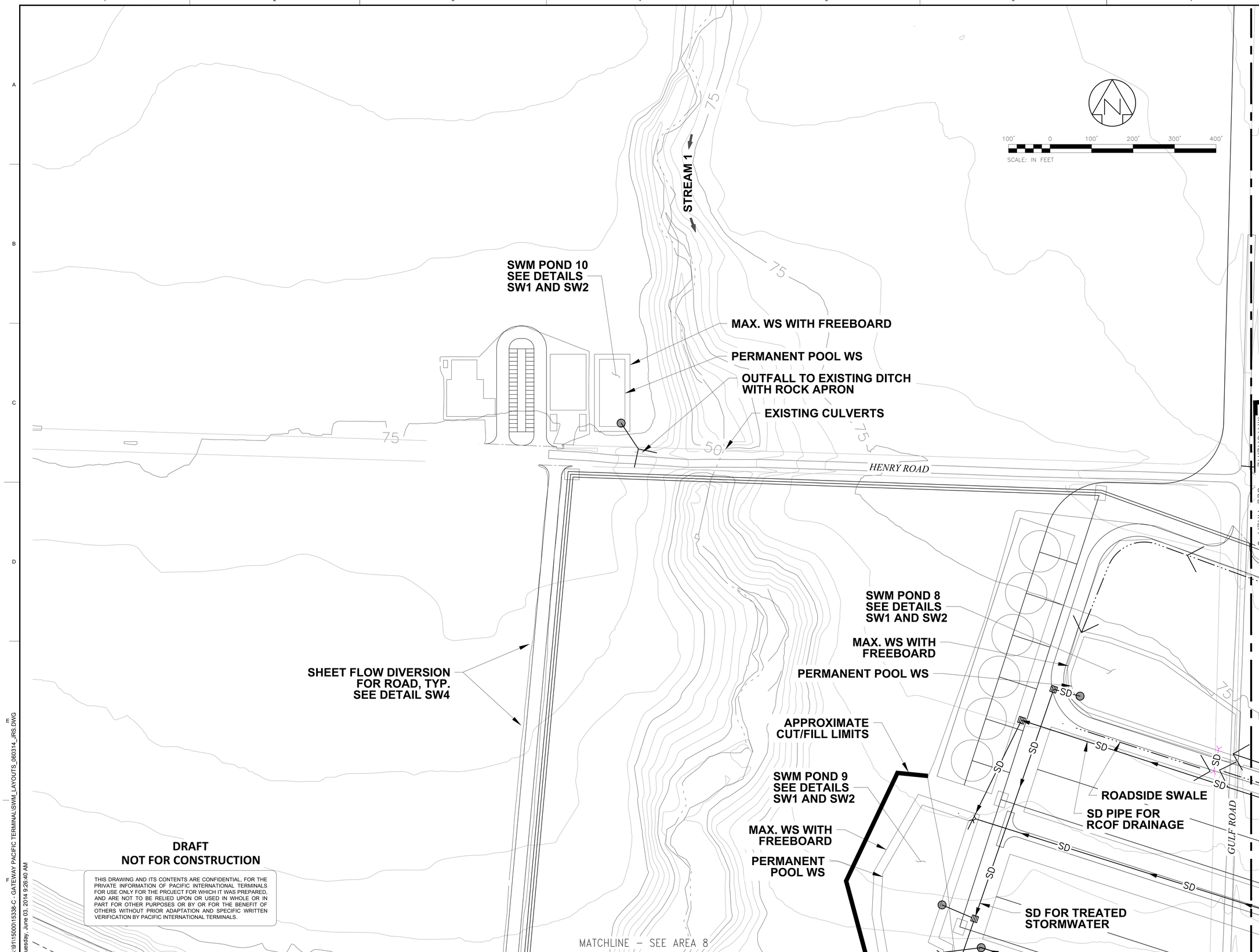
DWG. No.	REFERENCE	REF No.



LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
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ABBREVIATIONS

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EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

DRAFT
NOT FOR CONSTRUCTION

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REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED	BLT	DRAWN	JRS
DATE	2/27/14	CHECK	
SCALE	AS SHOWN	DESIGN	BLT
D	143166	DES. CHK.	
		CAD FILE:	SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Vanchi Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN AREA 5

DWG. NO. C5 | REV

G:\91115000\15338-C - GATEWAY PACIFIC TERMINAL\SWM_LAYOUTS_060314_JRS.DWG
Tuesday, June 03, 2014 9:26:40 AM

MATCHLINE – SEE AREA 3

CULVERT FOR RR STORMWATER

SWM POND 1 SEE DETAIL SW1

MAX. WS WITH FREEBOARD

POND BOTTOM

TOP OF BERM

TOE OF BERM

SWM POND 7 SEE DETAILS SW1 AND SW 2

MAX. WS WITH FREEBOARD

PERMANENT POOL WS

MATCHLINE – SEE AREA 5

MATCHLINE – SEE AREA 7

EXISTING HENRY ROAD

OUTFALL WITH ROCK APRON TO EXISTING DITCH

SEDIMENT POND

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

ROADSIDE SWALE

SWALE TO SWM POND 8

GULF ROAD

SD PIPE FOR ROOF DRAINAGE

ROADSIDE SWALE

CULVERT FOR STREAM 2A

MATCHLINE – SEE AREA 9

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SCALE: IN FEET

DWG. No.	REFERENCE	REF No.

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

REV	BY	APP'D	DESCRIPTION	YR	MO	DA

APPROVED BLT	DRAWN JRS
DATE 2/27/14	CHECK
SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Gaztic Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN AREA 6

DWG. NO. C6 REV

G:\91115000\15338-C - GATEWAY PACIFIC TERMINAL\SWM_LAYOUTS_060314_JRS.DWG
Tuesday, June 03, 2014 9:26:49 AM

MATCHLINE – SEE AREA 4

MATCHLINE – SEE AREA 6

DITCH FOR RR STORMWATER TO SWM POND 3

DITCH FOR RR STORMWATER TO SWM POND 2

DITCH FOR RR STORMWATER TO SWM POND 7

CULVERT FOR NATURAL STORMWATER

HENRY ROAD

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

SCALE: IN FEET 100' 0 100' 200' 300' 400'

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DWG. No.	REFERENCE	REF No.

REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED	BLT	DRAWN	JRS
DATE	2/27/14	CHECK	
SCALE	AS SHOWN	DESIGN	BLT
D	143166	DES. CHK.	
		CAD FILE:	SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Delta Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER DRAINAGE PLAN AREA 7

DWG. NO. C7 REV

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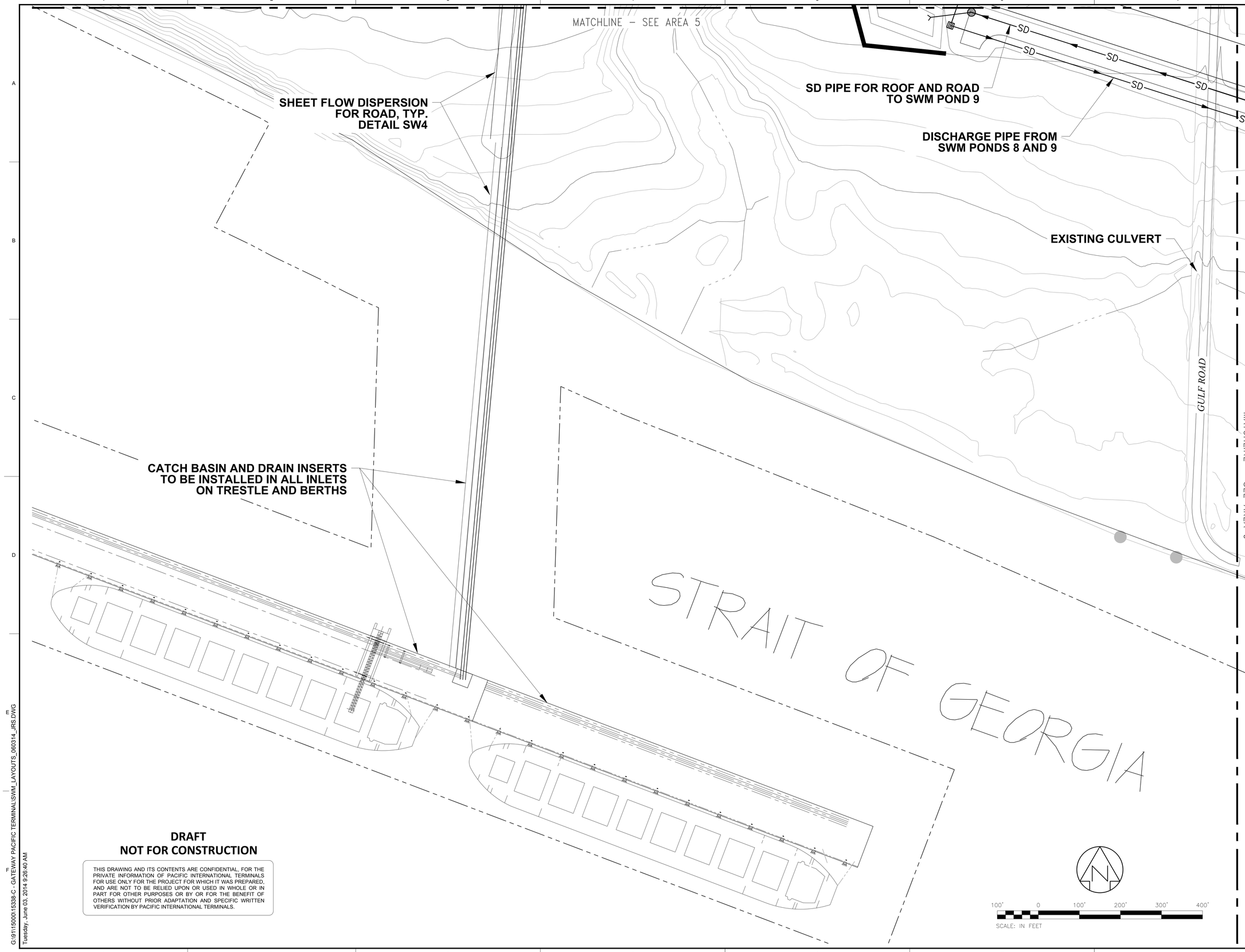

DWG. No.	REFERENCE	REF No.

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
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SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

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REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED BLT	DRAWN JRS
DATE 2/27/14	CHECK
SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

amec

CLIENT
Pacific International Terminals.
A Gerts Enterprise

PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
PROPOSED STORMWATER DRAINAGE PLAN
AREA 8

DWG. NO. C8 REV

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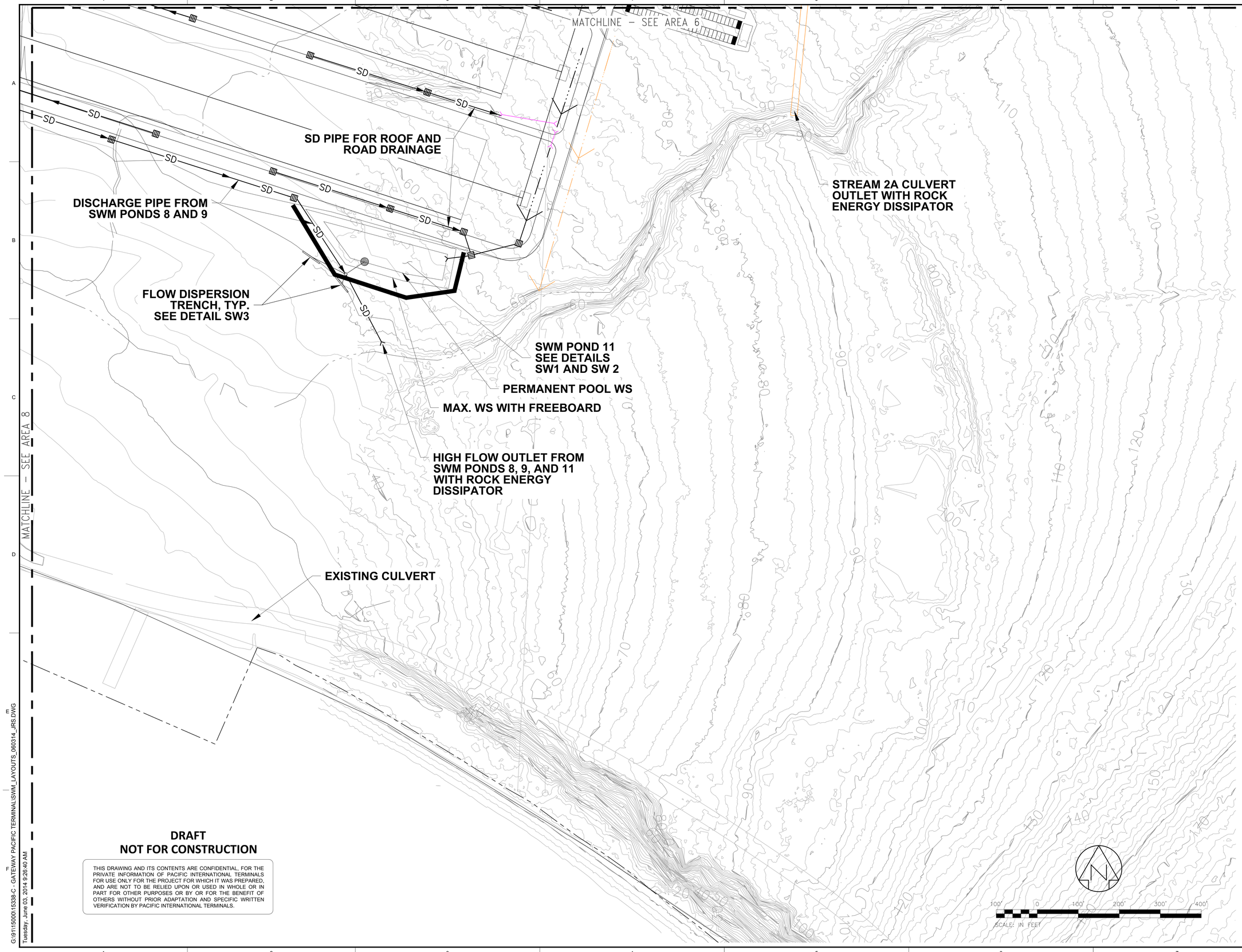

DWG. No.	REFERENCE	REF No.

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
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SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

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REV	BY	APP'D	DESCRIPTION	YR	MO	DA

APPROVED BLT	DRAWN JRS
DATE 2/27/14	CHECK
SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

amec

CLIENT
Pacific International Terminals.
A Gaotic Enterprise

PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
PROPOSED STORMWATER DRAINAGE PLAN
AREA 9

DWG. NO. C9 REV

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Tuesday, June 03, 2014 9:26:40 AM

DWG. No.	REFERENCE	REF No.

BP REFINERY

ALDERBROOK ROAD

BNSF YARD

LONSETH ROAD

GULF ROAD

HENRY ROAD

STRAIT OF GEORGIA

BNSF RR SPUR

APPROXIMATE AREA OF TRESTLE AND BERTH

1 2 3 4 5 6 7 8 9

SWM POND 5 SEE DETAILS SW1 AND SW2

SWM POND 6 SEE DETAILS SW1 AND SW2

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 4 SEE DETAILS SW1 AND SW2

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 3 SEE DETAILS SW1 AND SW2

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 2 SEE DETAILS SW1 AND SW2

SWM POND 12 SEE DETAILS SW1 AND SW2

SWM POND 1 SEE DETAILS SW1

SWM POND 10 SEE DETAILS SW1 AND SW2

SWM POND 7 SEE DETAILS SW1 AND SW 2

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 9 SEE DETAILS SW1 AND SW2

SWM POND 8 SEE DETAILS SW1 AND SW2

FLOW DISPERSION TRENCH, TYP. SEE DETAIL SW3

SWM POND 11 SEE DETAILS SW1 AND SW 2

LEGEND

- STORMWATER POND DISCHARGE RISER, PIPE AND OUTFALL
- PROPERTY BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- SD — PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER CULVERT
- NATURAL STORMWATER DRAINAGE
- NATURAL STORMWATER CULVERT
- 160 — MAJOR CONTOUR (10 FT)
- MINOR CONTOUR (2 FT)
- EXISTING ROAD
- EXISTING DRAINAGE

STORMWATER FACILITY
SWM POND 1
SWM POND 2
SWM POND 3
SWM POND 4
SWM POND 5
SWM POND 6
SWM POND 7
SWM POND 8
SWM POND 9
SWM POND 10
SWM POND 11
SWM POND 12

ABBREVIATIONS

BMP	BEST MANAGEMENT PRACTICE
EXST	EXISTING
LF	LINEAR FOOT/FEET
RR	RAILROAD
SD	STORM DRAIN
SWM	STORMWATER MANAGEMENT
TYP	TYPICAL
WS	WATER SURFACE

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500' 0 500' 1000' 1500' 2000'

SCALE: IN FEET

REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED BLT	DRAWN JRS
DATE 2/27/14	CHECK
SCALE AS SHOWN	DESIGN BLT
D 143166	DES. CHK.
	CAD FILE: SWM_LAYOUTS_060314_JRS

amec

CLIENT: Pacific International Terminals. A Gerfit Enterprise

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: PROPOSED STORMWATER FACILITIES AND SUBBASIN AREAS

DWG. NO. C10 REV

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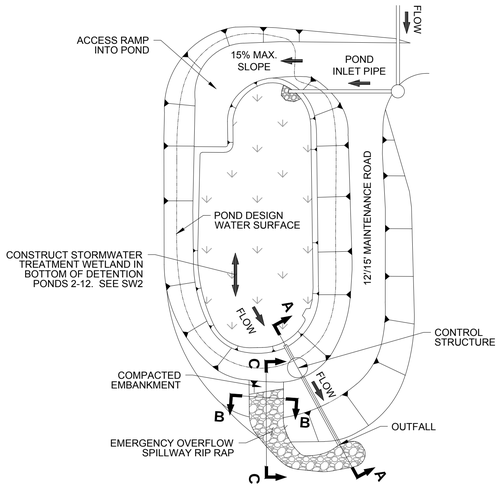
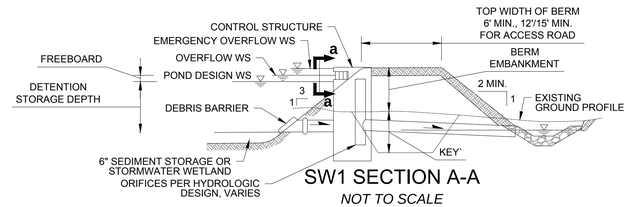


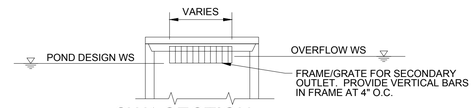
SW1 TYPICAL DETENTION POND PLAN VIEW

NOT TO SCALE



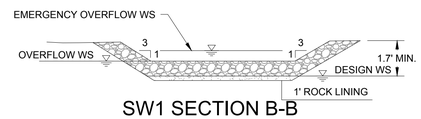
SW1 SECTION A-A

NOT TO SCALE



SW1 SECTION a-a

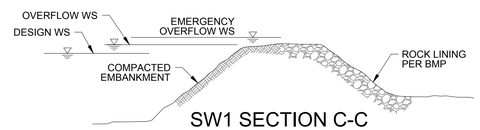
NOT TO SCALE



SW1 SECTION B-B

EMERGENCY OVERFLOW SPILLWAY

NOT TO SCALE



SW1 SECTION C-C

NOT TO SCALE

SW1 DETENTION POND DESIGN TABLE

Facility ID	Tributary Area acre	Area (top of berm) sf	Area (top of berm) acre	Area (bottom of detention) sf	Area (bottom of detention) acre	Detention Volume cf	Detention Volume acre-ft	Key Elevations (ft) outlet IE	Key Elevations (ft) design WS	Key Elevations (ft) top of berm	Dimensions storage depth	Dimensions freeboard	Dimensions side slope H:V
SWM POND 1 [3]	132.25	229,400	5.27	116,000	2.66	1,443,000	33.127	88.00	98.00	100.50	10.00	1.50	3.0
SWM POND 2	6.59	35,300	0.81	27,000	0.62	74,300	1.706	126.00	128.50	129.50	2.50	1.00	3.0
SWM POND 3	8.20	41,300	0.95	31,000	0.71	104,100	2.390	134.00	137.00	138.00	3.00	1.00	3.0
SWM POND 4	6.39	41,500	0.95	35,000	0.80	55,200	1.267	123.50	125.00	126.00	1.50	1.00	3.0
SWM POND 5	9.86	86,500	1.99	75,000	1.72	157,300	3.611	123.00	125.00	126.00	2.00	1.00	3.0
SWM POND 6	44.38	154,600	3.55	129,000	2.96	555,700	12.757	135.00	139.00	140.00	4.00	1.00	3.0
SWM POND 7	22.15	107,800	2.47	88,000	2.03	335,600	7.704	145.00	148.50	149.50	3.50	1.00	3.0
SWM POND 8	26.36	70,500	1.62	57,000	1.30	185,200	4.252	66.00	69.00	70.00	3.00	1.00	3.0
SWM POND 9	26.50	74,400	1.71	51,000	1.16	363,000	8.333	42.00	48.00	49.00	6.00	1.00	3.0
SWM POND 10	2.48	15,500	0.36	9,000	0.22	34,800	0.799	71.00	74.00	75.00	3.00	1.00	3.0
SWM POND 11	9.68	32,600	0.75	20,000	0.45	123,800	2.842	52.00	57.00	58.00	5.00	1.00	3.0
SWM POND 12	2.93	27,600	0.63	23,000	0.53	24,300	0.558	100.00	101.00	102.00	1.00	1.00	3.0
Total	304.54	917,000	21.05	661,000	15.15	3,456,300	79.346	n/a	n/a	n/a	n/a	n/a	n/a

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REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED	BLT	DRAWN	M. RAFFERTY
DATE	1/30/13	CHECK	BLT
SCALE	AS SHOWN	DESIGN	CDH
D	143166	DES. CHK.	BLT
		CAD FILE: GPT DETAIL SHEET-041014_JRS	

amec

CLIENT
Pacific International Terminals.
A Certis Enterprise

PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
STORMWATER TREATMENT DETAIL SW1

DWG. NO. C11 REV

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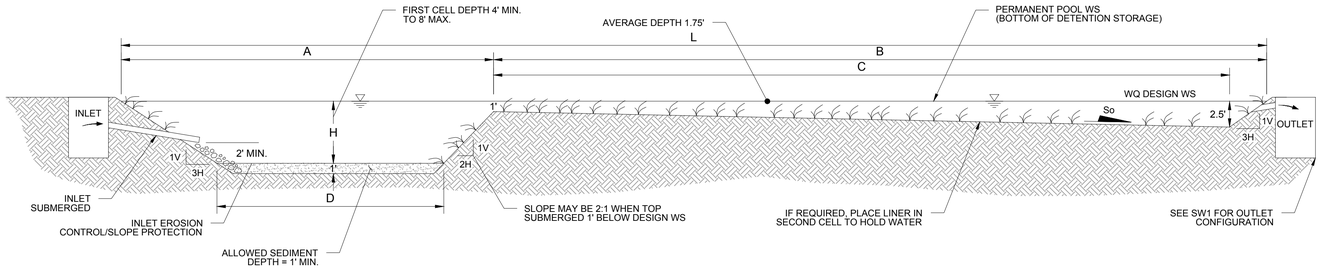
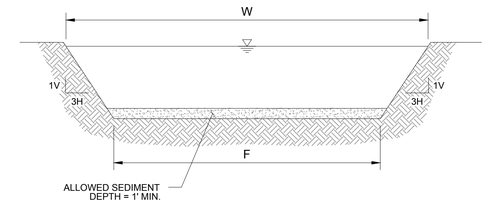


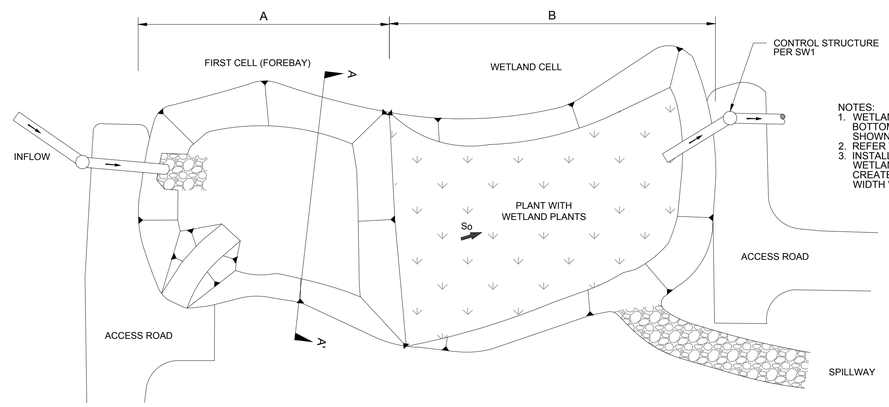
SW2 TYPICAL STORMWATER TREATMENT WETLAND PROFILE

NOT TO SCALE



SW2 SECTION A-A' VIEW

NOT TO SCALE



NOTES:
1. WETLAND TO BE CONSTRUCTED IN BOTTOM OF DETENTION PONDS WHERE SHOWN.
2. REFER TO TABLE FOR PRELIMINARY SIZING.
3. INSTALL 18" DIAMETER COIR LOGS IN WETLAND CELL TO DIRECT FLOWS AND CREATE FLOWPATH OF LENGTH "B" AND WIDTH "W" PER TABLE.

SW2 TYPICAL STORMWATER TREATMENT WETLAND PLAN

NOT TO SCALE

SW2 STORMWATER WETLAND DESIGN TABLE 1, 2

Facility ID	Total Wetland Surface		Total Wetland Volume		Forebay Surface		Forebay Volume		Elevation (ft)	Dimensions						
	sf	acre	cf	acre-ft	sf	acre	cf	acre-ft	Top of Permanent Pool	Forebay depth	Total surface length	Forebay surface length	Forebay Bottom Length	Wetland Cell Length	Surface Width	Bottom Width
DIMENSION ON DRAWING	--	--	--	--	--	--	--	--	--	H	L	A	D	B	W	F
SWM POND 1 [3]	--	--	--	--	--	--	--	--	--	--	--	--				
SWM POND 2	20,000	0.46	28,000	0.64	3,000	0.07	10,000	0.23	126.00	4.0	354	58	42	296	56	40
SWM POND 3	23,000	0.53	39,000	0.90	5,000	0.11	14,000	0.32	134.00	4.0	335	70	50	265	68	44
SWM POND 4	17,000	0.39	30,000	0.69	4,000	0.09	11,000	0.25	123.50	4.0	289	60	44	229	58	42
SWM POND 5	27,000	0.62	47,000	1.08	6,000	0.14	16,000	0.37	123.00	4.0	364	76	56	288	74	50
SWM POND 6	108,000	2.48	211,000	4.84	22,000	0.51	77,000	1.77	135.00	4.0	731	150	130	581	148	124
SWM POND 7	49,000	1.12	92,000	2.11	10,000	0.23	32,000	0.73	145.00	4.0	498	101	81	397	99	75
SWM POND 8	27,000	0.62	74,000	1.70	8,000	0.18	26,000	0.60	66.00	4.0	301	92	72	209	90	66
SWM POND 9	51,000	1.17	94,000	2.16	10,000	0.23	33,000	0.76	42.00	4.0	505	103	83	402	101	77
SWM POND 10	7,000	0.16	9,000	0.21	1,000	0.02	3,000	0.07	71.00	4.0	177	39	19	138	37	13
SWM POND 11	19,000	0.44	33,000	0.76	4,000	0.09	11,000	0.25	52.00	4.0	310	65	45	245	63	39
SWM POND 12	6,000	0.14	9,000	0.21	1,000	0.02	3,000	0.07	100.00	4.0	177	39	19	138	37	13
Total	354,000	8.13	666,000	15.289	74,000	1.70	236,000	5.418	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

NOTES:
1. AVERAGE DEPTH OF WETLAND CELL IS 1.75 FT. THE BERM SEPARATING CELLS IS SUBMERGED 1 FT UNDER WATER QUALITY VOLUME.
2. WETLAND LENGTH AND WIDTHS SHOWN ARE AVERAGES.
3. WETLAND NOT REQUIRED FOR THIS POND. POND ONLY TREATS COAL WASTE RUNOFF.

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DWG. No.	REFERENCE	REF No.

REV	BY	APPD	DESCRIPTION	YR	MO	DA

APPROVED BLT
DATE 1/30/13
SCALE AS SHOWN
DRAWN M. RAFFERTY
CHECK BLT
DESIGN CDH
DES. CHK. BLT
D 143166
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PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
STORMWATER TREATMENT DETAIL SW2

DWG. NO. C12
REV

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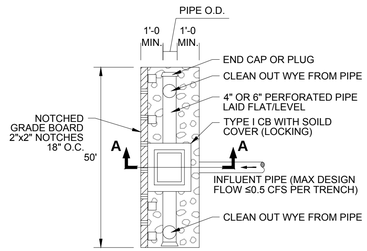
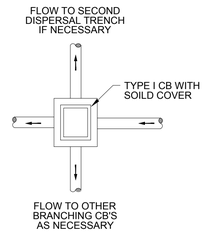
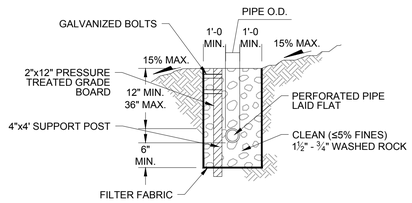


SW3 FLOW DISPERSAL TRENCH PLAN VIEW

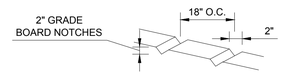
NOT TO SCALE





SW3 FLOW DISPERSAL TRENCH SECTION A-A

NOT TO SCALE



NOTES:
1. THIS TRENCH SHALL BE CONSTRUCTED SO AS TO PREVENT POINT DISCHARGE AND/OR EROSION.
2. TRENCHES MAY BE PLACED NO CLOSER THAN 50 FEET TO ONE ANOTHER (100 FEET ALONG FLOWLINE).
3. TRENCH AND GRADE BOARD MUST BE LEVEL. ALIGN TO FOLLOW CONTOURS OF SITE.
4. SUPPORT POST SPACING AS REQUIRED BY SOIL CONDITIONS TO ENSURE GRADE BOARD REMAINS LEVEL.
5. DISPERSION TRENCHES ALONG RAILROAD BERM (SW6) DO NOT REQUIRE PERFORATED PIPE.

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PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
STORMWATER TREATMENT DETAILS SW3 AND SW4

DWG. NO. C13 REV

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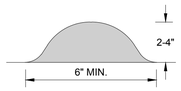
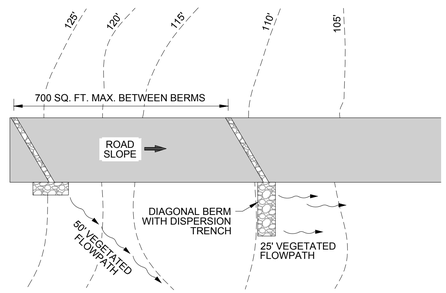
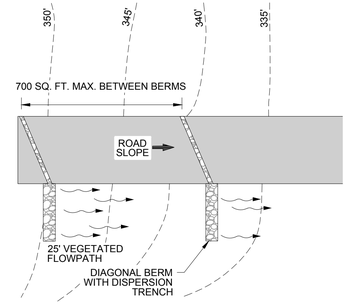


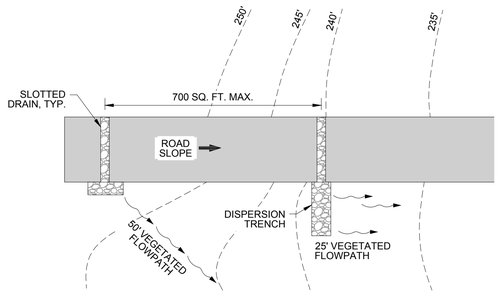
BERM DETAIL
NOT TO SCALE



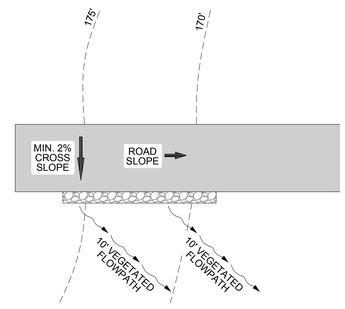
STEEP ROAD WITH DIAGONAL BERMS
NOT TO SCALE



ROAD DISPERSION TRENCH
ROAD TRENCH VARIES AND SLOPES TOWARDS STREET
NOT TO SCALE



STEEP ROAD WITH SLOTTED DRAINS
NOT TO SCALE



SHEET FLOW DISPERSION FROM A ROAD
FLAT TO MODERATELY SLOPING ROADS
NOT TO SCALE

SW4 TYPICAL CONCENTRATED FLOW DISPERSION FOR STEEP ROADS (FOR SLOPES >15%)

SW4 SHEET FLOW DISPERSION FOR ROADS (FOR SLOPES Ò15%)

FLOW DISPERSION NOTES:
1. THIS BMP SHALL BE CONSTRUCTED SO AS TO PREVENT POINT DISCHARGE, FLOODING OF DOWNSTREAM PROPERTIES, OR EROSION.
2. FLOW DISPERSION TO BE USED WHERE ROADS ARE ONLY SOURCE OF STORMWATER RUNOFF WHERE NOTED.
3. LOCATE DISPERSION BMP TO MATCH ROAD CONDITIONS. SLOPES LESS THAN 15% REQUIRE SHEET FLOW DISPERSION BMP. SLOPES GREATER THAN 15% REQUIRE CONCENTRATED FLOW DISPERSION.
4. A MAXIMUM OF 700 SQUARE FEET OF IMPERVIOUS AREA MAY DRAIN TO EACH FLOW DISPERSION BMP.
5. REFER TO VOLUME V - RUNOFF TREATMENT BMPS, BMP T5.11 AND BMP T5.12 FROM THE ECOLOGY SWMM 2012 FOR MORE DETAILS.

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PROJECT
GATEWAY PACIFIC TERMINAL

TITLE
STORMWATER TREATMENT DETAILS SW5 AND SW6

DWG. NO. C14 REV

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APPENDIX C

Proposed Modifications to Existing Streams and Drainage Courses

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APPENDIX C: PROPOSED MODIFICATIONS TO EXISTING STREAMS AND DRAINAGE COURSES

Gateway Pacific Terminal
Whatcom County, Washington

Development of the Gateway Pacific Terminal (Terminal) will include infrastructure to manage stormwater runoff. One goal of stormwater management at the facility will be to improve the existing system of streams and drainage courses to more closely mimic the natural predeveloped conditions that existed prior to development of the existing infrastructure at the site (i.e. public roads, drainage ditches, and other residential and agricultural improvements). A preliminary map of the proposed developed conditions drainage basins in presented on Figure 13 in the Draft Conceptual Stormwater Management Plan.

In an effort to restore natural drainage patterns in the project area, the following enhancements to hydrologic features are proposed as part of the Terminal project:

- The upper reach of Stream 1 will be reconnected to its historical alignment by demolishing and regrading the on-site segment of Lonseth Road to allow surface runoff to discharge directly into the relic unnamed stream. The relic unnamed stream is shown on Figure 13 where it is located within the Figure-8 railbed portion of the project area. Plantings are proposed along the restored stream channel to enhance the riparian zone and to stabilize the stream banks. This segment of restored channel will be considered the new main alignment of Stream 1.
- Drainage 1 and Stream 4 will be intercepted on the east side of the Figure-8 rail bed, and conveyed to the edge of the wetland north of the Figure-8 railbed. This modification will allow surface runoff from the east side of the Figure-8, and adjacent off-site areas to contribute flow to Point of Interest (POI) A instead of being routed to POI B.
- Existing drainages 8 and 9 along Lonseth Road will be permanently removed.
- Several catchments north of Henry Road, and Stream 5, will be reconnected to Stream 2 and Stream 2A east of the open storage area.
- Stream 2A will be redirected through open channels and a culvert to Stream 2 east of the covered storage area. This was done so that additional water is available to supply the wetland mitigation site located on the east side of Gulf Road. As an additional consideration, if Stream 2A remained in the covered storage area, it would need to be culverted beneath material stockpiles, where long term settlement could compromise the structural integrity of the culvert.

- A connection will be created to link the existing Drainage 3 with Stream 2. This will re-establish the predeveloped drainage pattern for the off-site area located east of the BNSF rail bed.
- Drainage 10 will be eliminated and replaced with on-site conveyances needed to transfer runoff from the covered storage area to stormwater management ponds.

APPENDIX D

Stormwater Management Requirements

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Table D-1. Requirement Comparisons
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Ecology Minimum Requirements-2012[a]	Whatcom Co. Minimum Requirements-2002[b]
1. Preparation of Stormwater Site Plans:	
The Stormwater Site Plan is a comprehensive report submitted to local permitting authorities that describes existing site conditions, explains development plans, examines potential off-site effects, identifies applicable Minimum Requirements, and proposes stormwater controls for both the construction phase and long-term stormwater management. Stormwater Site Plans are expected to follow the following steps set forth by Ecology: 1. Collect and Analyze Information on Existing Conditions 2. Prepare Preliminary Development Layout 3. Perform Off-site Analysis (at local government's option) 4. Determine Applicable Minimum Requirements 5. Prepare a Permanent Stormwater Control Plan 6. Prepare a Construction Stormwater Pollution Prevention Plan 7. Complete the Stormwater Site Plan 8. Check Compliance with All Applicable Minimum Requirements	
2. Construction Stormwater Pollution Prevention	**TESC During Construction Phase**
A Construction Stormwater Pollution Prevention Plan (Construction SWPPP) is a component of the Stormwater Site Plans and includes a narrative and drawings related to potential pollution problems. The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information concerning existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.	A Temporary Erosion and Sediment Control (TESC) plan is required for construciton on new and existing sites. The owner must submit a Preliminary TESC Plan to the Technical Administrator, who will determine whether the proposal will be subject to Small Development Minimum Requirements (Section 208) or Large Development Minimum Requirements (Section 209).
A Construction SWPPP as a minimum should contain the following 12 elements to be considered adequate by Ecology: • Mark Clearing Limits • Establish Construction Access • Control Flow Rates • Install Sediment Controls • Stabilize Soils • Protect Slopes • Protect Drain Inlets • Stabilize Channels And Outlets • Control Pollutants • Control De-Watering • Maintain Best Management Practices (BMPs) • Manage the Project	Temporary erosion and sediment control plan must cover the following areas of construction: #1 - CONSTRUCTION ACCESS ROUTES: Access onto off-site roads shall be protected by the installation of a minimum of 100 feet of quarry spall or other methods approved by the Technical Administrator. #2 - STABILIZATION OF DISTURBED AREAS: All exposed soils subject to erosion shall be stabilized through such soil stabilization measures as seed, sod or other vegetation application, plastic covering, mulching, or application of gravel base. #3 - CONTAINMENT OF SEDIMENT ON SITE: Prior to leaving the site, concentrated stormwater runoff shall pass through a sediment pond or sediment trap, or other appropriate sediment trapping methods. #4 - CONTROLLING OFF-SITE DAMAGE: Properties and waterways downstream from clearing sites shall be protected from damage resulting from increased stormwater runoff. #5 - DELINEATING CLEARING AND EASEMENT LIMITS: Prior to clearing, establish and mark on site clearing limits and other critical site features as appropriate. #6 - TIMING AND STABILIZATION OF SITE CONTAINMENT: Prior to other land disturbance activities, all erosion and sedimentation control methods shall be in place. #7 - CUT AND FILL SLOPES: Cut and fill slopes shall be stabilized. #8 - STORM DRAIN INLET PROTECTION: Storm drain inlets made operable during construction shall be protected so that unfiltered and/or untreated stormwater runoff shall not enter the conveyance system. #9: STABILIZATION OF TEMPORARY CONVEYANCE CHANNELS AND OUTLETS: All temporary on-site conveyance channels shall be designed, constructed, and stabilized to convey the peak flow from a one-year, 24-hour frequency storm with no appreciable erosion. Stabilization adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems. #10: DEWATERING CONSTRUCTION SITES: All dewatering devices shall discharge into a sediment trap or sediment pond. #11 - MAINTENANCE: Temporary sediment control measures must be satisfactorily maintained until the clearing and/or construction is completed, permanent drainage facilities are operational, and the potential for on-site erosion has passed. #12 - REMOVAL OF TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES: All temporary non-biodegradable erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved or after the temporary measures are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal shall be permanently stabilized.

Table D-1. Requirement Comparisons
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Ecology Minimum Requirements-2012[a]	Whatcom Co. Minimum Requirements-2002[b]
3. Source Control of Pollution The intention of source control BMPs is to prevent stormwater from coming in contact with pollutants, and BMPs are also typically a cost-effective means of reducing pollutants in stormwater, and, therefore, should be a first consideration in all projects. Source Control BMPs include Operational BMPs and Structural Source Control BMPs. An adopted and implemented basin plan (adaptation of Minimum Requirement #9) or a Total Maximum Daily Load (TMDL, also known as a Water Cleanup Plan) may be used to develop more stringent source control requirements that are tailored to a specific basin.	**Source Control of Pollution BMPs** Source control BMPs are designed to prevent pollutants from entering stormwater by eliminating the source of pollution or preventing contact of pollutants with rainfall and runoff. Source control BMPs may be selected, designed, and maintained according to the latest edition of the Stormwater Management Manual for the Puget Sound Basin Washington (Ecology 1992[c]).
4. Preservation of Natural Drainage Systems and Outfalls Preservation of Natural Drainage Systems and Outfalls is required to preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location. Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The following discharge requirement is recommended: Where no conveyance system exists at the abutting downstream property line and the natural (existing) discharge is unconcentrated, any runoff concentrated by the proposed project must be discharged as follows: a) If the 100-year peak discharge is less than or equal to 0.2 cfs under existing conditions and will remain less than or equal to 0.2 cfs under developed conditions, then the concentrated runoff may be discharged onto a rock pad or to any other system that serves to disperse flows. b) If the 100-year peak discharge is less than or equal to 0.5 cfs under existing conditions and will remain less than or equal to 0.5 cfs under developed conditions, then the concentrated runoff may be discharged through a dispersal trench or other dispersal system, provided the applicant can demonstrate that there will be no significant adverse impact to downhill properties or drainage systems. c) If the 100-year peak discharge is greater than 0.5 cfs for either existing or developed conditions, or if a significant adverse impact to downgradient properties or drainage systems is likely, then a conveyance system must be provided to convey the concentrated runoff across the downstream properties to an acceptable discharge point (i.e., an enclosed drainage system or open drainage feature where concentrated runoff can be discharged without significant adverse impact). Stormwater control or treatment structures should not be located within the expected 25-year water level elevations for salmonid-bearing waters. Such areas may provide off-channel habitat for juvenile salmonids and salmonid fry. Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties; all outfalls require energy dissipation.	**Storm Runoff - Design Flows for Runoff Management** Preservation of Natural Drainage Systems and Outfalls is required to preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location. Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. Stormwater runoff shall be controlled to be consistent with the following: Post-Development Stormwater Control: Post-development runoff shall be limited to the peak rate of runoff for the existing site condition as follows: i. 1-year, 24-hour, duration design storm event when applicable to Section 219.B.3.a (Ecology 1992) ii. 2-year, 24-hour, duration design storm event iii. 10-year, 24-hour, duration design storm event iv. 25-year, 24-hour, duration design storm event v. 100-year, 24-hour, duration design storm event This requirement may be modified if the subject property lies within a drainage basin covered by a County approved Drainage Basin Plan and post-development peak runoff conforms with the requirements of the plan. Existing Drainage to be Maintained: Off-site surface water drainage entering the site shall enter and leave the site at, or as near as practical to, the existing locations. Energy dissipaters shall be provided, as necessary, to minimize downstream stormwater damage. There shall be no significant diversions at the inlet or outlet locations, unless previously authorized by an approved Basin Plan or approved by affected property owners.
5. On-site Stormwater Management On-site Stormwater Management is a set of techniques that serve to infiltrate, disperse, and retain stormwater runoff onsite. Projects shall employ On-site Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff on site to the maximum extent feasible without causing flooding or erosion impacts. Roof Downspout Control BMPs, functionally equivalent to those described in Chapter 3 of Volume III (Ecology 2005), and Dispersion and Soil Quality BMPs, functionally equivalent to those in Chapter 5 of Volume V (Ecology 2005), shall be required to reduce the hydrologic disruption of developed sites.	**Stormwater Discharge Control Requirements** i. Stormwater discharges from the project must be treated and controlled by a suitable combination of BMPs. ii. Stormwater detention systems shall be designed in accordance with Best Management Practices. Volumes II, III, and IV, as amended, of the Ecology (1992) stormwater manual may be used as reference in the design and construction of stormwater facilities.

Table D-1. Requirement Comparisons
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Ecology Minimum Requirements-2012[a]	Whatcom Co. Minimum Requirements-2002[b]
6. Runoff Treatment The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms so that beneficial uses of receiving waters are maintained and, where applicable, restored. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment. Direct discharge of untreated stormwater from pollution-generating impervious surfaces to groundwater is prohibited, except for the discharge achieved by infiltration or dispersion of runoff from residential sites through use of On-site Stormwater Management BMPs. The water quality design storm volume and flow rates are intended to capture and effectively treat about 90-95% of the annual runoff volume in western Washington. Volume V of the 2005 Stormwater Management Manual for Western Washington includes performance goals for Basic, Enhanced, Phosphorus, and Oil Control treatment, and a menu of facility options for each treatment type. Treatment facilities that are selected from the appropriate menu and designed in accordance with their design criteria are presumed to meet the applicable performance goals. Treatment facilities applied consistent with this manual are presumed to meet the requirement of state law to provide all known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). Discharges must still comply with state water quality standards, WAC 173-201A; state groundwater quality standards, WAC 173-200; state sediment management standards, WAC 173-204; and the underground injection control program, WAC 173-218. Additional treatment to meet those standards may be required by federal, state, or local governments.	**Runoff Treatment BMPs** Runoff treatment BMPs are designed to remove pollutants that are contained in runoff. Treatment BMPs utilize a variety of mechanisms to remove pollutants from stormwater including sediment, filtration, plant uptake, ion exchange, absorption, and bacterial decomposition. Runoff treatment BMPs shall be sized to capture and treat the water quality design storm, defined as the 6-month, 24-hour return storm event. A high priority for treatment shall be to infiltrate as much as practicable of the design storm runoff. Groundwater recharge is only recommended when site conditions are appropriate and ground water quality will not be impaired. Direct discharge of polluted, untreated stormwater to ground water is prohibited. Runoff treatment BMPs shall be selected, designed, and maintained according to the latest edition of the Stormwater Management Manual for the Puget Sound Basin (Ecology 1992).

Table D-1. Requirement Comparisons
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Ecology Minimum Requirements-2012[a]	Whatcom Co. Minimum Requirements-2002[b]
7. Flow Control Projects must provide flow control to reduce the impacts of stormwater runoff from impervious surfaces and land cover conversions. Flow control BMPs typically control the rate, frequency, and flow duration of stormwater surface runoff. The need to provide flow control BMPs depends on whether a development site discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh water - except for projects that discharge to a water body listed in Appendix I-E (Ecology 2005) in accordance with the following restrictions: • Direct discharge to the exempt receiving water does not result in the diversion of drainage from any perennial stream classified as Types 1, 2, 3, or 4 in the State of Washington Interim Water Typing System, or Types "S", "F", or "Np" in the Permanent Water Typing System, or from any category I, II, or III wetland; and • Flow splitting devices or drainage BMPs are applied to route natural runoff volumes from the project site to any downstream Type 5 stream or category IV wetland: o Design of flow splitting devices or drainage BMPs will be based on continuous hydrologic modeling analysis. The design will assure that flows delivered to Type 5 stream reaches will approximate, but in no case exceed, durations ranging from 50% of the 2-year to the 50-year peak flow. o Flow splitting devices or drainage BMP's that deliver flow to category IV wetlands will also be designed using continuous hydrologic modeling to preserve pre-project wetland hydrologic conditions unless specifically waived or exempted by regulatory agencies with permitting jurisdiction. • The project site must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the exempt receiving water. • The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected. • Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.	**Streambank Erosion Control BMPs** Streambank erosion control BMPs are designed to prevent or control the excessive erosion that typically occurs in streams located in developing watersheds. The goal of streambank erosion control BMPs is to replicate, to the extent practicable, the historical dominant discharge of the stream or channel. Excessive erosion results from increased work being done upon the stream/channel banks, which increased work is occasioned by, and primarily due to, storm events with a return frequency of one year or less. a. Stormwater discharges to streams shall control stream bank erosion by limiting the peak rate of runoff from individual development sites to the existing condition for the one-year, 24-hour design storm event. This requirement applies only to situations where stormwater runoff is discharged directly into a stream or onto lands located within the stream drainage basin within 1000 feet of the stream. In such situations, this requirement must be met in addition to meeting the requirements of Section 219.C.1.a. of the Whatcom County Development Requirements (2002). b. As the first priority, stream bank erosion control BMPs shall utilize infiltration to the fullest extent practicable, only if site conditions are appropriate and groundwater quality is protected. c. Peak runoff control BMPs may be selected, designed, and maintained according to the latest edition of the Stormwater Management Manual for the Puget Sound Basin Washington (Ecology 2005).
8. Wetlands Protection Wetlands can be severely degraded by stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system. Changes in water levels and the frequency and duration of inundations are of particular concern. Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses. The hydrologic analysis shall use the existing land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction. A wetland can be considered for hydrologic modification and/or stormwater treatment in accordance with Guide Sheet 1B in Appendix I-D (Ecology 2005). The standard requirement does not excuse the obligation to apply whatever technology is necessary to comply with state water quality standards, WAC 173-201A, or state groundwater standards, WAC 173-200. Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for: • necessary conveyance systems as approved by the local government; or • as allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Guidesheet 1B. An adopted and implemented basin plan, or a Total Maximum Daily Load (TMDL), may be used to develop requirements for wetlands that are tailored to a specific basin.	**Wetland Quality Control BMPs** Wetland quality control BMPs are designed to prevent or control the degradation of water quality entering regulated wetland ecosystems. The requirements of this section apply only to situations where stormwater discharges through a conveyance system into a wetland. Pursuant to 9.8.10 of the Whatcom County Critical Areas Ordinance, wetlands shall not be used for the treatment of stormwater except when the stormwater facility meets all of the following criteria: i. The use of upland sites is determined by the County to be unfeasible. Criteria for such a determination are included in the Whatcom County Development Standards chapter that addresses Environment. ii. The functions and values of the existing wetland are enhanced by the creation of a constructed wetland and not materially degraded by its use in stormwater management. Requirements of this section must be met in addition to meeting the requirements of 16.16.600, of the Whatcom County Code. i. Discharges to wetlands shall approximate the hydro-period and flows of existing site conditions to the extent necessary to protect the important characteristic uses of the wetland. ii. Prior to discharging to a wetland, alternative discharge locations shall be evaluated. Natural water storage and infiltration opportunities outside the wetland shall be optimized, to the extent practical.

Table D-1. Requirement Comparisons
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Ecology Minimum Requirements-2012[a]	Whatcom Co. Minimum Requirements-2002[b]
9. Basin/Watershed Planning Primary objectives of basin planning are to reduce pollutant loads and hydrologic impacts to surface and ground waters in order to protect beneficial uses. Basin/watershed plans shall evaluate and include, as necessary, retrofitting urban stormwater BMPs into existing development and/or redevelopment in order to achieve watershed-wide pollutant reduction and flow control goals that are in Volume I – Minimum Technical Requirements 2-37 (Ecology 2005) and consistent with requirements of the federal Clean Water Act. Standards developed from basin plans shall not modify any of the above minimum requirements until the basin plan is formally adopted and implemented by the local governments within the basin, and approved or concurred with by Ecology.	
10. Operation and Maintenance Operation and maintenance shall be put in place to ensure that stormwater control facilities are adequately maintained and operated properly. An operation and maintenance manual that is consistent with the provisions in Volume V (Ecology 2005) shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the manual shall be retained on site or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.	**Maintenance of Stormwater Facilities** Proper Maintenance of Public and Private Stormwater Facilities is necessary to ensure they serve their intended function. Without adequate maintenance, sediment and other debris can quickly clog facilities, making them useless. a) Facilities shall be inspected annually (preferably early fall), shall be cleared of debris, sediment, and vegetation when they threaten to affect the functioning and/or design capacity of the facility. b) Grassy swales and other bio-filters are to be inspected annually and mowed or replanted as necessary. c) Facilities shall be inspected annually for evidence of rodent holes or water passing through rodent holes and provisions shall be made for their repair. d) Inspection of flow control facilities shall be performed annually and during major storms. e) Inspection every 2 years for accumulated sediment that exceeds 10% of the designed pond depth. f) Annual inspection for any deterioration threatening the structural integrity of the facility. g) Inspection and cleaning annually or after major storm events of catch basins and manholes for sediment accumulation if the depth of deposits are equal to or greater than one-third the depth from the basin to the invert of the lowest pipe into or out of the basin. h) Other information as required by the Technical Administrator on a site specific basis.

a. Stormwater Management Manual for Western Washington, Washington State Department of Ecology, Water Quality Program, Publication Numbers 12-10-030, August 2012.

c. Stormwater Management Manual for the Puget Sound Basin, Washington Department of Ecology, February 1992. The 1992 manual has been superseded by the Stormwater Management Manual for Western Washington (Ecology 2005); however, Whatcom County Code requires compliance with the 1992 Manual cited here.

b. Whatcom County, Development Standards, Chapter 2, Stormwater <http://www.co.whatcom.wa.us/publicworks/engineering/documents/ch2stormwater.pdf>, Published September 2002. Accessed March 2012.

Abbreviations
BMPs = best management practices
cfs = cubic feet per second
RCW = Revised Code of Washington
TESC = temporary erosion and sedimentation control
WAC = Washington Administrative Code

Table D-2. Stormwater Management Requirements
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Whatcom County Permanent Stormwater Management Technical Requirement	**Addressed in this report?**
1. Source Control BMPs	yes
2. Runoff Treatment BMPs	yes
3. Streambank Erosion Control BMPs	yes
4. Wetland Quality Control BMPs	yes

Ecology Minimum Requirement	**Addressed in this report?**
1. Preparation of Stormwater Site Plans	yes
2. Construction Stormwater Pollution Prevention	no (refer to NPDES process & permit)
3. Source Control of Pollution	yes
4. Preservation of Natural Drainage Systems and Outfalls	yes
5. On-site Stormwater Management	yes
6. Runoff Treatment	yes
7. Flow Control	yes
8. Wetlands Protection	yes
9. Basin/Watershed Planning	yes (no basin plan requirement)
10. Operation and Maintenance	no

References

Ecology, Stormwater Management Manual for Western Washington, 2012
Whatcom County, Development Standards Chapter 2 - Stormwater Management, 2002

Abbreviations

BMPs = best management practices
NPDES = National Pollutant Discharge Elimination System

Table D-3. Comparison of Hydrologic Standards/Methods
Preliminary Stormwater Information Report
Gateway Pacific Terminal
Whatcom County, Washington

Whatcom County Minimum Standard (2002)	Ecology Stormwater Manual for Western Washington (2012)
Hydrologic Modeling Method	
Event hydrology (TR-55 curve number method or equiv.)	Continuous hydrologic model (WWHM, MGSFlood)
Yields smaller ponds	Yields larger ponds
Assumed "Existing" Land Use	
Existing at time of application (wetland, roads, meadows, forest)	Forest
Yields smaller ponds	Yields larger ponds
Level of Detention Flow Control	
Existing flow rates	Predeveloped flow rates
Match 1-, 2-, 10-, 25-, 100- year peak rates	Match flow durations and peak rates 50% of 2- to 50- year flows
No volume control requirement	On-site volume controls to extent possible (infiltration, LID practices)
Does not achieve Ecology guidance	Exceeds Whatcom County current regs.

Abbreviations
LID = low-impact development
WWHM = Western Washington Continuous Simulation Hydrology Model

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APPENDIX E

Low Impact Development Practices Evaluated for Project

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APPENDIX E: LOW-IMPACT DEVELOPMENT PRACTICES EVALUATED FOR PROJECT

Gateway Pacific Terminal
Whatcom County, Washington

INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC), has conducted hydrologic modeling and developed a preliminary conceptual design for stormwater management facilities at the proposed Gateway Pacific Terminal in Whatcom County, Washington. As part of the stormwater runoff analyses and preliminary design work, AMEC evaluated a number of techniques for Low-Impact Development (LID), also referred to as on-site stormwater management and integrated management practices. LID practices typically involve the use of plants and soils to reduce stormwater runoff rates and volumes through infiltration and evapotranspiration, or rainwater harvesting/re-use.

This appendix provides a brief background on the LID practices evaluated as part of the preliminary stormwater system design, and lists some of the site factors to consider in evaluating the applicability of these techniques. The characteristics and site factors were taken into account when selecting appropriate LID practices for the project, which are described in the body of this report, as well as the compatibility of the practice with site grading requirements and traffic patterns, the ability of the practice to be effectively maintained, and the ability to irrigate vegetation based practices throughout the summer dry period.

DEFINITIONS

Bioretention is the term used to describe an engineered facility sized for specific water quality treatment and flow control objectives that includes designed soil mixes, underdrains, and control structures.

Integrated Management Practices (IMPs) are tools used in a low impact development project for water quality treatment and control.

Rain garden is the term used to describe a non-engineered landscape depression to capture stormwater from adjacent areas with less restrictive design criteria for the soil mix (typically without underdrains or other control structures).

DESCRIPTION OF PRACTICES

Bioretention Areas (Rain Gardens)

General Description

A bioretention area/rain garden may be defined as a stormwater practice that uses the chemical, biological, and physical properties of plants and soil microbe communities, and the mineral aggregate and organic matter present in soils, to transform, remove, or retain pollutants from stormwater runoff. Bioretention areas consist of one or more of the following features (Hinman and Wulun 2012):

- Shallow landscaped depressions with a designed mix of soils and plants adapted to the local climate and soil moisture conditions that receive stormwater from a small contributing area;
- Facilities designed to more closely mimic natural forested conditions, where healthy soil structure and vegetation promote infiltration, storage filtration, and slow release of stormwater flows;
- Small-scale features that are dispersed and integrated into the site as a landscape amenity; and
- An IMP designed as part of a larger LID approach.

Site Considerations

- Bioretention cells (Figure 1) are shallow depressions with a designated planting soil mix and a variety of plant material, including trees, shrubs, grasses, and/or other herbaceous plants (Hinman and Wulun 2012).
  - Side slopes are typically gentle, but may be steep or vertical where space is limited.
  - Catchment area is highly adaptable and can fit various settings.
  - Soils are typically composed of highly permeable sandy mineral aggregate mixed with compost and typically have a higher infiltration rate than surrounding subgrade.
  - Bioretention cells are typically used in landscaped parking lot islands or along roadways.
- Bioretention swales are designed in the same fashion as bioretention cells but with the ability to convey stormwater when maximum ponding depth is exceeded.
  - Gentle side slopes typically (3H:1V).
  - Catchment area is highly adaptable and can fit various settings.
  - Soils are typically composed of highly permeable, sandy mineral aggregates mixed with compost, and typically have a higher infiltration rate than surrounding subgrade.

- Designed for use in higher gradient settings with appropriate gradient controls (check dams, gravel mulch, and catch basins) to reduce flow velocity.

- Bioretention planter boxes consist of a designed soil mix and a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants (Hinman and Wulun 2012).
  - Vertical-walled container/s usually constructed from concrete. Catchment area is highly adaptable and can fit various settings. Planting pit is designed for storage.
  - Soils are typically composed of highly permeable, sandy mineral aggregates mixed with compost, and typically have a higher infiltration rate than surrounding subgrade.
  - Designs are often used in ultra-urban settings and include an enlarged planting pit for additional storage. Bioretention planter boxes are not generally recommended for new construction or less dense settings.

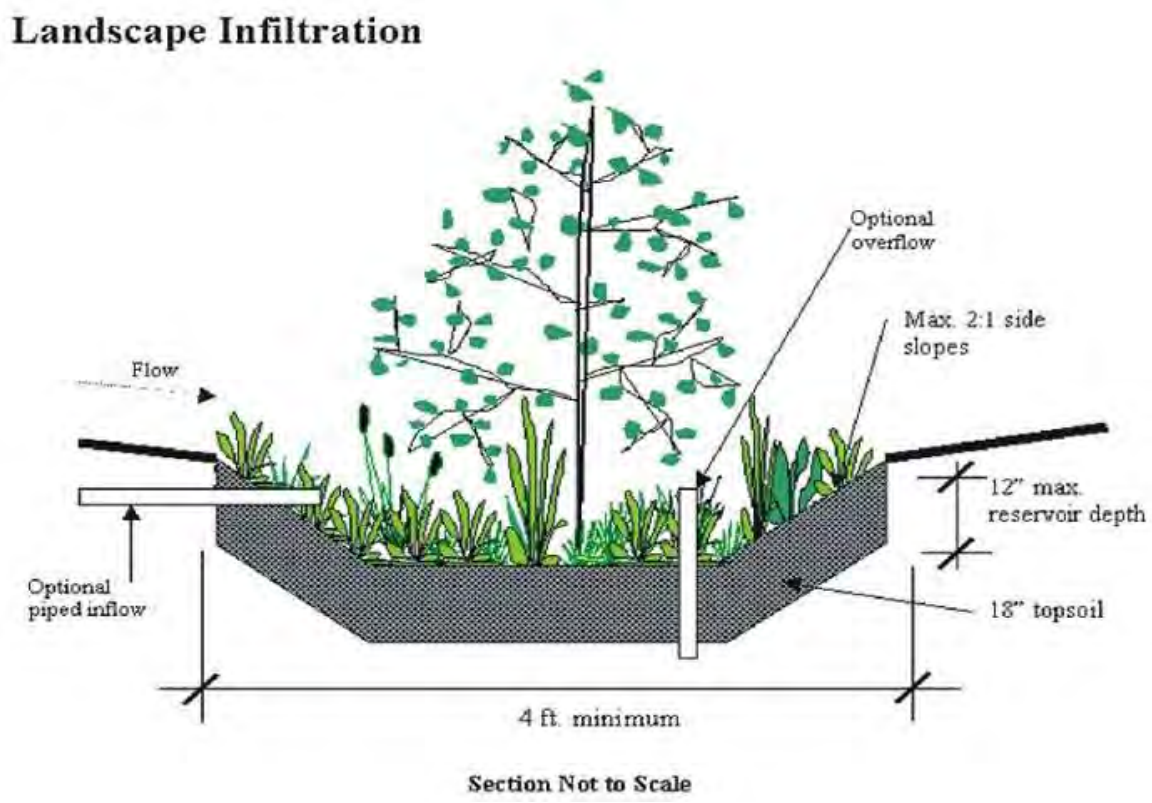

Figure 1: Typical Bioretention Cell (Source: EPA 2011).

Amending Construction Site Soils

General Description

Amended soils are enhanced soils that yield essential environmental benefits, including physical filtration, chemical transformation and biological uptake of pollutants, nutrients for plant growth, storage/slow release of storm flows, and pH buffering (Hinman and Wulun 2012).

Site Considerations

- Organic amended soils.
  - Soils on side slopes may be amended with up to 33 percent compost by volume without foreseeable adverse effects.
  - Catchment area is highly adaptable and can fit various settings.
  - Soils are typically composed of organic matter derived from compost, stockpiled on-site soil, or imported topsoil mixed with the native soil (8-10 percent organic matter by dry weight) (Figure 2).
  - Typically used in landscaped areas and developed catchment areas.

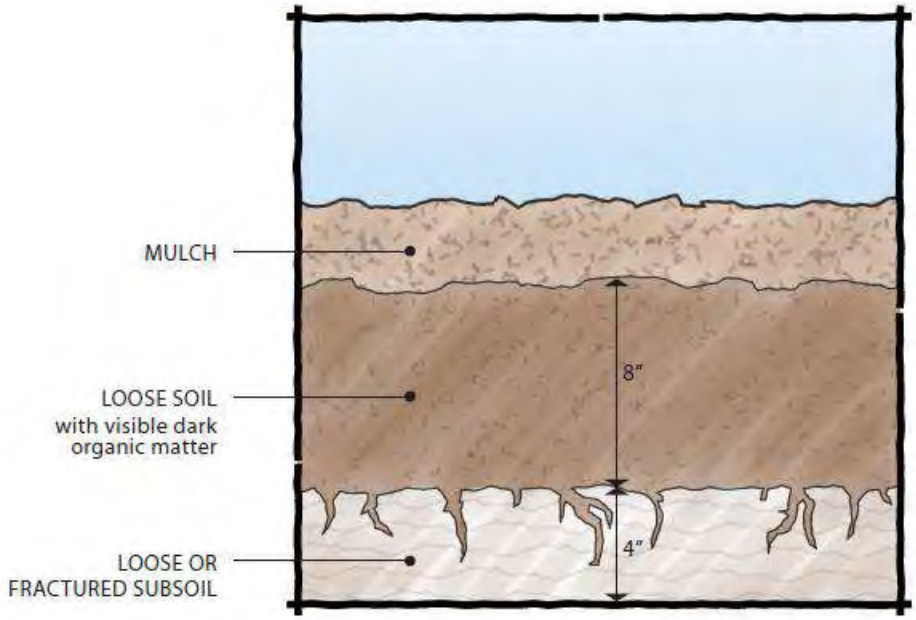

Figure 2: Typical amended soil cross section (Source: Curtis and Wulkan 2012)

Permeable Paving

General

Permeable paving surfaces (Figure 3) accommodate pedestrian and vehicle traffic, while allowing infiltration, treatment, and storage of stormwater. Several general types of permeable pavements are used including (Curtis and Wulkan 2012):

- Porous hot or warm-mix asphalt pavement, which is flexible and contains void spaces to allow for infiltration.
- Pervious Portland cement concrete is a rigid pavement with void spaces in the pavement surface to allow for water to infiltrate.
- Permeable interlocking concrete pavements are solid, precast, modular units that effectively create joints that are filled with permeable aggregates.
- Aggregate pavers are modular precast paving units made with similar sized aggregates bound together with Portland cement concrete and the joints are filled with open-graded aggregates.
- Grid systems are either concrete or plastic pre-manufactured systems filled with topsoil and grass, or permeable aggregate.

Site Considerations

- Permeable paving can be used anywhere where sidewalks, driveways, storage, or any other hard-surfaced area is required (Curtis and Wulkan 2012).
  - It is recommended that slopes be less than approximately 10 percent with subsurface detention structures, and less than 8 percent without).
  - Catchment area is highly adaptable and can fit various settings, but it is recommended that adjacent run-on areas be minimized. An adequate aggregate base is required to allow for structural stability of the pavements. If native soil is used, over-compaction needs to be minimized to allow for infiltration. Soil conditions need to be analyzed on a site-by-site basis.
  - Can be placed in areas where paving is required.

Figure 3: Typical permeable concrete paver cross section (Source: EPA 2009)

Vegetated Roofs

General Description

Vegetated roofs (also known as eco-roofs and green roofs) are thin layers of engineered soil and vegetation constructed on top of conventional flat or sloped roofs (Figure 4). Vegetated roofs provide several benefits to a site, including extending the life of a building roof, improving the aesthetics of the roof-scape, increasing the energy efficiency within the building, and stormwater volume reduction and flow attenuation (Hinman and Wulun 2012).

Site Considerations

- Vegetated roofs may be utilized on any suitable roof structure to reduce stormwater flows on site.
  - Vegetated roofs can be installed on slopes up to 40 degrees, but slopes between 5 degrees and 20 degrees (1V:12H and 5V:12H) are most suitable and can provide natural drainage by gravity.
  - Catchment area consists of the roof area.
  - Soil requirements in general are composed of porous and light-weight mineral aggregate, such as pumice, lava rock, expanded shale, and expanded slate (70-90 percent of mix). Organic content required typically consists of a bio-stable compost.
  - Green roofs can be placed on any building on site. It is best to implement these systems during new building construction projects as a sufficient load-bearing roof deck is required to support the green roof.

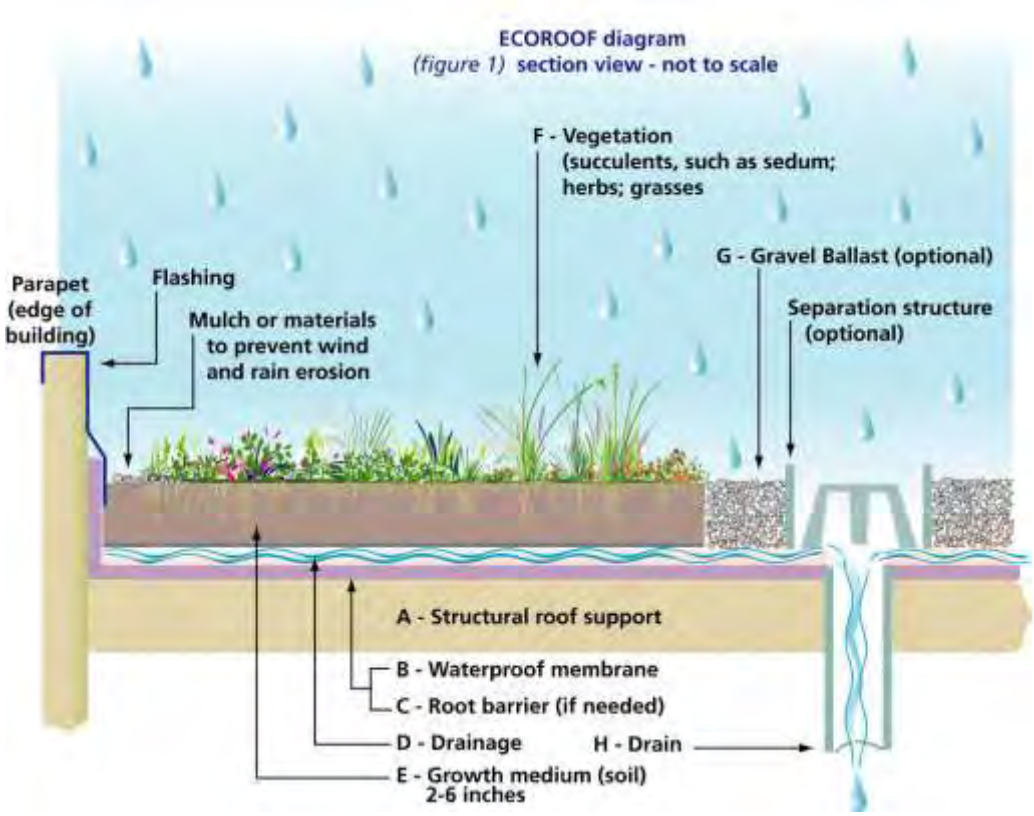

Figure 4: Typical green roof cross section (Source: Hinman and Wulun 2012)

Minimal excavation foundations

General Description

Minimal excavation foundation systems limit soil disturbance and allow storm flows to more closely approximate natural shallow subsurface interflow paths. Minimal excavation foundation systems can take many forms, but in essence are a combination of driven piles (Figure 5) and a connecting component at, or above, grade. The piles allow the foundation system to reach or engage deeper load-bearing soils without having to dig out and disrupt upper soil layers, which convey, infiltrate, store, and filter stormwater flows (Hinman and Wulun 2012).

Site Considerations:

- Minimal excavation foundations are strategic methods for reducing soil compaction during construction of heavy structures that allow a larger effective infiltration area.
- Slope varies based on the structure installed, but wall configurations are typically up to 10 percent slopes, and pier configurations are typically up to 30 percent slopes.

- Areas where implemented can accommodate natural catchment area flow depending on permeability of soils (some flow may need to be directed uphill of structures or to undisturbed soils).
- These systems can be installed on A/B and C/D soils (U.S. Department of Agriculture Soil Classification) provided that the material is penetrable and will support the intended type of piles (typical types of soils found in the Puget Sound region, including silt loams, sandy loams, fine gravels, tight soils with clay content, and partially cemented tills are applicable).
- Pier and perimeter wall configurations are suitable for residential or commercial structures up to three stories high. Secondary structures such as decks, porches, and walkways, can also be supported by this technology.

Figure 5: The initial stages of a post pile application (Source: Hinman and Wulun 2012)

Roof Rainwater Collection Systems

General Description

Typically, rainwater collection is used where rainfall or other environmental conditions limit the availability of domestic water supply. Applications generally include (Hinman and Wulun 2012):

- Reducing peak water demand during the summer months.
- Helping to maintain stream flows by reducing residential and commercial surface water and groundwater withdrawals (commercial and residential water usage).
- Reducing costly water distribution infrastructure by collecting water close to end use.

- Helping to reduce runoff by collecting runoff source water.

Site Considerations

- Roof rainwater collection systems may be placed at any elevated structure to collect roof runoff at the source. This helps to reduce site runoff.
  - Slope stability needs to be evaluated based on storage tank characteristics (weight, material, ground characteristics, etc).
  - Catchment area includes the roof area and needs to consider contaminant transport (lead, zinc, copper, etc.)
  - Roof material should not be metal/galvanized surfaces. Enameled standing seam material, ceramic tile, or slate materials are recommended.
  - Storage tanks can be placed in any areas where buildings or other elevated surfaces may provide reasonably clean water (Figure 6).

Figure 6: Underground cisterns used for stormwater storage (figure courtesy of Hinman and Wulun 2012)

RUNOFF DISPERSION

General Description

Site developments that preserve over 65 percent of a site in a forested/native condition are permitted to discharge runoff from the site into native vegetated areas so long as the total impervious area is less than 10 percent of the entire site area (Hinman and Wulun 2005).

Site Considerations

- Dispersion allows a site to convey stormwater to another portion of the site that is undeveloped to meet stormwater discharge requirements.
  - Catchment area may consist of the entire developed site where directed stormwater flows are collected and conveyed to undeveloped zones.
  - This process can be used on sites that meet the criteria indicated above. Appropriate stormwater collection systems must be used to collect and transport the stormwater to forested/native areas.

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Hinman, Curtis, and Bruce Wulkan. 2005. *Low Impact Development Technical Guidence Manual for Puget Sound*. Publication No. PSAT 05-03. Puget Sound Action Team (PSAT) and Washington State University (WSU). January.

Hinman, Curtis, and Bruce Wulkan. 2012. *Low Impact Development Technical Guidence Manual For Puget Sound. <http://www.psp.wa.gov/downloads/LID/draft_2012/LID_Letter-Email-1-6.pdf>*. Puget Sound Action Team (PSAT) and Washington State University (WSU). February 15. Draft.

U.S. Environmental Protection Agency (EPA). 2009. *Permeable Interlocking Concrete Pavement.* U.S. Environmental Protection Agency, Washington DC. Updated September 10. <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=136&minmeasure=5>. Accessed March 07, 2012.

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