FRESHWATER STREAMS BASELINE INVENTORY REPORT

Gateway Pacific Terminal

Whatcom County, Washington

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Project No. 0-915-15338-C

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PREFACE

Pacific International Terminals, Inc. (Pacific International 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. 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). The EIS will be prepared under guidelines of the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) by a lead federal agency and lead state agency or agencies working in cooperation.

This report is one of several technical reports prepared on behalf of Pacific International 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. It is provided to the lead federal, state, and local agencies for their use in preparation of a Draft EIS. Several of the technical reports have also been prepared to support specific project permit applications submitted to local, state, and federal agencies, or 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 and the phasing plan, is provided in the *Revised Gateway Pacific Terminal Project Information Document* (Pacific International Terminals 2012).

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EXECUTIVE SUMMARY

AMEC Environment & Infrastructure, Inc. (AMEC), conducted a baseline inventory of freshwater streams and drainages at the proposed location of the Gateway Pacific Terminal. The baseline inventory included assessment of the suitability of these watercourses to provide functioning fish habitat, and the present use of these watercourses by fish species. AMEC identified a total of 16 watercourses within the project boundaries. These watercourses occur as either roadside drainages or natural streams. Eight of these 16 watercourses were determined to have the potential to support fish, and were the focus of subsequent additional studies (Streams 1, 2, 4, 5, and 6; Drainages 1, 3, and 5).

Field surveys were conducted during three separate periods of investigation from 2008 to 2011 to characterize the streams for habitat and functional value and to inventory the fish present in streams. Stream 1 was characterized in November 2008, and seven watercourses (Streams 2, 4, 5, and 6; Drainages 1, 3, and 5) were characterized in April 2010. These seven watercourses were characterized following the proper functioning condition concept suggested by the National Oceanic and Atmospheric Administration National Marine Fisheries Service. In May 2011, fish use was assessed in Streams 1, 2, and 4. Based on those results, salmon spawner surveys were conducted biweekly from October 2011 to February 2012 on Stream 1. Stream habitat restoration opportunities were identified in consideration of the baseline results.

In November 2008, the lower reaches of Stream 1 were characterized as properly functioning with respect to accumulation of large woody debris and channel condition/dynamics. All of Stream 1 was not properly functioning in regard to habitat access as a result of physical barriers, substrate composition, and overall watershed conditions as indicated by the riparian corridor. Streams 4, 5, and 6, and Drainages 1, 3, and 5, were characterized as not properly functioning.

In May 2011, juvenile chum salmon (*Oncorhynchus keta*), juvenile coho salmon (*O. kisutch*), and three-spine stickleback (*Gasterosteus aculeatus aculeatus*) were identified at the mouth of Stream 1. No additional species were identified. Only juvenile coho salmon were identified above the mouth of Stream 1. No fish species were observed in Streams 2 and 4.

No spawning salmon were identified in Stream 1 from October 2011 to February 2012.

Fish habitat restoration opportunities were identified on Streams 1 and 2. Opportunities include strategically placing habitat gravels in the stream, rerouting and restoring stream flows in historic channels, reducing the amount of sediment entering the stream from the watershed, removing fish barriers, and installing fish-friendly culverts under roadways to increase fish access.

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ACRONYMS AND ABBREVIATIONS

µS/cm	microsiemens per centimeter
BFD	bankfull depth
BFW	bankfull width
Ecology	Washington State Department of Ecology
GPS	global positioning system
HCA	Habitat Conservation Areas
HGM	hydrogeomorphic
LWD	large woody debris
mm	millimeter
MPI	Matrix of Pathways and Indicators
NOAA	National Oceanographic and Atmospheric Administration
PEM	palustrine emergent
PFC	proper functioning condition
PFO	palustrine forested
PSS	palustrine scrub-shrub
RCW	Revised Code of Washington
RPW	relatively permanent waterways
TNW	traditional navigable water
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WCC	Whatcom County Code
WDFW	Washington Department of Fish and Wildlife
WFPB	Washington Forest Practices Board
WRIA	Water Resources Inventory Area

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1.0 INTRODUCTION

Pacific International Terminals, Inc., proposes to develop the Gateway Pacific Terminal (the "Terminal") at Cherry Point in Whatcom County, Washington. This report presents an inventory of freshwater streams and drainages in the project area, characterizes the streams and drainages with respect to their suitability as fish habitat, and provides a baseline assessment of fish presence or absence in the streams.

1.1 PROJECT AREA DESCRIPTION

The Terminal would be developed in an area of approximately 1,200 acres within the Cherry Point Industrial Urban Growth Area. The project area includes several roadside ditches and freshwater streams that drain to the Strait of Georgia in the Puget Sound, as shown on Figure 1. The project area boundary shown on Figure 1 represents the study area for this stream inventory. This freshwater streams baseline inventory report documents the presence or absence of fish in each of the streams and drainages and characterizes the suitability of streams and drainages within the study area to serve as fish habitat. This baseline information will be used to aid in the design of the Terminal and will help facilitate early project review and collaboration with Agency staff on draft and final plans to be developed at appropriate future stages in the permitting process.

1.2 PURPOSE AND NEED FOR THE FRESHWATER STREAM BASELINE INVENTORY REPORT

The purpose of this report is to provide an environmental baseline inventory of freshwater streams and drainages in the study area, characterize their suitability as potential habitat, document use of the streams and drainages by fish, and provide a detailed habitat assessment where suitable fish habitat is present. The results of this investigation will function as an environmental baseline for evaluating potential effects of site development on fish species and habitat within the project vicinity. The results of this investigation will also be used to identify habitat enhancement and restoration opportunities.

1.3 REGULATORY AUTHORITY OF WATERCOURSES

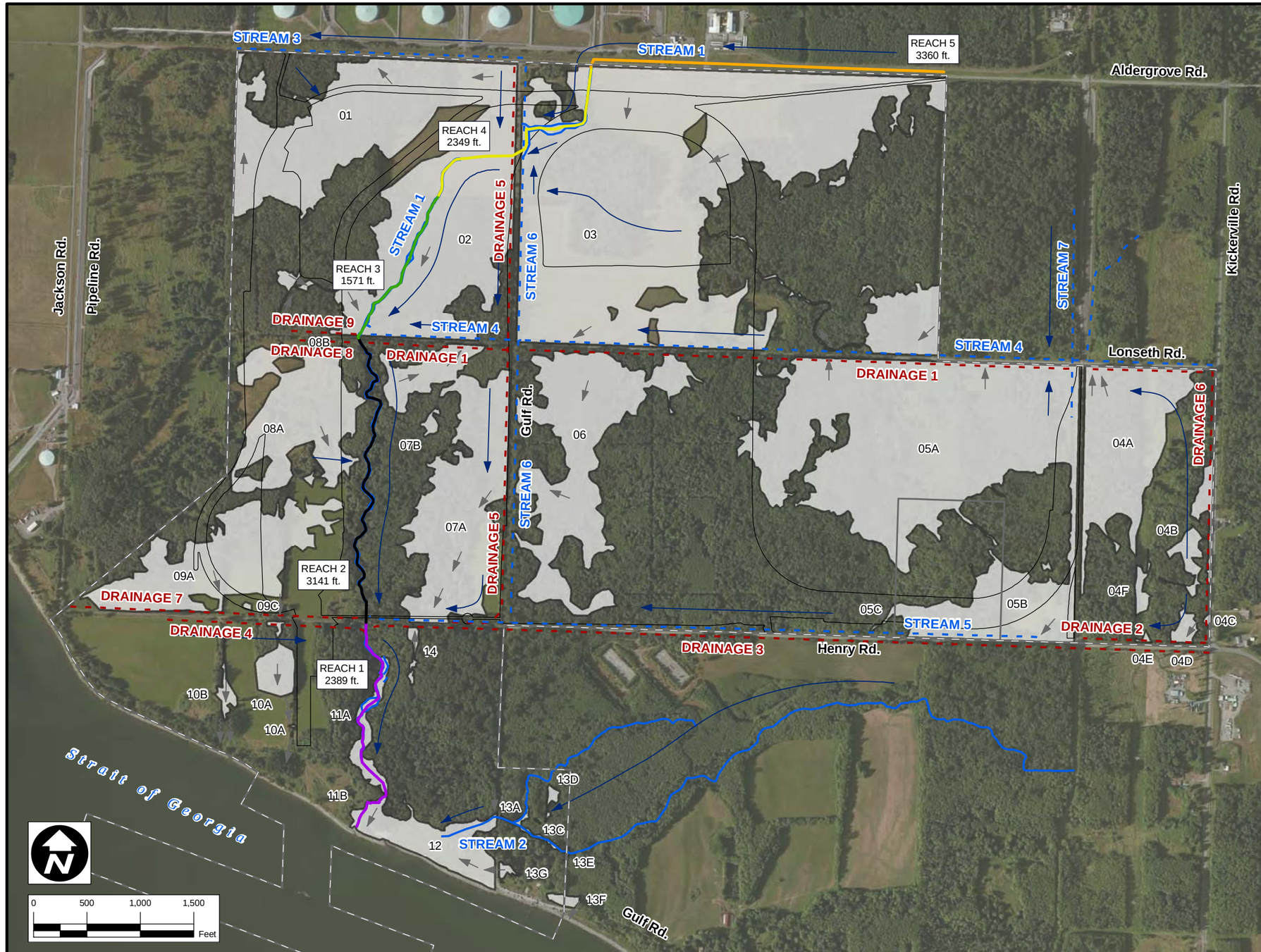
Whatcom County identified a total of 16 watercourses on the proposed Terminal site, occurring as either roadside drainages or natural streams (Whatcom County 2006a). Whatcom County recognizes 9 of the 16 watercourses as drainages (Drainage 1 through Drainage 9) and 7 as streams (Stream 1 through Stream 7) (Figure 1). According to Whatcom County, Stream 1 is the only presumed fish-bearing stream on the proposed Terminal site, and Stream 2 is the only presumed potential/historic fish-bearing stream (Whatcom County 2006a).

For planning purposes, the Washington State Department of Ecology (Ecology) grouped several small coastal watersheds into the Water Resources Inventory Area (WRIA) 1 watershed, including Stream 1 and Stream 2. Ecology identified Stream 1 as Stream 01.0100, and Stream 2 as Stream 01.0101. The

study area drains directly to coastal waters, has no hydrologic connection to interior mountain drainages, and is therefore considered an independent watershed as described later in this document.

On March 5, 2009, the U.S. Army Corps of Engineers (USACE) issued a Jurisdictional Determination for all wetlands and watercourses in the project site because they either abut or are adjacent to unnamed tributaries of the Strait of Georgia, which has been identified as a traditional navigable water (TNW) used for interstate and foreign commerce (Appendix A). The USACE also confirmed the extent and location of delineated wetlands on the project site at that time. As documented in the Jurisdictional Determination, Stream 1 through Stream 7 and Drainages 1, 3, 4, 7, 8, and 9 have continuous flow for at least 3 months of the year, and thus are considered relatively permanent waterways (RPWs). All other drainages were determined to be non-RPWs.

The Washington Department of Fish and Wildlife (WDFW) Hydraulic Code authority, as defined by 77.55 Revised Code of Washington (RCW) and Chapter 220-110 Washington Administrative Code (WAC), is limited to natural watercourses and natural watercourses that have been altered artificially. To determine whether a watercourse is a natural watercourse, a natural watercourse that has been altered artificially, or a wholly artificial watercourse, WDFW typically considers a wide range of information. WDFW may consider the origin or source of the water, downstream connectivity, physical characteristics, and historical evidence (geomorphology, soil survey data, historical land surveys, and remote sensing). Following this definition, WDFW determined that Streams 1 (Reaches 1, 2, and 3 only), 2, 4, 6, and 7 are the only watercourses regulated under the Hydraulic Code (Appendix A).



LEGEND

- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- STREAM AND DRAINAGE FLOW DIRECTION
- WETLAND FLOW DIRECTION

STREAM 1:

- REACH 1
- REACH 2
- REACH 3
- REACH 4
- REACH 5
- EXISTING WETLAND AREA
- DEVELOPMENT FOOTPRINT
- PROPERTY BOUNDARY
- PROJECT AREA BOUNDARY

NOTE: Streams regulated by WDFW under the Hydraulic Code (RCW 77.55 and WAC 220-110): Stream 1 (Reaches 1, 2, and 3), 2, 4, 6 & 7.

Streams regulated by Whatcom County per Critical Areas Ordinance Maps: Streams 1, 2, 3, 4, 5, 6, and 7 .

Source:
Ausenco Sandwell, 143166-A100-WC001-1.dwg (Rev. P1), 12/22/2011.

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CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	JG
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,000 feet

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: WETLANDS AND DRAINAGES WITHIN THE GATEWAY PACIFIC TERMINAL PROJECT SITE

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 1

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-04-04 - Fish and Stream Report\dwg\Revised\Figure 1 - Wetlands and Drainages.mxd

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2.0 STUDY AREA DESCRIPTION

The Terminal would be developed near Cherry Point on the Strait of Georgia. Cherry Point is a small promontory on the south side of Point Whitehorn and south of Birch Bay. This study area is located approximately 5 miles west of the city of Ferndale, approximately 18 miles northwest of the city of Bellingham, and approximately 17 miles south of the Canadian border (Figures 2 and 3). It covers portions of Sections 17, 18, and 19 of Township 39 North, Range 1 East, all in unincorporated Whatcom County.

2.1 LAND USE

The study area is in Whatcom County's designated Cherry Point Industrial Urban Growth Area 9 (Whatcom County 2006b). The BP Cherry Point Refinery borders the study area to the north and west. The ALCOA Intalco Works (aluminum plant) is located approximately 1 mile to the southeast. The Strait of Georgia lies to the southwest. The proposed wharf would be located in the Strait of Georgia between the BP Cherry Point Refinery pier and the ALCOA Intalco Works pier. The nearest residential areas are located on Kickerville Road, adjacent to the eastern edge of the study area. The Lake Terrell Wildlife Management Area, managed by WDFW, is located east of the study area, approximately 0.25 mile beyond Kickerville Road. Active pastures occur on lands to the southeast.

Roads, pipelines, power-line corridors, railroads, and other heavy industrial utilities further define the study area. The BNSF Railway's Custer Spur and a Bonneville Power Administration transmission line run north-south in the eastern portion of the study area. A natural gas pipeline doglegs through the area from the BP Cherry Point Refinery to the north toward the southeast.

2.2 PHYSICAL AND ENVIRONMENTAL SETTING

This section describes the physical and environmental setting of the study area, including, wetlands, watersheds, and surface water features. A U.S. Geological Survey (USGS) topographic map covering the study area is presented in Figure 3.

2.2.1 Wetlands

Wetlands, streams, and roadside ditches occur throughout the project area. Field investigations from 2006 through 2011 resulted in the delineation of wetlands on approximately 544.4 acres of the study area (Figure 1). Delineated wetlands were classified as riverine, slope, and depressional type wetlands according to the hydrogeomorphic (HGM) classification system. Palustrine forested (PFO), scrub-shrub (PSS), and emergent (PEM) wetland habitat types were identified in accordance with the Cowardin classification system (Cowardin 1979).

PFO wetlands are the dominant wetland type in the study area, and are intermixed with upland forests across the study area. Many of the PFO wetlands lack defined outlets, which results in the detention of surface water. PEM wetlands occur in wet pastures, hayfields, and mowed utility easements. PSS wetlands occur in areas of abandoned pastures, and in linear strips at the boundaries between forest and emergent wetland areas or forest and roadways.

Wetlands on the site drain to roadside ditches and streams, and to natural stream courses. Wetlands drain via several main pathways: (1) surface discharge from small channels within forested wetlands, (2) sheetflow, and (3) shallow groundwater throughflow that discharges to seeps along Stream 1. Baseflow in Stream 1 is supported by water detention in wetland areas as precipitation is captured and slowly released by these surface and groundwater discharges.

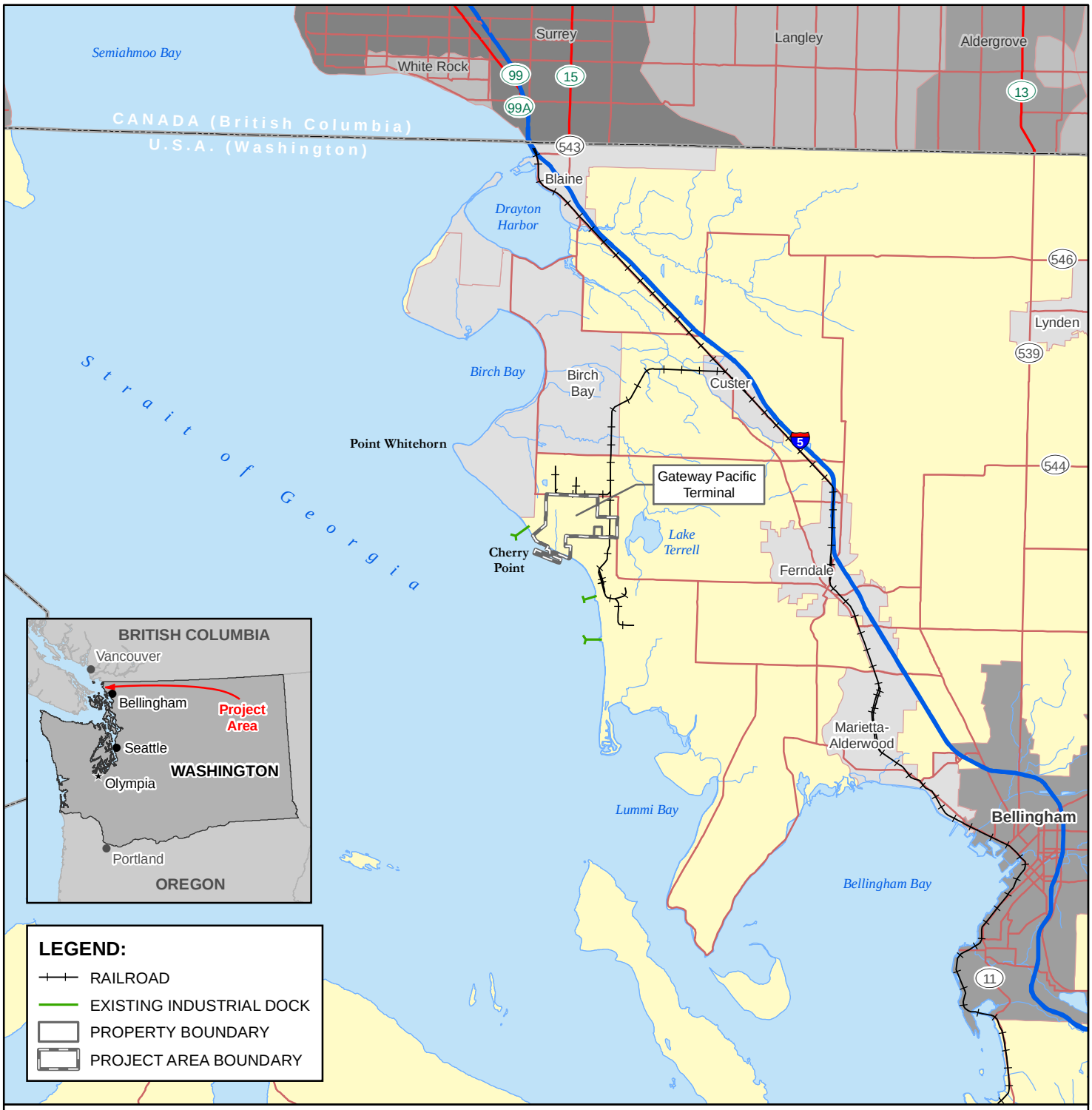
One particular wetland of note is an 11.2-acre coastal lagoon that abuts the Strait of Georgia shoreline west of Gulf Road (Figure 1- Wetland 12). This coastal lagoon wetland lies between the marine shoreline and upland slopes and riparian communities. The lagoon, a shallow depression, is separated from the sea by a barrier beach with two well-defined outlets. Both Stream 1 and Stream 2 supply fresh water to this area. The lagoon also receives inputs of saltwater through the porous sediments of the beach and over the beach during severe storm events (Appendix B).

2.2.2 Watersheds

The study area is drained by two coastal watersheds that drain to the Strait of Georgia: (1) the Birch Bay Watershed, and (2) an unnamed coastal watershed designated the Gateway Pacific Terminal Watershed for purposes of the Terminal project (Pacific International Terminals, Inc. 2012). Approximately 1,132 acres of the study area lie within the Gateway Pacific Terminal Watershed, while approximately 68 acres most likely drain instead to the Birch Bay Watershed (Figure 4). Of the seven streams and nine drainages identified in the study area, Stream 3 is located within the Birch Bay watershed, whereas all other streams and roadside drainages are located within the Gateway Pacific Terminal Watershed.

2.2.2.1 Gateway Pacific Terminal Watershed Characteristics

The Gateway Pacific Terminal Watershed has experienced extensive disturbance over the past century due to road building, rail development, pipeline and power line installation, homesteading, timber harvesting, and other development. Together these land uses have resulted in filling and ditching of wetlands, rerouting of streams, clear-cut logging and removal of other vegetation, and continuous grazing and hay production in some locations. During the last 20 years, intensive land-use practices in the watershed have decreased because homesteads are no longer present on property owned by Pacific International Terminals, Inc. (Pacific International Terminals, Inc. 2012).



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

PROJECT: GATEWAY PACIFIC TERMINAL	DWN BY: SD	DATUM: NAD83	DATE: APRIL 2012
TITLE: VICINITY MAP	CHK'D BY: JG	REV. NO.: -	PROJECT NO.: 091515338C-04-04
	PROJECTION: WA SP North, Ft.	SCALE: 1 inch=3 miles	FIGURE No.: FIGURE 2

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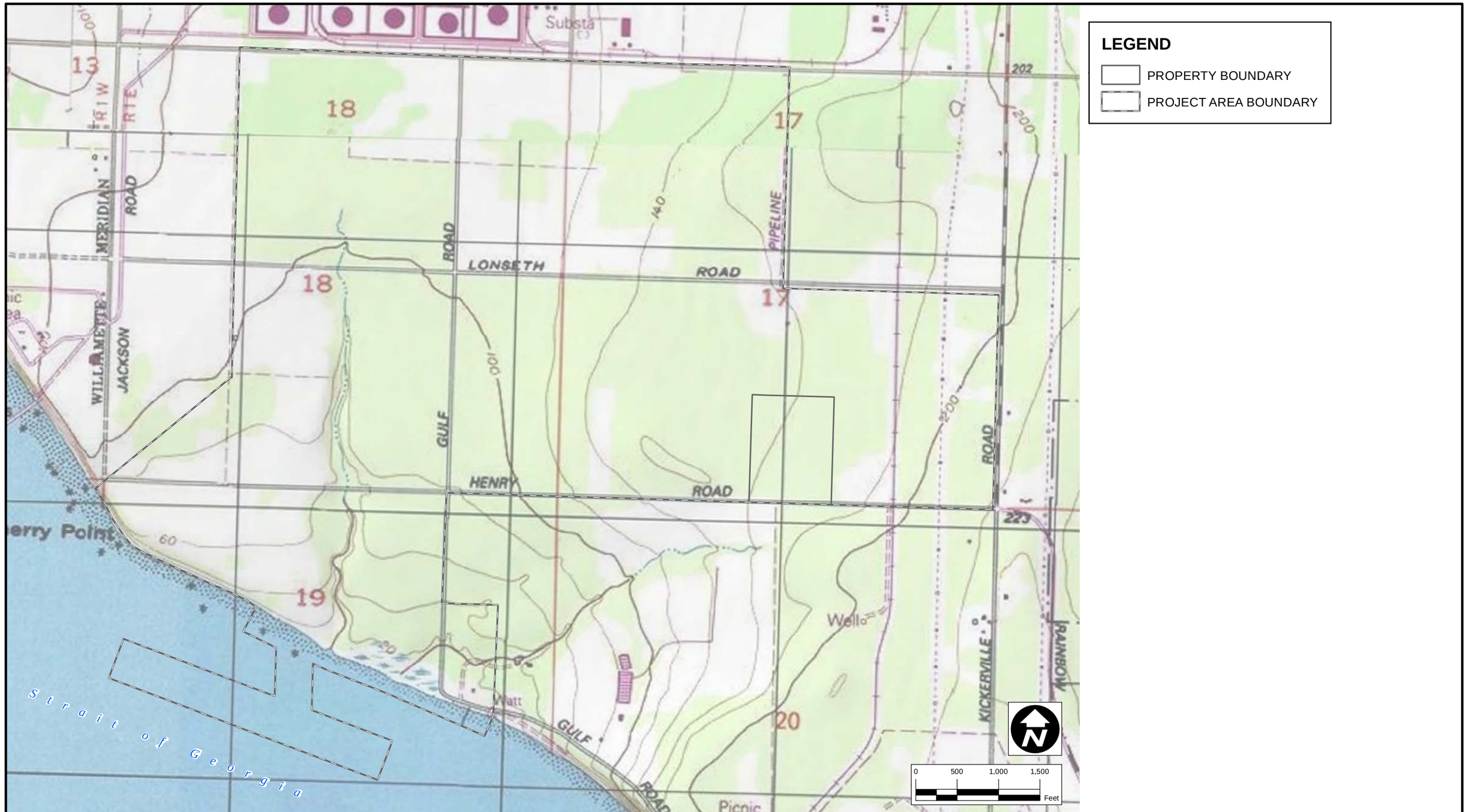

Source:
NGS USA Topographic Maps provided by ArcGIS Map Service:
http://server.arcgisonline.com/v93
U.S. Geological Survey. Lummi Bay quadrangle, Washington.
1:24,000. Washington D.C.: USGS, 1973.

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CLIENT:
PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	JG
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,100 feet

PROJECT:
GATEWAY PACIFIC TERMINAL

TITLE:
USGS TOPOGRAPHIC MAP

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
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FIGURE NO.:	FIGURE 3

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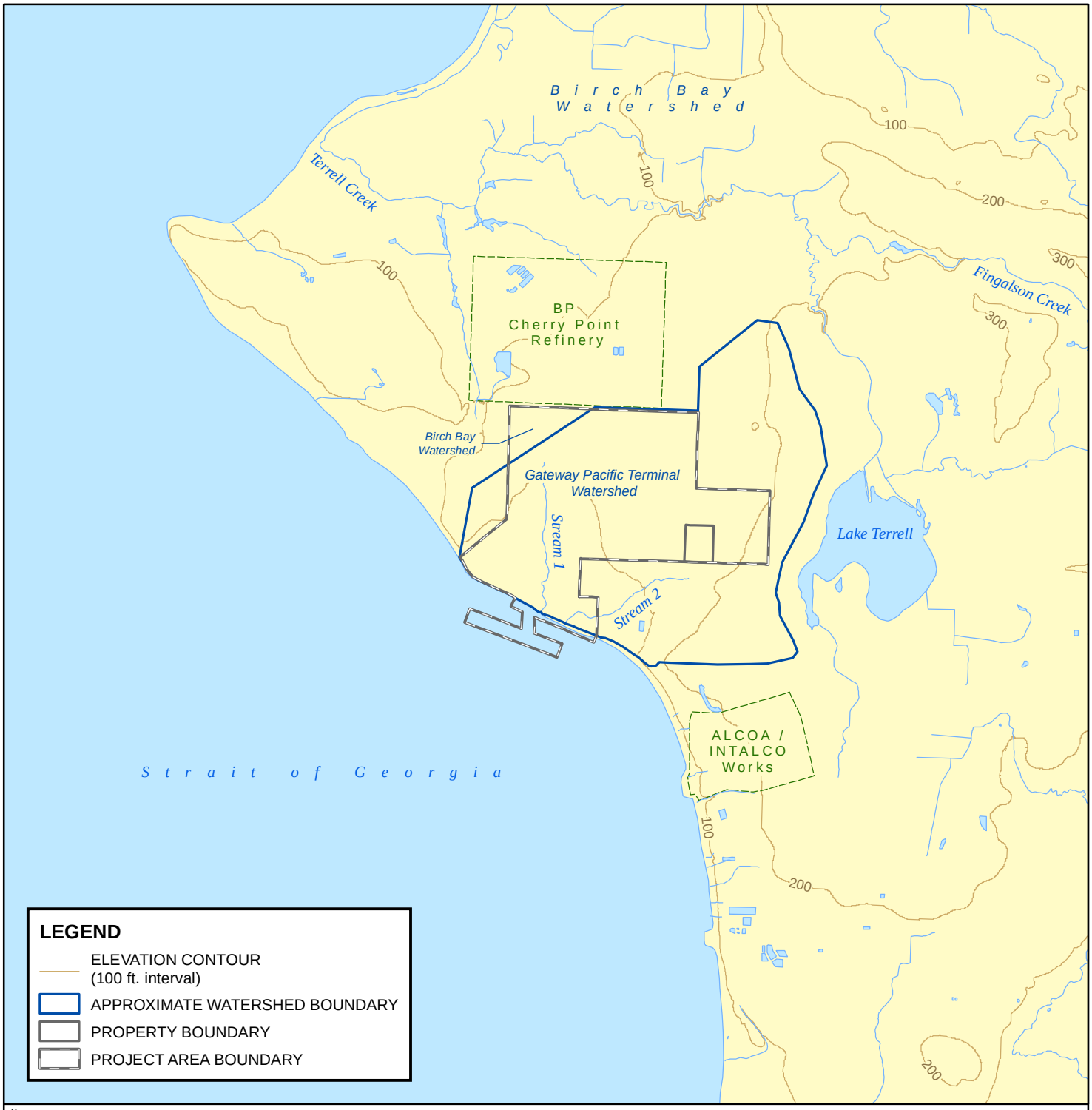

Source:
Elevation Contours from Whatcom County:
http://www.co.whatcom.wa.us/pds/planning/gis/gisdata.jsp

0 0.5 1 2 Miles

N

AMEC 11810 North Creek Parkway N Bothell, WA 98011	amec	Pacific International Terminals	CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.
PROJECT: GATEWAY PACIFIC TERMINAL		DWN BY: SD	DATUM: NAD83 / DATE: APRIL 2012
TITLE: WATERSHEDS WITHIN THE GATEWAY PACIFIC TERMINAL PROJECT SITE		CHK'D BY: JG	REV. NO.: - / PROJECT NO.: 091515338C-04-04
		PROJECTION: WA SP North, Ft.	SCALE: 1 inch=1 mile / FIGURE No.: FIGURE 4

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The principal hydrologic feature within the Gateway Pacific Terminal Watershed is Stream 1 (Figure 1). Stream 1 is approximately 2.4 miles long in the project vicinity and drains a total of approximately 800 acres, flowing through a combination of natural drainages and roadside ditches. Discharge in Stream 1 is a result of contributions from groundwater baseflow, surface contributions from small channels in wetland areas, roadside ditches and streams, surface sheet flow, and shallow groundwater throughflow that discharges to seeps along Stream 1. Field observations suggest that Stream 1 has continuous flow for approximately 9 to 10 months of the year, with dry periods occurring during late summer to early fall. Because it has continuous flow for at least three months of the year, Stream 1 is considered an intermittent stream.

The lower reach of a smaller stream, designated Stream 2, is located on the southeast portion of the study area (Figure 1). This intermittent stream drains the eastern portion of the Gateway Pacific Terminal Watershed as it flows through forested areas toward its confluence with Stream 1 to the southwest. It is approximately 1 mile long with about 1,160 linear feet located in the study area. The upper reaches of Stream 2 flow through adjacent, privately owned parcels. Approximately 250 feet east of the eastern study area boundary, an old stock pond with an earthen dam across the main channel prevents continuous flow in the portions of Stream 2 in the study area. Upstream of the stock pond, Stream 2 lies in a steep-sided ravine, and the riparian area is narrow but forested. Where Stream 2 exhibits steep sidewalls, groundwater seeps may provide important contributions to stream flow. A short tributary flowing from the northeast joins the primary channel of Stream 2 at a location approximately 300 feet east of Gulf Road. The stream then flows southwest through a culvert under Gulf Road and empties into the coastal lagoon (Figure 1).

In addition to the two natural stream features, other non-wetland water bodies in the study area include 14 watercourses occurring as either roadside ditches or streams. Roadside ditches within the study area were constructed to convey runoff, keep the road subbase dry, and provide a transition from public roads to private property. While all of the roadside conveyances produce a defined channel or bed, none of the roadside streams (Streams 4 through 7) or ditches occur in locations where natural streams existed before human alteration. Surface water contributions to roadside ditches and streams include overland sheet flow, runoff from asphaltic road surfaces, baseflow discharge through the streambed, and throughflow from surface soils. Nearly all roadside ditches and streams eventually flow into Stream 1.

2.2.2.2 Birch Bay Watershed Characteristics

A relatively small area (approximately 68 acres) in the extreme northwest corner of the study area is thought to be included within the Birch Bay Watershed. This area is currently drained by Stream 3, which flows west, parallel to Aldergrove Road, before turning northwest and flowing through the BP

Cherry Point Refinery property (Figure 1). Stream 3 is believed to be a relatively permanent tributary to Terrell Creek, which ultimately discharges to Birch Bay (Pacific International Terminals, Inc. 2012).

The portion of the Birch Bay Watershed within the study area includes Wetland 1 (approximately 44 acres), which is part of the drainage area contributing to Stream 3 (Figure 1). A single 6-inch culvert beneath Aldergrove Road provides surface water connection from Wetland 1 to Stream 3 only during periods of high flow (AMEC 2008); however, it is likely that shallow groundwater beneath Wetland 1 discharges to Stream 3 when the water table rises above streambed elevations.

2.2.3 Washington Department of Fish and Wildlife and Whatcom County Stream Types

WDFW and Ecology follow the guidelines of WAC 222-16-030 for designating Stream Types, while Whatcom County follows similar guidelines defined in Whatcom County Code (WCC) 16.16.700. Water typing systems are used for planning purposes at both the state and county levels. Tables 1 and 2 provide a list of stream types and the corresponding descriptions for Washington State and Whatcom County.

Table 1 Washington State Stream Types and Descriptions

Water Type	Description
Type S	All waters, within their bankfull width, as inventoried as “shorelines of the state,” and including periodically inundated areas of their associated wetlands.
Type F	Segments of natural waters other than Type S waters, which are within bankfull widths of defined channels and periodically inundated areas of their associated wetlands, or within lakes, ponds, or impoundments having a surface area of 0.5 acre or greater at seasonal low water and which in any case contain fish habitat.
Type Np	Segments of natural waters within the bankfull width of defined channels that are perennial, nonfish habitat streams.
Type Ns	Segments of natural waters within the bankfull width of the defined channels that are not Type S, F, or Np waters. These are seasonal, nonfish habitat streams in which surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is a Type Np water. Ns waters must be physically connected by an above-ground channel system to Type S, F, or Np waters.

Source: WAC 222-16-030

Table 2 Whatcom County Stream Types and Descriptions

Water Type	Description
HCA 1a	Shorelines of the state as defined by WAC 173-18-310 and designated in the Whatcom County Shoreline Master Program (WCC Title 23).
HCA 1b	Other fish-bearing streams that do not meet the definition of shorelines of the state but have known or potential use by anadromous or resident fish species.
HCA 1c	Non-fish-bearing streams that have no known or potential use by anadromous or resident fish.

Source: WCC 16-16-700
HCA = Habitat Conservation Areas

According to the State classification system, Stream 1 would be likely classified as a Type F stream, although no official stream rating exists. Streams 2, 3, 4, 5, 6, and 7 would be likely classified as Type Ns streams. Whatcom County classifies Streams 1 and 2 as Type HCA-1b streams, and Streams 3, 4, 5, 6, and 7 as Type HCA-1c streams. Summary information for all watercourses by watershed in the study area is presented in Tables 3, 4 and 5 below. See Figure 1 for the locations of each watercourse.

Table 3 Characteristics of Streams Identified in the Gateway Pacific Terminal Watershed

Stream ID	State of Washington Stream Type[1]	Whatcom County Stream Type[2]	Water Flow Characteristic[3]	Location
Stream 1	F	HCA 1b	Relatively permanent waterway. Begins as roadside ditch at north side of Aldergrove Road.	Flows mainly south through the project area.
Stream 2	Ns	HCA 1b	Relatively permanent waterway.	Flows southwest in the southernmost portion of the project area. Most of stream on adjacent property.
Stream 4	Ns	HCA 1c	Relatively permanent waterway.	Drainage ditch on the north side of Lonseth Road.
Stream 5	Ns	HCA 1c	Relatively permanent waterway.	Drainage ditch on the north side of Henry Road.
Stream 6	Ns	HCA 1c	Relatively permanent waterway.	Drainage ditch on the east side of Gulf Road.
Stream 7	Ns	HCA 1c	Relatively permanent waterway.	Drainage ditch located between Henry Road and Lonseth Road along the west side of the Custer Spur rail embankment in the Eliot Yard.

Notes

1 Source: WAC 222-16-030 (Water typing system).

2 Whatcom County regulates streams as Habitat Conservation Areas (HCAs) in accordance with WCC 16.16.700. Type HCA 1b streams are other fish-bearing streams that do not meet the definition of shorelines of the state but have known or potential use by anadromous or resident fish species; Type HCA 1c streams are non-fish-bearing streams that have no known or potential use by anadromous or resident fish.

3 Relatively permanent waterways must have continuous flow for at least three months of the year. Non-relatively permanent waterways have continuous flow for less than three months of the year.

Table 4 Characteristics of Drainages Identified in the Gateway Pacific Terminal Watershed

Drainage ID	Water Flow Characteristic[1]	Location
Drainage 1	Relatively permanent waterway.	Roadside ditch on the south side of Lonseth Road, east of Stream 1.
Drainage 2	Non-relatively permanent waterway.	Roadside ditch on the north side of Henry road, east of the BNSF railroad tracks.
Drainage 3	Relatively permanent waterway.	Roadside ditch on the south side of Henry Road, east of Stream 1.
Drainage 4	Relatively permanent waterway.	Roadside ditch on the south side of Henry Road, west of Stream 1.
Drainage 5	Non-relatively permanent waterway.	Roadside ditch on the west side of Gulf Road, north of Henry Road.
Drainage 6	Non-relatively permanent waterway.	Roadside ditch on the west side of Kickerville Road, north of Henry Road.
Drainage 7	Relatively permanent waterway.	Roadside ditch on the north side of Henry Road, west of Stream 1.
Drainage 8	Relatively permanent waterway.	Roadside ditch on the south side of Lonseth Road, west of Stream 1.
Drainage 9	Relatively permanent waterway.	Roadside ditch on the north side of Lonseth Road, west of Stream 1.

Notes

1 Relatively permanent waterways must have continuous flow for at least three months of the year. Non-relatively permanent waterways have continuous flow for less than three months of the year.

Table 5 Characteristics of Streams Identified in the Birch Bay Watershed

Stream ID	State of Washington Stream Type[1]	Whatcom County Stream Type[2]	Water Flow Characteristic/ Classification	Location
Stream 3	Ns	HCA 1c	Approximately 2,000 linear feet are adjacent to property. Relatively permanent water. Drains to Terrell Creek.	Drainage ditch on BP property adjacent to north side of Aldergrove Road.

Notes

1 Source: WAC 222-16-030 (Water typing system).

2 Whatcom County regulates streams as Habitat Conservation Areas (HCAs). HCA 1c are non-fish-bearing streams that have no known or potential use by anadromous or resident fish.

3.0 METHODS

The assessment of freshwater streams at the Terminal site was conducted as three separate investigations spanning three years. The initial investigation in 2008 was conducted to characterize the functional value of Stream 1. As described previously, Stream 1 is the primary drainage in the study area, and understanding baseline conditions of Stream 1 was a high priority. Additional investigations were conducted to characterize roadside streams and drainages in 2010. In May 2011, an investigation was conducted to determine fish use of Streams 1, 2, and 4. Based on those results, salmon spawner surveys in the lower most reach of Stream 1 were initiated in October 2011.

Photographs taken during various phases of field investigation are presented in Appendix C.

3.1 HABITAT CHARACTERIZATION

Habitat conditions of Stream 1, and roadside streams and drainages were characterized and evaluated relative to the NOAA Fisheries definition of “Properly Functioning Condition” (NOAA Fisheries 1996, 1999). Detailed methodology for approach used for Stream 1 and roadside streams and drainages is provided below.

3.1.1 Stream 1

On November 24 and 25, 2008, AMEC staff conducted a stream habitat characterization to assess potential salmonid spawning and rearing habitat in Stream 1. The riparian corridor throughout the lower three reaches of Stream 1 was assessed using aerial photography, quantitative field methods, and visual observations. The type, size, and density of vegetation along the streambanks were used to evaluate the potential for shade and input of large woody debris (LWD) to the stream. The type, size, and density of riparian trees determine both the durability and the potential for wood to be delivered to the stream to provide habitat features for fish.

Stream 1 was divided into five reaches based on changes in stream hydrological dynamics, fish passage barriers, and channel and riparian conditions. Individual reaches are shown on Figure 1. The comprehensive habitat assessment of Stream 1 was limited to the lower three reaches, as the upper two reaches are characterized as agricultural reaches and roadside ditches.

Table 6 describes the characteristics of Stream 1 by individual stream reach.

Table 6 Summary of Stream 1 Conditions by Reach

Reach Number	Length (linear feet)	Description (see Figure 1)	Characteristics
1	2,340	Stream mouth to Henry Road	Flows through a ravine, defined by steep slopes on both banks with a canopy of red alder (*Alnus rubra*) and a shrub understory dominated by willow (*Salix spp.*) and twinberry (*Lonicera involucrata*). Riverine wetlands are characteristic along the stream.
2	3,252	Henry Road to Lonseth Road	Narrow streambed with less emergent or aquatic vegetation than Reach 1, without riverine wetlands. The riparian community is characterized by a canopy of red alder with shrubs, including salmonberry (*Rubus spectabilis*) and snowberry (*Symphoricarpos albus*), in the understory.
3	1,571	Upstream of Lonseth Road to the pasture South of Aldergrove Road	Shallow streambed, poorly defined in places, not in a ravine. Travels through forested wetlands. No fish habitat, but provides water quality function.
4	2,349	From the pasture to Aldergrove Road	Ditch in active pasture delineated as wetlands. Not protected from grazing. In culvert under Gulf Road.
5	3,360	From culvert at Aldergrove Road to property boundary	Roadside ditch on north side of Aldergrove Road. Receives stormwater runoff from BP refinery and roadway.

Transects or cross-sections of the stream were established to characterize Stream 1. Transects were established approximately 150 feet apart. The cross-sections were established in areas found to be characteristic of the entire reach, as determined by May et al. (1997).The type and percentage cover of riparian vegetation was visually estimated at each transect. Dominant riparian vegetation was described using the following categories:

- Forest (greater than 6 meters in height): coniferous, deciduous, or mixed;
- Shrubs and vines;
- Tall herbaceous (e.g., unmowed field);
- Short herbaceous (e.g., mowed grass, pasture);
- Impervious (e.g., buildings, roads, asphalt, etc.); and
- Residential landscaped (mowed lawn with ornamental shrubs/trees).

In the forest category, layers were considered "mixed" if a vegetation type other than the dominant type constituted more than 10 percent of the areal coverage.

Methods to assess the abundance of LWD for this study followed a simplified adaptation of those described by Robison and Beschta (1990). All LWD was to be categorized according to location in the ditch and then separated into size classes based on length and diameter using visual estimates. Bank geometry measurements were recorded to assess channel stability during flood flows, long-term channel down-cutting, and fish concealment features, such as undercut banks. Parameters recorded included the estimated width and depth of the channel at bankfull stage (Kaufmann et al 1999). Bankfull width (BFW) is the width between each top of bank. Bankfull depth (BFD) is the average depth of water at bankfull stage.

Habitat conditions were evaluated following the proper functioning condition (PFC) concept suggested by the National Oceanographic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) (NOAA Fisheries 1996, 1999). NOAA Fisheries defines PFC as “the sustained presence of natural habitat-forming processes in a watershed (e.g., riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation” (NOAA 1999). PFC therefore incorporates the habitat component of the species’ biological requirements. Using the PFC framework, baseline environmental conditions are described as: (1) functioning, (2) at risk, or (3) not properly functioning. Additional details regarding habitat characterization methods are included in Appendix D.

NOAA Fisheries (1996) developed a methodology known as the Matrix of Pathways and Indicators (MPI) to aid in describing current freshwater habitat conditions and determining factors limiting salmon production within the PFC framework. The complete matrix is presented in Appendix D. Several indicators included in the NOAA Fisheries MPI were evaluated as part of the habitat characterization to assess the functioning condition of Stream 1 and roadside ditches and streams:

- Habitat access was evaluated by assessing the physical barriers present within a waterway;
- Habitat elements were indicated by substrate and the presence of LWD;
- Channel condition and dynamics were evaluated by measuring the BFW to BFD ratio (BFW:BFD); and
- Watershed conditions were assessed via riparian vegetation.

3.1.2 Roadside Streams and Drainages

Methods used to investigate water quality functions of the roadside ditches in roadside streams and drainages followed protocols developed by Snohomish County to assess roadside ditches for their potential to affect storm runoff water quality (Colwell et al. 2000).

Transect data collection characterized geometrical dimensions of each ditch and stream, as well as vegetation type, cover, and condition. The methods used to assess habitat function of roadside streams and drainages are similar to those described above for Stream 1. Similar to Stream 1, habitat conditions were evaluated relative to PFC:

- Characterize general habitat conditions;
- Assess the potential for roadside ditches to improve water quality; and
- Compare waterways characterized as ditches to those classified as streams by Whatcom County.

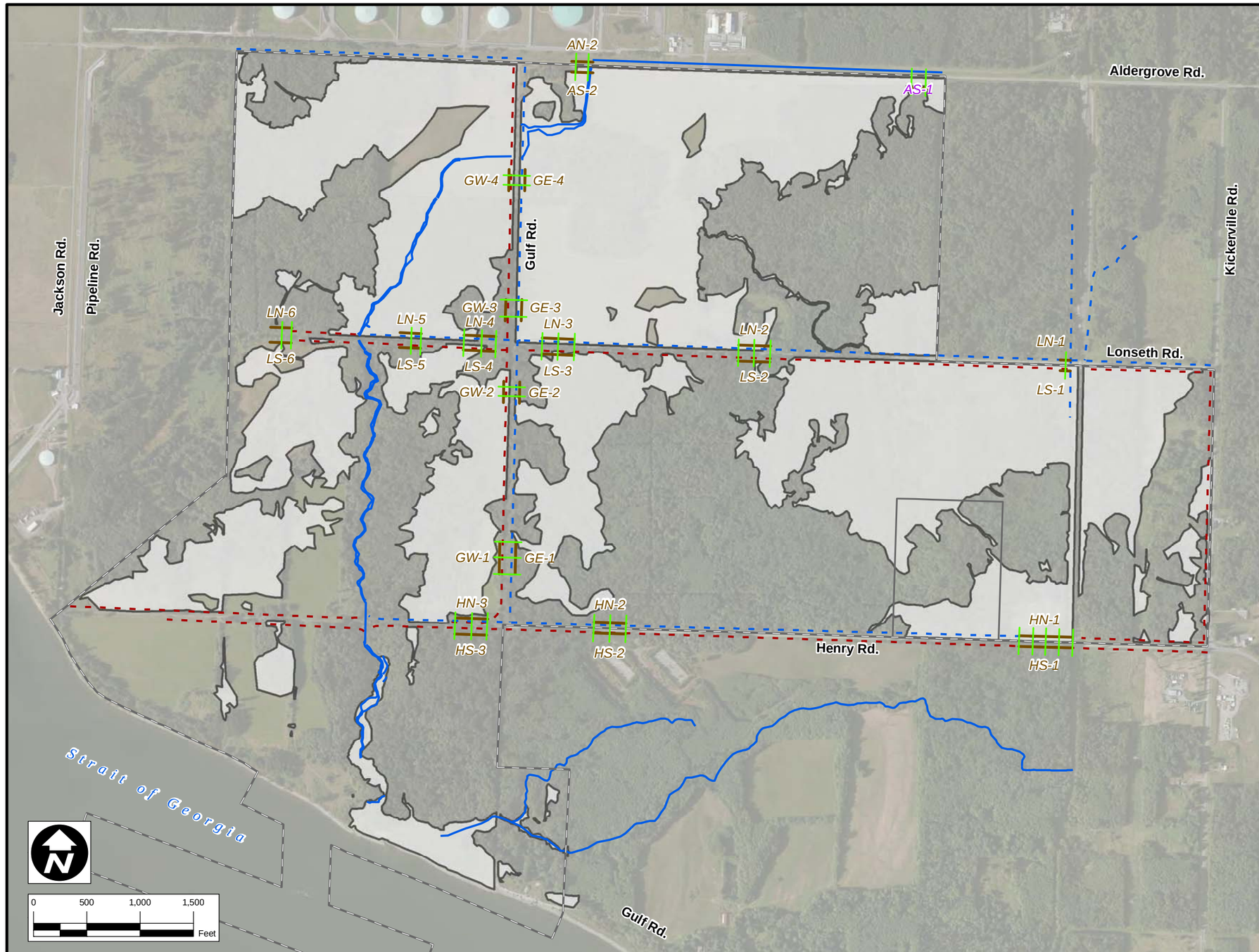
Conditions were evaluated at 65 transects (34 in streams and 31 in drainages). Habitat conditions were relatively homogenous along each of the streams and drainages inventoried. Stream segments were spaced between 500 and 2,000 feet apart, and were selected to capture varying and representative characteristics of each stream or ditch. A range of 2 to 5 cross sections were established per segment, depending on the homogeneity of the segment; two cross-sections were established in highly homogenous segments whereas five cross-sections were established in more variable segments. Figure 5 shows the transect locations. Linear ditch segment lengths varied from 100 to 500 feet, with a mean of 288 feet.

Indicators measured to assess stream habitat function included riparian condition and canopy coverage, abundance of LWD, BFW and BFD, and human impacts similar to the methods used for Stream 1 described above. However, no LWD was identified in roadside stream/drainage segments, so no data on LWD were recorded.

3.2 Fish Presence Assessment

From May 18 through 20, 2011, AMEC staff performed a fish presence survey on Streams 1 (Reaches 1 and 2), 2, and 4, and the coastal lagoon, at the request of WDFW. The study plan for the fish presence survey was developed in conjunction with the WDFW Area Habitat Biologist to focus sampling in habitats most likely to support fish. WDFW requested that Streams 1, 2, and 4 be surveyed for fish presence based on WDFW jurisdiction, and the presence of suitable fish habitat.

The fish presence survey was initiated with an assessment of potential blockages to upstream fish passage. Specifically, the configuration of the log jams at the mouth of Streams 1 and 2 were assessed, along with the culverts under Henry Road (Stream 1) and Gulf Road (Streams 2 and 4).



LEGEND

- CROSS-SECTION
- DITCH
- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- EXISTING WETLAND AREA
- PROPERTY BOUNDARY
- PROJECT AREA BOUNDARY

Pacific International Terminals
A Gemix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	JG
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,000 feet

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: DITCHES AND CROSS-SECTIONS

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 5

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The methods employed to capture fish were determined by assessing local conductivity and water temperature. In the streams, favorable water quality conditions and habitat types warranted electrofishing techniques. However, in the coastal lagoon, electrofishing techniques were precluded by brackish water conditions resulting from tidal influence (Appendix B). As such, hand nets were used to corral and capture fish in the coastal lagoon. Seining, another method to capture fish, was not possible in the coastal lagoon due to dense vegetation.

Global positioning system (GPS) coordinates, water temperature, and conductivity were recorded at all sampling points (waypoints). The length (millimeters [mm]) and species of each sampled fish were recorded on field data sheets. Field data were transferred to a Microsoft Excel spreadsheet once the field investigation was complete.

3.2.1 Electrofishing

The field crew consisted of four people: one field leader who was certified and experienced in electrofishing procedures, and three accompanying scientists who netted fish and monitored fish recovery. A Smith-Root Model 12 P.O.W. backpack electrofisher was used to capture fish. The instrument was operated following manufacturer's specifications and adjusted to the settings described by NOAA Fisheries (2000) (Table 7). Surveys were conducted in mid-May, when spawning salmonids were not present in the streams.

Table 7 Guidelines for Initial and Maximum Settings for Backpack Electrofishing

Parameter	Initial Settings	Maximum Settings	
Voltage	100 V	Conductivity (µS/cm)	Max. Voltage
		<100	1,100 V
		100 – 300	800 V
		>300	400 V
Pulse width	500 µs	5 ms	
Pulse rate	30 Hz	70 Hz	

Source: Adapted from Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act, National Oceanic and Atmospheric Administration (NOAA Fisheries, 2000).

Abbreviations
V: volt
Hz: hertz
µs: microsecond
µS/cm: microsiemens per centimeter

Settings on the electrofisher were optimized and regularly adjusted for site conditions. The backpack electrofisher was originally configured with the settings shown in Table 7. If conductivity was low, or if no fish response was observed, the voltage was incrementally increased to the maximum settings indicated in Table 7 based on the measured conductivity of water in the targeted stream. If still no fish response was observed, the pulse rate was increased incrementally. Once the settings were

optimized to induce a positive fish response while avoiding injury, the crew commenced with the survey.

The survey began at the downstream end of each reach and continued upstream. Stream segments were sampled in a systematic manner, moving the anode continuously in a herringbone pattern, sampling areas where fish were anticipated to be present. Extra care was taken in areas where high fish concentrations were expected or observed. Electrofishing was not conducted in any one location for an extended period of time in order to avoid potential harm to fish.

Captured fish were hand-netted and placed in a plastic bucket with ambient stream water to recover and be identified. Fish were regularly observed by crew members for indicators of stress. Dark bands on the body and longer recovery times are signs of injury and handling stress, and indicate that the settings for the electrofishing unit need to be adjusted. A sufficient number of buckets were available to prevent overcrowding of captured fish while they recovered. Additionally, water temperatures inside the buckets were monitored, and holding times were kept to a minimum.

At regular intervals the crew stopped and processed the captured fish, which involved identifying the species and measuring fork length. Once processed, the fish were returned to a bucket with ambient stream water until fully recovered, and then released into the same reach from which they were collected.

3.2.2 Corral and Capture

In the coastal lagoon areas where conductivity was too high to effectively electrofish, small hand nets were used to corral and capture fish. Seining, another method to capture fish, was not possible due to dense vegetation in the coastal lagoon. Corralled and captured fish were hand-netted and transferred to buckets filled with ambient lagoon water. The crew then identified each individual fish to species, measured the fork length, and placed the fish back into a separate holding bucket. After all processing was complete, the fish were released back into the water from which they were captured.

3.3 SALMONID SPAWNER SURVEYS

Salmonid spawner surveys on Stream 1 were initiated in October 2011 and completed in February 2012. The purpose of the spawner surveys was to determine whether salmonids spawn in the lower reach of Stream 1, and if spawning salmonids were identified, to record the location, timing, and species of spawning salmonids.

To quantify the degree and extent to which adult salmonids utilize habitat in Stream 1 for spawning, two biologists conducted biweekly visual surveys of the total number of live and dead spawning salmonids and the spatial extent of each species in Stream 1 for the duration of the spawning period

(October 15, 2011, through February 2, 2012). The first survey occurred on October 19, 2011, and the final survey on February 2, 2012. The investigation was limited to the downstream segment of Stream 1 below the fish passage barrier (culvert) at Henry Road.

For the purposes of quantifying the spatial extent of the distribution of each salmon species, the stream was divided into 100-meter segments using a hand-held GPS unit and flagged in the field. For each 100-meter segment, the total number of live and dead spawners of each species was enumerated using hand-held tally counters. The upper extent of each species within the stream was defined by the 100-meter segment above which no live or dead fish were observed for a distance of at least 200 meters. The locations of spawning salmonids, as well as any identified redds, were mapped based on reference to the marked 100-meter stream sections or using GPS.

The survey on each survey date began at the mouth of Stream 1 at the Strait of Georgia, and ended at the fish passage barrier at Henry Road. To access the stream mouth, vehicles were parked on Henry Road, and biologists hiked down to the shoreline through open fields west of the stream. If fish were observed during the spawner surveys, WDFW was notified by AMEC staff to inform them of fish presence in the stream.

4.0 RESULTS

This section presents the results of stream habitat characterization, fish presence surveys, and salmon spawner surveys.

4.1 HABITAT CHARACTERIZATION OF STREAM 1

This section presents the results of habitat characterization of Stream 1. The lower three reaches (Reaches 1, 2, and 3) occur in a natural channel (non-roadside ditch), and were considered suitable for assessing salmonid habitat conditions. Reaches 4 and 5 are ditched, have low functioning habitat, and were not rigorously assessed for potential salmonid habitat.

4.1.1 Riparian Conditions

NOAA Fisheries (1996) specifies that a properly functioning stream should have “greater than 80 percent intact canopy cover to provide stream shading, aquatic insect recruitment, and an adequate source of LWD.”

The riparian corridor along Stream 1 is nearly continuous; however, the relatively thin, deciduous overstory with intermittent coniferous forest offers little potential for creating habitat features. The deciduous overstory is dominated by young, relatively small-diameter individuals of species that include big leaf maple (*Acer macrophyllum*), black cottonwood (*Populus trichocarpa*), and red alder

(*Alnus rubra*). Coniferous species includes intermittent western hemlock (*Tsuga heterophylla*) and Douglas fir (*Pseudotsuga menziesii*). Despite the nearly continuous riparian corridor, both visual and calculated estimates of canopy cover for the stream itself are below the NOAA Fisheries reference value of "greater than 80 percent intact canopy cover" to be considered in properly functioning condition (Table 8). All three reaches are therefore considered not properly functioning with respect to riparian cover. As a result, much of the stream is likely to be exposed to direct solar radiation, potentially resulting in elevated stream temperatures. Maintaining and restoring riparian vegetation would improve temperature regulation of the stream, which would improve salmon habitat.

Table 8 Riparian Cover on Stream 1

	Canopy Cover		Understory Cover		Ground Cover		
Reach Number	Deciduous	Mixed	Woody shrubs/saplings	Non-woody herbs, grasses, and forbs	Woody shrubs	Non-woody	Bare dirt
1	<10%	10-40%	40-75%	<10%	<10%	10-40%	10-40%
2	<10%	10-40%	40-75%	10-40%	<10%	10-40%	<10%
3	<10%	10-40%	>75%	10-40%	<10%	10-40%	<10%

Preservation of the riparian corridor would provide shade, maintain lower water temperatures, and attract prey species. Additionally, preservation of the riparian corridor would allow the alder-dominated riparian community to be replaced by conifers as natural succession of the plant community occurs. Conifers provide increased habitat functionality. Preservation of the riparian area along Reach 3 would specifically increase the amount of cover that is currently provided by the sparse canopy.

4.1.2 Large Woody Debris

Large woody debris functions to dissipate energy flow, protect stream banks, stabilize stream beds, store sediment, and provide in-stream cover and habitat diversity (Keller and Swanson 1979; Bilby 1984; Harmon et al. 1986; Bisson et al. 1987; Gregory et al. 1991). NOAA Fisheries (1996) defines *properly functioning condition* as more than 50 pieces per kilometer of LWD greater than 24 inches in diameter and greater than 50 feet long. Other studies have described normal LWD frequencies in natural streams in the Pacific Northwest as 150 to 670 pieces per kilometer (Ralph et al. 1994; Murphy and Koski 1989).

A second measure of stream health and LWD is the presence of "key pieces." The Washington Forest Practices Board (WFPB) *Standard Methodology for Conducting Watershed Analysis* (WFPB, 1996) suggests that a stream channel must contain a few larger pieces of wood that provide stability and function in unison with smaller pieces. These pieces of LWD have been termed "key pieces" by WFPB and NOAA Fisheries. The *California Salmonid Stream Habitat Restoration Manual*, Third Edition (Flosi

et al. 1998), defines “key pieces” for LWD in unanchored applications by the following minimum size requirements: logs with a minimum diameter of 12 inches, and a minimum length 1.5 times the mean bankfull width of the stream channel at the deployment site.

Based on published standards for LWD per a given stream reach, all three lower reaches of Stream 1 (Reaches 1, 2, and 3) contain sufficient LWD, as well as enough pieces of key LWD per linear foot, to be considered in properly functioning condition (Table 9).

Table 9 Frequency and Characteristics of LWD in Stream 1

Reach	Pieces LWD per Linear foot	Key pieces of LWD per Linear foot
Reference	*0.046*[1]	*0.015*
1	0.21	0.19
2	0.22	0.14
3	0.08	0.06

Notes
1 Several studies have found the low end of the range of LWD abundance in natural conditions to be 150 pieces per kilometer or 0.046 pieces per foot (Murphy and Koski 1989, Ralph et al. 1994, Beechie and Sibley 1997).

4.1.3 Channel Condition and Dynamics

Stream channel morphology is influenced by overland and channel flow, drainage systems and channel networks, stream discharge and basin area, and stream erosion. The condition of stream morphology can be evaluated quantitatively as the bankfull width relative to the bankfull depth. The NOAA Fisheries (1996) criterion for properly functioning condition for stream channel morphology is a BFW:BFD ratio of under 10.

The bankfull width-to-depth ratios for all three reaches were below the 10:1 NOAA Fisheries threshold, indicating properly functioning condition for all three reaches (NOAA Fisheries 1996). The average BFW:BFD ratios in Stream 1 were 1.5:1 for Reach 1, 2:1 for Reach 2, and 4:1 for Reach 3 (Table 10).

Table 10 Bankfull Width-to-Depth Ratios for Stream 1

Reach	Average BFW (feet)	Average BFD (feet)	Average BFW:BFD Ratio
Reference			*10:1*[1]
1	6.3	4.3	1.5:1
2	5.3	2.8	2:1
3	6.3	1.8	4:1

Notes
1 The NOAA Fisheries matrix categorizes streams with a bankfull width/depth ratio of less than 10:1 as properly functioning (NOAA Fisheries 1996).

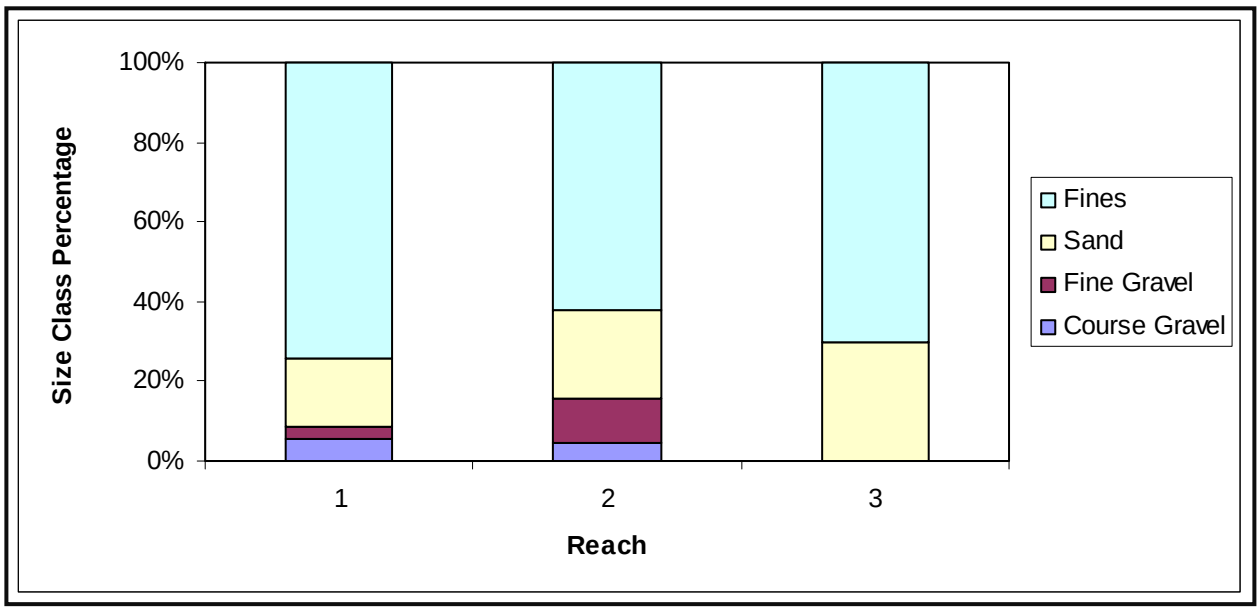
4.1.4 Substrate

Salmon require substrates dominated by gravel and cobble for spawning and rearing. An abundance of fines and sand can suffocate salmon embryos. Results of the field investigation indicate that fines are the dominant substrate in all three reaches of Stream 1. According to the NOAA Fisheries MPI, substrates dominated by sand, silt, or small gravel are considered “not properly functioning.”

As mentioned above, fines were the dominant substrate particle size class within the three reaches of Stream 1 (Figure 6). The next most abundant substrate in all three reaches was sand. Reach 1 and Reach 2 had the greatest diversity of substrates, including fines, sand, fine gravel, and coarse gravel. On average, Reach 1 was composed of 74 percent fines and 17 percent sand. Within Reach 2, fines accounted for an average 62 percent of the substrate composition, while sand accounted for an average of 22 percent. Reach 3 was composed entirely of fines and sand, averaging 70 percent fines and 30 percent sand.

Excessive erosion does not appear to be occurring in Reaches 1, 2, or 3 of Stream 1, as incised stream banks and excessive scouring of the stream channel were not observed. The abundance of fines and sand in all three reaches is most likely due to seasonal low flow volumes and low streamflow velocities, and less due to excessive erosion in the watershed. Low stream flow limits the stream’s ability to carry sediment, which prevents sediment transport. This results in increased fine sediment deposition throughout the stream channel.

Figure 6 Comparison of Substrate Size Class Percentage between Stream 1 Reaches



Note: The NOAA Fisheries matrix suggests that streams are “properly functioning” if the dominant substrate is gravel or cobble. An area is considered “not properly functioning” if bedrock, sand, silt, or small gravel is the dominant substrate (NOAA Fisheries 1996).

4.1.5 Habitat Access

Fish access to suitable habitat in Stream 1 was limited by the approximately 100-foot-long, perched, concrete culvert underneath Henry Road. The culvert is approximately 48 inches tall, and had shallow sheet flow at the time of site investigation. Because of this barrier to fish passage, fish access to suitable habitat within Stream 1 and associated roadside stream and drainages upstream of the Henry Road culvert is limited.

A logjam at the mouth of the stream and a beaver dam approximately 300 feet upstream are potential barriers to fish passage as well. However, it was determined that these features only serve as barriers during low flow periods in Stream 1, and would otherwise not act as barriers during seasonally high flows in the wet season.

4.1.6 Summary of Matrix of Pathways and Indicators Relative to Properly Functioning Condition

Table 11 presents the conditions of all five reaches of Stream 1 for each of the five main NOAA Fisheries indicators compared with reference values for properly functioning. Overall conditions for Stream 1 in its entirety are then presented in Table 12. The three condition levels of the NOAA Fisheries MPI are: (1) functioning, (2) at risk, and (3) not properly functioning. Of the five indicators measured on the three lower reaches of Stream 1, only LWD and BFW:BFD ratio indicate properly functioning conditions. All remaining functions indicate not properly functioning conditions. No functions on Stream 1 were considered at risk.

According to the definition of *properly functioning condition*, the lowest reach of Stream 1 has indicators of properly functioning conditions with regard to BFW:BFD ratio and LWD; however, other indicators are lacking. Stream 1 provides limited fish habitat because of barriers to fish passage, intermittent flow, few high-quality pools, lack of spawning gravels, poor water quality attributed to sediment load, and garbage in the stream. The only fish species identified within the stream channel during the stream characterization work in 2008 was the three-spine stickleback (*Gasterosteus aculeatus aculeatus*), schools of which were present in Reach 1.

Table 11 Pathways and Indicators Relative to Properly Functioning Conditions in Stream 1, Reaches 1 through 5

Pathway	Indicator	Level of Function[1]
Reach 1		
Habitat Access	Physical Barriers	Not Properly Functioning
Habitat Elements	Substrate	Not Properly Functioning
Habitat Elements	Large Woody Debris	Properly Functioning
Channel Condition and Dynamics	Width/Depth Ratio	Properly Functioning
Watershed Conditions	Riparian Reserves	Not Properly Functioning
Reach 2		
Habitat Access	Physical Barriers	Not Properly Functioning
Habitat Elements	Substrate	Not Properly Functioning
Habitat Elements	Large Woody Debris	Properly Functioning
Channel Condition and Dynamics	Width/Depth Ratio	Properly Functioning
Watershed Conditions	Riparian Reserves	Not Properly Functioning
Reach 3		
Habitat Access	Physical Barriers	Not Properly Functioning
Habitat Elements	Substrate	Not Properly Functioning
Habitat Elements	Large Woody Debris	Properly Functioning
Channel Condition and Dynamics	Width/Depth Ratio	Properly Functioning
Watershed Conditions	Riparian Reserves	Not Properly Functioning
Reach 4		
Habitat Access	Physical Barriers	Not Properly Functioning
Habitat Elements	Substrate	Not Properly Functioning
Habitat Elements	Large Woody Debris	Not Properly Functioning
Channel Condition and Dynamics	Width/Depth Ratio	Not Properly Functioning
Watershed Conditions	Riparian Reserves	Not Properly Functioning
Reach 5		
Habitat Access	Physical Barriers	Not Properly Functioning
Habitat Elements	Substrate	Not Properly Functioning
Habitat Elements	Large Woody Debris	Not Properly Functioning
Channel Condition and Dynamics	Width/Depth Ratio	Not Properly Functioning
Watershed Conditions	Riparian Reserves	Not Properly Functioning

1 According to the NOAA Fisheries definitions, after USDI-BLM (1993): Level of functioning is either properly functioning, at risk, or not properly functioning.

Table 12 NOAA Fisheries Matrix of Pathways and Indicators Evaluated for Stream 1

Pathway	Indicator	Properly Functioning	Not Properly Functioning
Habitat Access	Physical Barriers		X
Habitat Elements	Substrate		X
Habitat Elements	Large Woody Debris	X	
Channel Condition and Dynamics	Width/Depth Ratio	X	
Watershed Conditions	Riparian Reserves		X

4.2 HABITAT CHARACTERIZATION OF ROADSIDE STREAMS AND DRAINAGES

Overall conditions for roadside streams and drainages are presented in Table 13. Channel condition and dynamics in 65 transects were used to characterize roadside streams and drainages. In general, the results of the investigation showed little difference between roadside conveyances classified as ditches versus streams; therefore they are discussed jointly in the results below.

Habitat in roadside drainages and streams is not in properly functioning condition. Of the five indicators measured on roadside streams and drainages, only bankfull width/depth ratios indicate properly functioning conditions. All remaining functions indicate not properly functioning conditions. No functions provided by roadside drainages or streams were considered at risk.

Habitat access, for migratory salmonids and other freshwater fishes, to these roadside drainages and streams was limited because of the culvert under Henry Road. Access to Drainage 3, which flows into Stream 1 below the Henry Road, was limited because of a steep ravine, garbage piles, and concrete rubble. These features act as physical barriers that limit fish access.

The riparian canopy for most of the roadside stream and drainage segments investigated was composed of deciduous forests, with an average canopy cover of less than 20 percent. The assessment of riparian conditions for roadside streams and drainages was limited to the stream/drainage bank opposite the road. In general, both the drainages and streams in the study area provide limited habitat value due to the lack of a mature, coniferous overstory.

No LWD was identified in the surveyed roadside streams and drainages. The lack of mature, coniferous overstory throughout all of the roadside stream and drainage segments eliminates the potential recruitment of LWD. Furthermore, if LWD were recruited naturally, it would most likely be removed artificially to prevent clogging the ditch and to maintain roadway safety.

Table 14 presents results from measurement of the BFW:BFD ratio. The average width-to-depth ratios for all streams and drainages in the study area was 1.22:1. The average for streams and drainages was 1.4:1 and 1.2:1, respectively (Table 14). The NOAA Fisheries (1996) criterion for properly functioning condition for stream channel morphology is a BFW:BFD ratio under 10. The roadside streams and drainages are therefore considered properly functioning with regard to channel condition and dynamics.

Fines are the dominant substrate in all roadside stream and drainage segments evaluated. According to the NOAA Fisheries matrix, substrates dominated by sand, silt, or small gravel are considered "not properly functioning." Thus all roadside stream and drainage segments evaluated are considered not properly functioning with respect to substrate.

Table 13 NOAA Fisheries Matrix of Pathways and Indicators Evaluated for Roadside Streams and Drainages

Pathway	Indicator	Stream 4	Stream 5	Stream 6	Drainage 1	Drainage 3	Drainage 5
Habitat Access	Physical Barriers	NPF	NPF	NPF	NPF	NPF	NPF
Habitat Elements	Substrate	NPF	NPF	NPF	NPF	NPF	NPF
Habitat Elements	Large Woody Debris	NPF	NPF	NPF	NPF	NPF	NPF
Channel Condition and Dynamics	Width/Depth Ratio	PF	PF	PF	PF	PF	PF
Watershed Conditions	Riparian Reserves	NPF	NPF	NPF	NPF	NPF	NPF

Abbreviations

PF = Properly functioning.

NPF = Not properly functioning.

Table 14 Bankfull Width-to-Depth Ratios for Roadside Streams and Drainages

	Streams	Ditches	Overall
# Transects	34	31	65
Average BFD (feet)	2.2	2.4	2.3
Average BFW (feet)	9.2	10.3	9.6
Average BFW: BFD Ratio	1.2	1.4	1.22

4.3 RESULTS OF FISH PRESENCE SURVEYS

A summary of fish counts in each stream surveyed by species name and size class is presented in Table 15. GPS locations and observations for each station are presented in Table 16. Figure 7 presents the locations of the streams surveyed for the presence of fish in 2011. The presence of juveniles and smolts (up to 175 mm) of both coho and chum salmon was confirmed in Stream 1 (Reach 1) during the 2011 fish presence survey. Coho and chum salmon were not identified in Reaches 2 or 3 of Stream 1, in Stream 2, in Stream 4, or in the coastal lagoon. Three-spine stickleback was identified in the coastal lagoon, and was the only other fish species identified within the study area.

Electrofishing surveys were conducted in Stream 1, Stream 2, and Stream 4. As detailed in Section 3.2, electrofishing was not feasible in the coastal lagoon, and therefore nets were used for corral and capture of fish specimens within the lagoon.

Details on survey results and observations for each surveyed water body are presented in the following sections.

4.3.1 Stream 1

Locations and a summary of results for fish surveys in Stream 1 are shown on Figure 7. At the time of the field investigation, the mouth of Stream 1 flowed across the beach and into the Strait of Georgia. Southeast of the mouth, the coastal lagoon is drained via a small channel network into Stream 1 in the upper intertidal zone. At this confluence, an extensive raft of large logs covered the stream and made it difficult to sample effectively. Sufficient flow and water depth were maintained beneath these logs to provide unhindered fish passage, at least in the configuration observed at the time of the survey. The mouth of Stream 1 was sampled during low tide when conductivity and temperature were within an acceptable range for electrofishing.

At the mouth of Stream 1 (stations WP 29 to WP 35), juvenile chum salmon (*Oncorhynchus keta*) (36 – 45 mm), juvenile coho salmon (*O. kisutch*) (83 – 175 mm), and three-spine stickleback (*Gasterosteus aculeatus aculeatus*) (20 – 50 mm) were captured (Table 16). Three-spine sticklebacks were also found in the coastal lagoon (WP 25 and WP 26) (50 mm).

Moving upstream from the mouth, Stream 1 was characterized by low-gradient, braided channels with extensive depositions of fine sediment (WP 36 to WP 39). No fish were found in this braided segment of Stream 1. As the gradient increased and a more defined single channel became apparent, juvenile coho (22 – 56 mm) were captured at upstream locations until the perched culvert at the Henry Road crossing (WP 40 to WP 42) (Figure 8). No fish were found above the Henry Road culvert (WP 43 to WP 45).

4.3.2 Stream 2

The mouth of Stream 2 braided into multiple channels, and diffused into a low-gradient, forested wetland west of Gulf Road. The braided channels and wetland appeared to drain into the coastal lagoon and marsh to the south and west. Starting on the east side of Gulf Road, the field crew followed the main channel of Stream 2 east until reaching the site boundary, indicated by a remnant barbed wire fence and fence posts (Figure 9). Stream 2 had long stretches with extensive deposition of fine sediments. Mud 0.5 foot to 1.5 feet thick was the dominant substrate from Gulf Road east to the property boundary. Stream 2 frequently braided and ponded in areas as a result of embedded vegetation, deposited fine sediments, and low gradient. Stream velocity was low due to these stream features. No fish were found in Stream 2 despite adjusting the electrofisher settings multiple times.

4.3.3 Stream 4

Stream 4 is a roadside drainage ditch lined with reed canarygrass (*Phalaris arundinacea*). It was surveyed from its confluence with Stream 1 west of Gulf Road, to the project area boundary and utility right-of-way approximately 1,000 feet west of the railroad tracks (Figure 10). Stream flow was very minimal, and water depths were rarely greater than 5 centimeters. No fish were found in Stream 4, and numerous frogs and worms were observed reacting to the electricity. Little to no habitat for fish was observed due to the consistently level stream bottom and shallow water depths.

4.3.4 Coastal Lagoon

The coastal lagoon contained ponded water greater than 18 inches deep with communities of dense aquatic and emergent vegetation. A distinct pycnocline and halocline were evident in these pooled areas immediately west of Gulf Road. Conductivity and temperature measurements in the ponded area were 432 microsiemens per centimeter (µS/cm) and 20.3° Celsius (°C) at the surface, respectively, and 868 µS/cm and 15.3°C at the bottom. On the same day but in a different location in the pool, conductivity and temperature were measured as 351 µS/cm and 17.3°C at the surface, and 3.40 µS/cm and 16.4°C at the bottom.

Survey locations and results for the coastal lagoon are shown on Figure 8. Young-of-the-year three-spine stickleback (approximately 20 mm) and polliwogs were observed near the surface and were captured with dip-nets. Electrofishing was ineffective in the lagoon, presumably due to the higher conductivity conditions, the small size of the fish, and their tendency to dart into deep murky water and the aquatic vegetation. More information regarding the coastal lagoon vegetation communities, temperature, and conductivity levels is provided in Appendix B.

4.4 Results of Salmonid Spawner Surveys

No dead or alive spawning salmonids or salmon redds were identified in Stream 1 during the field survey. Six spawner surveys were conducted from 2011 to 2012 on the following dates: October 19,

November 2, November 16, November 30, December 21, January 4, and February 2. The streams were thoroughly surveyed by at least two biologists on each survey date, but use of the stream by spawning salmonids was not observed.

Table 15 Summary of Fish Survey Data from May 18 to 20, 2011

			Size Classes (counts)							
Water Feature	**Date**	**Fish Species**	**20 – 40 mm**	**41 – 60 mm**	**61 – 80 mm**	**81 – 100 mm**	**101 – 120 mm**	**121 – 140 mm**	**141 – 160 mm**	**161 – 180 mm**
Stream 1	5/19/11	Stickleback	1	2	—	—	—	—	—	—
		Coho	2	32	—	2	1	7	2	1
		Chum	1	1	—	—	—	—	—	—
Stream 2	5/20/11	Stickleback	—	—	—	—	—	—	—	—
		Coho	—	—	—	—	—	—	—	—
		Chum	—	—	—	—	—	—	—	—
Stream 4	5/18/11	Stickleback	—	—	—	—	—	—	—	—
		Coho	—	—	—	—	—	—	—	—
		Chum	—	—	—	—	—	—	—	—
Coastal Lagoon	5/18/11	Stickleback	—	40	—	—	—	—	—	—
		Coho	—	—	—	—	—	—	—	—
		Chum	—	—	—	—	—	—	—	—

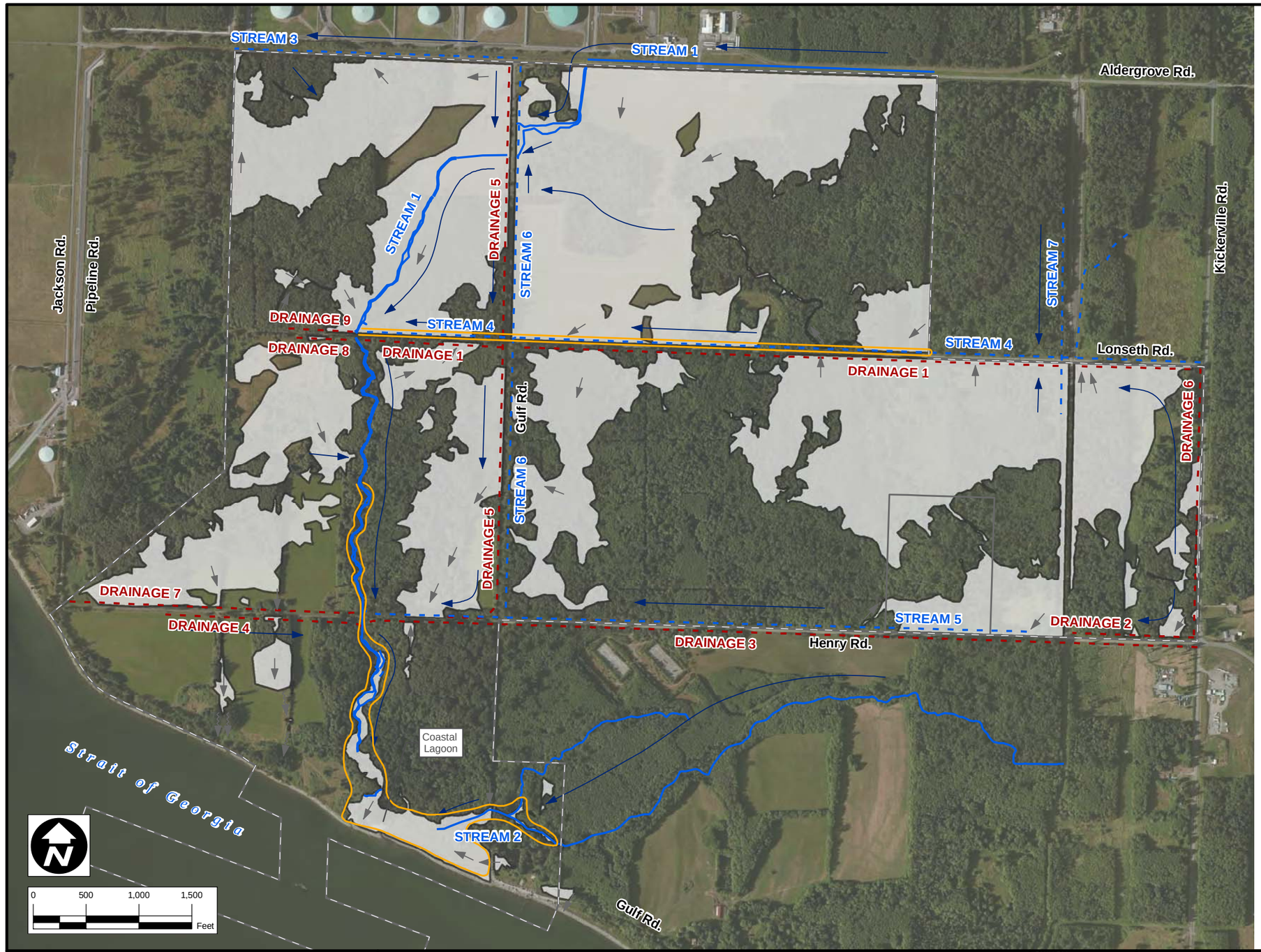
Table 16 Results of Fish Presence Surveys and GPS Coordinates, May 18 to 20, 2011

Water Feature	Date	Waypoint[1]	Easting	Northing	Fish Presence (#)
Stream 1	5/19/11	WP 29	519351.05	5411656.69	Chum (2)
		WP 30	519364.04	5411675.74	Coho (3)
		WP 31	519362.83	5411685.63	Coho (1), Stickleback (3)
		WP 32	519343.54	5411725.80	Coho (2)
		WP 33	519333.51	5411722.10	Coho (1)
		WP 34	519325.60	5411738.86	Coho (1)
		WP 35	519347.90	5411759.39	Coho (5)
		WP 36	519263.07	5411876.15	
		WP 37	519261.62	5411892.82	
		WP 38	519293.18	5412035.55	
		WP 39	519296.86	5412096.37	
		WP 40	519309.71	5412156.22	Coho (3)
		WP 41	519314.29	5412189.03	Coho (23)

Table 16 Results of Fish Presence Surveys and GPS Coordinates, May 18 to 20, 2011

Water Feature	Date	Waypoint[1]	Easting	Northing	Fish Presence (#)
		WP 42	519270.49	5412235.35	Coho (8)
		WP 43	519248.24	5412433.25	
		WP 44	519246.81	5412549.97	
		WP 45	519232.55	5412687.88	
Stream 2	5/20/11	WP 47	519670.33	5411722.61	
		WP 48	519813.57	5411665.54	
		WP 49	519863.89	5411643.37	
Stream 4	5/18/11	WP 5[2]	519218.78	5413086.91	
		WP 6	519257.05	5413089.37	
		WP 7	519289.60	5413093.60	
		WP 8	519289.75	5413092.82	
		WP 9	519306.77	5413088.88	
		WP 10	519394.32	5413092.96	
		WP 11	519425.86	5413090.85	
		WP 12	519493.97	5413094.42	
		WP 13	519540.12	5413087.47	
		WP 14	519577.40	5413080.93	
		WP 15	519639.84	5413091.04	
		WP 16	519738.69	5413091.17	
		WP 17	519888.08	5413088.36	
		WP 18	520870.21	5413075.06	
Coastal Lagoon	5/18/11	WP 19	519660.51	5411553.39	
		WP 20	519629.93	5411573.51	
		WP 21	519597.86	5411577.07	
		WP 22	519663.44	5411556.06	
		WP 23	519656.98	5411555.49	
		WP 24	519654.62	5411559.03	
		WP 25	519645.66	5411563.23	Stickleback (30)
		WP 26	519464.46	5411630.85	Stickleback (10)
		WP 27	519384.51	5411673.70	
		WP 28	519364.93	5411672.52	
		WP 46	519658.26	5411548.15	

Notes
1 GPS waypoints recorded with a handheld Garmin Colorado 400t.
2 No data provided for Waypoints 1 through 4 (user training).



LEGEND

- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- STREAM AND DRAINAGE FLOW DIRECTION
- WETLAND FLOW DIRECTION
- SURVEYED STREAM FOR FISH PRESENCE
- EXISTING WETLAND AREA
- PROPERTY BOUNDARY
- PROJECT AREA BOUNDARY

Pacific International Terminals
A Cermix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	JG
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,000 feet

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: WETLANDS AND DRAINAGES WITHIN THE GATEWAY PACIFIC TERMINAL PROJECT SITE

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 7

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-04-04 - Fish and Stream Report\dwg\Revised\Figure 7 - Surveyed Streams and Water Features 2011.mxd

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LEGEND

FISH SURVEY LOCATION:

- CHUM
- COHO
- COHO & STICKLEBACK
- NO FISH PRESENCE
- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- WETLAND FLOW DIRECTION
- STREAM AND DRAINAGE FLOW DIRECTION
- SURVEYED STREAM FOR FISH PRESENCE
- EXISTING WETLAND AREA
- PROJECT AREA BOUNDARY

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A Gentix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

DWN BY:	SD
CHK'D BY:	JG
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 300 feet

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: STREAM 1 FIELD SURVEY FOR FISH PRESENCE - 2011

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 8

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LEGEND

FISH SURVEY LOCATION:

- CHUM
- COHO
- COHO & STICKLEBACK
- STICKLEBACK
- NO FISH PRESENCE
- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- WETLAND FLOW DIRECTION
- STREAM AND DRAINAGE FLOW DIRECTION
- SURVEYED STREAM FOR FISH PRESENCE
- EXISTING WETLAND AREA
- PROJECT AREA BOUNDARY

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A Cerrix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

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

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: STREAM 2 & COASTAL LAGOON FIELD SURVEY FOR FISH PRESENCE - 2011

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 9

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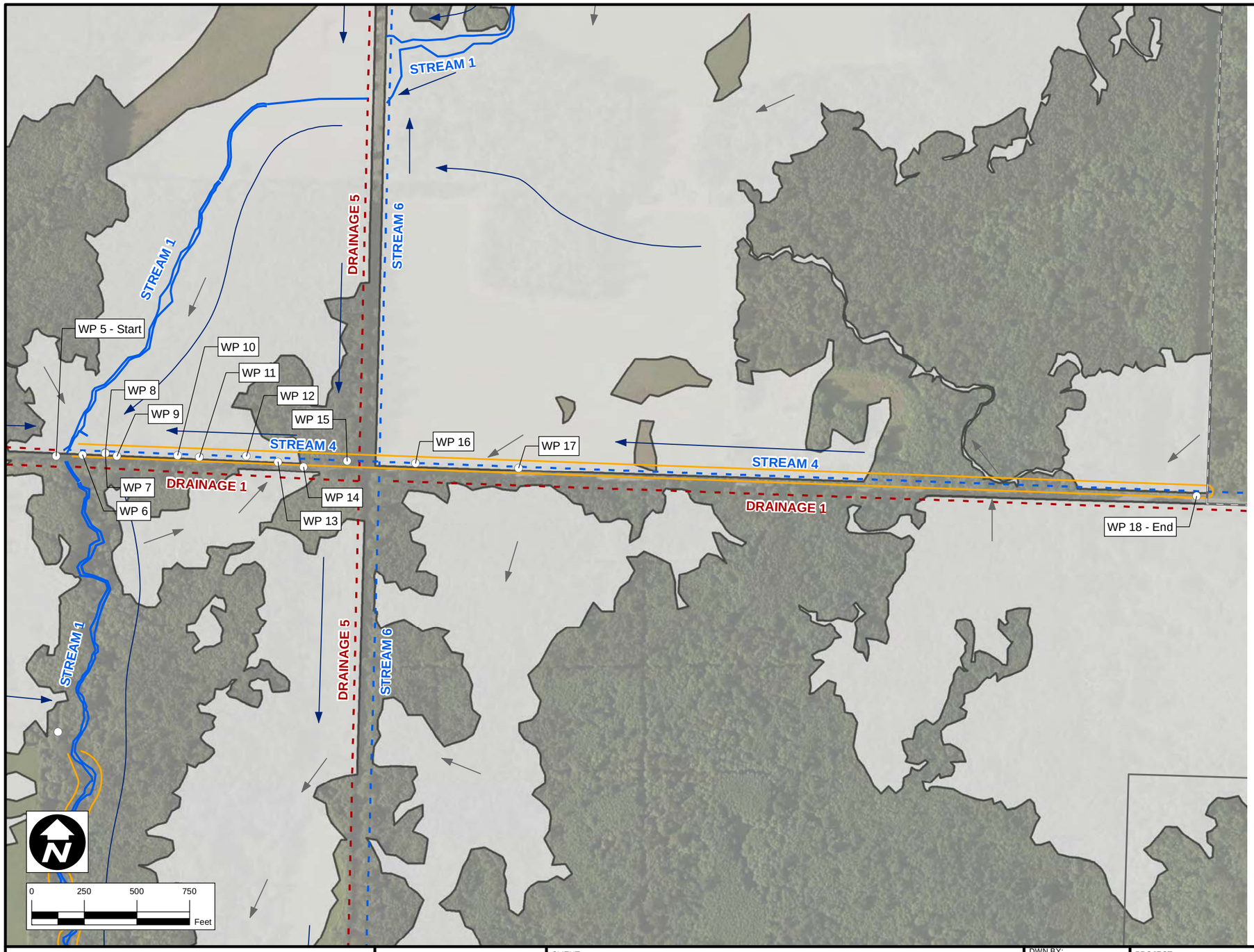

LEGEND

FISH SURVEY LOCATION:

- NO FISH PRESENCE
- APPROXIMATE DRAINAGE
- APPROXIMATE STREAM
- SURVEYED STREAM
- WETLAND FLOW DIRECTION
- STREAM AND DRAINAGE FLOW DIRECTION
- SURVEYED STREAM FOR FISH PRESENCE
- EXISTING WETLAND AREA
- PROPERTY BOUNDARY
- PROJECT AREA BOUNDARY

Pacific International Terminals
A Cantex Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC
11810 North Creek Parkway N
Bothell, WA 98011

amec

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

PROJECT: GATEWAY PACIFIC TERMINAL

TITLE: STREAM 4 FIELD SURVEY FOR FISH PRESENCE - 2011

DATE:	APRIL 2012
PROJECT NO.:	091515338C-04-04
REV. NO.:	-
FIGURE NO.:	FIGURE 10

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-04-04 - Fish and Stream Report\dwg\Revised\Figure 10 - Stream 4 Field Survey.mxd

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It's important to note that continuous surface flows in Stream 1 did not occur until the November 30 field survey. Climatic data from the National Water and Climate Center (USDA-NRCS, 2002) were subsequently analyzed to determine if normal precipitation conditions existed during the survey period. Since Stream 1 receives groundwater and surface inputs throughout its reach, abnormal precipitation levels may cause uncharacteristic low flows that could undermine fish use and presence in Stream 1 during this survey period. Precipitation can be considered "normal" when it falls between the 30th and 70th percentiles of the 30-year average monthly precipitation totals (Spreecher and Warne 2000). Precipitation patterns at the weather station in Blaine, Washington (Station ID KWABLAIN13, accessed January 30, 2012) were evaluated by comparing monthly precipitation data for the 2011/2012 water year to the monthly precipitation averages from 1971 through 2001. Precipitation amounts from August 2011 to January 2012 were considered low using this methodology, because rainfall amounts were below the 30th percentile for the corresponding months (Table 17). Regardless of the low precipitation amounts during the monitoring period, no salmon were observed between November 30 and February 2 when surface water was present in Stream 1.

Table 17 2011 – 2012 Monthly Precipitation versus 30-Year (1971 – 2001) Average Monthly Precipitation

Month	Average (inches)	30% Chance precipitation less than (inches)	30% Chance precipitation greater than (inches)	2011-2012 Monthly Total (inches)	Dry, Normal, or Wet?
January 2011	5.32	3.83	6.28	6.81	Wet
February 2011	4.21	2.82	5.04	2.20	Dry
March 2011	3.60	2.87	4.14	3.02	Normal
April 2011	2.85	2.09	3.35	3.72	Wet
May 2011	2.58	1.72	3.09	4.13	Wet
June 2011	2.14	1.38	2.57	1.00	Dry
July 2011	1.49	0.86	1.81	1.00	Normal
August 2011	1.51	0.62	1.86	0.42	Dry
September 2011	1.82	0.94	2.22	0.62	Dry
October 2011	3.67	2.58	4.35	1.97	Dry
November 2011	6.29	4.70	7.36	4.08	Dry
December 2011	5.78	4.42	6.71	2.01	Dry
January 2012	5.32	3.83	6.28	2.97	Dry

4.5 CONCLUSION

This report documents the fish species present within the study area, the life stages and size ranges of fish observed during field surveys, and the habitat conditions of streams within the study area. Streams 1, 2, 4, and the coastal lagoon were targeted for survey based on the likelihood of fish using

those streams. All surveyed streams are located in what is currently identified as the Gateway Pacific Terminal Watershed, which drains to the Strait of Georgia.

Stream habitat surveys were conducted in 2008 using the NOAA Fisheries Matrix of Pathways and Indicators (NOAA Fisheries 1996). The survey resulted in characterization of Stream 1 as properly functioning with regard to LWD accumulation and channel condition/dynamics. Stream 1 was not properly functioning with regard to habitat access as a result of physical barriers, substrate composition, or overall watershed conditions as indicated by the riparian corridor. Roadside streams 4, 5, and 6, and roadside drainages 1, 3, and 5, were characterized as not in properly functioning condition.

The fish presence survey in 2011 documented juvenile coho and chum salmon in Stream 1, three-spine stickleback in the coastal lagoon, and no fish species in Streams 2 and 4. Streams were thoroughly surveyed for fish presence via electrofishing and field identification by field staff.

The 2011-2012 salmonid spawner and redd surveys documented no use of Stream 1 by spawning salmonids during the monitoring period.

5.0 IDENTIFIED RESTORATION OPPORTUNITIES

This section identifies potential habitat restoration and improvement opportunities that could enhance stream habitats at the Gateway Pacific Terminal site.

5.1 STREAM 1

Habitat restoration opportunities, such as strategically placing gravels and reducing the amount of sediment entering the stream from the watershed, would potentially increase the amount of suitable salmonid spawner habitat on Stream 1, and provide an ecological lift to the stream system by enhancing accessibility and habitat functions (Saldie-Caromile et al. 2004). Potential restoration opportunities along Stream 1 include:

- Replacement of culverts to permit fish passage further upstream;
- Rerouting of ditches at the site back into Stream 1's historic channels in order to restore natural hydrologic conditions, to potentially increase baseflow rates, and to indirectly improve substrate conditions;
- Preservation of the riparian corridor to allow for natural succession of vegetation; and
- Installation of habitat gravel.

In order to restore habitat connectivity in Stream 1, culverts underneath Henry Road and Gulf Road could be replaced with structures that allow for fish passage. Reach 2 is inaccessible to salmonids from Reach 1 because of the perched culvert under Henry Road. Replacing the culvert underneath Lonseth Road would reconnect Reach 2 to Reach 3.

The headwaters of Stream 1 could be restored by rerouting roadside ditches through historical channels that traditionally formed Stream 1. Natural hydrological conditions in Stream 1 would be restored as more water is retained on site to feed Stream 1 throughout the year. Restoring the headwaters could substantially enhance fish habitat throughout Stream 1 by deepening the stream channel, providing increased year-round flows, and reducing sedimentation downstream.

5.2 ROADSIDE STREAMS AND DRAINAGES

While all of the roadside conveyances produce a defined channel or bed, none occur in locations where natural streams existed prior to human alteration. The roadside ditches were constructed to hold water displaced by the installation of roadways through wet areas. The historical alterations have resulted in very poor habitat conditions for fish in these roadside ditches. Multiple restoration opportunities are available for these water bodies if they can be rerouted into natural stream courses rather than roadside ditches. However, no restoration opportunities exist as long as they are maintained on a regular basis for the purpose of managing County roads.

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APPENDIX A

Correspondence

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Scott Boettcher

From: Dunkin, Kristie A <Kristie.Dunkin@amec.com>
Sent: Friday, May 13, 2011 9:29 AM
To: Scott Boettcher; Dewell, Jane (ORA)
Subject: FW: GPT- Stream Determination
Attachments: GPT Watercourse Determiniatin - HPA.pdf

See attached and below for WDFW stream designations

From: Williams, Brian W (DFW) [mailto:Brian.Williams@dfw.wa.gov]
Sent: Wednesday, April 27, 2011 3:01 PM
To: Dunkin, Kristie A
Subject: GPT- Stream Determination

Kristie,

WDFW has reviewed the watercourse designations presented on Figure 5-10 of the PID and offer the following comments for your consideration.

WDFW's Hydraulic Code authority, as defined by 77.55 RCW and Chapter 220-110 WAC, is limited to natural watercourses and natural watercourses that have been altered artificially.

Guided by the requirements and definitions of Chapter 77.55 RCW and Chapter 220-110 WAC, WDFW staff typically consider a wide range of information in determining whether a watercourse is a natural watercourse, a natural watercourse that have been altered artificially, or a wholly artificial watercourse. To determine the status of a watercourse, WDFW staff typically assesses the current and historical state, including any alterations by humans. For each watercourse, WDFW staff may consider some or all of the following sources of information:

A. ORIGIN OR SOURCE OF THE WATER
The character of the watershed and water sources supporting the flows in the watercourse.

B. DOWNSTREAM CONNECTIVITY
The pathway of a watercourse from the headwater areas of its watershed to its confluence with a significant watercourse or water body.

C. PHYSICAL CHARACTERISTICS
The extent to which the watercourse exhibits characteristics common to natural watercourses, such as being in dynamic equilibrium between erosion and deposition driven by hydraulic processes, having a channel with a defined bed and bank that moves and sorts sediments or bedload, and fluctuations in water discharge that results in changes in the width, depth, velocity, and sediment transport.

D. HISTORICAL EVIDENCE
Chapter 77.55 RCW does not limit the extent of the historic record that can be considered in determining whether a watercourse is natural, wholly artificial, or altered artificially. WDFW Regional staff used several methods to examine the historic timeline of the watercourses.

1) Light Detection and Ranging (LIDAR): a recent remote sensing technology that provides evidence of geomorphic processes on the landscape over a much longer time period (geologic timeline) than defined by the petitioners. LIDAR data are collected with aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and have a vertical precision of 15 centimeters (6 inches). LIDAR creates a high resolution three-dimensional characterization of site topography by rapidly pulsing laser light to the surface of the earth and measuring the time of pulse return. Millions of data points can be collected within minutes and hundreds of thousands of data points can be collected per square mile. Therefore, LIDAR is much more sensitive than traditional aerial photography and mapping technology.
2) Geomorphology: the study of how landforms evolved. It provides a science based foundation upon which to understand historic land forming processes and conditions in the Skagit River delta.
3) Soil survey data: examining the soil types in the vicinity of the watercourses provides insights into the historic conditions in the context of a geologic time scale rather than the much shorter historic timeline identified by the petitioners.
4) General Land Office (GLO) Survey maps and field notes: survey data that provide important historical reference, but the data contained in these surveys have limitations.
5) United States Coast and Geodetic Survey (USC&GS) charts: charts submitted as evidence by the petitioners.

In consultation with the Whatcom County Planning Department Based and based on our review of the available data for the GPT project site, WDFW has concluded that the Hydraulic Code, as defined by 77.55 RCW and Chapter 220-110 WAC , is limited to the watercourses highlighted in green on the attached figure.

If you have any questions, please call me at 360-466-4345 extension 250.

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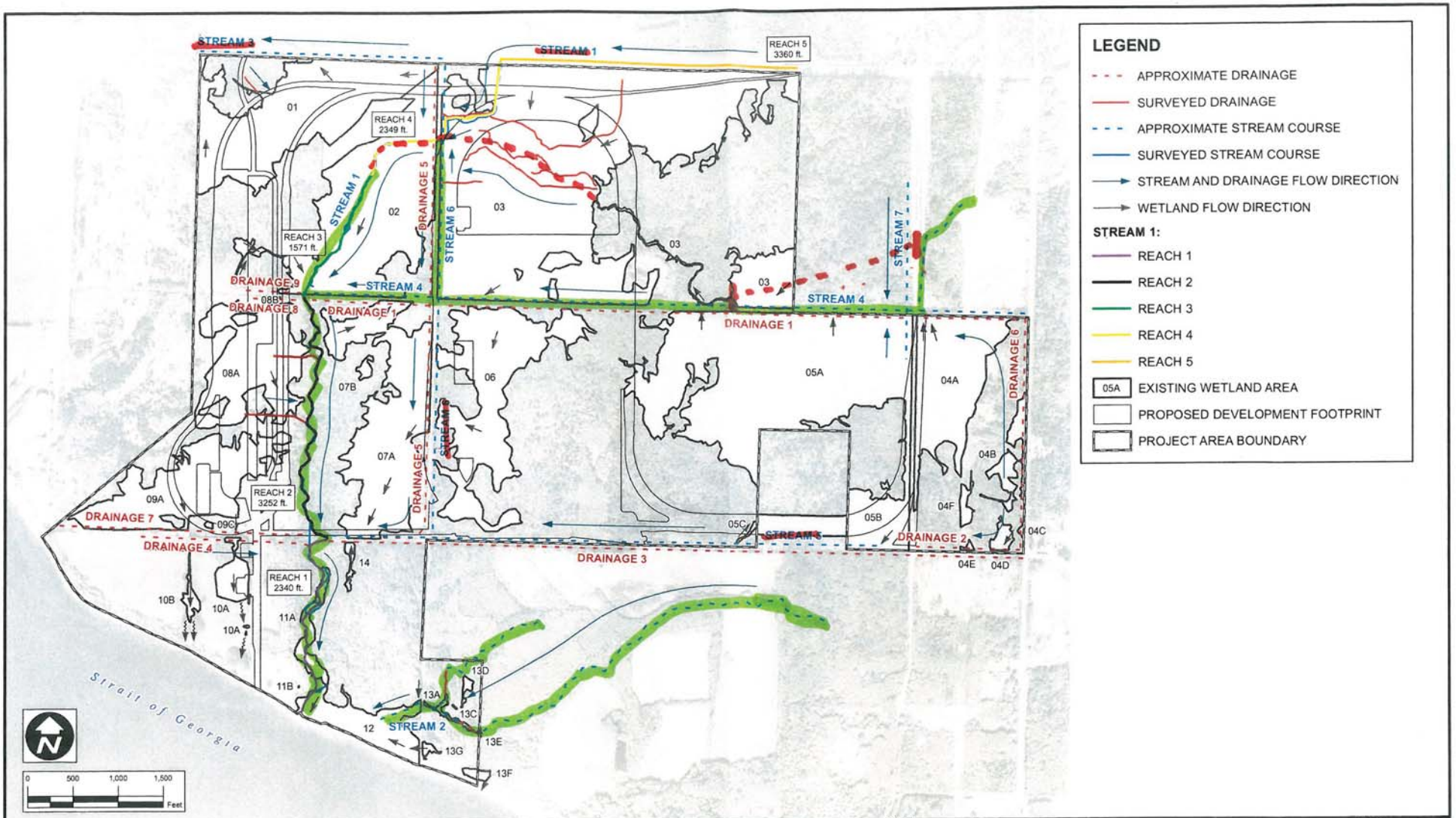

Pacific International Terminals

CLIENT:	PACIFIC INTERNATIONAL TERMINALS, INC.
DWN BY:	SD
CHK'D BY:	KD
DATUM:	NAD83
PROJECTION:	WA SP North, Ft.
SCALE:	1 inch = 1,000 feet
PROJECT:	PROPOSED GATEWAY PACIFIC TERMINAL
TITLE:	EXISTING CONDITIONS STREAM NETWORK, WETLANDS, AND HYDROLOGIC FLOW
DATE:	FEBRUARY 2011
PROJECT NO.:	091515336C-18-01
REV. NO.:	1
FIGURE NO.:	FIGURE 5-10

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): 4 March 2009

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Seattle District – Pacific International Terminals, NWS-2008-260-NO

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State: WA County/parish/borough: Whatcom City: Ferndale
Center coordinates of site (lat/long in degree decimal format): Lat: 48.8704º Long. -122.73657º
Universal Transverse Mercator: Zone 10 N E
Name of nearest waterbody: Strait of Georgia
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Strait of Georgia
Name of watershed or Hydrologic Unit Code (HUC): 17110002, Strait of Georgia
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: 11 February 2008
☐ Field Determination. Date(s): 23 & 24 March 2008 and 6 November 2008

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.
There **Are** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area.
☒ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.
There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☒ TNWs, including territorial seas
   ☒ Wetlands adjacent to TNWs
   ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☒ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☒ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☒ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 15.17 linear mile: 3' average width (ft) and/or 5.52 acres.
   Traditional Navigable Waters: 20 acres
   Wetlands: 529.12 acres

   c. **Limits (boundaries) of jurisdiction** based on:
   Wetlands - 1987 Delineation Manual
   Elevation of established OHWM (if known): Varies.
   Elevation of established MHHW (if known): 9.08' (MLLW datum).
   Elevation of established MHWM (if known): 8.21' (MLLW datum).

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain:

---

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW

Identify TNW: Strait of Georgia

Summarize rationale supporting determination: The Strait of Georgia is a tidal waterbody used for interstate and foreign commerce.

2. Wetland adjacent to TNW

Summarize rationale supporting conclusion that wetland is "adjacent": According to information provided by the applicant and direct observation during site visits, Wetlands 10A, 10B, 11B, 12, 13F, and 13G are contiguous to or bordering the Strait of Georgia.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under Rapanos have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

Streams 1, 2, 3, 4, 5, 6, and 7 and Drainages 1, 3, 4, 7, 8, and 9 are seasonal RPWs; Drainages 2, 5, and 6 are non-RPWs

(i) General Area Conditions:

Watershed size: 955 **square miles**

Drainage area: 1,800 **acres**

Average annual rainfall: 36.00 inches

Average annual snowfall: 8 inches

(ii) Physical Characteristics:

(a) Relationship with TNW:

☒ Stream 1 flows directly into TNW.

☒ Streams 2, 4, 5, and 6 and Drainages 4, 5, 7, 8, and 9 flow through **1** tributary before entering TNW.

☒ Stream 7 and 3 and Drainage 1 flow through **2** tributary before entering TNW.

☒ Drainages 2 and 6 flow through **3** tributary before entering TNW.

Project waters are **1-2** river miles from TNW.

Project waters are **1 (or less)** river miles from RPW.

Project waters are **1-2** aerial (straight) miles from TNW.

Project waters are **1 (or less)** aerial (straight) miles from RPW.

Project waters cross or serve as state boundaries. Explain: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

Identify flow route to TNW[5]:
Stream 1 flows into the Strait of Georgia.
Stream 2 flows into Wetland 12, which is adjacent to the Strait of Georgia.
Stream 3 flows offsite to the west and into an unnamed tributary of the Strait of Georgia
Stream 4 flows into Stream 1, which flows into the Strait of Georgia.
Stream 5 flows into Stream 1, which flows into the Strait of Georgia.
Stream 6 flows into Stream 1, which flows into the Strait of Georgia.
Stream 7 flows into Stream 4, which flows into Stream 1, a tributary of the Strait of Georgia.

Drainage 1 flows into Stream 6 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 2 flows into Wetland 5B which abuts Stream 5, a tributary of Stream 1, which flows into the Strait of Georgia.
Drainage 3 flows into Drainage 4, a tributary of Stream 1, which flows into the Strait of Georgia.
Drainage 4 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 5 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 6 flows into Drainage 1, a tributary of Stream 6 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 7 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 8 flows into Stream 1, which flows into the Strait of Georgia.
Drainage 9 flows into Stream 1, which flows into the Strait of Georgia.

Tributary stream order, if known: 1st for Streams 2, 3, 5, 6, and 7 and Drainages 2, 3, 4, 5, 6, 7, 8, and 9. 2nd for Streams 1 and 4 and for Drainage 1.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☒ Natural - Stream 1and 2
☒ Artificial (man-made). Explain: Remaining Streams and Drainages are man-made ditches excavated in upland and wetland soils. Artificial features have replaced historic natural drainages in the project vicinity.
☐ Manipulated (man-altered). Explain: .
Tributary properties with respect to top of bank (estimate):
Average width: 3.5 feet
Average depth: 2 feet
Average side slopes: **2:1**.

Primary tributary substrate composition (check all that apply):
☒ Silts ☒ Sands ☐ Concrete
☐ Cobbles ☒ Gravel ☐ Muck
☐ Bedrock ☒ Vegetation. Grass species, 75% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: Stable.
Presence of run/riffle/pool complexes. Explain: None.
Tributary geometry: **Meandering** for Streams 1and 2; : **Relatively straight** for remaining Streams and Drainages
Tributary gradient (approximate average slope): 3 %

(c) Flow:
Tributaries provide:
Streams 1, 2, 3, 4, 5, 6, and 7 and Drainages 1, 3, 4, 7, 8, and 9: **Seasonal flow**
Drainages 2, 5, and 6: **Intermittent but not seasonal flow**

Estimate average number of flow events in review area/year:
Streams 1, 2, 3, 4, 5, 6, and 7 and Drainages 1, 3, 4, 7, 8, and 9: **2-5**
Drainages 2, 5, and 6: **6-10**

Describe flow regime:
Streams 1, 2, 3, 4, 5, 6, and 7 and Drainages 1, 3, 4, 7, 8, and 9: Continuous flow for approximately 3 - 5 months with additional periodic flow in response to precipitation.
Drainages 1, 3, 4, 7, 8, and 9: Continuous flow during extreme wet season (December-January) with additional periodic flow in response to precipitation
Other information on duration and volume: .

Surface flow is: **Pick List.**
Characteristics: Surface flows contained within stream and ditch channels.
Subsurface flow: **Unknown**. Explain findings: .
☐ Dye (or other) test performed: .

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

Tributaries have (check all that apply):

☒ Bed and banks

☒ OHWM[6] (check all indicators that apply):

- ☒ clear, natural line impressed on the bank
- ☐ changes in the character of soil
- ☒ shelving
- ☒ vegetation matted down, bent, or absent
- ☐ leaf litter disturbed or washed away
- ☒ sediment deposition
- ☐ water staining
- ☐ other (list):
- ☒ the presence of litter and debris
- ☒ destruction of terrestrial vegetation
- ☐ the presence of wrack line
- ☐ sediment sorting
- ☒ scour
- ☐ multiple observed or predicted flow events
- ☐ abrupt change in plant community

☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☒ High Tide Line indicated by:

- ☐ oil or scum line along shore objects
- ☐ fine shell or debris deposits (foreshore)
- ☐ physical markings/characteristics
- ☐ tidal gauges
- ☐ other (list):

☒ Mean High Water Mark indicated by:

- ☐ survey to available datum;
- ☐ physical markings;
- ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:

Characterize tributaries (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: Water is usually clear and water quality is fair. Tributaries convey water from natural sources and runoff from agricultural/residential/industrial lands and roads.

Identify specific pollutants, if known: herbicides/fertilizers and petrochemicals (oil from roads).

(iv) Biological Characteristics. Channel supports (check all that apply):

☒ Riparian corridor. Characteristics (type, average width): Forested corridor for Streams 1 and 2; Corridor for remaining Streams and Drainages limited by development (roads, pastures, etc.); primarily herbaceous with shrub cover.

☒ Wetland fringe. Characteristics: wetland fringes of tributaries are primarily PEM dominated by grass species. PSS/PFO in scattered spots

☒ Habitat for:

☐ Federally Listed species. Explain findings: .

☒ Fish/spawn areas. Explain findings: Per WDFW data, Stream 1 may be utilized by Pacific salmon (coho). Pacific salmon habitat is designated as Essential Fisheries Habitat under the Magnuson-Stevens Fishery Conservation and Management Act

☐ Other environmentally-sensitive species. Explain findings: .

☒ Aquatic/wildlife diversity. Explain findings: Diversity of aquatic species in Stream 1 rated moderate by WA Department of Fish & Wildlife..

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW
Wetlands 4F, 5B, 5C, 7B, 9C, 13C, 13D, and 13E are adjacent to seasonal RPWs; Wetlands 4B are 4C are adjacent to non-RPWs

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: 10 wetlands totaling 8.91 acres

Wetland type. Explain: depressional PEM and depressional and slope PSS/PFO

Wetland quality. Explain: Wetlands rated as Category III and IV per WA State wetland Rating System (based on a scale of I to IV, I being the highest functioning). Wetlands were previously used for agriculture or disturbed by logging.

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Ephemeral flow**. Explain: Water flows from wetlands to tributaries ditches during heavy rain events.

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.

[7] Ibid.

Surface flow is**: Pick List**
Characteristics: Wetlands abutting ditches; accumulated water flows from deeper areas of wetlands to drainage ditches and streams via discreet flow paths.

Subsurface flow: **Unknown**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☒ Not directly abutting
☒ Discrete wetland hydrologic connection. Explain: accumulated water flows from deeper areas of wetlands to drainage ditches via discreet flow paths.
☒ Ecological connection. Explain: Some wetlands connected to drainages by continuum of hydric soils and by downslope flows across wetland and upland areas.
☒ Separated by berm/barrier. Explain: Some wetlands separated from ditch by fill from human activities (ditch cleaning, upland site improvements, etc.). Wetlands meet definition of "adjacent" found at 33 CFR 238.3(c).

(d) Proximity (Relationship) to TNW
Project wetlands are **1-2** river miles from TNW.
Project waters are **1 (or less)** aerial (straight) miles from TNW.
Flow is from: **Wetland to navigable waters.**
Estimate approximate location of wetland as within the **100 - 500-year** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: Water is clear with some organic material load.
Identify specific pollutants, if known: pesticides, fertilizers.

(iii) Biological Characteristics. Wetland supports (check all that apply):
☒ Riparian buffer. Characteristics (type, average width): Widths vary, herbaceous and shrub/forested cover
☒ Vegetation type/percent cover. Explain: PEM - grass species 95%; shrub species 5%.
PSS/PFO - Shrub species 65%, tree species 15%, herbaceous 20%
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributaries (if any)
All wetland(s) being considered in the cumulative analysis: **25-30**
529.14 acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Wetland	Directly abuts? (Y/N)	Size (in acres)	Wetland	Directly abuts? (Y/N)	Size (in acres)
1	Y	44.21	9B	N	0.11
2	Y	53.28	10A	Y	3.73
3	Y	144.37	10B	Y	1.09
4A	Y	26.62	11A	Y	3.54
4B	Y	4.36	11B	Y	0.003
4C	Y	0.15	12	Y	11.17
5A	Y	95.24	13A	Y	5.50
5C	N	0.22	13C	N	0.02
6	Y	36.93	13D	N	0.37
7A	Y	40.06	13E	Y	0.06
8A	Y	24.79	13F	Y	0.62
8B	Y	0.15	13G	Y	0.37
9A	Y	28.24	14	Y	0.67
4D	N	1.31	4E	N	0.17
4F	N	1.07	5B	N	0.13
7B	N	0.59			

Summarize overall biological, chemical and physical functions being performed: See Section C below.

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For

each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:

   Subject wetlands and non-RPWs have a significant nexus to downstream TNW.

   Subject reaches includes Drainages 2, 5, and 6 and associated wetlands. Drainages 2, 5, and 6 connect to Stream 1 and convey water from site wetlands, uplands, and road runoff. Watershed has been moderately developed for agricultural, industrial, and residential uses. Essential Fish Habitat for Pacific salmon (designated under the Magnuson-Stevens Fishery Conservation and Management Act) extends from the TNW (Strait of Georgia) upstream into Stream 1. Fish species listed under the Endangered Species Act utilize the waters of the Strait of Georgia; designated critical habitat for Chinook salmon, bull trout, and killer whales exists in the project vicinity (Strait of Georgia).

   The tributaries have the capacity to carry pollutants (herbicides and pesticides from agriculture, oil and grease from road runoff) or flood waters to a TNW. The lengthy vegetated tributaries have the capacity to capture pollutants (herbicides and pesticides from agriculture, oil and grease from road runoff) to reduce the amount of pollutants, sediments or flood waters from reaching a TNW and provide detention for water and reduces velocity of water entering the TNW.

   Wetland functions are moderate to high wildlife habitat and habitat diversity, moderate to high enhanced food web support, moderate floodwater storage/attenuation, and moderate sediment input reduction and toxin removal.

   The tributaries in combination with their adjacent and abutting wetlands provide downstream habitat and lifecycle support functions for fish. The wetlands create and transfer organic carbon which supports the downstream food web of the TNW. Wetlands improve downstream water quality in TNW through sediment and toxin interception. The lengthy vegetated tributaries with wetland complexes have the capacity to capture pollutants (agricultural herbicides/pesticides, road runoff, and sediments) to reduce the amount of pollutants, sediments and flood waters from reaching the TNW. Wetlands attenuates downstream flooding by reducing peak flow in the watershed during major storm events and attenuates erosion by detaining high flows during storms and reduce the duration of erosive flows, thus decreasing downstream erosion in streams.

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

   Subject wetlands and RPWs have a significant nexus to downstream TNW.

   Subject reaches includes Streams 1 and 2, their tributaries, and their associated wetlands. Watershed has been moderately developed for agricultural, industrial, and residential uses. Essential Fish Habitat for Pacific salmon (designated under the Magnuson-Stevens Fishery Conservation and Management Act) extends from the TNW (Strait of Georgia) upstream into Stream 1. Fish species listed under the Endangered Species Act utilize the waters of the Strait of Georgia; designated critical habitat for Chinook salmon, bull trout, and killer whales exists in the project vicinity (Strait of Georgia).

Wetland functions are moderate to high wildlife habitat and habitat diversity, moderate to high enhanced food web support, moderate floodwater storage/attenuation, and moderate sediment input reduction and toxin removal.

The tributaries in combination with their adjacent wetlands provide downstream habitat and lifecycle support functions for fish. The wetlands create and transfer organic carbon which supports the downstream food web of the TNW. Wetlands improve downstream water quality in TNW through sediment and toxin interception. The lengthy vegetated tributaries with wetland complexes have the capacity to capture pollutants (agricultural herbicides/pesticides, road runoff, and sediments) to reduce the amount of pollutants, sediments and flood waters from reaching the TNW. Wetlands attenuates downstream flooding by reducing peak flow in the watershed during major storm events and attenuates erosion by detaining high flows during storms and reduce the duration of erosive flows, thus decreasing downstream erosion in streams.

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☒ TNWs: linear feet width (ft), Or, 20 acres.
   ☒ Wetlands adjacent to TNWs: 16.98 acres (Wetlands 10A, 10B, 11B, 12, 13F, 13G).

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide rationale indicating that tributary flows seasonally: .
   ☒ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: Per information provided by the consultant, all site streams and drainages (ditches) have a continuous flows for at least 3 months out of the year.

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☒ Tributary waters: 13.07 linear mile: 3' average width (ft) and/or 4.75 acres.
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☒ Tributary waters: 2.10 linear mile: 3' average width (ft) and/or 0.76 acres.
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: **.**

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☒ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☒ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above.

   ☒ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **The document titled "*Wetland Determination and Delineation, Gateway pacific Terminal Property, Whatcom County, Washington,*" dated 22 February 2008 identifies some wetland boundaries extending to the edge of the unnamed tributaries with no intervening uplands, berms, etc. Site visits to the subject property confirmed the connections.**

   Provide acreage estimates for jurisdictional wetlands in the review area: 504.25 acres (Wetlands 1, 2, 3, 4A, 5A, 6, 7A, 7B, 8A, 8B, 9A/B, 11A, 13A, 13E, and 14).

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☒ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: 3.40 acres (Wetlands 4D, 4E, 4F, 5B, 5C, 9C, 13C, 13D).

[8]See Footnote # 3.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   ☒ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: **4.51** acres (Wetlands 4B and 4C).

7. **Impoundments of jurisdictional waters.**[9]
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: Wetland delineation report dated 22 February 2008.
- ☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☒ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☐ U.S. Geological Survey Hydrologic Atlas: .
  - ☐ USGS NHD data.
  - ☐ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: 7.5 minute Lummi Bay and Blaine Quads
- ☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
- ☐ National wetlands inventory map(s). Cite name: .
- ☒ State/Local wetland inventory map(s): WA State Department of Ecology, 2001
- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): WA State Department of Ecology, 2005.
  or ☐ Other (Name & Date): .
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: .
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD:

1. **Site Description and Significant Resources in the area:** The site consists of 1,092 acres of mostly undeveloped industrial zoned land in the vicinity of Cherry Point in Whatcom County. Roughly rectangular in shape, the site is bounded by an oil refinery to the north, undeveloped and agricultural lands to the east and west, and by the Strait of Georgia to the south. A portion of the site has been historically used for agricultural activities (pasturage); the project vicinity has been moderately developed for agricultural, industrial, and residential uses. The terrain throughout the study area is characterized as generally flat to gently rolling slopes. Elevations range from sea level to 210 feet. The highest portion of the study area occurs nearest the eastern property boundary, with site elevation gradually decreasing to the west and to the south. Moderate slopes and steep bluffs border the westernmost stretch of shoreline. A steep ravine lies in the south central portion of the study area. Property generally trends from north and northeast to the south. The site contains three natural streams (Streams 1, 2, and 4) and 11 manipulated drainages (ditches), all flowing into the Strait of Georgia. Artificial features have replaced historic natural drainages in the project vicinity. A wetland delineation of the site identified 31 wetlands. Wetlands are PEM (wet pasture), PSS, and PFO systems.

2. **Project Purpose and Description:** Fill/grade associated with construction of industrial facilities.

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[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

3. Physical / Chemical Characteristics:

a. Streamflow c.f.s.: NA

b. Salinity: NA

c. Soils:

Birchbay silt loam - 0-3% slopes and 3-8% slopes (non-hydric with hydric inclusions)
Whitehorn silt loam - 0-2% slopes (hydric)
Kickerville silt loam - 3-8% slopes (non-hydric with hydric inclusions)
Neptune very gravelly sandy loam - 0-3% slopes (non-hydric)
Whatcom silt loam - 30-60% slopes (non-hydric with hydric inclusions)

Wetlands
10 YR 2/1 silt loam
10YR 2/2 sandy loam with 7.5YR 5/6 redox features
10YR 3/2 sand loam with 5YR 4/4 redox features

Uplands
10YR 3/3 silt loam
10YR 3/3 sandy loam

d. Hydrology: Saturation at shallow depth and signs of inundation at center of forested wetlands.

4. Biological Characteristics:

a. Percentage of dominant vegetation FAC or wetter: 85% in wetlands

b. Vegetation species list:

PEM (Meadow) Wetlands
Bentgrass (*Agrostis* sp) FACW-FACU
Meadow foxtail (*Alopecurus pratensis*) FACW
Sweet vernal grass (*Anthoxanthum odoratum*) FACU
Tall buttercup (*Ranunculus acris*) FACW

PSS Wetlands
Nootka rose (*Rosa nutkana*) FAC
Douglas spirea (*Spiraea douglasii*) FACW
Himalayan blackberry (*Rubus armeniacus*) FACU
Salmonberry (*Rubus spectabilis*) FAC
Lady fern (*Athyrium filix-femina*) FACW
Slough sedge (*Carex obnupta*) OBL
Pacific silverweed (*Potentilla pacifica*) OBL
Stinging nettle (*Urtica dioica*) FAC+

PFO Wetlands
Red alder (*Alnus rubra*) FAC
Black cottonwood (*Populus trichocarpa*) FAC
Western red cedar (*Thuja plicata*) FAC
Twinberry (*Lonicera involucrate*) FAC
Salmonberry (*Rubus spectabilis*) FAC
Red-osier dogwood (*Cornus stolonifera*) FACW
Pacific willow (*Salix lucida*) FACW+
Sitka willow (*Salix sitchensis*) FACW

c. Fauna: birds (including turkey), coyote, small mammal presence.

d. NWI Classification, associations/communities: PEM, PSS, & PFO

5. Lateral Extent of Jurisdiction:

a. OHW, MHHW, MHW and datum: unidentified OHW for drainage ditches

b. Acreage of wetlands to be impacted: unknown

c. Total acreage of wetlands/waters on site: 554.47 acres

6. Conclusions: Areas are jurisdictional wetlands. Corps staff visited the site on 3 occasions. Extensive sampling verified the accuracy of the methods used by the consultants to establish wetland boundaries. After the 23 & 24 March 2008 visit, the consultants were asked to re-sample and redefine the boundaries of Wetlands 2 (SE portion) and 9 (between 9A and 9B, NE, and SE portions). Consultants provided a revised delineation on 30 July 2008. The area between wetlands 9A and 9B was determined to be a wetland, making 9A and 9B contiguous. Additional areas of wetlands were identified in the northeast corner of wetland 9A and on the east boundary of wetland 2. Corps staff verified the revisions during a site visit on 6 November 2008.

Streams 1, 2, 3, 4, 5, 6, and 7 and Drainages 1, 3, 4, 7, 8, and 9 are seasonal RPWs that are tributary to the Strait of Georgia, a tidal waterbody used for interstate and foreign commerce. Drainages 2, 5, and 6 are non-RPWs that have a significant nexus to the downstream waters of the Strait of Georgia. These tributaries are jurisdictional waters of the U. S.

Wetlands 10A, 10B, 11B, 12, 13F, 13G are adjacent to the Strait of Georgia, a tidal waterbody used for interstate and foreign commerce.
Wetlands 1, 2, 3, 4A, 5A, 6, 7A, 7B, 8A, 8B, 9A/B, 11A, 13A, 13E, 14 abut seasonal RPWs that are tributary to the Strait of Georgia
Wetlands 4D, 4E, 4F, 5B, 9C, 13C, and 13D, are adjacent to seasonal RPWs and, in combination with their associated tributaries, have a significant nexus to the downstream watrs of the Strait of Georgia.
Wetlands, 4B and 4C are adjacent to non-RPWs and, in combination with their associated tributaries, have a significant nexus to the downstream waters of the Strait of Georgia.
The wetlands listed above are jurisdictional water of the U. S.

7. **Attachments:** Jurisdictional map, wetland boundary map, aerial photos, WA state wetland inventory, topographic map, and site photos.

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APPENDIX B

Technical Memo – Re: Salinity Levels in the Coastal Lagoon

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Memorandum

To	Kristie Dunkin AMEC Environment & Infrastructure, Inc.	File no	Gateway Pacific Terminal #091515338C
		cc	
From	Jeff Gray AMEC Environment & Infrastructure, Inc.		
Date	April 19, 2012		

Subject Wetland 12 – Lagoon Classification

Wetland 12 was investigated to determine whether or not it classifies as a coastal lagoon per the 2008 Wetland Rating System for Western Washington (Hruby 2004). Site investigations occurred on 3 consecutive days from May 18 – 20, 2011. Conductivity and temperature readings were documented in standing pool locations at the top and bottom of the water column if total water depth exceeded 12 inches. Conductivity and temperature readings were measured in the middle of the water column in pool locations that were less than 12 inches deep. Salinity levels were derived using a conductivity and temperature conversion table based on the equation of P.K. Weyl (1964). Dominant vegetation species were visually surveyed and also recorded.

Per Section 5.0 - Special Characteristics of the 2008 Rating System (Hruby 2004), a wetland is classified as a coastal lagoon if it has specific characteristics, including:

1) It lies in a depression with open water adjacent to marine waters;
2) Unvegetated areas of lagoon contain water that is saline/brackish (>0.5 ppt); and
3) The lagoon retains some surface water at low tide during spring tides.

If the wetland meets all three qualifiers to be classified as a lagoon, then it can be rated as either a Category 1 or Category 2 wetland. Requirements for a Category 1 wetland lagoon include:

1) The wetland is relatively undisturbed;
2) 75% of wetland edge has a 100-foot buffer of shrub/forest/grassland; and
3) The wetland is larger than 0.1 acre.

If the wetland lagoon does not qualify as a Category 1 wetland, then it is automatically rated as a Category 2 wetland lagoon.

Results

Wetland 12 is a Category 1 wetland in a coastal lagoon. The data in Table 1 shows salinity levels in ponding areas in the lagoon greater than 0.5 ppt. The lagoon and wetland are located in a depression with open water adjacent to marine waters, and the system retained surface water at low tide as observed during the May 18 – 20, 2011 site visits. Highest salinity levels were documented closest to the shoreline, whereas measurements indicating freshwater conditions (<0.5 ppt) were recorded at the north end of the lagoon where Stream 2 flows into it. These salinity measurements indicate that this wetland is receiving saltwater intrusions either through periodic storm surges overtopping the barrier beach, or by lateral flow through the porous sediments of the beach.

Table 1 – Recorded data in the lagoon from May 18 – 20, 2011

Date	Location	Total Depth (in.)	S/B[1]	Temp. (*C)	Conductivity[2]	Salinity (ppt)[3]	GPS Waypoint
5/18/11	Just west of Gulf Rd (mid-tide); 3pm	24	S	17.3	351 (µS/cm)	<1.0	19
			B	16.4	3.40 (mS/cm)	2.2	
		6	-	17.9	249.1 (µS/cm)	<1.0	21
		16	S	17.2	398 (µS/cm)	<1.0	23
			B	15.6	1012 (µS/cm)	<1.0	
		18	S	20.3	432 (µS/cm)	<1.0	25
			B	15.3	868 (µS/cm)	<1.0	
	In stream channel through lagoon area	6	-	15.0	368 (µS/cm)	<1.0	26
5/19/11	Just west of Gulf Rd (low tide); 4pm	18	S	18.4	396 (µS/cm)	<1.0	46
			B	14.8	4.20 (mS/cm)	2.8	
5/20/11	Just west of Gulf Rd (mid-tide); 9am	18	S	13.8	428 (µS/cm)	<1.0	
			B	13.1	4.20 (mS/cm)	3.0	
	Back pond north of sitka rose line; 11am	10	-	13.9	1252 (µS/cm)	<1.0	

1 S/B = Temperature and conductivity levels recorded at the surface (S) or bottom (B) in the water column, depending on total depth.
2 µS/cm = microsiemens per centimeter; mS/cm = millisiemens per centimeter.
3 Data derived from the equation of Weyl (1964). Conversion table not rigorous enough for salinity levels below 1 ppt.

Dominant vegetation species identified in the lagoon include: saltgrass (*Distichlis spicata*), seacoast bulrush (*Scirpus maritimus*), Nootka rose (*Rosa nutkana*), and cattail (*Typha spp.).*

Other vegetation species identified in the lagoon include seaside arrowgrass (*Triglochin maritimum*), saltmarsh dodder (*Cuscuta salina*)*,* fat-hen (*Atriplex patula*), pickleweed (*Salicornia virginica*), water parsley (*Oenanthe sarmentosa*), spike-rush (*Eleocharis palustris*), speedwell (*Veronica spp.),* Pacific silverweed (*Potentilla pacifica*), and *Polygonum spp*.

Sources:

Hruby, T. 2004. Washington State Wetland Rating System for Western Washington – Revised. Ecology Publication # 04-06-025. Olympia, WA.

Weyl, P.K. 1964. On the change in electrical conductance of sea water with temperature. *Limnology and Oceanography*, 9(1), 75-78.

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APPENDIX C

Stream Fish and Habitat Survey Photographs

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Photo 1 – Chum salmon captured and identified at the logjam at the mouth of Stream 1 on May 19, 2011.

Photo 2 – Mouth of Stream 1 as it drains to the Strait of Georgia through the cobble-dominated shoreline on November 24, 2008.

Photo 3 – Mouth of Stream 1 as it drains to the Strait of Georgia on November 24, 2008. The ALCOA/Intalco wharf can be seen in the background.

Photo 4 – View facing upstream of Stream 1 as it flows from the forested setting, across the cobble beach, and into the Strait of Georgia. Photo taken on November 24, 2008.

Photo 5 – Pool on Reach 1 of Stream 1 during the fish habitat survey conducted November 24 and 25, 2008.

Photo 6 – Photo of Reach 1 on Stream 1 looking upstream on November 24, 2008. The thick, woody understory in the riparian corridor is typical of Reaches 1 and 2 on Stream 1.

Photo 7 – Photo of the typical riparian corridor along Reach 1 of Stream 1; recorded on November 25, 2008.

Photo 8 – Photo of Reach 3 on Stream 1 within the secondary growth, alder-dominated forested wetland.

APPENDIX D

Methods – 2008 Habitat Survey

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METHODS

Protocols and methodologies for assessing stream habitat in the Pacific Northwest have been developed by many Federal, State and Local agencies. Recently, King County conducted a habitat assessment of the main-stem of Juanita Creek that incorporated a variety of methods used by the agencies (King County 2002). Additionally, the U.S. Environmental Protection Agency (EPA) uses physical habitat assessment methods as a standard for collecting stream habitat data in its Environmental Monitoring and Assessment Program (EMAP). The methods used in the present habitat assessment of Stream 1 were modeled after a combination of the Juanita Creek study methods and the EPA's EMAP methods (Kaufmann et al. 1999).

FIELD METHODS

For the purpose of analysis, Stream 1 was subdivided into three reaches. Stream reaches were defined by fish passage barriers at the two culverted road crossings in the study area. The three reaches range in length from 1,571 to 3,252 feet. Cross sections were established in each reach to investigate riparian condition, human influence, habitat value and other parameters. Cross sections were established at systematically spaced intervals, approximately 300-feet apart, along the length of each reach.

CROSS SECTION CHARACTERIZATION

Stream characteristics were evaluated using a variety of techniques at cross sections along each reach. Riparian condition and canopy cover, large woody debris (LWD) abundance, bankfull width and depth, and human impacts including land use data were collected at each cross section. Photographs were also taken at each cross section to record the upstream, bank left, downstream, and bank right view.

Riparian Condition

Visual estimation was used to characterize the type and percent cover of riparian vegetation. This method, used to evaluate the condition and level of disturbance of the stream corridor, is based on the EMAP method. Following the EMAP field methods, the riparian vegetation was divided into three layers: a canopy layer (> 5 meters [m] high), an understory (0.5 to 5 m high), and a ground cover layer (< 0.5 m high). Dominant riparian vegetation was described for the right and left banks using the following categories:

- Forest (greater than 6 m in height): coniferous, deciduous, or mixed;
- Shrubs and vines;
- Tall herbaceous (e.g., unmowed field);

- Short herbaceous (e.g., mowed grass, pasture);
- Impervious (e.g., buildings, roads, asphalt, etc.); and
- Residential landscaped (mowed lawn with ornamental shrubs/trees).

It is important to note that in the forest category, layers were considered "mixed" if more than 10% of its areal coverage was made up of an alternate vegetation type. The four entry choices for cover within each of the three vegetation layers were "0" (absent: zero cover), "1" (sparse: < 10%), "2" (moderate: 10 to 40%), "3" (heavy: 40 to 75%), and "4" (very heavy: > 75%) (Kaufmann et al. 1999).

The density of the overstory canopy was estimated and measured with a spherical densiometer. Measurements from a densiometer are objective and relatively precise. The densiometer uses a spherical-shaped reflector mirror engraved with a cross-shaped grid of 24 quarter inch squares. For each cross-section, densiometer measurements were taken separately in four directions positioned at the center of the stream and facing the upstream at the wetted channel margins of both banks. These measurements were used to calculate canopy cover over the channel and within the riparian corridor.

Large Woody Debris

The LWD methods for this study are a simplified adaptation of those described by Robison and Beschta (1990) which are used in the EMAP methods (Kaufmann et al. 1999). All LWD was categorized according to location in channel or bridging above bankfull channel and then separated into size classes based on length and diameter using visual estimates.

LWD is defined as woody material with a diameter of at least 10 centimeters (cm) (4 inches), and length of at least 1.5 m (5 feet). At each cross section, the length and diameter of each piece of LWD identified within 15 feet, upstream and downstream (30 linear feet per cross section) were recorded. The diameter classes evaluated are as follows:

- 0.1 m to < 0.3 m;
- 0.3 m to < 0.6 m;
- 0.6 m to < 0.8 m; and
- > 0.8 m.

The length classes were defined as by Kaufmann et al 1999:

- 1.5m to < 5.0 m;
- 5 m to < 15 m; and
- > 15 m.

Large woody debris smaller than 1.5 m in length or 10 cm in diameter at the large end were not recorded.

The number of pieces recorded in each reach was divided by the number of cross sections in each reach multiplied by 30 feet, the linear distance investigated at each cross section, to produce the number of pieces per linear feet. These values were used to compare the abundance of LWD between stream reaches, and to evaluate the abundance of LWD in each reach relative to “properly functioning” condition (NOAA 1996). NOAA Fisheries Service suggests that 50 pieces/km or .015 pieces/linear foot that are at least 0.6 m wide by 15 m long, as the reference value for properly functioning condition.

Bankfull Width and Depth

Bank morphology measurements are used to assess channel stability during flood flows, long-term channel down-cutting, and fish concealment features such as undercut banks. Bank angle and undercut distances were measured on the left and right banks at each cross section. Other parameters recorded include the wetted width of the channel, the width of exposed mid-channel gravel or sand bars, the estimated incision height, floodplain width, and the estimated width and depth of the channel at bankfull stage, and floodplain (Kaufmann et al. 1999). Bankfull width (BFW) is the width between these field indicators on each bank. Bankfull depth (BFD) is the average depth of water at bankfull stage.

Substrate

Substrate size and embeddedness were recorded at each of the cross-sections following the EMAP field methods (Kaufmann and Robison 1999) to determine the extent of habitat present by assessing the amount of suitable spawning and rearing substrates present at each cross section. In the field, biologists measured the width of the channel from ordinary high water, and sampled the channel at four equidistant points. Sediment data collected at some of the samples were outside of the wetted width of the stream channel. Field crews evaluated the size of substrate at each sample point according to the following size classes:

RS Bedrock (Smooth) > 4000 millimeters (mm)

RR Bedrock (Rough)	> 4000 mm
HP Hardpan	> 4000 mm
BL Boulders	> 250 to 4000 mm
CB Cobbles	> 64 to 250 mm
GC Gravel (Coarse)	> 16 to 64 mm
GF Gravel (Fine)	> 2 to 16 mm
SA Sand	> 0.06 to 2 mm
FN Silt, clay, muck	< 0.06 mm
WD Wood	Regardless of Size
OT Other	Regardless of Size

Embeddedness is described according to the portion of a particle's surface that is surrounded by (embedded in) fine sediments on the stream bottom. Sand and finer substrates are defined as 100% embedded (Kaufmann et al. 1999).

QUALITY CONTROL

To ensure precise data were collected, field biologists reviewed the survey protocols prior to going to the field. The designer of the field survey also provided field staff with hands-on training in the field to provide biologists with the opportunity to become more familiar with the protocol.

To ensure that the data were accurately entered into Microsoft Excel spreadsheets, all data were entered and verified by at least two different data technicians. Data analysis was similarly inspected for accuracy.

ANALYSIS

Summarized in-stream and riparian values for each stream reach were evaluated to determine whether the stream reach could potentially provide habitat for anadromous fish species. Data from each stream reach were analyzed and compared to published values representing natural conditions in the Pacific Northwest, or values that were determined to indicate properly functioning conditions for salmonid habitat by the NOAA Fisheries in their Matrix of Pathways and Indicators (matrix) (Table A1). Comparisons were also made between the three different stream reaches. Each stream reach was then evaluated to identify potential restoration opportunities.

NOAA Fisheries developed a tool for evaluating and maintaining stable and healthy streams for anadromous salmonid populations (NOAA 1996). The matrix sets three condition levels for environmental parameters important to production and survival of anadromous fishes. The three

condition levels are: (1) properly functioning, (2) at risk, and (3) not properly functioning. The criteria for the environmental parameters at each condition level are described in the matrix (NOAA 1996).

Table A1 Matrix of Pathways and Indicators (NOAA Fisheries 1996)

Pathway	Indicator	Properly Functioning	At Risk	Not Properly Functioning
Habitat Access	Physical Barriers	Any man-made barriers present allow upstream/downstream fish passage at all flows	Any man-made barriers present do NOT allow upstream/downstream fish passage at base/low flows	Any man-made barriers present do NOT allow upstream/downstream fish passage at a range of flows
Habitat Elements	Substrate	Dominant substrate is gravel or cobble	Gravel and cobble is subdominant, or if dominant, embeddedness 20-30%	Bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%
Habitat Elements	Large Woody Debris	>50 pieces/km that are greater than 24 inches in diameter and greater than 50-feet long	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment
Channel Condition and Dynamics	Width/Depth Ratio	<10	10-12	>12
Watershed Conditions	Road Density and location	No roads in stream valley	Some stream valley roads	No stream valley roads
Watershed Conditions	Riparian Reserves	Adequate shade, LWD recruitment, and habitat protection and connectivity	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, incomplete protection of habitats and refugia for sensitive aquatic species	Riparian reserve system fragmented, poorly connected, inadequate protection of habitats and refugia for sensitive aquatic species

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