

Critical Areas Report Stormwater Treatment Wetland Snohomish County, Washington

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Prepared for

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EXECUTIVE SUMMARY

The City of Arlington, Washington (City) is proposing to construct a water quality treatment wetland (project) to treat City-derived stormwater prior to discharging it into the Stillaguamish River. The project is funded by a grant from the Washington State Department of Ecology (Ecology) Stormwater Management Implementation Grant program. The project consists of construction of 6 acres of wetlands and associated piping infrastructure and is intended to improve water quality, increase habitat functions, and provide opportunities for public recreation and education. Landau Associates was contracted by the City to assist with design and environmental documentation related to the project. The project site is located within upland areas on the southeastern portion of a 21.9-acre City-owned parcel (Parcel 31050200300200; subject property) at 238 North Olympic Avenue, as well as within the adjacent right-of-way [under Washington State Department of Transportation (WSDOT) and City jurisdiction] in Snohomish County, Washington. A critical areas study was conducted to document critical areas and/or habitat present within the vicinity of the project area, in order to avoid and/or minimize impacts. Key conclusions are listed below:

- The subject property contains a portion of the Stillaguamish River, a shoreline of the state. The project is in keeping with Shoreline Management Act policies.
- The upland portions of the subject property are located behind a dike, and include floodway and floodway fringe. The project is located outside of the floodway and river buffer within a grass field. The project will increase floodplain storage capacity. Under the proposed design, typical and floodwater hydrologic patterns will be similar under current and proposed conditions, except that there will be increased storage capacity and desynchronization of flows as a result of the proposed project.
- No wetlands are located within the subject property or project area.
- A wetland complex, consisting of a natural wetland and a WSDOT mitigation wetland, is located south of the subject property.
- No federally listed (under the Endangered Species Act) species or state priority species or habitats are present within the project area; however, such species and habitats are located within the Stillaguamish River, near the project area.
- A historic site is located within the subject property, near the project area.
- The project will have no adverse impacts on critical areas and their buffers and will have a benefit to the ecosystem and will increase public access to and value of the shoreline.

This report presents the methods and results of the critical areas investigation, including a habitat management plan related to the project, as well as overall design goals and objectives. Detailed design information can be found in the engineering plan set and/or in the Full Drainage Report (Landau Associates 2009a,b).

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TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	ii
LIST OF ABBREVIATIONS AND ACRONYMS	vi
1.0 INTRODUCTION	1-1
1.1 PROJECT LOCATION	1-1
1.2 PROJECT DESCRIPTION AND NEED	1-1
1.2.1 Water Quality Regulatory Requirements	1-2
1.2.2 Stormwater Wetland Design Features	1-3
2.0 METHODS	2-1
2.1 INFORMATION REVIEW	2-1
2.2 FIELD INVESTIGATION	2-2
2.2.1 Stream	2-2
2.2.2 Groundwater	2-2
2.2.3 Soils	2-2
2.2.4 Wetlands	2-3
2.3 WETLAND AND STREAM CLASSIFICATION, RATING, AND BUFFER WIDTH	2-3
3.0 RESULTS	3-1
3.1 SITE LAYOUT AND INFRASTRUCTURE	3-1
3.1.1 Stormwater System and Basin	3-1
3.2 STILLAGUAMISH RIVER	3-2
3.3 FLOODWAY/FLOODWAY FRINGE	3-2
3.4 GROUNDWATER	3-3
3.5 SHORELINE	3-3
3.6 SOILS	3-4
3.7 WETLANDS AND OTHER SURFACE WATERS	3-4
3.7.1 Offsite Wetlands	3-4
3.7.2 Offsite Bioswale	3-5
3.7.3 Onsite Wetland Investigation	3-5
3.7.3.1 Vegetation	3-5
3.7.3.2 Soils	3-5
3.7.3.3 Hydrology	3-5
3.8 PROTECTED SPECIES AND HABITATS	3-6
3.9 CULTURAL RESOURCES	3-6
3.10 SUMMARY OF CRITICAL AREAS	3-7
3.11 PERTINENT SNOHOMISH COUNTY CODE	3-8
4.0 MITIGATION SEQUENCING	4-1
4.1 AVOIDANCE OF IMPACTS (FLOOD HAZARD AND RIVER FLOWS)	4-1
4.2 MINIMIZATION OF IMPACTS (FLOOD HAZARD)	4-1
5.0 HABITAT MANAGEMENT PLAN	5-1
5.1 SPECIES AND HABITATS	5-1
5.2 COMPLIANCE WITH HABITAT PROTECTION PLANS	5-1
5.3 STANDARD MITIGATION MEASURES	5-2

LIST OF ABBREVIATIONS AND ACRONYMS

BGS	Below Ground Surface
cfs	Cubic Feet per Second
City	City of Arlington, Washington
CAPA	Critical Area Protection Area
DAHP	Washington State Department of Archaeology and Historic Preservation
DNR	Washington State Department of Natural Resources
DO	Dissolved Oxygen
DP	Data Plot
Ecology	Washington State Department of Ecology
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FEMA	Federal Emergency Management Agency
ft	Feet
ft ²	Square Feet
ft ³	Cubic Feet
GIS	Geographic Information System
HGM	Hydrogeomorphic
HMP	Habitat Management Plan
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OBL	Obligate
OHWM	Ordinary High Water Mark
PEM	Palustrine Emergent
PFO	Palustrine Forested
PHS	Priority Habitats and Species
PSS	Palustrine Scrub-Shrub
RMF	Redoxymorphic Feature
SMP	Shoreline Master Program
SR	State Route
TMDL	Total Maximum Daily Load
TP	Test Pit
UDC	Snohomish County Unified Development Code
UPL	Obligate Upland
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WSDOT	Washington State Department of Transportation
WRF	Wastewater Reclamation Facility
WWTP	Wastewater Treatment Plant
yd ³	Cubic Yards

1.0 INTRODUCTION

The City of Arlington (City) is proposing to construct a water quality treatment wetland (project) to treat City-derived stormwater prior to discharging it into the Stillaguamish River. The project is funded by a grant from the Washington State Department of Ecology (Ecology) Stormwater Management Implementation Grant program. The City contracted Landau Associates to assist with design and environmental documentation related to the project. Landau Associates conducted a critical areas study to document critical areas and/or habitat present within the vicinity of the project area in order to avoid and/or minimize impacts. This report presents the methods and results of the critical areas investigation, including mitigation sequencing (avoidance) and a habitat management plan related to the project. It also includes overall design goals and key elements.

Additional detailed design information can be found in the engineering plan set and/or in the Full Drainage Report (Landau Associates 2009a,b). Soil logs and data are provided in Appendix A. Selected site photographs are provided in Appendix B, wetland/upland data forms are provided in Appendix C, modeled water levels for the site during flood events are provided in Appendix D. An Illustration of the Wetland Features is presented in Appendix E, and water quality data are provided in Appendix F.

1.1 PROJECT LOCATION

The project is located in Water Resource Inventory Area 11, Stillaguamish (Hydrological Unit Code 17110008). The project site is located in the southeastern portion of a 21.9-acre City-owned parcel (Parcel 31050200300200; subject property), also known as the Hammer Property, at 238 North Olympic Avenue in Section 2, Township 31 North, Range 5 East, Quarter SW at latitude 48.2006°/longitude -122.1318°, and UTM zone 10 (X,Y) 564515, 5338963, in Snohomish County, Washington (Figure 1). The subject property is bordered to the east by State Route (SR) 9, to the south by SR 530, to the west by Dike Road, and to the north by the Stillaguamish River (Figure 2). Note that a portion of the subject property consists of the Stillaguamish River, a shoreline of the state. Connective piping will be located within the Washington State Department of Transportation (WSDOT) right-of-way associated with SR 9 (see Figure 1). The Wastewater Treatment Plant (WWTP) currently serving the City is located east of the subject property on the east side of SR 9 at 108 West Haller in Arlington (Figure 3).

1.2 PROJECT DESCRIPTION AND NEED

In the late 1990s, the City became aware that there was a growing problem with water quality in the Stillaguamish River and that the City's stormwater discharge could be a contributing factor. Water quality in the Stillaguamish River downstream of the City has been impaired for multiple parameters,

resulting in listings under Section 303(d) of the Clean Water Act in 1996, 1998, and 2004 for dissolved oxygen (DO), temperature, and fecal coliform (City of Arlington 2007). Currently, stormwater is discharged to the Stillaguamish River untreated and at accelerated rates, with very little flow control (City of Arlington 2007). The constructed wetland will be designed to meet accepted removal efficiencies for the common parameters affecting the Total Maximum Daily Loads (TMDLs), as found in the regional literature using Best Available Science and all known available and reasonable methods of prevention, control, and treatment (AKART) for constructed wetlands (City of Arlington 2007). It will be designed in accordance with *Stormwater Management Manual for Western Washington: Volume III – Hydrologic Analysis and Flow Control Design/BMPs* (Ecology 2005a). The proposed project is designed to reduce pathogens, remove nutrients that are understood to result in lower instream DO, lower water temperature, and reduce peak flows to the river. The treatment wetland will receive year-round stormwater from the Old Town catchment area [identified as the downtown basin in the working draft City of Arlington Stormwater Comprehensive Plan (City of Arlington 2008)] via gravity flow. A flow bypass system will be installed for certain storm events and/or for isolation of the wetland for maintenance.

In order to meet the projected growth within the existing urban growth area and additional annexations and expected regulatory requirements (described in the following section) through 2025 (Kennedy/Jenks 2007), the City will upgrade and expand its WWTP to a Wastewater Reclamation Facility (WRF) including a Membrane Bioreactor with aerobic digestion. As part of the future project, some of the reclaimed water from the WRF may be used to supplement hydrology for the treatment wetland when stormwater flow is low.

1.2.1 WATER QUALITY REGULATORY REQUIREMENTS

The largest contiguous storm drainage catchment in the City, 286 acres of Old Town Arlington (see Figure 3), predates Ecology's 1992 stormwater manual technical requirements, and most of the stormwater runoff from this area discharges untreated to the Stillaguamish River at the Butler outfall. TMDLs and Arlington's National Pollutant Discharge Elimination System (NPDES) permit require the City to implement actions to improve water quality. Wastewater discharge limits are defined in the City's NPDES permit. The WWTP currently discharges treated municipal wastewater into the Stillaguamish River in accordance with NPDES Permit No. WA-002256-0; modification #1, October 13, 2006. The discharge is released through an outfall whose placement is permitted in Washington Department of Natural Resources (WDNR) Aquatic Lands Outfall Easement No. 51-070281, expiring September 2034. TMDL parameters for the Stillaguamish River are summarized in the table below.

TMDL Target in Stillaguamish River			Parameter			
Aquatic	Reference Condition	Recreation	Temperature (°C)	DO (%)	Conductivity (µmhos/cm)	Fecal Coliform (Col/100 mL)
			(Max.)	(Min.)	(Max.)	(Max.)
Class A	Higher	Class A	18	8.0	200	100
Non-core	N/A	Secondary	17.5	8.0	100	200
Core	N/A	Primary	16	9.5	75	100
Char	Lower	Extraordinary	12	9.5	50	50

Source: Ecology 2005b.
µmhos/cm = microhos per centimeter
Col = Colonies
N/A = Not applicable.

The City is required under its NPDES Phase II stormwater permit to fully implement the requirements of the cleanup plans. Essential elements of the plan include: 1) treatment of stormwater from Old Town; and potentially 2) treatment of reclaimed water from the future WRF via the proposed treatment wetland (to be permitted as a separate project in the future). Refer to Appendix F for recent water quality data, showing exceedances of temperature, DO, and/or fecal coliform parameters during the summer.

1.2.2 STORMWATER WETLAND DESIGN FEATURES

The total size of the treatment wetland (area of site disturbance) is approximately 9.8 acres, including approximately 5.5 acres of created wetland area, consisting of four cells, separated by weirs, as shown on Figure 4. Project goals, objectives, and design aspects are summarized in Table 1. A summary of proposed water quality treatment, habitat, and hydrologic information for each cell is provided in Table 2. Design characteristics by wetland cell are summarized in Table 3. A list of important design features is presented below:

- The design will avoid critical areas, including river buffer, floodway, and the historic site (see Section 3.9 for more information), etc. The area surrounding the historic site will be used for viewing and interpretive signage (with views of the wetland) and/or for sale of harvested cattail.
- An underground pipe from Cell 4 to the outfall will be installed to avoid the septic system protection area and the WSDOT bioswale.
- A maintenance truck access road [15 feet (ft) wide] will be constructed to connect the existing access road (under SR 9) spanning the entire length of Cell 1 and continuing to the existing groundwater well (and turnaround location), and also allowing access for all proposed piping (inlets and outlets).
 - Approximately 750 cubic yards (yd³) of imported gravel material will be required to construct the road.

- The net cut is 15,000 yd³ (9.8 acre-feet), such that it will provide 9.8 acre-feet of additional storage for surface water.
- A summary of grading volumes is provided below:

	Cut (yd³)	Fill (yd³)	Import (yd³)	Export (yd³)
Grub (organic)	13,700	9,800	0	3,900
Structural (subsoil)	15,000	4,500	0	10,500
Road Surfacing (gravel)	N/A	N/A	750	N/A
Trail Surfacing (gravel)	N/A	N/A	150	N/A
TOTAL	28,700	14,300	900	14,400

- A trail will be constructed around and through the wetland with viewing points and will contain 2 inches of gravel surfacing (150 yd³). A future mowed grass trail may be located along the northern edge of the wetland, with connection to the existing dike/Eagle Trail.
- The design will incorporate connectivity to existing and future public access space, including the Eagle Trail and Haller Park, existing roundhouse access, and parking areas. No increased traffic will occur.
- Footbridges will be installed over weirs to increase trail connectivity and access.
- Some weirs will be adjustable to allow for adaptive management of water regime within the wetland.
- The wetland will function at multiple water inflow rates, while maintaining a long residence time; optional adjustable weirs may allow for adaptive management during the first years of use, or as needed. Refer to the Full Drainage Report (Landau Associates 2009b) for details.
- The design will include multiple habitat types and will increase ecological connectivity between shoreline habitats. A total of 8.14 acres of current field will be planted with wetland and upland native plants, ranging from emergent wetland to forested vegetation communities. See Figures 5a and 5b for the planting plan.

2.0 METHODS

The methods used to investigate critical areas are described in this section.

2.1 INFORMATION REVIEW

Public domain resources were reviewed prior to the field investigation to determine existing conditions and potential critical areas or habitats, including wetland or surface waters indicators and state priority or federally listed species, within at least 300 ft of the subject property (study area). The following resources were reviewed:

- Aerial photographs (Google Earth website 2009)
- Topographic map (USGS 1993)
- National Wetlands Inventory maps (USFWS 1981 to present)
- Natural Resources Conservation Service (NRCS) Soil Survey (NRCS 2008)
- National Hydric Soils Lists (USDA, NRCS 2009)
- StreamNet Interactive Mapping, including the Pacific Northwest Mapper (StreamNet website; various dates)
- WDNR Natural Heritage Program (WDNR website 2009a)
- WDNR Forest Practices Application Review System (WDNR website 2009b)
- Snohomish County Permit Planning and Zoning Maps (Snohomish County 2009a)
- Ecology Digital Coastal Atlas (Ecology website 2006)
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) database (WDFW 2008)
- Federal Emergency Management Agency (FEMA) Flood Zone maps (FEMA website 2009)
- National Oceanic and Atmospheric Administration (NOAA), National Weather Service river forecast data (NOAA website 2009).
- Snohomish County Permit Planning and Zoning Map Geographic Information System (GIS) data layers (Snohomish County 2009a)
- Stillaguamish River – Summary Assessment of Avulsion Risk Factors between RM 13 and SR 9 (R2 Resource Consultants 2005)
- City of Arlington Hydrogeologic Conceptual Model Summary Report (Pacific Groundwater Group 2007)
- City water quality sampling data from three locations in the Stillaguamish River (Butler outfall, Haller Park boat ramp, and railroad bridge) provided in Excel data format (City of Arlington 2008a)
- AutoCAD survey data files created for the project (Huey Surveying and Land Consulting 2008)

- City GIS maps showing storm and wastewater conveyance infrastructure (City of Arlington 2008b)
- As-built plans and designs related to SR 9, bioswales, and wetlands (WSDOT 1998)
- Cultural Resources Assessment (Northwest Archaeological Associates 2008).

2.2 FIELD INVESTIGATION

Landau Associates conducted a field investigation to determine existing wetland and stream conditions within the study area. The field investigation methodology is summarized below.

2.2.1 STREAM

City of Arlington Water Resources Planner, Mike Wolanek and staff conducted a delineation of the Ordinary High Water Mark (OHWM) in August 2008. The OHWM was delineated according to methodology endorsed by Ecology (Olson and Stockdale 2008). The methodology focuses on examining existing hydrologic data and observation of field indicators including hydrology, soil and sediment, vegetation, and marks of scouring, etc. Of note is that the delineation is conservative, based on the upper limits of the willow (*Salix* spp.) rooting zone, as well as on an OHWM delineation, conducted by ESA Adolfson in March 2008, for a stretch of river located adjacent to the subject property (Martin 2008).

2.2.2 GROUNDWATER

City staff conducted a groundwater investigation in order to determine grading depths for the treatment wetland that would result in water storage and infiltration without interference with groundwater. Water levels were monitored within the City-owned well located on the project site (shown on Figure 2) in March 2008. River stage was also recorded by the City at the Haller Park boat ramp, located several hundred feet upstream of the site. Landau Associates compared the two data sets to determine the relationship between river stage and groundwater levels within the project area. In addition, three test pits (TPs) were excavated by the City and Landau Associates in May 2008. Sacha Maxwell of Landau Associates and Bill Blake conducted a site reconnaissance on September 18, 2009 to confirm the location of an outlet from the offsite WSDOT/Wetland 4 wetland complex.

2.2.3 SOILS

A soils investigation was conducted by Landau Associates with assistance by City staff on May 27, 2008 to determine soil geotechnical properties and infiltration rates, which are pertinent to design and modeling tasks. Three TPs were excavated using a backhoe (as described above) from the areas shown on Figure 2. See Appendix A for a description of soils profiles from the TPs. A representative sample

was collected from TP 2 at 3.5 ft below ground surface (BGS) and analyzed for grain size distribution and to determine the U.S. Department of Agriculture (USDA) textural classification (see Appendix A). Infiltration rates are used as stated in the USDA Natural Resources Conservation Service (NRCS) online database for the soil type present (NRCS website 2008). Information on soils was also collected as part of the cultural resources and the wetland investigations, and was reviewed. Additional soil descriptive information was acquired from the NRCS web soil survey. Pertinent soil properties, as excerpted from the NRCS database, are also provided in Appendix A.

2.2.4 WETLANDS

The wetland investigation was conducted in accordance with the U.S. Army Corps of Engineers (USACE) *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (USACE 2008) and Ecology's *Washington State Wetlands Identification and Delineation Manual* (Ecology 1997). The USACE and Ecology recommend gathering preliminary data and synthesizing available background information, followed by a field investigation. The wetland investigation was conducted using the routine determination methodology, which includes a three-parameter approach to determine the presence or absence of wetlands that requires evaluating vegetation, soil, and hydrology (Table 4). Following this method, an area is determined to be wetland if all of the following three criteria are met: 1) the dominant vegetation is hydrophytic; 2) soils are hydric; and 3) wetland hydrology is present.

A site visit for the wetland reconnaissance was conducted by Bill Blake on June 10, 2008, which roughly represents the middle of the official growing season recognized by the Seattle District USACE (USACE 1994). Data on vegetation, soils, and hydrology were recorded at locations [data plots (DPs)] suspected most likely to meet the mandatory wetland criteria (such as depressions in topography, where some wetland-adapted vegetation were present). These data are provided in the form of wetland data forms (see Appendix C). Observations of offsite wetlands were also made; however, no formal DPs were recorded outside of the subject property. The boundaries of wetlands located outside of the study area were estimated based on visual observation from the study area and aerial photographs and/or other information from the background information review.

2.3 WETLAND AND STREAM CLASSIFICATION, RATING, AND BUFFER WIDTH

Wetland classification follows the U.S. Fish and Wildlife Service (USFWS) classification system (Cowardin et al. 1979) and the hydrogeomorphic (HGM) classification system (Brinson 1993). Wetland rating is in accordance with the *Washington State Wetlands Rating System for Western Washington*,

Revised Edition (Hruby 2004), which is accepted practice under the current Snohomish County Unified Development Code (UDC; Snohomish County 2009b). A formal rating evaluation was not conducted for offsite wetlands, but assumptions for ratings were made based on the community types present and other information obtained from the information review process.

Stream classification for the Stillaguamish River is according to UDC Chapter 30. Buffer widths for wetlands and streams were also made according to UDC Chapter 30.

3.0 RESULTS

The results of the critical areas investigation are presented below.

3.1 SITE LAYOUT AND INFRASTRUCTURE

A site plan showing critical areas and other site features is presented on Figure 2. The subject property is bound to the northwest by the Stillaguamish River; to the northeast by SR 9 and smaller parcels that contain agricultural buildings and a residence, “the round house”; to the southeast by a native growth protection area; and to the southwest by Dike Road and undeveloped land. The site is currently hayed on an annual basis to prevent the establishment of invasive species. The site is also used for passive recreation for fishing access, birding, and dog walking. The site will continue to provide agricultural uses, including harvesting of cattail from the wetland. Existing structures are located on smaller City-owned parcels located north of the project area. These parcels are served by power (Snohomish County Public Utility District) and an individual septic system.

A groundwater well is located on the subject property, which is connected to buildings located on adjacent property to the north. A septic system is located just outside of the project area, which requires a 100-ft-setback from surface water per WAC 246-272A-0210.

One historic site is documented as existing on the subject property, consisting of an old privy/outhouse (see Section 3.9). The protection area for this site is shown on Figure 2. No excavation will occur within the protection area, and minimal fill may be placed along its southern boundary.

3.1.1 STORMWATER SYSTEM AND BASIN

A City-owned stormwater pipe bisects the northeast corner of the site. Stormwater collected from the City’s municipal storm sewer system is conveyed to an outfall, the Butler outfall, which is located north of the subject property (see Figure 2). The outlet of this 36-inch concrete pipe is collapsing (see Appendix B, Photographs 14 and 15) and will be maintained as a separate project (however, maintenance of the structure is not necessary to accommodate this project).

Existing conveyance systems are shown on Figure 3. The upstream basin for the treatment wetland, also referred to as the downtown basin, is composed of piping and catch basins that collect water from the entire basin, and convey it to the project area before discharging to the river via the Butler outfall. The basin is predominantly composed of a mixture of commercial and residential properties located on a hillside.

3.2 STILLAGUAMISH RIVER

The Stillaguamish River is immediately adjacent to the northwest edge of the subject property, and portions of its channel bed are located within the northern extent of the property. The OHWM is shown on Figure 2, and is to be considered conservative. The actual boundary is likely to be located at least 20 ft farther waterward than currently mapped (the delineation has not been verified by Ecology or any other agency at this time).

3.3 FLOODWAY/FLOODWAY FRINGE

The property is floodplain, with approximately the northwesternmost third of the property mapped as floodway, and the remaining two-thirds of the property mapped as floodway fringe (FEMA website 2009; Snohomish County 2009a; see Figure 2). The river is diked by a continuous levee on both banks upstream and downstream of the subject property (these are referred to as the Dike Road Dike on the south side of the river and the Schloman Road Training Dike on the north side of the river). The portion of the dike along the northern extent of the property is referred to as the Johnson levee. The Johnson levee dike was breached in 2002 (R2 Resource Consultants 2005) and during winter 2008-2009 flooding events, and has since been repaired.

Adjacent to the subject property, the river flood stage is 65.4 ft and bankful stage is 64.2 ft (NAVD88; NOAA website 2009). The top of dike elevation is approximately 68 to 69 ft and the river level during a 100-year event is approximately 71 ft (NAVD88; NOAA website 2009), such that that the river overtops the dike near a 100-year event (NOAA website 2009).

Based on observations by the City during these and other flooding events, and modeling and analysis conducted by R2 Resource Consultants to assess avulsion risk in the Stillaguamish River within the vicinity of the project area, floodwaters on the site flow southwest, bypassing the treatment wetland project site, and overtop a dike associated with Dike Road to continue southwest in a “split flow channel” (R2 Resource Consultants 2005). Dike Road Dike overtops during flood events that exceed approximately 19 ft at Arlington (flood stage is 14 ft at Arlington).

According to the R2 study:

Of the six dike locations, the Johnson Dike location...was considered to be of lowest relative risk of erosion leading to avulsion in the vicinity of a breach. There is an existing breach at Location 1 that is approximately 3 feet deep and 10 feet wide, but the invert of the breach appears to be around 2 feet or so higher than the adjacent floodplain, which is relatively level. In addition, Dike Road forms a downstream grade control (elevation ~61.1 ft, NAVD88) that may restrict the flow rate through the existing breach which should prevent the breach from becoming significantly larger. The Dike Road surface is not substantially elevated above the floodplain and the downstream side slope of the road prism is gentle. These topographic factors contribute to a relatively low risk of avulsion

in the vicinity of the dike because they limit the erosive forces locally in the vicinity of the dike and the road.

During the 2-, 5-, and 100-year flood events, the simulated water depths range from 0 ft (near the levee) to approximately 8 ft deep at the southern property boundary and reach up to approximately 10 ft within Wetland 4 (R2 Resource Consultants 2005; see Appendix D). Flow velocity on the majority of the property, including the project site, is modeled as being in the range of 0 to 1 cubic feet per second (cfs) (R2 Resource Consultants 2005).

3.4 GROUNDWATER

Groundwater was first investigated on the site in early March 2008, when water tables were assumed to be highest. Water levels in four backhoe excavation pits (see Figure 2) were below 6.8 ft across the site. Specifically, groundwater was not encountered in three of the four excavation pits; however, groundwater was encountered at 6.8 ft in Pit 1, located in the eastern portion of the project area (the area for proposed treatment Cell 1) (City of Arlington 2008c). In late May 2008, groundwater was not encountered in TPs 1 through 3, which ranged from 7 to 8 ft BGS (see Figure 2). Ten backhoe trenches and 88 shovel TPs were excavated as part of the cultural resources investigation in March 2008 (Northwest Archaeological Associates 2008; not shown on Figure 2). Six of the trenches were located within proposed wetland areas. No groundwater was encountered to the depth of the trench (approximately 5 ft BGS) and all TPs were dry with the exception of those located near the WSDOT bioswale/location of proposed Cell 1, which contained saturated soil at approximately 3 to 4 ft BGS (Northwest Archaeological Associates 2008).

Results of the water level monitoring at the City well located within the project area show that water levels were near 10 to 10.8 ft BGS in June and July 2008, while river stage was near 54.2 ft NAVD88 (this generally represents low flow conditions). Groundwater elevation is understood to fluctuate with river stage; however, a complete evaluation of this relationship is not available.

Analysis of alluvial aquifer groundwater elevations for the areas of exposed river alluvium associated with the Stillaguamish River show the contours decrease from 60 ft elevation (NAVD88) in the western portion of the subject property in a west/northwest direction toward the river to approximately 55 ft (extrapolated from 10-ft contour intervals as mapped) near the western portion of the property (Pacific Groundwater Group 2007).

3.5 SHORELINE

The subject property is located within the shoreline management zone as designated by Snohomish County under its Shoreline Master Program (SMP). The majority of the subject property is

designated as rural shoreline environment under the current Snohomish County shoreline master program. A small area, located outside of the dike, is designated as conservancy shoreline environment (Snohomish County 2009a). The subject property is proposed for designation as Resource under the Draft SMP (not adopted at the time of this investigation) (Snohomish County website 2009).

3.6 SOILS

Soil on the subject property is identified in the Soil Survey of Snohomish County, Washington (NRCS 2008) as Puyallup fine sandy loam, which is classified as hydrologic soil group B non-hydric soil (NRCS website 2008) and Puget silty clay loam, which is classified as hydrologic soil group C hydric soil (NRCS website 2008).

A soils investigation was conducted by Landau Associates with assistance by City staff on May 27, 2008. Three TPs were excavated using a backhoe from the areas shown on Figure 2. A representative sample was collected from TP 2 at 3.5 ft BGS and analyzed for grain size distribution and determination of the USDA textural classification (see Appendix A).

Soils across the site generally consist of silt with varying amounts of sand (as described for TP 1 and TP 2); however, TP 3 consisted of Puget Silty Clay Loam from approximately 2.5 ft BGS to depth. The soil from TP 2 at 3.5 ft BGS was determined to be a silt loam according to the USDA textural classification.

The underlying soils are composed almost entirely of gravelly-sandy loams, sands, and gravels. These well-draining soils are deep and a water table is not usually encountered in building or utility construction within this basin.

3.7 WETLANDS AND OTHER SURFACE WATERS

The USFWS National Wetlands Inventory does not show any wetlands within the project site. One large wetland that is associated with the gravel bar area of the Stillaguamish River is mapped as existing within the subject property (USFWS 1981 to present). The U.S. Geological Survey (USGS) Quadrangle map does not show wetlands within the study area (USGS 1993).

3.7.1 OFFSITE WETLANDS

An existing wetland is located off site, south of the subject property (see Figure 2). This wetland consists of a complex comprised of a pre-existing wetland, called "Wetland 4," and a created mitigation wetland, designed by WSDOT in 1997 in association with the SR 9/Haller Bridge and SR 530 construction project (WSDOT 1997). Hydrology for the Wetland 4/WSDOT wetland complex is primarily derived from precipitation and groundwater, as well as roadway runoff. Neither have inlets.

Wetland 4 has one large low- to moderately-constricted outlet (an approximately 42-inch culvert, based on a site reconnaissance conducted by Sacha Maxwell and Bill Blake on September 18, 2009) that drains surface water from the wetland south underneath SR 530. Vegetation within Wetland 4 consists of emergent vegetation, while the WSDOT wetland is dominated by trees and shrubs, with an emergent understory.

3.7.2 OFFSITE BIOSWALE

A bioswale exists near the subject property outside of its eastern border, within the WSDOT right-of-way (see Figure 2). It is documented as a created feature (WSDOT 1998).

3.7.3 ONSITE WETLAND INVESTIGATION

No wetland is present on the subject property above the OHWM. The upland area is characterized by DPs A, B, and C (see Appendix C). DP A met criteria for hydrophytic vegetation but does not have hydric soils or wetland hydrology. DP B met criteria for hydrophytic vegetation and hydric soils but does not have wetland hydrology. DP C does not satisfy any of the three mandatory wetland criteria.

3.7.3.1 Vegetation

The DPs were located in an annually hayed pasture and consisted of herbaceous plants. In DPs A and B, dominant vegetation included common velvetgrass (*Holcus lanatus*, FAC), creeping buttercup (*Ranunculus repens*, FACW), orchardgrass (*Dactylis glomerata*, FACU), and clover (*Trifolium* spp., FACU). Dock (*Rumex* spp.) was also present in DP B. DP C was dominated by bentgrasses (*Agrostis* spp., FAC), velvetgrass, orchardgrass, and tall fescue (*Festuca arundinacea*, FAC-).

3.7.3.2 Soils

The soil in DP A was a dark grayish brown (2.5Y 4/2) clay loam with no redoxymorphic features (RMFs) from 0 to 18 inches. In DP B, the soil was a dark gray (2.5Y 4/1) clay loam with no RMFs from 0 to 10 inches, and a dark grayish brown (2.5Y 4/2) clay loam with yellowish brown sandy loam (10YR 5/6) with trace, faint, single mottle RMFs from 10 to 18 inches. In DP C, the soil was a very dark grayish brown (10YR 3/2) clay loam with no RMFs from 0 to 18 inches.

3.7.3.3 Hydrology

Soils were dry to moist and indicators of wetland hydrology were not present in any of the DPs.

3.8 PROTECTED SPECIES AND HABITATS

Land use in the area consists primarily of urban and residential use associated with the City, and low-intensity land use to the north within Snohomish County. Nearby large wildlife corridors consist of the Stillaguamish River corridor, including the river's north and south forks. The PHS reports reveal that no state priority or federally listed species are found within the project site; however, some listed fish species are potentially located approximately 200 ft from project site, within the Stillaguamish River (within the subject property).

The following state (WDFW) priority species are present in the Stillaguamish River: resident cutthroat (*Oncorhynchus clarki*), fall Chinook (*O. tshawytscha*), fall chum (*O. keta*), summer Chinook, coho salmon (*O. kisutch*), bull trout (*Salvelinus confluentus*), pink salmon (*O. gorbuscha*), rainbow trout (*O. mykiss*), sockeye salmon (*O. nerka*), and summer and winter steelhead (*O. mykiss*). Of these species, Chinook, steelhead, and bull trout are listed as threatened species under the Endangered Species Act. Within 0.5 mile (to the east and northeast) of the subject property, mapped riparian zones exist. Vaux's swifts (*Chaetura vauxi*; state candidate species) and a Vaux's swift communal roost are located approximately 0.5 mile southeast of the project area. Within 1 mile of the project area there are two bald eagle (*Haliaeetus leucocephalus*) nests and one bald eagle communal roost to the northwest. There is a large riparian area with a regular large concentration of bald eagles in this same area. There are also approximately five small creeks within a 1-mile radius of the project area that contain at least one of the aforementioned priority fish species.

Records from the WDNR *Washington Natural Heritage Program Geographic Information System WNHP Data Set* do not indicate any listed threatened or endangered plant species or critical habitats in the project area.

3.9 CULTURAL RESOURCES

An archaeological and cultural resources assessment conducted for the project site located a privy (designated as site AWTP-06-01) (Northwest Archaeological Associates 2008). During the investigation, approximately 133 artifacts were recovered dating from 1890 to 1930. This site is recommended as eligible for listing in the National Register of Historic Places because it has yielded, and may be likely to yield, information important in prehistory or history. The Washington State Department of Archaeology and Historic Preservation (DAHP) concurred with the finding of "no cultural resource impact" associated with the project and the project is now in compliance with Executive Order 05-05 (DAHP 2008). No excavation will occur within the protection area (see Figure 2), and minimal fill may be placed along its southern boundary.

3.10 SUMMARY OF CRITICAL AREAS

The Stillaguamish River is a Type S shoreline of the state, requiring a 150-ft buffer per the UDC. The subject property is within the shoreline jurisdiction, and is designated as Rural (within the project site) and Conservancy (outside of the project site). The wetland reconnaissance confirmed that no wetland is present within the subject property, based on the absence of wetland vegetation and wetland hydrology. The WSDOT wetland complex was not delineated or formally rated as a part of this study; however, Landau Associates wetland ecologists assume that it is likely to be considered a Category 3 wetland, with low intensity land use, thus requiring a 75-ft buffer, per UDC. The WSDOT bioswales are considered a non-regulatory feature, as it was created for water quality treatment purposes.

A summary of critical areas, their location relative to the project area, and their buffer requirements is presented in the table below.

System	Location to Project	Classification	Buffer Width
Stillaguamish River	Adjacent to and within subject property; outside of project area	Type S Water (shoreline of the state)	150 ft
WSDOT/Wetland 4 Complex	Adjacent to subject property; outside of project area	PFO; PSSE, and PEME / Depressional (Cowardin/HGM) (assumed Ecology Category 3)	75 ft (a)
Critical Area Buffer (Stream/Wetland)	Along edges of property; outside of project area	Forested and herbaceous upland buffer	N/A
Shorelands	Entire property and project area	Rural within majority of parcel and within project area; Conservancy, outside of project area based on current SMP	N/A
Floodplain	Entire property and project area	Floodway within northern portion of parcel, outside of project area; Floodway fringe in southern portion of property project area	N/A
Protected Species and Habitats	Within Stillaguamish River, within property; outside of project area	State Priority fish species; federally listed (threatened) fish species	N/A
Historic Site	Within property, outside of project area	Historic building and associated below-ground archaeological site (privy/outhouse)	(Protection area shown on Figure 2)

PFO = Palustrine Forested
PSS = Palustrine Scrub-shrub
PEM = Palustrine emergent
E = Seasonally flooded/saturated
N/A = Not applicable

(a) Preliminary. Note that wetland was created on County property by WSDOT and that created buffers from this wetland are assumed not to extend onto the subject property, such that additional land use restrictions would be placed on the subject property.

3.11 PERTINENT SNOHOMISH COUNTY CODE

This project is in compliance with the UDC [30.62A.320(d)], which states that “construction of pedestrian walkways or trails in buffers is allowed when constructed with natural permeable materials and does not exceed 6 ft in width.”

The property is zoned A10-SA, Agriculture-10 Acre. The intent and function of the Agriculture-10 Acre zone is to preserve those portions of the county that contain prime farmland for agricultural purposes. The suffix “SA” indicates areas in which the A-10 zone is used to implement the Transfer of Development Rights Sending Area land use designation where the prime function of the zoning is to establish the proper area standards and permitted uses, which will encourage the use and preservation of this land for agricultural purposes (Snohomish County 2009a). The subject property is generally in compliance with this zoning in that cattail and other plants will be harvested from the site for sale.

4.0 MITIGATION SEQUENCING

The proposed project is located within the shoreline management zone and floodway fringe/100-year floodplain. Mitigation sequencing, including avoidance and minimization of impacts, were implemented as described below.

4.1 AVOIDANCE OF IMPACTS (FLOOD HAZARD AND RIVER FLOWS)

The floodway and stream buffer was avoided by siting the project outside of the floodway and the Stillaguamish River buffer. The proposed project will not interfere with the flow path for floodwaters. An upland protection area is designed for around the existing well.

All water diverted into the wetland will remain within the river or its hyporheic zone via the following pathways: 1) Surface water will continue to flow into the river via its current outlet and; 2) shallow groundwater (from infiltration) is expected to move laterally toward the river, in keeping with the existing hydrologic regime for the site. Thus, no diversion of water from the river is expected. The Habitat Management Plan (see Section 6.0) outlines additional considerations to minimize impacts to critical fish and wildlife habitat.

4.2 MINIMIZATION OF IMPACTS (FLOOD HAZARD)

The project will be located within the floodway fringe, as there is no location on the site where siting within floodway fringe can be avoided. In order to minimize impacts to the floodway, the design of the treatment wetland allows for flooding to occur as it would under pre-existing conditions. No berm is located between the wetland and the river or the wetland and western portion of the property, so that water can directly flow across the site toward Dike Road, as it would under existing conditions (should water overtop the dike).

The Butler outfall outlet (elevation 51.7 ft NAVD88/48.0 ft NGVD29) is often at or just above river level during summer low flows, and is often below river level during higher winter flows. There is currently no floodgate on the outfall to prevent river water from flowing back to the proposed wetland when the river level rises. Thus, backwater conditions currently occur on the site, with water spilling to the surface near the WSDOT bioswales. For instance, on November 17, 2009, during a 2-year storm event, when river levels was approximately 66 ft in elevation at the Butler outfall (above bankful stage of 54.2 ft, approximately 43,000 cfs flow), water was observed to be near the point of backwatering from the catch basin located immediately north of the WSDOT bioswale (water was still flowing out of the outfall into the river) (Welch, P., 2009, personal communication).

Total water storage volume within the wetland (to elevation 63 ft) is about 11 acre-feet, with the wetland capable of storing and handling an entire 6-month storm volume even if the Butler outfall was blocked for the entire storm event. Larger storm events [over a 100-year (2.75 inch) event] or high river levels, for which the outfall is blocked for a significant period of time, would lead to flooding from the wetland to adjacent areas. An overflow structure (spillway) will be located on the southern edge of the wetland to allow for water to move out of the wetland southward toward the WSDOT/Wetland 4 wetland complex as it does under current backwater conditions. In this way, hydrology to the WSDOT/Wetland 4 complex will not be impacted. A detailed review of this process is presented below:

1. Backwater begins in the outlet piping at the Butler outfall. As wetland water flows toward the outfall and cannot exit either as fast as it enters or at all, a pool begins to form in the Butler outfall pipe. This pool interferes with the performance of the next pipe in the system, and this continues up the chain of piping until the water begins to pool in Cell 4.
2. After the pool in Cell 4 reaches elevation 60.25 ft, it will begin to interfere with the flows from Cell 3 into Cell 4. Eventually Cell 3 and Cell 4 will become like a single pool of water that rises at the same rate.
3. After the combined Cell3/Cell 4 pool reaches elevation 61.0 ft, it will begin to interfere with the flows from the lower Weir 2 notch into Cell 3. At elevation 61.5 ft, it will begin to interfere with the upper (high flow) notch from Cell 2 into Cell 3. Eventually Cells 2, 3, and 4 will become a single pool of water that rises at the same rate.
4. When backwater reaches elevation 62.5 ft, water will begin to flow into the WSDOT wetland through the proposed overflow spillway from Cell 2.
5. When backwater reaches elevation 63 ft, water will begin to exit the WSDOT bioswale onto the property and will begin to overtop the wetland on the northern side of the wetland.

In summary, the design is such that typical and floodwater hydrologic patterns will be similar under current and proposed conditions, except that there will be increased storage capacity and desynchronization of flows as a result of the proposed project. Additional information can be found in the Full Drainage Report for the project (Landau Associates 2009b).

5.3 STANDARD MITIGATION MEASURES

Standard mitigation measures include permanent protection of fish and wildlife habitat conservation area/Critical Area Protection Area (CAPA) and replacement ratios for allowed disturbance to fish and wildlife habitat conservation areas. The area within the 150-ft river buffer of the Stillaguamish River OHWM is partially forested [with red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera*)], and partially dominated by pasture grasses, with some pre-existing farmhouses and buildings. No project work will occur within this buffer area. Per UDC, "...existing legally established structures including but not limited to... pastures are not required to be designated as CAPA." The City feels that by maintaining a narrow strip of pasture grasses between the project and existing levee, a greater diversity in habitat structure exists by maintaining edge-type habitat providing opportunities for greater diversity in wildlife. The project is a vegetation enhancement project converting the 8.7 acres from pasture grasses to riparian forest and palustrine wetland and forested floodplain conditions.

The conversion from a pasture to young forest and wetland habitat will not result in a loss of the functions such as thermal, bank stability or deposition of large woody debris to the river. There will be a short time of 3 to 12 months for the maturity of the wetland and soil armoring to prevent erosion from sediment, but the design provides meandering and deposition zones with no flow-through of sediments expected. The project is expected to provide immediate gains to riparian function from existing conditions.

5.4 ANALYSIS OF POTENTIAL PROJECT IMPACTS ON CRITICAL FISH AND WILDLIFE HABITAT

No critical fish species or habitat is expected to be located within 200 ft of the project site during the construction season (in summer) when the gravel bar area adjacent to the project site is dry (no fish will be present). Critical fish habitat is located within 300 ft of the project site within the Stillaguamish River. Any potential project-related effects are temporary in nature and consist of: ground disturbance related to grading activities, erosion due to ground disturbance, and project-related noise, but none of these activities will occur within approximately 200 ft of the Stillaguamish River.

There will be no in-water work, and upland work will be conducted during the dry season and will use appropriate temporary erosion and sediment controls (such as covering exposed soils and isolating pipes from outlets to the river while they are under construction). For these reasons, no adverse impacts to aquatic wildlife habitat are expected to occur as a result of the project.

Project-related noise is expected to be insignificant relative to existing noise in the project site area (including noise from SR 9 traffic). No trees or shrubs will be removed. For these reasons, no impacts to terrestrial wildlife habitat are expected to occur as a result of the project.

5.5 PROJECT IMPACTS ON WATER QUALITY AND HYDROLOGY

This section describes potential project impacts on water quality in the Stillaguamish River, and proposed methods or practices to avoid degradation of water quality.

5.5.1 WATER QUALITY IMPACTS

There will be no in-water work and all work will occur in upland areas. Appropriate temporary erosion and sediment controls will be in place. Any disturbed soil will be seeded and planted. No equipment fueling will occur on site. For these reasons, the project will not have any negative impact to water quality within the Stillaguamish River or nearby wetlands or waterways.

Over time, the project will provide the necessary shade to decrease stormwater temperatures during summer storm events. Currently during summer storms, the water hits the impervious surfaces of Old Town and runs directly into the river. The project provides temperature reduction function from the wetland of cell 2, and the forested wetland conditions of cell 3. The infiltration and storage of water in wetland cell 2 will provide base flow support to the river by providing desynchronization of storm flows and cooler groundwater inputs. The shade of the forested wetland conditions of cell 3 will provide a riparian micro-climate cooling effect prior to release to the river.

5.5.2 HYDROLOGIC IMPACTS

The project is a hydrologic enhancement project. The current stormwater from Old Town runs directly into the river with no treatment or storage. The project will address the limiting factors resulting from historical urban development listed in the Salmon Recovery Plan (SIRC 2005).

Infiltration is expected to occur, but with a decreasing rate over time as hydric soil conditions develop. This is a desired condition for capture in hydric soil layer A/B and uptake by wetland plants of nutrients and pollutants. The current system puts stormwater pollutants directly in to the river. The infiltration into the hyporheic zone in this close proximity to the river should provide base flow augmentation similar to historical riverine wetlands adjacent to the main channel. There may be the need to dredge portions of cells 1 and 2 over time in order to maintain storage and treatment efficacy. The recent groundwater study completed by the Arlington Public Works Department indicated the groundwater in that reach runs south to north supporting base flows.

5.6 ASSESSMENT OF SPECIAL MANAGEMENT RECOMMENDATIONS FOR SPECIES OR HABITAT

This section is intended to address special management recommendations that have been developed for species or habitats located on the site by any federal or state agency. No critical species or

habitat is located on the project site. Therefore, no applicable special management recommendations are appropriate.

5.7 PROPOSED MEASURES TO MINIMIZE OR AVOID IMPACTS

A list of best management practices and measures are provided below:

- No activities will occur within the fish and wildlife habitat conservation areas.
- All work will be located behind a densely vegetated dike, which will provide an existing buffer between the project area and the river.
- Construction equipment will operate during normal working hours.
- Most earthmoving and construction work will be completed in the summer and no earthwork will occur within critical area buffers.
- No trees or shrub vegetation will be removed.
- Temporary soil and gravel stockpiles will be located in areas that are already disturbed and existing access roads will be used for construction equipment.
- Temporary soil stockpiles will be covered or wetted to prevent dust from blowing into the river. Appropriate temporary erosion and sediment controls will be in place.
- No equipment fueling or disposal of soil (from well installation) will occur on site.
- Future maintenance equipment will remain on gravel areas.
- The offsite WSDOT wetland and buffer will be protected with a fence and CAPA signage.
- High visibility fencing will clearly mark the limits of clearing, grading, and staging in order to avoid intrusion into fish and wildlife habitat conservation areas and limit access to buffers.

5.8 ONGOING MANAGEMENT PRACTICES

No temporary or permanent impacts to listed or priority habitats or species will occur as a result of the project. Therefore, ongoing management practices to protect critical fish and wildlife habitat after the project is completed, such as monitoring and/or maintenance programs, are not necessary and not proposed.

5.9 CONCLUSION

The project is expected to have net benefits for the environment and the public. Key benefits are listed below:

- The grading plan will result in a net increase in flood storage capacity, which will serve as a net benefit to the Stillaguamish River system, of which much of the historical floodplain area has been isolated by dikes/levees.
- The project will increase desynchronization of surface water flows to the Stillaguamish River from the Old Town contributing basin.

- The project will decrease peak flows from the Butler outfall during storm events.
- The increased infiltration of stormwater to shallow groundwater will result in recharge to the Stillaguamish hyporheic zone during low river levels.
- The project is designed to reduce pathogens, remove nutrients that are understood to result in lower in-stream DO, and lower water temperature before reaching the river.
- By creating wetland and buffer habitat within an area that had been converted to hay fields, the project will increase habitat structure and connectivity between existing wetlands, floodplain, and a shoreline of the state.
- The project will enhance public access to a shoreline of the state and provide for educational opportunities, while protecting historical resources.
- The growth and harvest of cattails and other native species for traditional and modern day retail sales will provide opportunity to test alternative agricultural production strategies that may be more compatible with the developing ecosystem service credit market.
- The project will help the City respond to historical complaints from downstream agricultural landowners concerned about the impacts of urban runoff from Arlington.

The project is not expected to have negative effects on (and is designed to have positive effects in the form of protections and enhancement for) critical habitat, federal listed and state priority species, water quality, flood storage and flows, aesthetics, public access, or cultural resources. Therefore, no mitigation for the project is necessary.

6.0 SUMMARY AND CONCLUSION

No negative impacts to critical areas or protected species or habitats will occur as a result of the proposed stormwater wetland project. The project is expected to provide overall benefit to species and habitats by enhancing ecological function in situ and by improving water quality and quantity functions within the sub-basin and downstream. The proposed treatment wetland design is expected to reduce peak flows to the Stillaguamish River from and reduce pollutant load within stormwater. The result will be an overall improvement in water quality, including but not limited to TMDL parameters. The growth and harvest of cattails and other native species for traditional and modern day retail sales will provide opportunity to test alternative agricultural production strategies that may be more compatible with the developing ecosystem service credit market. The project will help the City respond to historical complaints from downstream agricultural landowners concerned about the impacts of urban runoff from Arlington. Finally, the project will increase public access to shoreline areas by creating trails and viewing areas, and will improve habitat functions for wildlife by creating multiple wetland communities.

7.0 USE OF THIS REPORT

This report was prepared for use by the City of Arlington and applicable regulatory agencies. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk.

This document has been prepared by the following key staff.

LANDAU ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read 'Perry Welch', written over the printed name.

Perry Welch
Senior Ecologist

WPW/ccy

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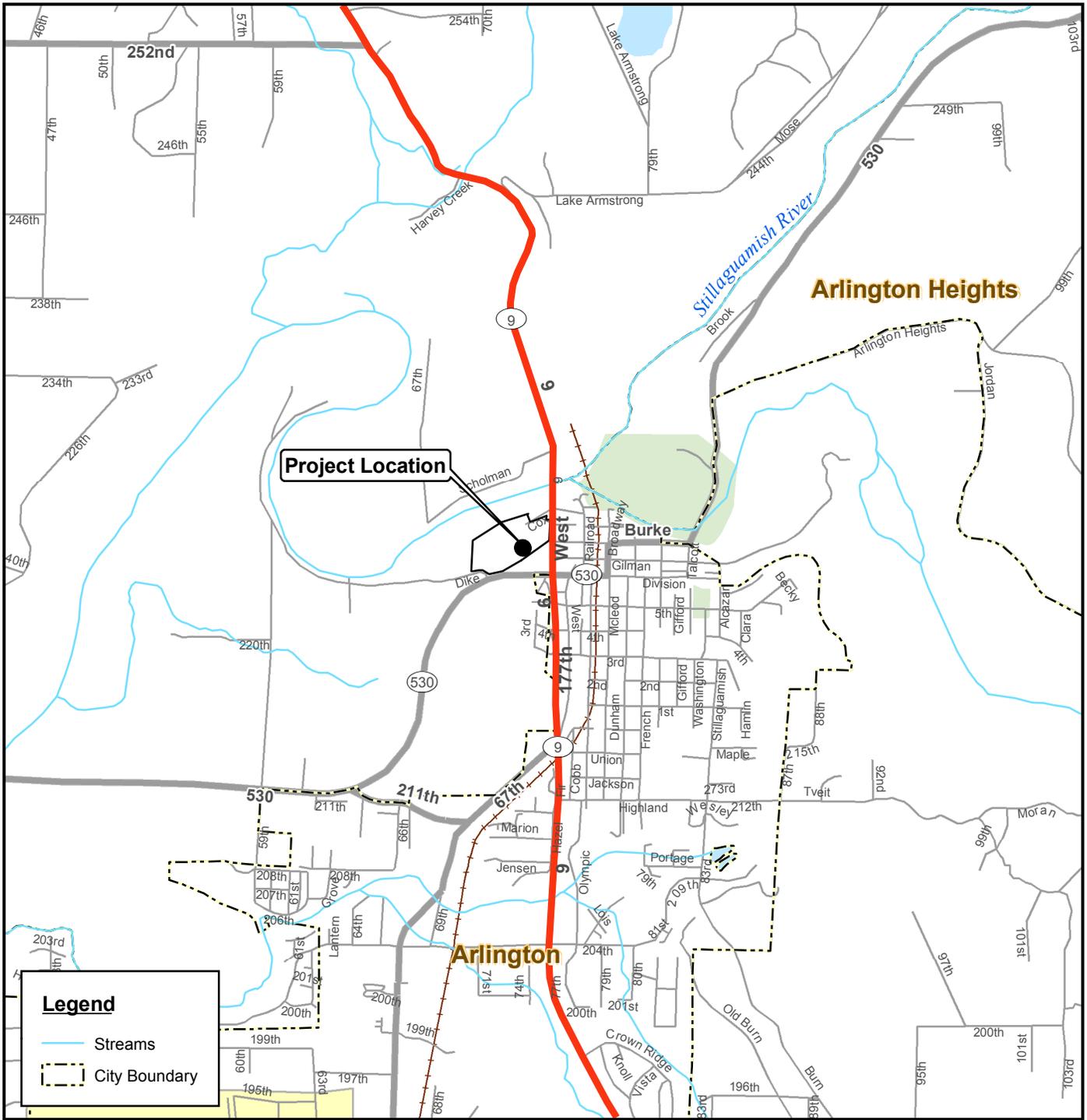
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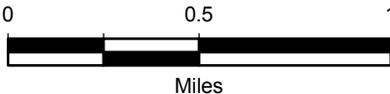
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Legend

- Streams
- City Boundary



Data Source: ESRI 2006

City of Arlington
 Stormwater Wetland Project
 Snohomish County, Washington

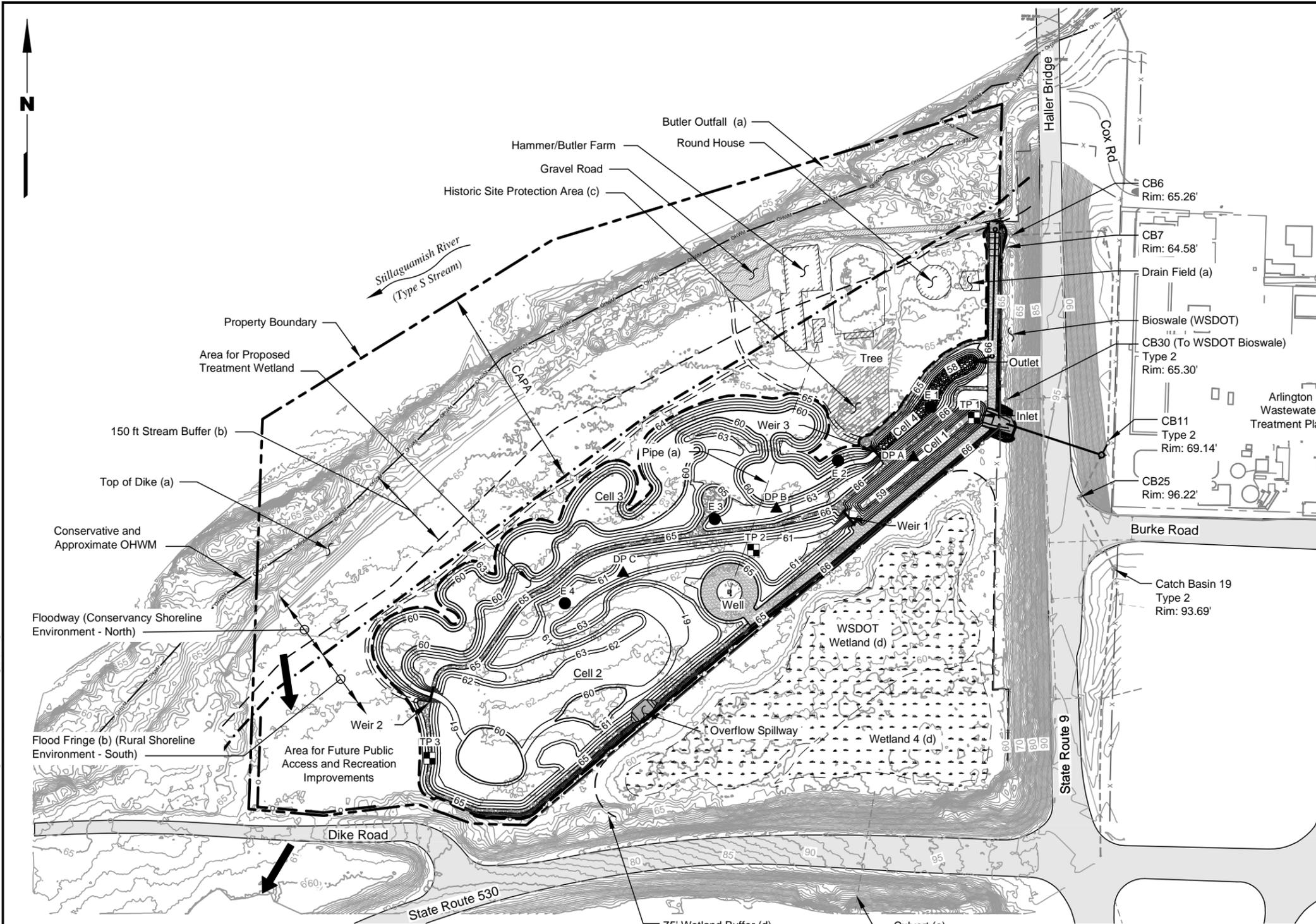
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Critical Areas Report | V:\1097001\1010015\DCons R3 Revised\CAR Fig 2_4_5A_5B R3.2.dwg (A) *Figure 2* 5/13/2010



Legend	
TP 1	Test Pit Location and Designation
E 3	Excavation Test Location and Designation
DP B	Excavated Soil Pit Location and Designation (a)
---	Property Boundary
---	Clearing And Grading Limits
---	Proposed Contours
---	Existing Contours
---	Silt Fence
---	Existing Wire Fence
---	Proposed Pipe
---	Existing Pipe
---	CAPA - Floodway Boundary (Snohomish County Permit and Zoning Map 2009)
---	Ordinary High Water Mark
---	Wetland / Stream Buffer
---	River Rock (Rounded Cobbles)
---	Proposed Mowed Grass Path
---	Proposed Gravel Path
---	Proposed Improved Roadway
---	Existing Trail
---	Existing Gravel Road
---	Existing Paved Road
---	Wetland
---	Existing Building
---	Historic Protection Area
---	Dominant Flood Path (e)

Legal Description
 Sec 02 Twp 31 Rge 05 Rt-22-22b) Beg S1/4 Cor Th N88°42'50w 241.8 Ft Th N01°06'00w 502.4 Ft Th N09°23'00w 942.74 Ft Th S89°24'30w 1452.22 Ft To Tpb Th N00°22'00e 687.43 Ft Th N56°42'00e 590.28 Ft Th N71°34'30e 515 Ft M/I To Ely Mgn Vac Market St Ext Nly Plat Haller City Th Sly Alg Ext Ely Mgn Aforsd Market St To Nly Mgn River- Side Ave Th Ely Alg Sd Nly Mgn River- Side Ave To Wly Mgn Minor St Th Sly Alg Sd Wly Mgn Minor St To Nly Mgn Div Ave Th Wly Alg Sd Nly Mgn Div Ave To Tpb Less Ptn Dd Or Dedicated To Co Or St For Rd Subj Ese Pud Less S/hy & Less Addl R/w To State Per Scc 97-2-07732-8
 Records of Snohomish County, Washington.

Tax Parcel Number: 31050200300200
 Site Address: 201 West Cox
 Contact Persons: Perry Welch, PWS
 Dave Pischer, PE
 Landau Associates
 130 2nd Ave S.
 Edmonds, WA 98020
 Phone: (425) 778-0907
 Applicant: City Of Arlington
 Bill Blake
 238 North Olympic Ave.
 Arlington, WA 98223
 Phone: (360) 403-3500

Site Information	
Current Zoning:	A-10-SA (Snohomish County)
General Policy Plan:	111 Single Family Residence - Detached
Proposed Land Use:	Stormwater Wetland Construction
Gross Square Footage:	21.90 Acres
Water Supply:	City Of Arlington
Sewage Disposal:	Onsite Septic System
School District:	City of Arlington

- Sources**
- a. Not Surveyed / Approximate (From As-Builts)
 - b. Snohomish County Permits - Planning and Zoning Map 2009 / FEMA Firm
 - c. Northwest Archaeological Associates 2008
 - d. WSDOT 1998
 - e. R2 Resource Consultants 2005

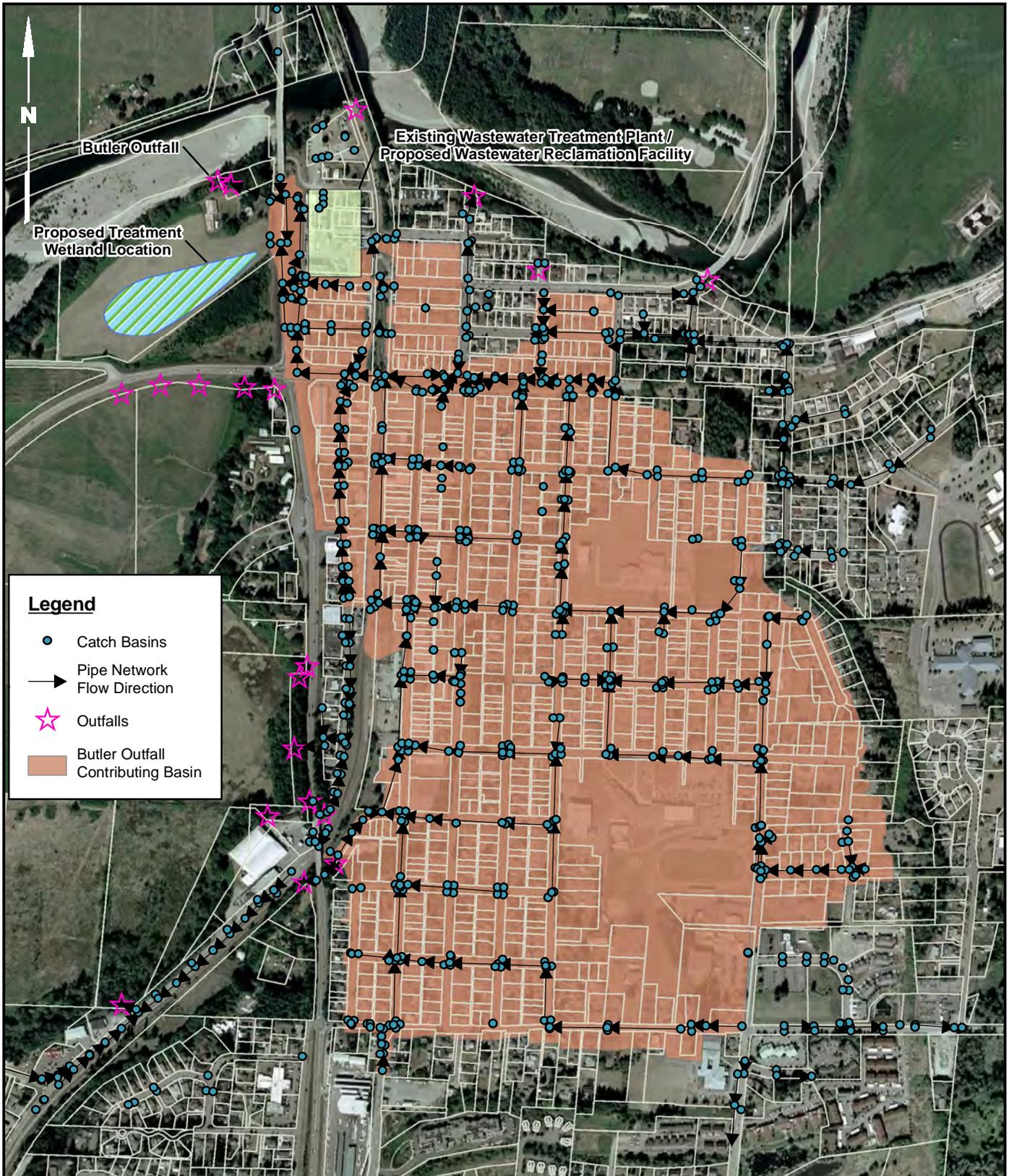
- Misc. Notes**
1. There is an existing WSDOT bioswale located within 15 ft of the property in the WSDOT right-of-way east of the house site.
 2. The stormwater pollution source control BMPs being proposed at this site are good housekeeping.
 3. The permanent water quality and quantity control facility being proposed is a created wetland.
 4. The temporary BMPs being proposed on this site shall consist of the installation of filter fabric fences, a construction entrance and onsite infiltration of construction stormwater.



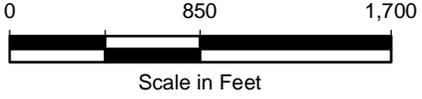
Base Map Source: Huey Surveying and Land Consulting 2008



City of Arlington Stormwater Wetland Project Snohomish County, Washington	Site, Shoreline/Flood Hazard, and TESC Plan	Figure 2
---	---	--------------------



Y:\Projects\109700\1010\MapDocs\ButlerOutfallBasins_9_25.mxd 12/2/2009



Data Source: City of Arlington; ESRI Image Server



City of Arlington
 Stormwater Wetland Project
 Snohomish County, Washington

Stormwater Basin

Figure
3

Critical Areas Report | V:\1097001\1010015\DI\Cons R3 Revised\CAR Fig 2_4_5A_5B R3.2.dwg (A) *Figure 4* 5/13/2010



- ### Legend
- * Interpretive Sign
 - Watch Your Step Sign
 - * Future Sculpture / Art Location
 - * Bench, Picnic Table or Kiosk
 - * Shelter
 - Proposed Contours
 - Existing Contours
 - CAPA - Floodway Boundary (Snohomish County Permit and Zoning Map 2009)
 - Ordinary High Water Mark
 - Stream Buffer
 - Coir Fiber Fabric
 - River Rock (Rounded Cobbles)
 - Proposed Mowed Grass Path
 - Proposed Gravel Path
 - Proposed Improved Roadway
 - Existing Trail
 - Existing Gravel Road
 - Existing Paved Road
 - Wetland
 - Existing Building
 - Historic Protection Area

Feature Notes

* Features to be designed and / or installed as part of a future volunteer effort.



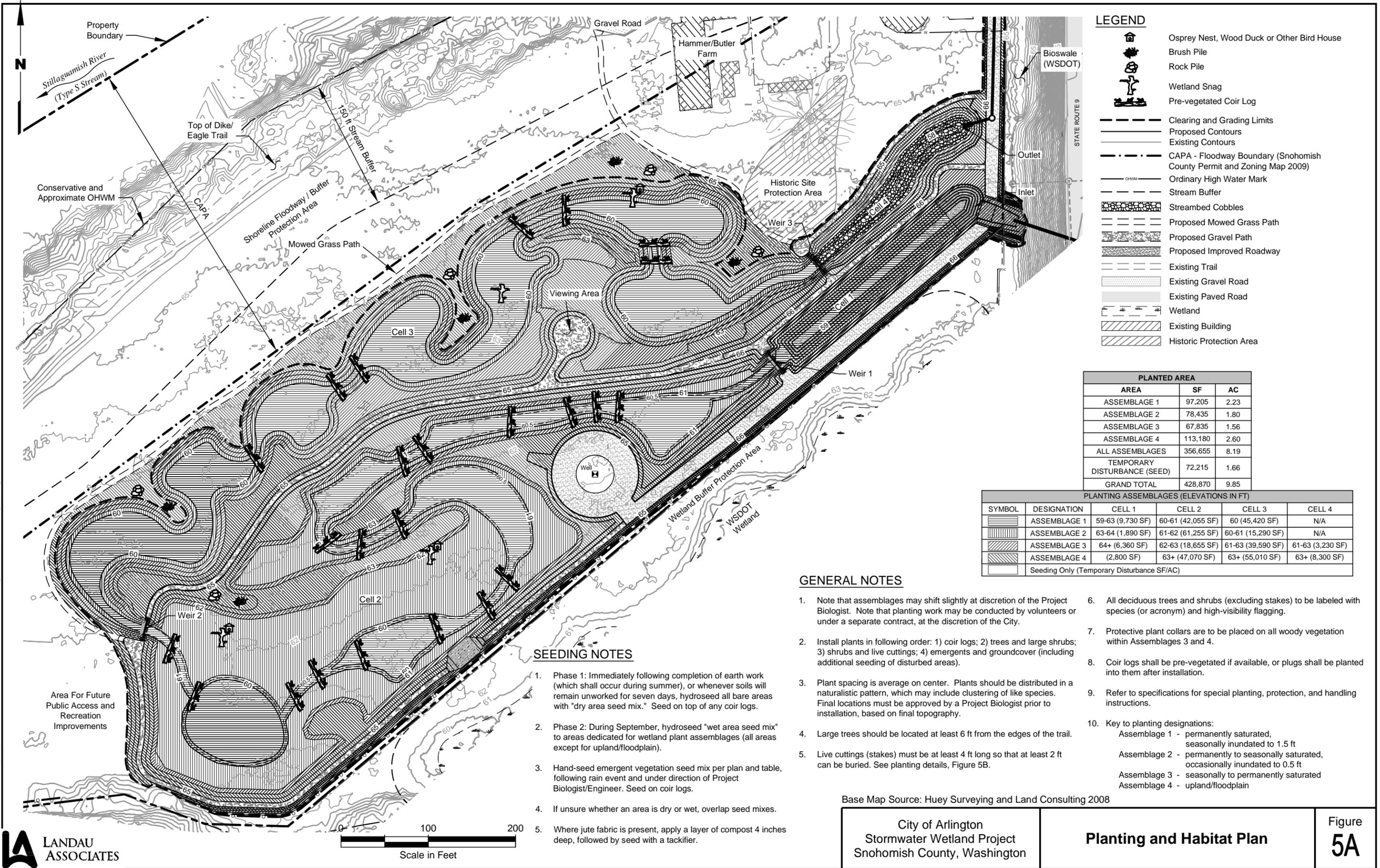
Base Map Source: Huey Surveying and Land Consulting 2008

City of Arlington
Stormwater Wetland Project
Snohomish County, Washington

**Grading, Soil Amendment,
Public Access, and
Permanent Site Protection Plan**

Figure
4

Critical Areas Report | V:\1097001\1010015\DCons R3 Revised\CAR Fig 2_4_5A_5B_R3.dwg (A) *Figure 5A 5/13/2010



LEGEND

- Osprey Nest, Wood Duck or Other Bird House
- Brush Pile
- Rock Pile
- Wetland Snag
- Pre-vegetated Coir Log
- Clearing and Grading Limits
- Proposed Contours
- Existing Contours
- CAPA - Floodway Boundary (Snohomish County Permit and Zoning Map 2009)
- Ordinary High Water Mark
- Stream Buffer
- Streambedded Cobbles
- Proposed Mowed Grass Path
- Proposed Gravel Path
- Proposed Improved Roadway
- Existing Trail
- Existing Gravel Road
- Existing Paved Road
- Wetland
- Existing Building
- Historic Protection Area

PLANTED AREA

AREA	SF	AC
ASSEMBLAGE 1	97,205	2.23
ASSEMBLAGE 2	78,435	1.80
ASSEMBLAGE 3	67,835	1.56
ASSEMBLAGE 4	113,180	2.60
ALL ASSEMBLAGES	356,655	8.19
TEMPORARY DISTURBANCE (SEED)	72,215	1.66
GRAND TOTAL	428,870	9.85

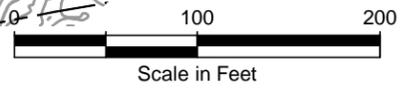
PLANTING ASSEMBLAGES (ELEVATIONS IN FT)

SYMBOL	DESIGNATION	CELL 1	CELL 2	CELL 3	CELL 4
	ASSEMBLAGE 1	59-63 (9,730 SF)	60-61 (42,055 SF)	60 (45,420 SF)	N/A
	ASSEMBLAGE 2	63-64 (1,890 SF)	61-62 (61,255 SF)	60-61 (15,290 SF)	N/A
	ASSEMBLAGE 3	64+ (6,360 SF)	62-63 (18,655 SF)	61-63 (39,590 SF)	61-63 (3,230 SF)
	ASSEMBLAGE 4	(2,800 SF)	63+ (47,070 SF)	63+ (55,010 SF)	63+ (8,300 SF)
	Seeding Only (Temporary Disturbance SF/AC)				

- SEEDING NOTES**
- Phase 1: Immediately following completion of earth work (which shall occur during summer), or whenever soils will remain unworked for seven days, hydroseed all bare areas with "dry area seed mix." Seed on top of any coir logs.
 - Phase 2: During September, hydroseed "wet area seed mix" to areas dedicated for wetland plant assemblages (all areas except for upland/floodplain).
 - Hand-seed emergent vegetation seed mix per plan and table, following rain event and under direction of Project Biologist/Engineer. Seed on coir logs.
 - If unsure whether an area is dry or wet, overlap seed mixes.
 - Where jute fabric is present, apply a layer of compost 4 inches deep, followed by seed with a tackifier.

- GENERAL NOTES**
- Note that assemblages may shift slightly at discretion of the Project Biologist. Note that planting work may be conducted by volunteers or under a separate contract, at the discretion of the City.
 - Install plants in following order: 1) coir logs; 2) trees and large shrubs; 3) shrubs and live cuttings; 4) emergents and groundcover (including additional seeding of disturbed areas).
 - Plant spacing is average on center. Plants should be distributed in a naturalistic pattern, which may include clustering of like species. Final locations must be approved by a Project Biologist prior to installation, based on final topography.
 - Large trees should be located at least 6 ft from the edges of the trail.
 - Live cuttings (stakes) must be at least 4 ft long so that at least 2 ft can be buried. See planting details, Figure 5B.
 - All deciduous trees and shrubs (excluding stakes) to be labeled with species (or acronym) and high-visibility flagging.
 - Protective plant collars are to be placed on all woody vegetation within Assemblages 3 and 4.
 - Coir logs shall be pre-vegetated if available, or plugs shall be planted into them after installation.
 - Refer to specifications for special planting, protection, and handling instructions.
 - Key to planting designations:
 Assemblage 1 - permanently saturated, seasonally inundated to 1.5 ft
 Assemblage 2 - permanently to seasonally saturated, occasionally inundated to 0.5 ft
 Assemblage 3 - seasonally to permanently saturated
 Assemblage 4 - upland/floodplain

Base Map Source: Huey Surveying and Land Consulting 2008



Critical Areas Report | V:\1097001\1010015\DCons R3 Revised\CAR Fig 2_4_SA_5B_R3.dwg (A) *Figure 5B 5/13/2010

Assemblage 1 (seasonally inundated emergent wetland to 1.5 ft)					
Species		Form	Specifications		
Scientific Name	Common Name		Quantity	Size / Type	Density **
<i>Salix lucida</i>	Pacific willow	Tree	100	4' stake/ live cutting	8' - plant on hummocks
<i>Salix sitchensis</i>	Sitka willow	Shrub	100		
(Wet Area Seed Mix)	(See Seed Mix Table)	Emergent	184 lbs	Seed	100 lbs/ac
(Emergent Seed Mix)	(See Seed Mix Table)	Emergent	184 lbs	Seed	100 lbs/ac

Assemblage 2 (permanently saturated / seasonally inundated scrub-shrub wetland to 0.5 ft)					
Species		Form	Specifications		
Scientific Name	Common Name		Quantity	Size	Density **
<i>Fraxinus latifolia</i>	Oregon ash	Tree	600	4' stake	6'
<i>Salix lucida</i>	Pacific willow	Tree	600	4' stake	6'
<i>Cornus sericea</i>	Red osier dogwood	Shrub	1500	Bare root	6'
<i>Rosa pisocarpa</i>	Swamp rose	Shrub	420	1 gal	4'
<i>Physocarpus capitatus</i>	Pacific ninebark	Shrub	1500	Bare root	4'
<i>Salix sitchensis</i>	Sitka willow	Shrub	1500	4' stake	6'
(Wet Area Seed Mix)	(See Seed Mix Table)	Emergent	175 lbs	Seed	100 lbs/ac
(Emergent Seed Mix)	(See Seed Mix Table)	Emergent	175 lbs	Seed	100 lbs/ac

Assemblage 3 (seasonally saturated forested wetland)					
Species		Form	Specifications		
Scientific Name	Common Name		Quantity	Size	Density **
<i>Malus fusca</i>	Western crabapple	Tree	100	Bare root	6'
<i>Picea sitchensis</i>	Sitka spruce	Tree	100	Bare root	6'
<i>Populus balsamifera</i>	Black cottonwood	Tree	100	Bare root	8'
<i>Alnus rubra</i>	Red Alder	Tree	100	Bare root	6'
<i>Rhamnus purshiana</i>	Cascara	Tree	100	Bare root	6'
<i>Thuja plicata</i>	Western red cedar	Tree	200	Bare root	8' *
<i>Populus tremuloides</i>	Quaking aspen	Tree	100	1 gal	8'
<i>Cornus sericea</i>	Red osier dogwood	Shrub	366	Bare root	4'
<i>Lonicera involucrata</i>	Black twinberry	Shrub	366	Bare root	4'
<i>Physocarpus capitatus</i>	Pacific ninebark	Shrub	366	Bare root	4'
<i>Rosa nutkana</i>	Nootka rose	Shrub	366	1 gal	4'
<i>Rosa pisocarpa</i>	Swamp rose	Shrub	366	1 gal	4'
<i>Rubus spectabilis</i>	Salmonberry	Shrub	366	Bare root	4'
<i>Salix scouleriana</i>	Scouler's willow	Shrub	366	4' stake	4'
<i>Symphoricarpos albus</i>	Snowberry	Shrub	366	1 gal	4'
(Wet Area Seed Mix)	(See Seed Mix Table)	Emergent	80 lbs	Seed	75 lbs/ac
(Dry Area Seed Mix)	(See Seed Mix Table)	Herb.	80 lbs	Seed	75 lbs/ac

Summary Table	
Size / Type	#
1 Gallon	5018
Bare Root	9004
Live Cutting	3466
Seed	1320
Tree	3640
Shrub	11548

Assemblage 4 (upland/floodplain)					
Species		Form	Specifications		
Scientific Name	Common Name		Quantity	Size	Density **
<i>Acer macrophyllum</i>	Big-leaf maple	Tree	240	Bare root	8'
<i>Abies grandis</i>	Grand fir	Tree	240	Bare root	8'
<i>Alnus rubra</i>	Red Alder	Tree	240	Bare root	6'
<i>Pseudotsuga menziesii</i>	Douglas fir	Tree	240	Bare root	8'
<i>Tsuga heterophylla</i>	Western hemlock	Tree	240	Bare root	8' *
<i>Acer circinatum</i>	Vine maple	Tree	240	Bare root	6'
<i>Amelanchier alnifolia</i>	Serviceberry	Shrub	600	Bare root	6'
<i>Holodiscus discolor</i>	Oceanspray	Shrub	600	Bare root	6'
<i>Mahonia aquifolium</i>	Tall Oregon grape	Shrub	600	Bare root	5'
<i>Oemleria cerasiformis</i>	Indian plum	Shrub	600	Bare root	5' *
<i>Ribes sanguineum</i>	Red flowering currant	Shrub	600	1 gal	4'
<i>Rosa nutkana</i>	Nootka rose	Shrub	600	1 gal	4'
<i>Symphoricarpos albus</i>	Snowberry	Shrub	600	1 gal	4'
<i>Gaultheria shallon</i>	Salal	Shrub	210	1 gal	4' *
<i>Polystichum munitum</i>	Sword fern	Fern	210	1 gal	4' *
(Dry Area Seed Mix)	(See Seed Mix Table)	Herb.	800 lbs	Seed	100 lbs/ac

* Plant of northeast side of slope or other shading feature (e.g. a bushy shrub/tree, bridge, etc.).

** Density is calculated at rate of 8 feet on center for trees over area, plus 4 feet on center for shrubs over area (average density is 6 ft on center), with the exception of emergent wetland areas.

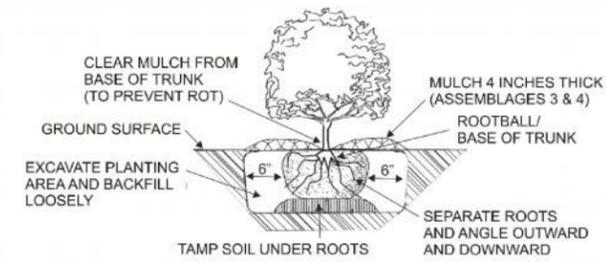
Seed Mixes			
Scientific Name	Common Name	Percentage of Mix	Location, Rate, Area and Amount
Dry Area Mix			
<i>Bromus carinatus</i>	California brome	20%	Assemblage 3 - 1.1 ac (75 lb/ac) and Assemblage 4 - 2.1 ac (100 lb/ac). TOTAL 210 lbs
<i>Elymus glaucus</i>	Blue wildrye	20%	
<i>Poa compressa</i>	Canada wildrye	20%	
<i>Festuca rubra commutata</i> OR <i>Festuca longifolia</i>	Chewings fescue OR Hard fescue	20%	
Multiple species (TBD)*	Pacific Northwest wildflower mix	20%	
Wet Area Mix			
<i>Agrostis gigantea</i>	Redtop	20%	Assemblages 1 and 2 - 3.6 ac (100 lb/ac) and Assemblage 3 - 1.1 ac (75 lb/ac). TOTAL 360 lbs
<i>Eleocharis palustris</i>	Common spikerush	20%	
<i>Glyceria occidentalis</i>	Western mannagrass	20%	
<i>Deschampsia caespitosa</i>	Tufted hairgrass	20%	
<i>Agrostis palustris</i>	Creeping bentgrass	20%	

Emergent Mix (Pools and wettest areas)			
Scientific Name	Common Name	Percentage	Location, Rate, Area and Amount
<i>Typha latifolia</i>	Common cattail	20%	Estimated to be Assemblages 1 and parts of 2 - 2 ac (100 lb/ac). TOTAL 200 lbs
<i>Scirpus microcarpus</i>	Small-fruited bulrush	20%	
<i>Glyceria occidentalis</i>	Western mannagrass	20%	
<i>Deschampsia caespitosa</i>	Tufted hairgrass	20%	
<i>Scirpus acutus</i>	Hardstem bulrush	20%	

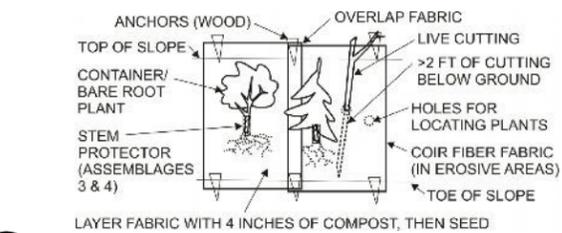
* Species to be selected based on availability at time of planting.

** Locations to be determined based on observation of ponded areas following rain events, under direction of the Project Biologist/Engineer - likely to be Assemblage 1.

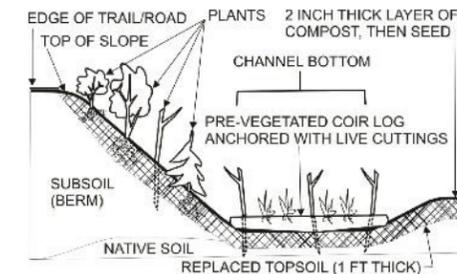
Note that Assemblage 3 has an overlapping of both Dry and Wet Area seed mixes.



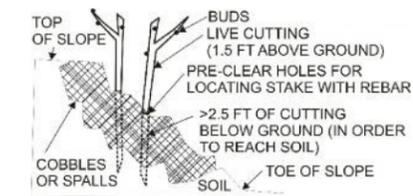
1 CONTAINER/BAREROOT PLANTING
SCALE: NONE



3 PLANTS IN COIR FIBER NETTING
SCALE: NONE



2 SOIL AMENDMENT, COIR LOG INSTALLATION AND PLANTING
SCALE: NONE



4 PLANTING WITH RIPRAP/COBBLE
SCALE: NONE

TABLE 1
PROJECT GOALS, OBJECTIVES, AND DESIGN ASPECTS
CITY OF ARLINGTON STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

Goal 1: Meet NPDES permit requirements for water quality in effluent at the Butler outfall and provide additional treatment	
Objectives:	A) Reduce water temperatures in street runoff, stormwater, and/or reclaimed water effluent
	B) Increase dissolved oxygen content in stormwater and effluent
	C) Reduce nutrient concentration and biological oxygen demand in stormwater
Design Aspects:	A) Provide settling area for suspended solids and associated nutrients and toxicants
	B) Provide forested canopy cover to shade water and lower temperature
	C) Provide aeration of effluent
	D) Provide increased retention time and interaction with soils and vegetation for nutrient cycling
	E) Provide sink for trace metals (copper, zinc, etc.) via chemisorption with organic matter
	F) Reduce bacterial loads through deposition of sediments and infiltration
Goal 2: Reduce peak flows at outfall from stormwater and wastewater sources.	
Objectives:	A) Provide water storage to reduce peak flows to the river
	B) Provide alternative discharge location for reclaimed wastewater from City WWTP
Design Aspects:	A) Provide large area for water storage
	B) Provide long, sinuous route for water travel during low flows
	C) Provide inlets for stormwater and for reclaimed water, including bypass mechanisms
	D) Allow for periodic river flooding during storm events
Goal 3: Provide wildlife habitat within wetland and buffer area.	
Objective:	A) Provide multiple habitat types
	B) Provide connectivity to other habitats (shoreline corridor)
Design Aspects:	A) Create areas with varying water depths
	B) Install habitat features, such as bird nesting boxes, snags, rock piles and amphibian refuge
	C) Provide contiguous buffer corridor between wetland habitats and river
	D) Maintain water movement to prevent mosquito breeding
Goal 4: Provide recreational and education opportunities.	
Objectives:	A) Provide shoreline access, recreation and wildlife viewing opportunities
	B) Provide educational opportunities
Design Aspects:	A) Create public access trail along the river and through the wetland
	B) Install informational signs and viewing areas
	C) Designing functional elements like fountain and waterfall to be aesthetically pleasing
	D) Provide structure for volunteers to collect donations / sell harvested cattail bouquets
	E) Retain open space and existing buildings for future public use

TABLE 2
POLLUTANTS, TOTAL MAXIMUM DAILY LOAD PARAMETERS, SOURCES, AND MECHANISMS FOR TREATMENT
CITY OF ARLINGTON STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

Pollutant(s)	TMDL Parameter	Source(s)	Treatment Mechanisms
Heat	Temperature	Stormwater, Reclaimed Water	Shading with trees and woody shrubs; infiltration through soil
Phosphorus	Dissolved oxygen (DO)	Stormwater, Reclaimed Water	Particulate P - sediment deposition in Cell 1 (settling pond); dissolved P - uptake by plants
Nitrogen	DO	Stormwater, Reclaimed Water	Cycling in wetlands – uptake by plants and denitrification in seasonally saturated areas
Pathogens	Fecal coliform (FC)	Stormwater	Sediment deposition; wetland discharge to groundwater, with secondary discharge via ephemeral channel
Oil and grease	None; can affect DO	Stormwater	Retention of free and dispersed floatable oil in baffled stilling basin (oil/water separator); deposition of sediments as for TSS
TSS	DO and FC	Stormwater	Sediment deposition in baffled stilling basin, bioswales, and wet pond cell
Metals	None	Stormwater	Settling associated with TSS and/or uptake by emergent vegetation (removal via harvest)
Gross solids	None	Stormwater	Filtration in influent bioswales and baffled stilling basin

Source: City of Arlington 2007.

TABLE 3
TREATMENT WETLAND DESIGN CHARACTERISTICS BY CELL
CITY OF ARLINGTON STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

Characteristic	Cell			
	1	2	3	4
Primary Purpose	Settling	Storage and Treatment	Storage and Treatment	Conveyance
Water Storage Area (Approximate)	35,000 ft ³ (to elevation 64 ft)	116,000 ft ³ (to elevation 63 ft)	123,000 ft ³ (to elevation 62 ft)	None
Deepest Elevation	59 ft	60 ft	60.25 ft	Exit at elevation 57.5 ft; Butler outfall invert at elevation 51.7 ft
Weir Information	Weir notch at elevation 63.0 ft; notch 10 ft wide and 2.5 ft deep; top of weir at elevation 65.5 ft	Two weir notches: Lower notch is at elevation 61.0 ft and is 0.5 ft deep and 2 ft wide; the upper notch is at elevation 61.5 ft and is 11 ft wide and 2 ft deep; top of weir at elevation 63.5 ft	Weir notch at elevation 60.25 ft; notch is 8 ft wide and 2.75 ft deep; top of weir at elevation 63.0 ft	N/A
Water Drop Over Weir	Water drop into Cell 2 is 1.5 ft	Water drop from the lower notch into Cell 3 is 1 ft	Water drop into Cell is 1.05 ft	N/A
Primary Water Quality Treatment Parameters	TSS, Garbage, Oils and Grease	Nutrients and Toxicants	Temperature, Nutrients, and Toxicants	DO
Key Water Quality Characteristic	Can be Dredged	Emergent, Shrub Vegetation, Infiltration	Tree Canopy Cover, Infiltration	Waterfall and Rough Channel Surface
Weekly (Typical) Depth of Storage	4.2 ft	1.21 ft	.017 ft (2 inches)	None
Maximum (100-year Storm Event) Depth of Storage	5.92 ft (100-year event)	2.87 ft*	2.16 ft*	5.75 ft**
Other Key Features	Accessible by Truck and Foot	Slower Infiltration Rate (0.25 inch/hr)	Increased Infiltration Rate (0.5 inch/hr)	Rounded Cobble Lined Channel
Dominant Habitat Types	PEM	PEM, PSS	PEM, PSS, PFO (some UPL)	Unconsolidated Bottom/PSS

Notes

* = Controlled by lowest point in berm (overflow).

** = Occurs when there is backwater from river during high river stage and/or storm events.

DO = Dissolved Oxygen.

TSS = Total Suspended Solids.

PEM = Palustrine Emergent.

PFO = Palustrine Forested.

PSS = Palustrine Scrub-Shrub.

UPL = Upland.

TABLE 4
METHODS FOR WETLAND DETERMINATION
CITY OF ARLINGTON STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

Parameter	Definition	Field Indicators	Field Assessment
Wetland Hydrology (c)	The area is inundated either permanently or periodically at mean water depths less than or equal to 6.6 ft, or The soil is inundated or saturated to the surface for at least 14 consecutive days during the growing season (the time during which two or more non-evergreen vascular plant species growing in a wetland or surrounding area exhibit biological activity, such as new growth, or as determined by soil temperature).	Primary indicators include surface inundation (standing water), saturated soils, water marks, drift lines, sediment deposits, and drainage patterns. Secondary indicators of hydrology include water-stained leaves, oxidized root channels, or local soil survey data for identified soils. In the absence of any primary indicators, at least two secondary indicators are required to meet the wetland hydrology criterion.	During investigation of soils, soil pits are allowed to stand up to 20 minutes in order to allow percolation of any groundwater into the pit to determine groundwater level in the soil profile. Additional digging may occur to 24 inches BGS during the dry season to investigate groundwater levels. In addition, the extent of soil saturation and presence/absence of oxidation are determined in the soils removed as part of the soils investigation (see Wetland Soils). Other indicators of wetland hydrology are observed at ground surface.

Notes:

- (a) Categories were originally developed and defined by the USFWS National Wetlands Inventory and were modified by the National Plant List Panel.
- (b) Per USACE 1987, 2008; NRCS 2006.
- (c) Per USACE 1987, 2008.
- (d) Modifiers:
 - + Frequency toward the higher end of the category (more frequently found in wetlands).
 - Frequency toward the lower end of the category.
 - * Tentative assignment based on limited information from which to determine the indicator status.

Soil Logs and Descriptions from the Natural Resources Conservation Service

Soil Classification System

	MAJOR DIVISIONS	CLEAN GRAVEL (Little or no fines)	GRAPHIC SYMBOL	USCS LETTER SYMBOL ⁽¹⁾	TYPICAL DESCRIPTIONS ⁽²⁾⁽³⁾
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
		SAND WITH FINES (Appreciable amount of fines)		GC	Clayey gravel; gravel/sand/clay mixture(s)
		CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SP	Poorly graded sand; gravelly sand; little or no fines
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)		ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity	
			CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay	
			OL	Organic silt; organic, silty clay of low plasticity	
	SILT AND CLAY (Liquid limit greater than 50)		MH	Inorganic silt; micaceous or diatomaceous fine sand	
			CH	Inorganic clay of high plasticity; fat clay	
			OH	Organic clay of medium to high plasticity; organic silt	
		PT	Peat; humus; swamp soil with high organic content		

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

- Notes:
- USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
 - Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
 - Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:
 - Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
 - Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
 - > 15% and ≤ 30% - "gravelly," "sandy," "silty," etc.
 - Additional Constituents: > 5% and ≤ 15% - "with gravel," "with sand," "with silt," etc.
 - ≤ 5% - "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.
 - Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

Drilling and Sampling Key		Field and Lab Test Data	
SAMPLER TYPE	SAMPLE NUMBER & INTERVAL	Code	Description
Code	Description	Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon	PP = 1.0	Pocket Penetrometer, tsf
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon	TV = 0.5	Torvane, tsf
c	Shelby Tube	PID = 100	Photoionization Detector VOC screening, ppm
d	Grab Sample	W = 10	Moisture Content, %
e	Single-Tube Core Barrel	D = 120	Dry Density, pcf
f	Double-Tube Core Barrel	-200 = 60	Material smaller than No. 200 sieve, %
g	2.50-inch O.D., 2.00-inch I.D. WSDOT	GS	Grain Size - See separate figure for data
h	3.00-inch O.D., 2.375-inch I.D. Mod. California	AL	Atterberg Limits - See separate figure for data
i	Other - See text if applicable	GT	Other Geotechnical Testing
1	300-lb Hammer, 30-inch Drop	CA	Chemical Analysis
2	140-lb Hammer, 30-inch Drop		
3	Pushed		
4	Vibrocore (Rotasonic/Geoprobe)		
5	Other - See text if applicable		

Groundwater

- Approximate water level at time of drilling (ATD)
- Approximate water level at time other than ATD

10/09 \IEDM\DATA\GINT\PROJECTS\1097001.010.GPJ SOIL CLASS SHEET

TP-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	
0						ML	Excavation Method: <u>Rubber-tired Backhoe</u> Ground Elevation (ft): _____ Excavated By: <u>None</u> Logged By: <u>MWB</u>
1		S-1				ML	ALLUVIUM Dark brown (2.5 y 4/3), SILT with trace roots (stiff, moist) ----- Light brown to orange (2.5 y 5/3), fine sandy SILT with trace roots (stiff, moist) -A-horizon ends at 1.5 feet -Redox at 2.5 feet ----- Light brown to orange (2.5 y 5/3), fine sandy SILT (stiff, moist to wet) ----- Light brown to orange (2.5 y 4/3), fine sandy SILT (stiff, wet)
2		S-2				ML	
6		S-3				ML	
8		S-4				ML	
Test Pit Completed 06/27/08 Total Depth of Test Pit = 8.5 ft.							

TP-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	
0						ML	Excavation Method: <u>Rubber-tired Backhoe</u> Ground Elevation (ft): _____ Excavated By: <u>None</u> Logged By: <u>MWB</u>
1		S-1				ML	ALLUVIUM Dark Brown (2.5 y 4/4), mottled with brownish black, SILT with trace fine sand and trace roots (stiff, moist) ----- Brown (2.5 y 4/3), mottled with brownish black, SILT with trace fine sand (stiff, moist) ----- Dark Brown (2.5 y 4/4), mottled with blackish gray, SILT with trace fine sand (stiff, moist)
4		S-2		W = 31 GS		ML	
8		S-3				ML	
Test Pit Completed 06/27/08 Total Depth of Test Pit = 8.0 ft.							

- Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
 2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
 3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1097.01 10/9/09 \MED\MDATA\GINT\GINT\PROJECTS\1097001\010.GPJ TEST PIT LOG



City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

Log of Test Pits

Figure
A-2

TP-3

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft) 0 2 4 6 8 10	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: <u>Rubber-tired Backhoe</u> Ground Elevation (ft): _____ Excavated By: <u>None</u> Logged By: <u>MWB</u>
		S-1			[Vertical Lines]	ML	Dark brown (2.5 y 4/2), SILT with trace sand and trace roots, (stiff, moist) ALLUVIUM
		S-2			[Diagonal Lines]	ML/CL	Light brown to orange (2.5 y 5/3), silty CLAY (stiff, moist) -Increased clay at 3.5 feet
		S-3			[Diagonal Lines]	ML/CL	Light brown to orange (2.5 y 5/3), silty CLAY (stiff, wet)
	S-4						Groundwater not encountered.
Test Pit Completed 06/27/08 Total Depth of Test Pit = 8.0 ft.							

- Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
 2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
 3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

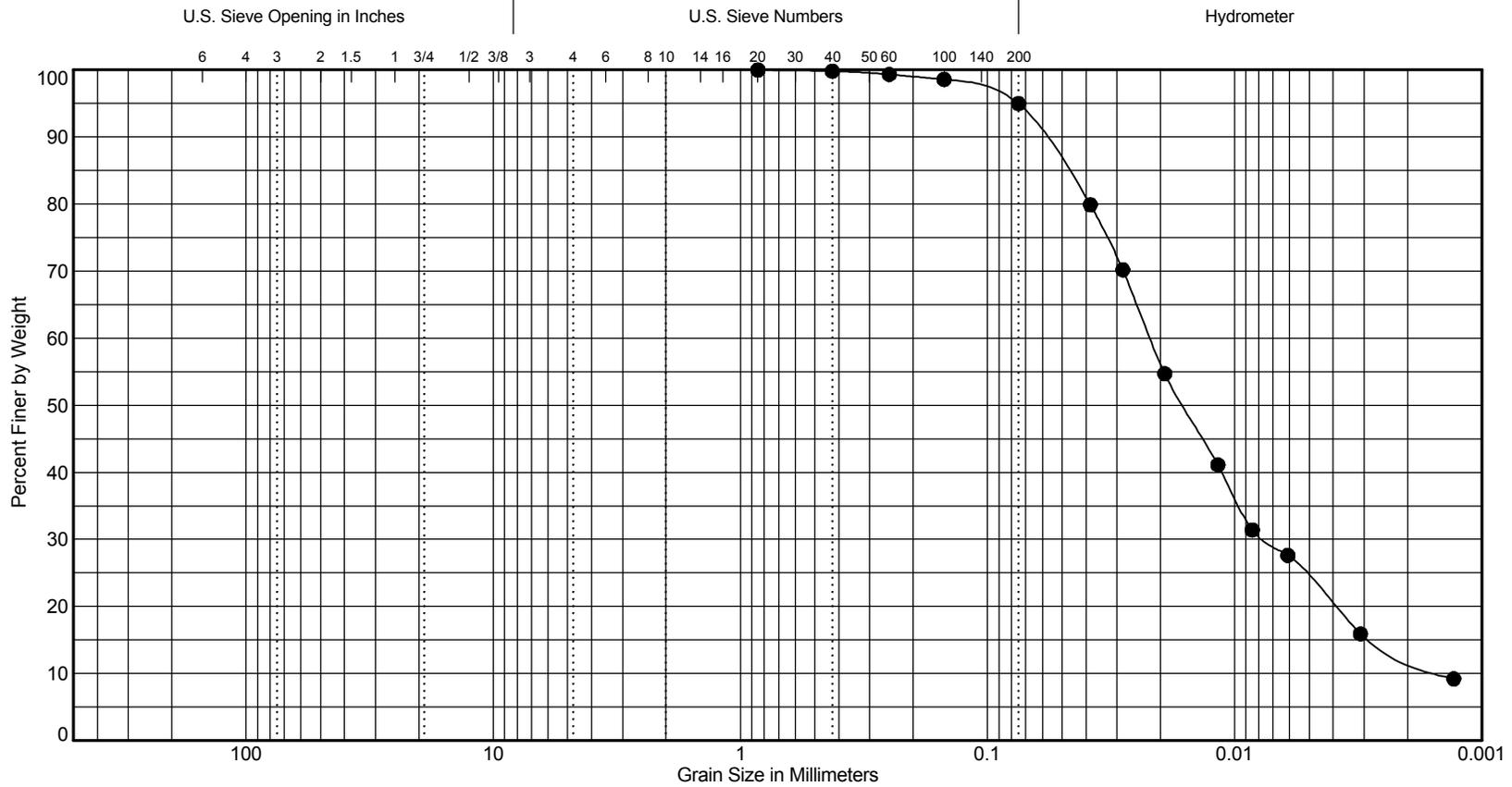
1097.01 10/9/09 \MED\MDATA\GINT\GINT\PROJECTS\1097001.010.GPJ TEST PIT LOG



City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

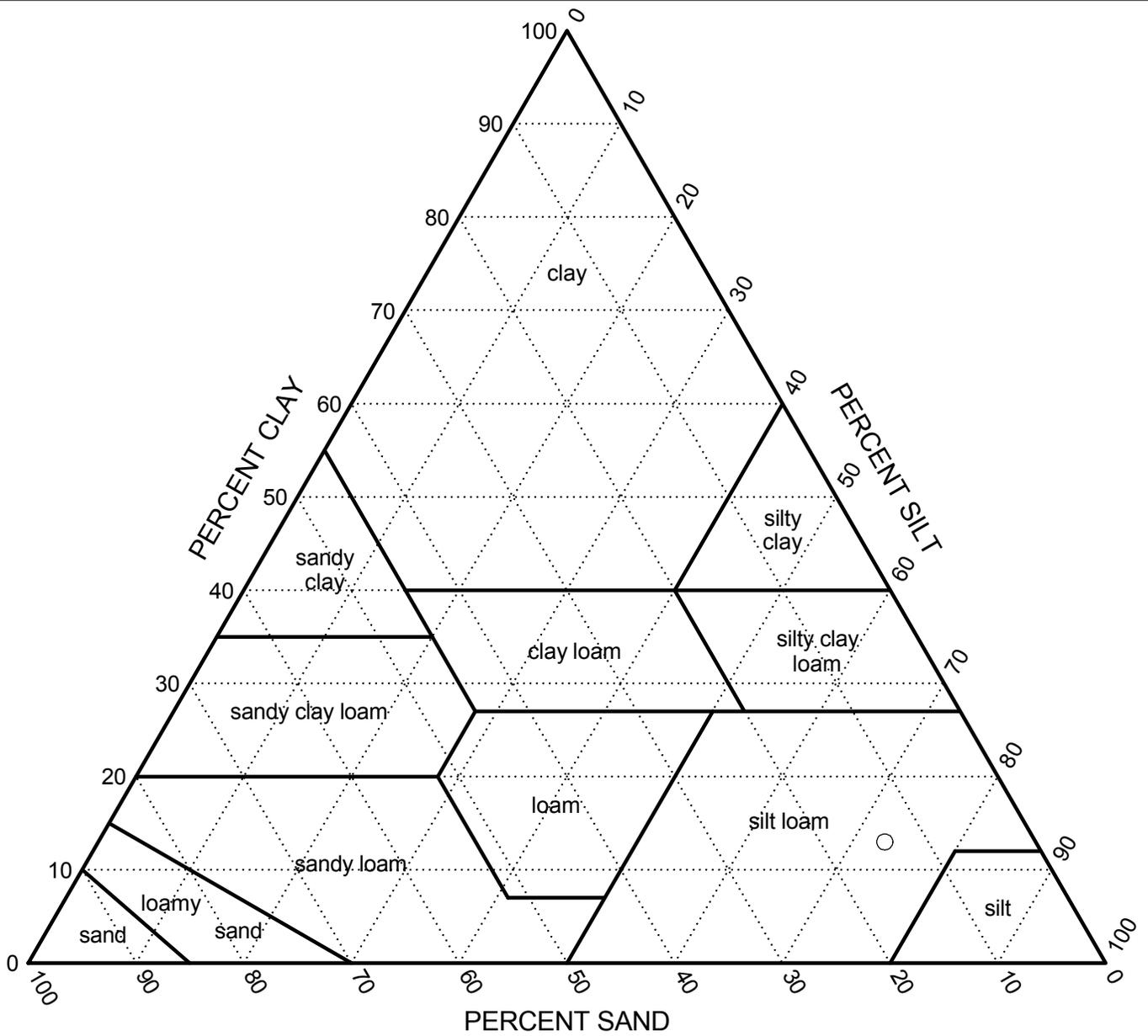
Log of Test Pits

Figure
A-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-2		3.5	31		



	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	USDA Textural Classification	USCS Classification
○	TP-2		3.5	31	SILT LOAM	

APPENDIX A

SOIL DESCRIPTIONS AND PROPERTIES

LOCATION PUGET WA
Established Series
Rev. DES/RJE/TDT
05/2000

PUGET SERIES

The Puget series consists of very deep, poorly drained soils that formed in recent alluvium on floodplains and low river terraces. Slopes are 0 to 3 percent. The average annual precipitation is about 40 inches. The mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, nonacid, mesic Fluvaquentic Endoaquepts

TYPICAL PEDON: Puget silty clay loam - pasture. (Colors are for moist soil unless otherwise noted.)

A1--0 to 1 inches; very dark grayish brown (2.5Y 3/2) silt loam, moderate thin platy structure; hard, firm, slightly sticky and slightly plastic; many roots; moderately acid (pH 6.0); abrupt smooth boundary. (1 to 7 inches thick)

A2--1 to 7 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light gray (2.5Y 7/2) dry; common fine prominent dark brown (7.5YR 4/4) redox concentrations; moderate very coarse prismatic structure; hard, firm, moderately sticky and moderately plastic; many roots; moderately acid (pH 6.0); clear smooth boundary. (0 to 7 inches thick)

Bg1--7 to 17 inches; dark grayish brown (2.5Y 5/2) silty clay loam, light olive gray (2.5Y 7/2) dry; common medium prominent strong brown (7.5YR 5/6, 5/8) redox concentrations; moderate medium prismatic structure; hard, firm, moderately sticky and moderately plastic; many roots; slightly acid (pH 6.2); clear smooth boundary. (5 to 12 inches thick)

Bg2--17 to 25 inches; grayish brown (2.5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; many medium prominent yellowish red (5YR 5/8, 4/8) redox concentrations; strong very coarse prismatic structure; very hard, firm, moderately sticky and moderately plastic; common roots; slightly acid (pH 6.4); abrupt smooth boundary. (0 to 12 inches thick)

Bg3--25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (5Y 7/2) dry; many medium prominent dark yellowish brown (10YR 3/6) and yellowish red (5YR 5/8, 4/6) redox concentrations; moderate medium angular blocky structure; hard, firm, moderately sticky and moderately plastic; few roots; moderately acid (pH 6.0); abrupt wavy boundary. (0 to 6 inches thick)

Bg4--31 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (5Y 7/1) dry; common fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/8) redox concentrations;

strong very coarse prismatic structure; hard, firm, moderately sticky and moderately plastic; few roots; moderately acid (pH 5.8); clear smooth boundary. (0 to 10 inches thick)

Cg1--40 to 45 inches; greenish gray (5GY 5/1) silty clay loam, light gray (5Y 7/1) and white (5Y 8/1) dry; common fine prominent strong brown (7.5YR 5/6) and brown (7.5YR 4/4) redox concentrations; massive; hard, firm, moderately sticky and moderately plastic; moderately acid (pH 5.8); clear smooth boundary. (0 to 6 inches thick)

Cg2--45 to 60 inches; gray (5Y 5/1) silty clay, light gray (5Y 7/1) dry; few fine prominent yellowish red (5YR 4/8, 5/8) and common medium distinct light olive brown (2.5Y 5/4) redox concentrations; massive; very hard, firm, moderately sticky and moderately plastic, moderately acid (pH 6.0).

TYPE LOCATION: King County, Washington; 1/2 mile southwest of Carnation; 2,640 feet north and 600 feet east of the southwest corner of sec. 21, T. 25 N., R. 7 E.

RANGE IN CHARACTERISTICS: The mean annual soil temperature is 47 to 52 degrees F. The particle-size control section lacks coarse fragments, has less than 15 percent fine and coarser sand, and 18 to 35 percent clay.

The A horizon has hue of 10YR or 2.5Y, value of 3 through 5 moist, 4 through 7 dry and chroma of 1 or 2 moist and dry. Subhorizons with a value of 3 moist are less than 7 inches thick. It is moderately acid to neutral.

The Bg horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist, 6 or 7 dry and chroma of 2 moist, 1 or 2 dry. It is silt loam or silty clay loam. Some pedons have thin strata (less than 2 inches thick) or sand or loamy sand. This horizon is slightly acid to very strongly acid.

The Cg horizon has hue of 10YR, 2.5Y, 5Y, or 5GY, value of 4 or 5 moist, 6 or 7 dry and chroma of 0 to 2 moist and dry. It is silt loam, silty clay loam or silty clay and has strata of sand or loamy sand. It is slightly acid to very strongly acid.

COMPETING SERIES: This is the [Aetna](#) series. Aetna soils have a buried mollic epipedon that is 10 to 24 inches thick.

GEOGRAPHIC SETTING: The Puget soils are on flood plains at elevations ranging from 10 to 650 feet. They formed in recent alluvium. Slopes are 0 to 3 percent. The soils are in a mild marine climate. Average annual precipitation ranges from 35 to 55 inches, most of which falls as rain during the winter. Snow is infrequent. The average January temperature is about 38 degrees F.; average July temperature is about 64 degrees F.; and mean annual temperature is about 50 degrees F. The frost-free season is about 150 to 190 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Briscot](#), [Nooksack](#), [Oridia](#), [Puyallup](#), and [Sultan](#) soils. Briscot soils are coarse-loamy. Nooksack, Puyallup, and Sultan soils have a xeric moisture regime. In addition, Nooksack and Puyallup soils have a mollic epipedon. Oridia soils are coarse-silty.

DRAINAGE AND PERMEABILITY: Poorly drained; slow to ponded runoff; moderately slow permeability. These soils are subject to occasional periods of flooding from December to March. An apparent water table is as high as 1 foot over the surface to 1 foot below the surface at times from November to April unless the soil is drained.

USE AND VEGETATION: Most of the Puget soil has been cleared and drained for use as cropland. Seeded grass pasture, grass-legume hay, oats, and green-chop are the major crops. The natural vegetation is red alder, black cottonwood, western redcedar, and willow with an understory of trailing blackberry, salmonberry, Oregon-grape, western swordfern, Indian plum, hardhack, willow, and rush.

DISTRIBUTION AND EXTENT: The Puget Sound Basin of Western Washington; MLRA 2. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Eastern part of Puget Sound Basin, Reconnaissance, 1909.

REMARKS: Laboratory data are available on this series NSSL #S74WA61-7- 341-345. Diagnostic horizons and features recognized in this pedon are an ochric epipedon and a cambic horizon from 17 to 40 inches. The sediments have more than 0.2 percent organic carbon to a depth of 60 inches or more.

National Cooperative Soil Survey

U.S.A.

**Snohomish County Area, Washington Version date: 12/12/2006
10:53:45 PM**

55—Puget silty clay loam (east portion of site)

Map Unit Setting

- *Elevation:* 10 to 650 feet
- *Mean annual precipitation:* 35 to 55 inches
- *Mean annual air temperature:* 48 to 50 degrees F
- *Frost-free period:* 160 to 180 days

Map Unit Composition

- *Puget, drained, and similar soils:* 85 percent
- *Minor components:* 6 percent

Description of Puget, Drained

Setting

- *Landform:* Flood plains
- *Parent material:* Alluvium

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* About 24 to 48 inches
- *Frequency of flooding:* Rare
- *Frequency of ponding:* None
- *Available water capacity:* High (about 12.0 inches)

Interpretive groups

- *Land capability classification (irrigated):* 3w
- *Land capability (nonirrigated):* 3w

Typical profile

- *0 to 9 inches:* Silty clay loam
- *9 to 38 inches:* Silty clay loam
- *38 to 60 inches:* Silty clay loam

Minor Components

Snohomish

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

Sumas

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

LOCATION PUYALLUP WA
Established Series
Rev. RJE
10/2002

PUYALLUP SERIES

The Puyallup series consists of deep, well drained soils formed in recent alluvium. Puyallup soils are on floodplains and low terraces. Slopes are 0 to 3 percent. The mean annual temperature is about 50 F. The average annual precipitation is about 45 inches.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, isotic over mixed, mesic Vitrandic Haploxerolls

TYPICAL PEDON: Puyallup fine sandy loam - cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 4 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; slightly acid (pH 6.2); abrupt smooth boundary. (3 to 8 inches thick)

A2--4 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; moderately acid (pH 6.0); clear smooth boundary. (3 to 5 inches thick)

A3--8 to 18 inches; dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; many fine and medium and few large pores; slightly acid (pH 6.3); abrupt wavy boundary. (8 to 20 inches thick)

2Cl--18 to 27 inches; dark brown (10YR 3/3) loamy sand, grayish brown (10YR 5/2) dry; single grained; loose; few fine roots; slightly acid (pH 6.4); abrupt wavy boundary. (8 to 15 inches thick)

2C2--27 to 60 inches; very dark grayish brown (2.5Y 3/2) gravelly sand, grayish brown (2.5Y 5/2) dry; single grained; loose; 20 percent pebbles; neutral (pH 6.8).

TYPE LOCATION: Clark County, Washington; along Lower East Fork Lewis River Road about 2,240 feet north and 600 feet west of the southeast corner of sec. 19, T. 4 N., R. 2 E.

RANGE IN CHARACTERISTICS: Depth to the 2C horizon is 15 to 30 inches. The mollic epipedon is 10 to 20 inches thick. Estimated mean annual soil temperature at a depth of 20 inches ranges from 47 to 53 degrees F. These soils are usually moist, but they are dry in all parts between depths of 7 and 20 inches for 60 to 75 consecutive days. The upper part of the particle-size control section has 5 to 15 percent clay and includes fine sandy loam or loam. The lower part has 0 to 5 percent clay. The soil ranges from neutral to moderately acid. The A horizon has hue

of 10YR or 2.5Y, value of 2 or 3 moist, 3 to 5 dry, and chroma of 1 through 3 moist and dry. Below 10 inches it is loam or fine sandy loam. Some pedons have a B or C horizon.

The 2C horizon has hue of 10YR or 2.5Y, value of 3 through 5 moist, 4 through 7 dry, and chroma of 1 through 4 moist and dry. It is sand, loamy sand, or gravelly sand and has 0 to 20 percent pebbles.

COMPETING SERIES: These are the [Boesel](#), [Chamokane](#), [Newberg](#), and [Snakelum](#) series in other families. Boesel soils are frigid. Chamokane soils have a mollic epipedon more than 20 inches thick. Newberg soils lack contrasting textures within the 10- to 40-inch control section. Snakelum soils lack a mollic epipedon and have a regular decrease in organic matter content as depth increases.

GEOGRAPHIC SETTING: These soils are on floodplains and low stream terraces at elevations of 20 to 650 feet. The soils formed in mixed recent alluvium. The climate is humid; summers are cool and dry, and winters are mild and moist. Average annual precipitation is 35 to 60 inches. Mean January temperature is 37 degrees F, mean July temperature is 62 degrees F, mean annual temperature is about 50 degrees F, and frost-free season is 170 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Briscot](#), [Mt. Vernon](#), [Oridia](#), [Pilchuck](#), [Puget](#), and [Sultan](#) soils. Briscot, Oridia, and Puget soils have an aquic moisture regime. Pilchuck soils are sandy throughout. Mt. Vernon soils are medial over loamy. Sultan soils are fine-silty and have an ochric epipedon.

DRAINAGE AND PERMEABILITY: Well drained; very slow runoff; moderately rapid permeability in the upper part of the control section and rapid below. These soils are subject to occasional brief periods of flooding from November to April unless protected.

USE AND VEGETATION: Used for cropland. Principal crops are hay, pasture, and row crops. Native vegetation is Douglas-fir, western redcedar, bigleaf maple, black Cottonwood, western hemlock, and red alder, with an understory of trailing blackberry, salmonberry, Oregon-grape, western swordfern, vine maple, and western brackenfern.

DISTRIBUTION AND EXTENT: Western Washington and possibly western Oregon. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Snohomish County, Washington, 1936.

REMARKS: Classification only updated 3/94 because of recent amendments to Soil Taxonomy. Diagnostic horizons and features recognized in this pedon are a mollic epipedon from the surface to 18 inches and a textural change to sandy material at 18 inches. Organic carbon content is assumed to decrease irregularly with depth.

National Cooperative Soil Survey

U.S.A.

56—Puyallup fine sandy loam (west portion of site)

Map Unit Setting

- *Mean annual precipitation:* 35 to 60 inches
- *Mean annual air temperature:* 50 degrees F
- *Frost-free period:* 170 to 200 days

Map Unit Composition

- *Puyallup and similar soils:* 85 percent
- *Minor components:* 6 percent

Description of Puyallup

Setting

- *Landform:* Terraces
- *Parent material:* Alluvium

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* Rare
- *Frequency of ponding:* None
- *Available water capacity:* Moderate (about 6.3 inches)

Interpretive groups

- *Land capability classification (irrigated):* 2w
- *Land capability (nonirrigated):* 2s

Typical profile

- *0 to 10 inches:* Fine sandy loam
- *10 to 30 inches:* Fine sandy loam
- *30 to 60 inches:* Sand

Minor Components

Puget

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

Sumas

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (rating values)	Acres in AOI	Percent of AOI
55	Puget silty clay loam	Somewhat limited	Puget, Drained (85%)	Depth to saturated zone (0.95) Cutbanks cave (0.10)	5.5	30.9%
56	Puyallup fine sandy loam	Very limited	Puyallup (85%)	Cutbanks cave (1.00)	12.3	69.1%
Totals for Area of Interest (AOI)					17.8	100.0%



Tables — Shallow Excavations — Summary by Rating Value



Summary by Rating Value

Rating	Acres in AOI	Percent of AOI
Very limited	12.3	69.1%
Somewhat limited	5.5	30.9%
Totals for Area of Interest (AOI)	17.8	100.0%



Description — Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	All Hydric	5.5	30.9%
56	Puyallup fine sandy loam	Partially Hydric	12.3	69.1%
Totals for Area of Interest (AOI)			17.8	100.0%



Description — Hydric Rating by Map Unit

This rating provides an indication of the proportion of the map unit that meets the criteria for hydric soils. Map units that are dominantly made up of hydric soils may have small areas, or inclusions, of nonhydric soils in the higher positions on the landform, and map units dominantly made up of nonhydric soils may have inclusions of hydric soils in the lower positions on the landform.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

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 Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of
 Agriculture, Natural Resources Conservation Service.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	5.5	30.9%
56	Puyallup fine sandy loam	All areas are prime farmland	12.3	69.1%
Totals for Area of Interest (AOI)			17.8	100.0%



Description — Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	3	5.5	30.9%
56	Puyallup fine sandy loam	2	12.3	69.1%
Totals for Area of Interest (AOI)			17.8	100.0%



Description — Nonirrigated Capability Class

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for

practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
55	Puget silty clay loam	92	5.5	30.9%
56	Puyallup fine sandy loam	>200	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.



Rating Options — Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	Rare	5.5	30.9%
56	Puyallup fine sandy loam	Rare	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.



Rating Options — Flooding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	None	5.5	30.9%
56	Puyallup fine sandy loam	None	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — Ponding Frequency Class

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare,

occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	C	5.5	30.9%
56	Puyallup fine sandy loam	B	12.3	69.1%
Totals for Area of Interest (AOI)		17.8	100.0%	



Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	CL	5.5	30.9%
56	Puyallup fine sandy loam	SM	12.3	69.1%
Totals for Area of Interest (AOI)		17.8	100.0%	



Description — Unified Soil Classification (Surface)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and

Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
55	Puget silty clay loam	0.20	5.5	30.9%
56	Puyallup fine sandy loam	0.10	12.3	69.1%
Totals for Area of Interest (AOI)		17.81	100.0%	



Description — Available Water Capacity

Available water capacity (AWC) refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in centimeters of water per centimeter of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure, with corrections for salinity and rock fragments. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. It is not an estimate of the quantity of water actually available to plants at any given time.

Available water supply (AWS) is computed as AWC times the thickness of the soil. For example, if AWC is 0.15 cm/cm, the available water supply for 25 centimeters of soil would be 0.15 x 25, or 3.75 centimeters of water.

For each soil layer, AWC is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55	Puget silty clay loam	6.3	5.5	30.9%

Summary by Map Unit — Snohomish County Area, Washington

56	Puyallup fine sandy loam	6.5	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — pH (1 to 1 Water)

Soil reaction is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion. In general, soils that are either highly alkaline or highly acid are likely to be very corrosive to steel. The most common soil laboratory measurement of pH is the 1:1 water method. A crushed soil sample is mixed with an equal amount of water, and a measurement is made of the suspension.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
55	Puget silty clay loam	0	5.5	30.9%
56	Puyallup fine sandy loam	0	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — Calcium Carbonate (CaCO₃)

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating (milliequivalents per 100 grams)	Acres in AOI	Percent of AOI
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Summary by Map Unit — Snohomish County Area, Washington

55	Puget silty clay loam	23.0	5.5	30.9%
56	Puyallup fine sandy loam	33.0	12.3	69.1%
Totals for Area of Interest (AOI) 17.8100.0%				



Description — Cation-Exchange Capacity (CEC-7)

Cation-exchange capacity (CEC-7) is the total amount of extractable bases that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

Snohomish County Area, Washington

Map symbol and soil name	Pct. of map unit	Awm - overland flow process treatment of wastewater		Awm - rapid infiltration disposal of wastewater		Awm - slow rate process treatment of wastewater	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
55—Puget silty clay loam							
Puget, drained	85	Very limited		Very limited		Somewhat limited	
		Seepage	1.00	Slow water movement	1.00	Slow water movement	0.96
		Depth to saturated zone	0.43	Depth to saturated zone	1.00	Depth to saturated zone	0.43
		Flooding	0.40				
Snohomish	3	Not rated		Not rated		Not rated	
Sumas	3	Not rated		Not rated		Not rated	
56—Puyallup fine sandy loam							
Puyallup	85	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Slow water movement	0.32	Filtering capacity	0.99
		Flooding	0.40				
Puget	3	Not rated		Not rated		Not rated	
Sumas	3	Not rated		Not rated		Not rated	

Selected Site Photographs



1. View of WSDOT bioswale and CB 7 facing upgradient (south) during high water.



2. CB 6 at north end of WSDOT bioswales, just south of access road.



3. Another view of bioswales and stormwater sampling at CB 6.



4. View of WSDOT bioswale facing upgradient (south) during dry season.

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5. View of Test Pit 2.



6. View from center of project area facing east to SR-9.



7. View from center of project area facing north to WSDOT Wetland.



8. View of access road under Haller Bridge facing northwest.

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9. View of Haller Park boat ramp during low flow in the Stillaguamish River.



10. View of Haller Park boat ramp during high flow in the Stillaguamish River.



11. View of data logging in CB 7 in March 2008.



12. View of data logging in CB 7 in March 2008.

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13. View of data logging in CB 6 in March 2008.



14. View of Butler outfall during low flow event.



15. View of Butler outfall during high flow event.

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Wetland Data Forms

DATA FORM 1
Routine Wetland Determination
 (WA State Wetland Delineation Manual or
 1987 Corps Wetland Delineation Manual)

Project/Site: <u>Arlington Old Town Stormwater Wetland Creation</u> Applicant/owner: <u>Arlington</u> Investigator(s): <u>B. Blake, S. Blake</u>	Date: <u>6/10/08</u> County: <u>Spokane</u> State: <u>WA</u> S/T/R: _____
Do Normal Circumstances exist on the site? <input checked="" type="radio"/> yes <input type="radio"/> no Is the site significantly disturbed (atypical situation)? <input type="radio"/> yes <input checked="" type="radio"/> no Is the area a potential Problem Area? <input type="radio"/> yes <input checked="" type="radio"/> no	Community ID: _____ Transect ID: _____ Plot ID: <u>A (20' south of water, lot 1)</u>

VEGETATION annually hayed pasture

	Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
70	<u>Holcus lanatus</u>	<u>H</u>	<u>FAC</u>			
-10	<u>Dactylis glomerata</u>	<u>H</u>	<u>FACU</u>			
10	<u>Trifolium spp.</u>	<u>H</u>				
5	<u>Ranunculus repens</u>	<u>H</u>	<u>FACW</u>			
5	<u>Rumex spp.</u>	<u>H</u>				

HYDROPHYTIC VEGETATION INDICATORS:

% of dominants OBL, FACW, & FAC: 100%

Check all indicators that apply & explain below:

Regional knowledge of plant communities <input checked="" type="checkbox"/>	Wetland plant list (nat'l or regional) <input checked="" type="checkbox"/>	OTHER _____
Physiological or reproductive adaptations _____	Morphological adaptations _____	
Technical Literature _____	Wetland Plant Data Base _____	

Hydrophytic vegetation present? yes no
 Rationale for decision/Remarks: _____

HYDROLOGY

Is it the growing season? <input checked="" type="radio"/> yes <input type="radio"/> no Based on: _____	Water Marks: <input type="checkbox"/> yes <input type="checkbox"/> no Drift Lines: <input type="checkbox"/> yes <input type="checkbox"/> no	Sediment Deposits: <input type="checkbox"/> yes <input type="checkbox"/> no Drainage Patterns: <input type="checkbox"/> yes <input type="checkbox"/> no
Dept. of inundation: <u> </u> inches	Oxidized Root (live roots) Channels <12 in. <input checked="" type="checkbox"/> yes <input type="checkbox"/> no	Local Soil Survey: <input type="checkbox"/> yes <input type="checkbox"/> no
Depth to free water in pit: <u> </u> inches	FAC Neutral: <input type="checkbox"/> yes <input type="checkbox"/> no	Water-stained Leaves: <input type="checkbox"/> yes <input type="checkbox"/> no
Depth to saturated soil: <u> </u> inches	Other: _____	
Check all that apply & explain below: Stream, Lake or gage data: _____ Aerial photographs: _____ Other: _____		

Wetland hydrology present? yes no
 Rationale for decision/Remarks: _____

70
-10
10
5
5
-

no
water
or
seeps

SOILS

Map Unit Name Puget silty clay loam
 (Series & Phase)

Drainage Class _____

Taxonomy (subgroup) _____

Field observations confirm Yes No
 mapped type?

Profile Description						
Depth (inches)	Horizon	Matrix color (Munsell moist)	Mottle colors (Munsell moist)	Mottle abundance size & contrast	Texture, concretions, structure, etc.	Drawing of soil profile (match description)
0-18		2.5 Y 4/2	—	—	clay loam	

Hydric Soil Indicators: (check all that apply)

- Histosol
- Histic Epipedon
- Sulfidic Odor
- Aquic Moisture Regime
- Reducing Conditions
- Gleyed or Low-Chroma Colors
- Concretions
- High Organic Content in Surface Layer of Sandy Soils
- Organic Streaking in Sandy Soils
- Listed on Local Hydric Soils List
- Listed on National Hydric Soils List
- Other (explain in remarks)

Hydric soils present? yes no
 Rationale for decision/Remarks:

Wetland Determination (circle)

Hydrophytic vegetation present? yes no
 Hydric soils present? yes no Is the sampling point
 Wetland hydrology present? yes no within a wetland? yes no

Rationale/Remarks:

NOTES:

DATA FORM 1
Routine Wetland Determination
 (WA State Wetland Delineation Manual or
 1987 Corps Wetland Delineation Manual)

Project/Site: <u>Arlington Old Town Stormwater Wetland Creation</u> Applicant/owner: <u>Arlington</u> Investigator(s): <u>B. Blake, S. Blake</u>	Date: <u>6/10/08</u> County: <u>Sanbornish</u> State: <u>WA</u> S/T/R: _____
Do Normal Circumstances exist on the site? <u>yes</u> no Is the site significantly disturbed (atypical situation)? yes <u>no</u> Is the area a potential Problem Area? yes <u>no</u>	Community ID: _____ Transect ID: _____ Plot ID: <u>B (West of plot 1, adjacent to water plot 2)</u>

VEGETATION annually hayed pasture

%
 over
 70
 10
 10
 10
 dominant

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
<u>Holcus lanatus</u>	<u>H</u>	<u>FAC</u>			
<u>Ranunculus repens</u>	<u>H</u>	<u>FACW</u>			
<u>Dactylis glomerata</u>	<u>H</u>	<u>FACU</u>			
<u>Trifolium spp</u>	<u>H</u>				

HYDROPHYTIC VEGETATION INDICATORS:
 % of dominants OBL, FACW, & FAC: 100%

Check all indicators that apply & explain below:

Regional knowledge of plant communities	<input checked="" type="checkbox"/>	Wetland plant list (nat'l or regional)	<input checked="" type="checkbox"/>	OTHER _____
Physiological or reproductive adaptations	<input type="checkbox"/>	Morphological adaptations	<input type="checkbox"/>	
Technical Literature	<input type="checkbox"/>	Wetland Plant Data Base	<input type="checkbox"/>	

Hydrophytic vegetation present? yes no
 Rationale for decision/Remarks: _____

HYDROLOGY

Is it the growing season? <u>yes</u> no Based on:		Water Marks: yes no Drift Lines: yes no Oxidized Root (live roots) Channels <12 in. yes <u>no</u>	Sediment Deposits: yes no Drainage Patterns: yes no Local Soil Survey: yes no
Dept. of inundation: _____ inches Depth to free water in pit: _____ inches Depth to saturated soil: _____ inches	<u>no water or seeps</u>	FAC Neutral: yes no Water-stained Leaves: yes no	

Check all that apply & explain below:
 Stream, Lake or gage data: _____
 Aerial photographs: _____ Other: _____

Wetland hydrology present? yes no
 Rationale for decision/Remarks: _____

SOILS

Map Unit Name Puyallup fine sandy loam
(Series & Phase)

Drainage Class _____

Taxonomy (subgroup) _____

Field observations confirm Yes No
mapped type?

Profile Description						
Depth (inches)	Horizon	Matrix color (Munsell moist)	Mottle colors (Munsell moist)	Mottle abundance size & contrast	Texture, concretions, structure, etc.	Drawing of soil profile (match description)
0-10		2.5Y 4/1	—	—	clay loam	
10-18		2.5Y 4/2	10YR 5/6	faint single mottie, 1% coverage	sandy loam	

Hydric Soil Indicators: (check all that apply)

- Histosol
- Histic Epipedon
- Sulfidic Odor
- Aquic Moisture Regime
- Reducing Conditions
- Gleyed or Low-Chroma Colors
- Concretions
- High Organic Content in Surface Layer of Sandy Soils
- Organic Streaking in Sandy Soils
- Listed on Local Hydric Soils List
- Listed on National Hydric Soils List
- Other (explain in remarks)

Hydric soils present? yes no

Rationale for decision/Remarks:

Wetland Determination (circle)

- Hydrophytic vegetation present? yes no
- Hydric soils present? yes no
- Wetland hydrology present? yes no
- Is the sampling point within a wetland? yes no

Rationale/Remarks:

NOTES: bald eagle flew over site during this plot.

DATA FORM 1
Routine Wetland Determination
 (WA State Wetland Delineation Manual or
 1987 Corps Wetland Delineation Manual)

Project/Site: <u>Arlington Old Town Stormwater Wetland Creation</u> Applicant/owner: <u>Arlington</u> Investigator(s): <u>B. Blake, S. Blake</u>	Date: <u>6/10/08</u> County: <u>Snohomish</u> State: <u>WA</u> S/T/R: _____
Do Normal Circumstances exist on the site? <input checked="" type="radio"/> yes <input type="radio"/> no Is the site significantly disturbed (atypical situation)? <input type="radio"/> yes <input checked="" type="radio"/> no Is the area a potential Problem Area? <input type="radio"/> yes <input checked="" type="radio"/> no	Community ID: _____ Transect ID: _____ Plot ID: <u>C (center of depression)</u>

VEGETATION annually mowed pasture

70
ever

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
<u>Agrostis spp.</u>	<u>H</u>	<u>FAC</u>			
<u>Holcus lanatus</u>	<u>H</u>	<u>FAC</u>			
<u>Festuca arundinacea</u>	<u>H</u>	<u>FAC-</u>			
<u>Dactylis glomerata</u>	<u>H</u>	<u>FACU</u>			

HYDROPHYTIC VEGETATION INDICATORS:

% of dominants OBL, FACW, & FAC: 50%

Check all indicators that apply & explain below:

Regional knowledge of plant communities <input checked="" type="checkbox"/>	Wetland plant list (nat'l or regional) <input checked="" type="checkbox"/>	OTHER _____
Physiological or reproductive adaptations _____	Morphological adaptations _____	
Technical Literature _____	Wetland Plant Data Base _____	

Hydrophytic vegetation present? yes no
 Rationale for decision/Remarks:

HYDROLOGY

Is it the growing season? <input checked="" type="radio"/> yes <input type="radio"/> no	Water Marks: <input type="radio"/> yes <input type="radio"/> no	Sediment Deposits: <input type="radio"/> yes <input type="radio"/> no
Based on:	Drift Lines: <input type="radio"/> yes <input type="radio"/> no	Drainage Patterns: <input type="radio"/> yes <input type="radio"/> no
Dept. of inundation: <u> </u> inches	Oxidized Root (live roots) Channels <12 in. <input checked="" type="radio"/> yes <input type="radio"/> no	Local Soil Survey: <input type="radio"/> yes <input type="radio"/> no
Depth to free water in pit: <u> </u> inches	FAC Neutral: <input type="radio"/> yes <input type="radio"/> no	Water-stained Leaves: <input type="radio"/> yes <input type="radio"/> no
Depth to saturated soil: <u> </u> inches	Other: _____	

no water or seeps

Check all that apply & explain below:
 Stream, Lake or gage data: _____
 Aerial photographs: _____ Other: _____

Wetland hydrology present? yes no
 Rationale for decision/Remarks:

SOILS

Map Unit Name Puyallup fine sandy loam
(Series & Phase)

Drainage Class _____

Taxonomy (subgroup) _____

Field observations confirm Yes No
mapped type?

Profile Description

Depth (inches)	Horizon	Matrix color (Munsell moist)	Mottle colors (Munsell moist)	Mottle abundance size & contrast	Texture, concretions, structure, etc.	Drawing of soil profile (match description)
0-18		10YR 3/2	—	—	clay loam	

Hydric Soil Indicators: (check all that apply)

- Histosol
- Histic Epipedon
- Sulfidic Odor
- Aquic Moisture Regime
- Reducing Conditions
- Gleyed or Low-Chroma Colors
- Concretions
- High Organic Content in Surface Layer of Sandy Soils
- Organic Streaking in Sandy Soils
- Listed on Local Hydric Soils List
- Listed on National Hydric Soils List
- Other (explain in remarks)

Hydric soils present? yes no

Rationale for decision/Remarks:

Wetland Determination (circle)

Hydrophytic vegetation present? yes no

Hydric soils present? yes no

Wetland hydrology present? yes no

Is the sampling point within a wetland? yes no

Rationale/Remarks:

NOTES:

**Modeled Water Levels During Flooding
(Excerpt from R2 Resource Consultants 2005)**

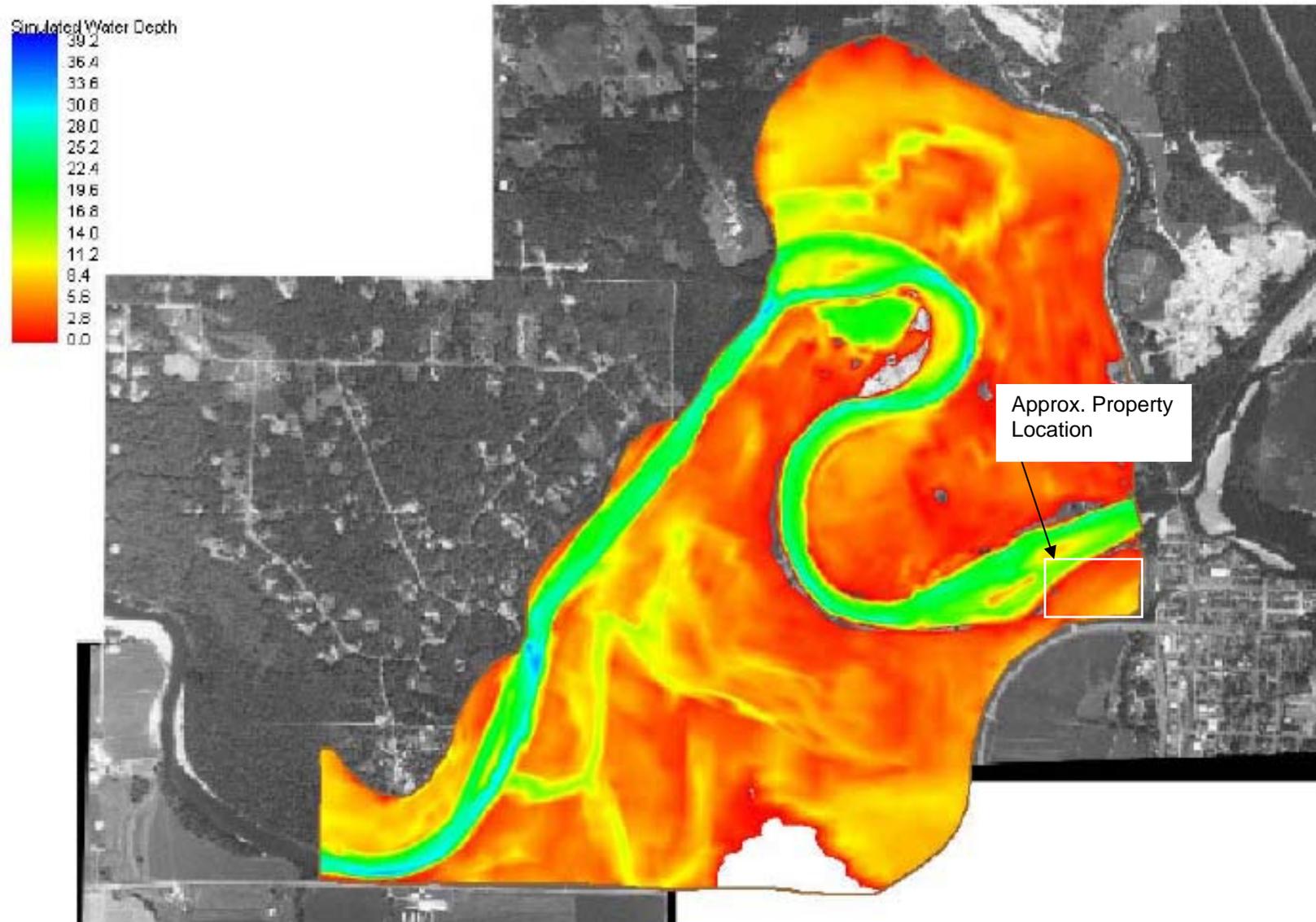
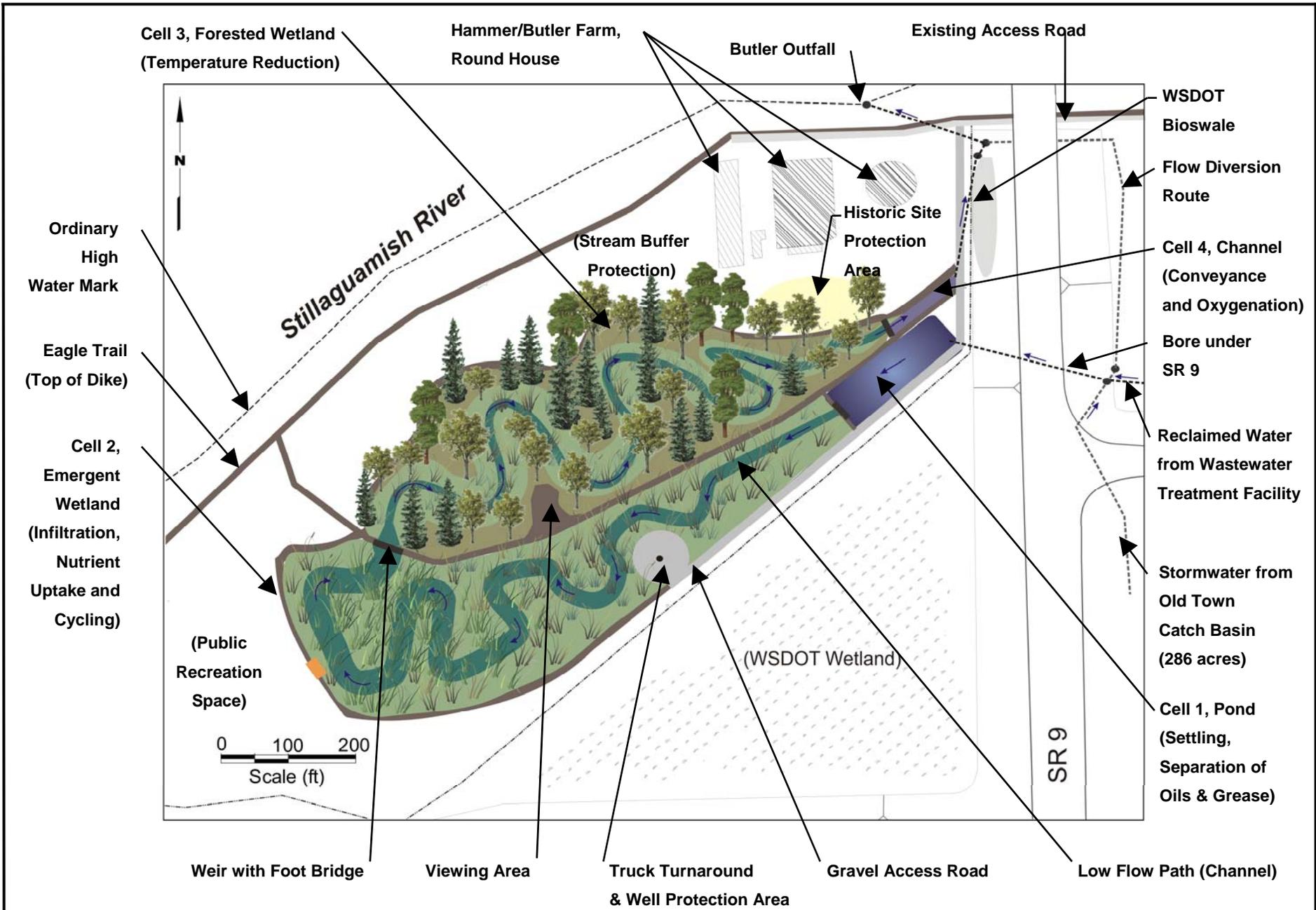


Plate 5. Simulated water depth contours for the 100-year flood event.

Illustration of Stormwater Wetland Features



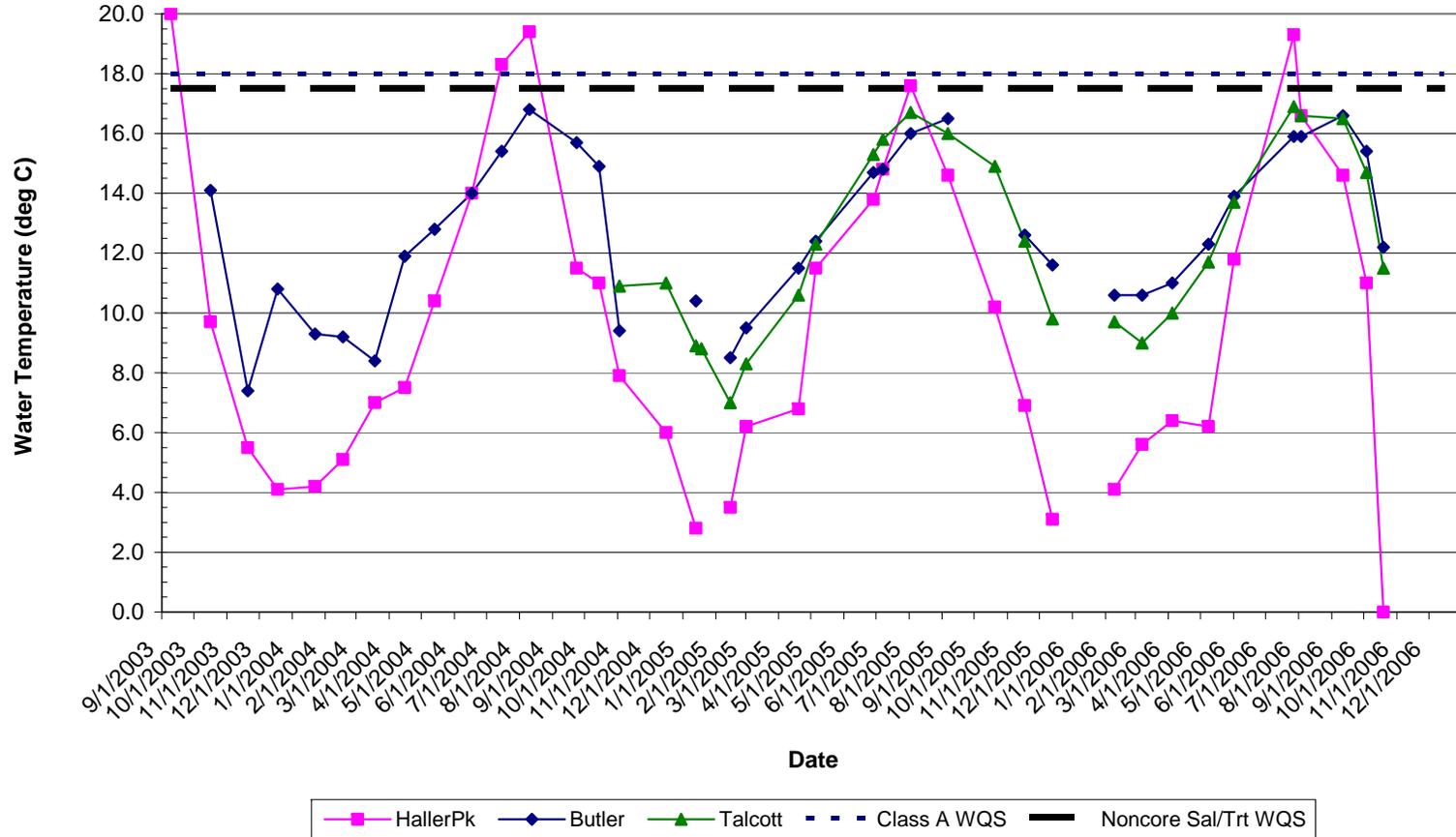
City of Arlington
 Stormwater Wetland Project
 Snohomish County, Washington

Illustration of Design Features and Habitat

Water Quality Data

Stillaguamish TMDL Temperature Monitoring

Stillaguamish River at Haller Park, Butler Outfall, Talcott Outfall



Source: City of Arlington

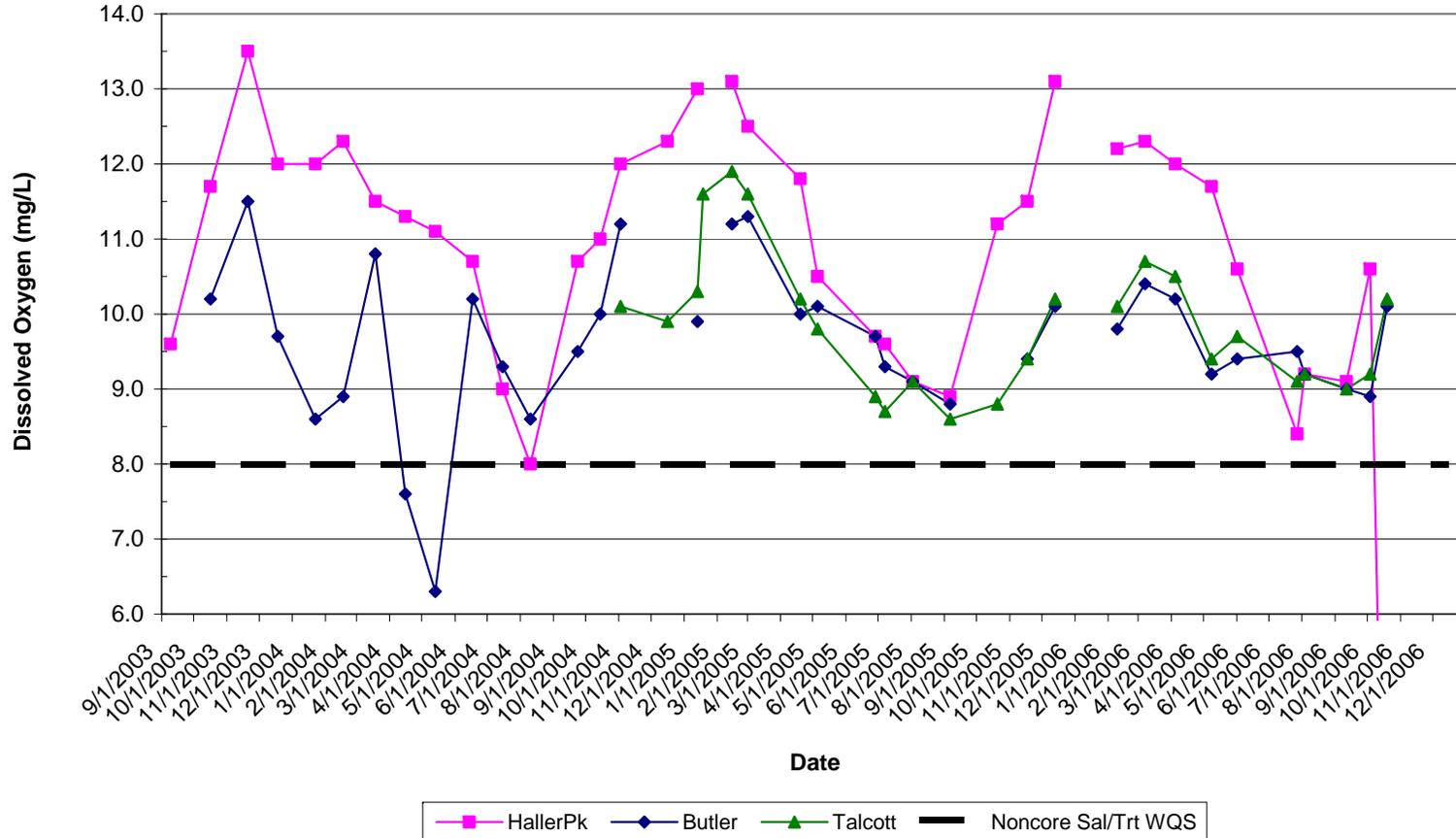
City of Arlington
Stormwater Wetland Project
Snohomish, Washington

**Stillaguamish TMDL
Temperature Monitoring**

Figure
F-1

Stillaguamish TMDL Dissolved Oxygen Monitoring

Stillaguamish River at Haller Park, Butler Outfall, Talcott Outfall



Source: City of Arlington

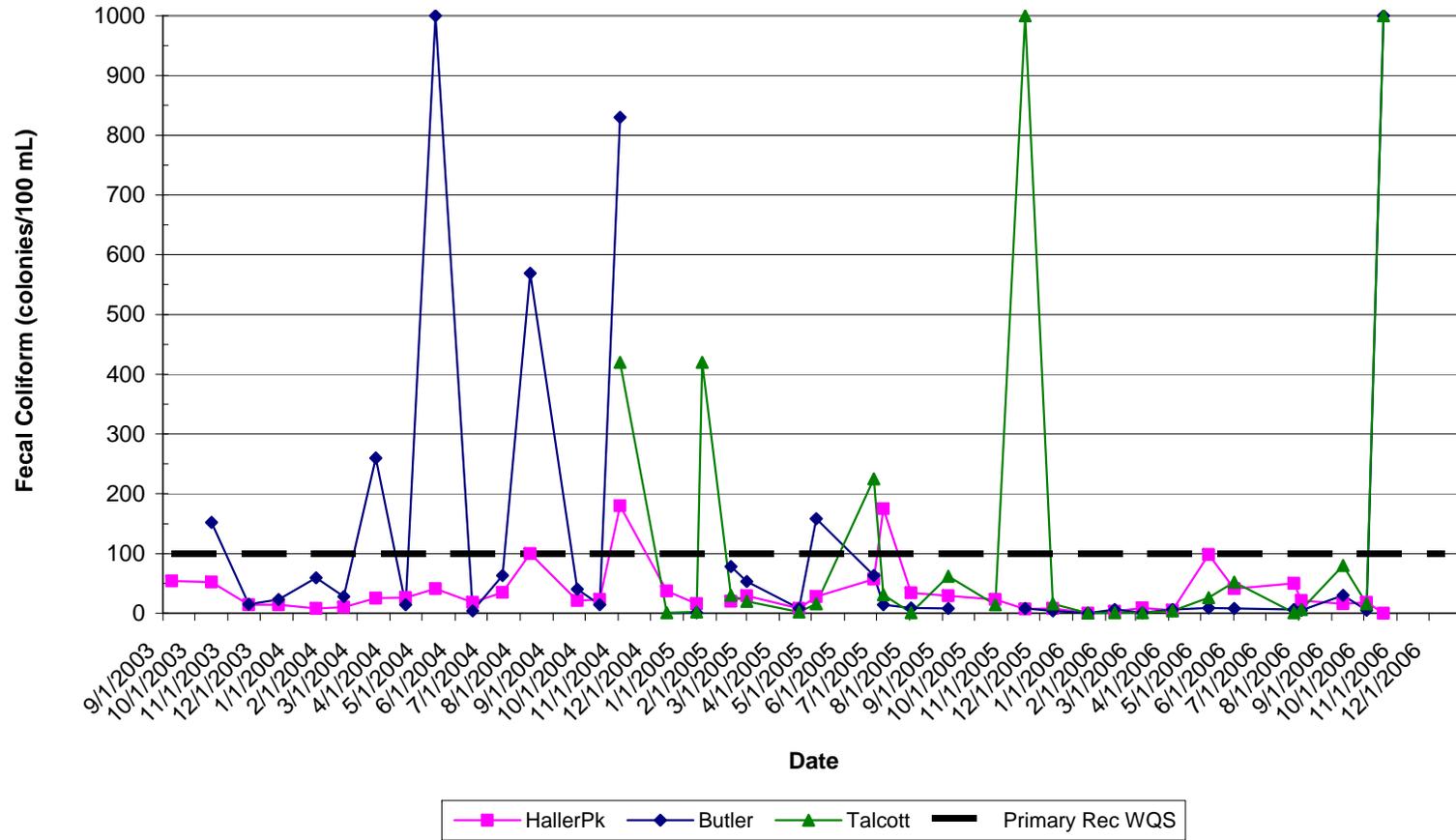
City of Arlington
Stormwater Wetland Project
Snohomish, Washington

**Stillaguamish TMDL
Dissolved Oxygen Monitoring**

Figure
F-2

Stillaguamish TMDL Fecal Coliform Monitoring

Stillaguamish River at Haller Park, Butler Outfall, Talcott Outfall



Source: City of Arlington

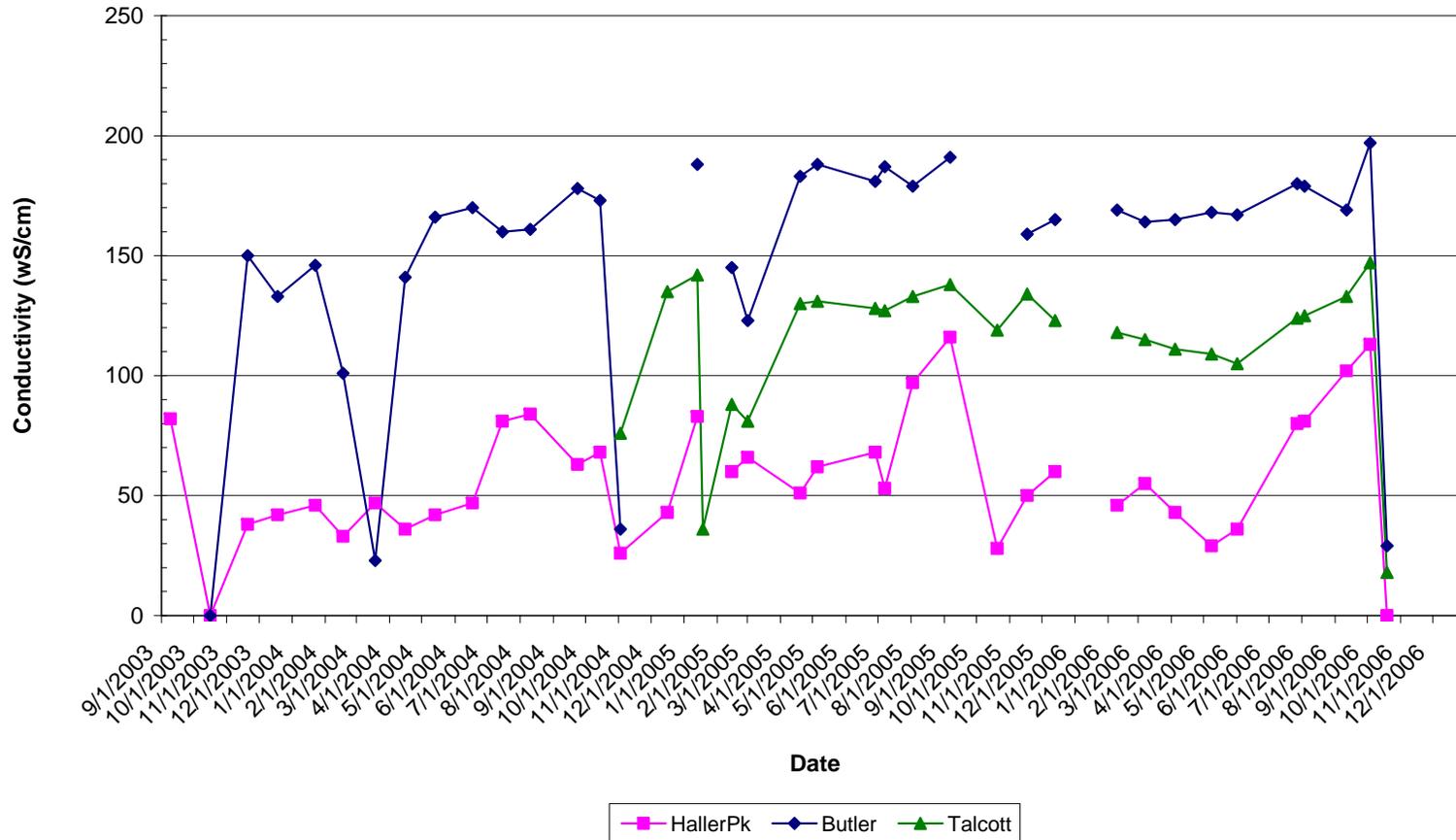
City of Arlington
Stormwater Wetland Project
Snohomish, Washington

**Stillaguamish TMDL
Fecal Coliform Monitoring**

Figure
F-3

Stillaguamish TMDL Conductivity Monitoring

Stillaguamish River at Haller Park, Butler Outfall, Talcott Outfall



Source: City of Arlington

City of Arlington
Stormwater Treatment Wetland
Snohomish, Washington

**Stillaguamish TMDL
Conductivity Monitoring**

Figure
F-4