From: Priscilla Ricci
Purchasing Agent of Record

CLARK COUNTY

RFP #872

PRPJ0000287/CRP391112 MASON CREEK BARRIER IMPROVEMENTS

QUESTIONS and ANSWERS

UPDATED: OCTOBER 18, 2023

	QUESTION	ANSWER
1.	**Why is the County resoliciting for this work?**	County performed a constructability review on planning grant plans and documents and identified design conflicts that needed to be resolved prior to moving forward with permitting and construction. County intends to utilize the products of the planning grant to create a bid-ready PS&E package for construction of this project.
2.	**What is Average Daily Traffic (ADT) on NE 102nd Ave?**	1394 vehicles per year 2017 sample
3.	**Where can I find the planning grant, project plans and documents?**	Please see 'project attachments' on Washington State Recreation and Conservation Office webpage link- PRISM Project Snapshot - Washington State Recreation and Conservation Office
4.	**The Grant/PRISM website includes 100% Plans that are signed and dated December 2020. It appears that the final design is complete, what changed and what is expected of the selected design team?**	County performed a constructability review on planning grant plans and documents and identified design conflicts that needed to be resolved prior to moving forward with permitting and construction. County intends for consultant to evaluate feasibility of the products of the planning grant and utilize them to create a bid-ready PS&E package for construction of this project.
5.	**What is the County's estimated budget for this final design?**	County estimated total cost for this project currently is $2,560,000; however cost is not a consideration in selection of a consultant.
6.	**Is the proposed stream alignment and crossing structure set, or does the County anticipate design changes to the AECOM final Plans?**	The proposed stream alignment and crossing structure is not set. County does not anticipate design changes, consultant to evaluate feasibility of the products of the planning grant and utilize them to create a bid-ready PS&E package for construction of this project.

7.	**The project background describes that a JARPA has been prepared for the project. Did the County submit Nationwide Permit documents already?**	County has not submitted for Nationwide Permit.
8.	**Does the County have permit agency or resource co-manager (tribal) comments from the previous design development?**	County has not submitted for permits, no agency comments are available to share from the previous design development.
9.	**Is it possible to get a copy of the Critical Area Report for the project?**	Please find attached previous design Wetland Report.
10.	**Request for copy of the project Geotechnical Report.**	Please find attached previous design Geotechnical Report.

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Mason Creek Fish Passage Barrier Removal Project

Wetland Delineation Report

December 2020

Job# 60615503

Executive Summary

On behalf of Clark County Public Works (County), AECOM Technical Services (AECOM) conducted a field study to delineate and assess wetlands and waterways within the vicinity of the proposed Mason Creek Fish Passage Barrier Removal project in rural Clark County, Washington. The project, which received a grant from the Washington Department of Fish and Wildlife, proposes to remove two barriers to anadromous fish passage: one barrier is a small-sized culvert on Mason Creek at NE 102nd Avenue that will be replaced with a large box culvert; the other barrier is a large instream log (approximately 750 feet upstream of the culvert) that will have a fish-passable notch cut into it. Because of the creek and associated riparian wetlands, this study was necessary to determine the stream and wetland extents to minimize impacts from proposed work.

AECOM visited the Mason Creek fish passage project areas on October 10, 2019, to delineate stream and wetland boundaries and to rate the wetland to determine wetland categories. One wetland totaling 0.017 acre (741 square feet) and one waterway (Mason Creek) totaling 0.174 acre (approximately 334 linear feet) were identified within the study areas. This report describes site conditions, assessment methods, and results of the field study. This report also provides photographs and maps of Mason Creek, the wetland, and associated buffer areas that are regulated under Clark County's Critical Areas Ordinances for habitat conservation (Clark County Code [CCC] Chapter 40.440) and wetland protection (CCC Chapter 40.450).

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Appendices

Site Data Summary

Project Name	Mason Creek Fish Passage Project	
Client Contact	Jennifer Taylor, Clark County Public Works Jennifer.Taylor@clark.wa.gov (360) 397-2121 x4227	
AECOM Wetland Delineators	Noah Herlocker, PWS Wetland Ecologist Noah.Herlocker@aecom.com (971) 323-6299	Michelle Brownell, WPIT Ecologist Michelle.Brownell@aecom.com (206) 438-2424
Report Preparer	Michelle Brownell and Brian Fletcher	
Quality Control	Danni Kline and Noah Herlocker	
Site Visit Dates	October 10, 2019	
Site Location	The Mason Creek Fish Passage project is located at NE 102nd Road, approximately 0.25 mile north of NE 314th Street and 400 feet south of NE 322nd Street.	
Legal Description	SW ¼ of Section 04 Township 4N, Range 2E	
Latitude/Longitude	45.851887°, -122.568688°	
USGS Topo Map	Battle Ground 7.5-minute quadrangle	
Zoning	Forest-80 (FR-80), Rural-20 (R-20)	
Elevation	418–442 feet	
Drainage Path	Mason Creek → East Fork Lewis River → Lewis River → Columbia River	
WRIA	27 – Lewis	
Mapped NRCS Soil Series	HcB–Hesson clay loam, 0-8% slopes; HcF–Hesson clay loam, 30-55% slopes; OhF–Olequa silty clay loam, heavy variant, 20-45% slopes; WgB – Washougal gravelly loam, 0-8% slopes	
Cowardin Classes	PFO, Riverine	
HGM Classes	Riverine	
Study Area Size	3.00 acres	
Total On-Site Wetland Area	0.017 acre (741 square feet)	
Total On-Site Waters Length	334 feet (0.174 acre)	

Section A. Introduction

A.1 Project Location

The Mason Creek Fish Passage Barrier Removal project site is in northern Clark County, Washington, just south of the intersection at NE 322nd Street and NE 102nd Avenue. The study area comprises the existing Mason Creek culvert at NE 102nd Avenue and an area extending 50 feet perpendicular to the creek for 100 feet upstream and downstream of the culvert. Also included is a small area on Mason Creek approximately 750 feet upstream (northeast) of the culvert. The project location is shown on Figure 1 in Appendix A.

A.2 Project Background

In 2018, AECOM prepared an application on behalf of Clark County Public Works to remove two barriers to anadromous fish passage on Mason Creek. The application was approved by the Washington Department of Fish and Wildlife (WDFW) Fish Barrier Removal Board (FBRB). Clark County is proposing to remove the existing 50-year-old culvert and replace it with a fish-friendly box culvert to allow passage of all life stages of salmonids. The project must also be evaluated for compliance with the National Historic Preservation Act (NHPA).

Wetland and stream boundaries and associated buffers will be used to inform design concepts to minimize aquatic impacts, if possible. The buffer boundaries will also be used for critical areas permitting, which may be necessary for the culvert replacement.

A.3 Site Description

Mason Creek flows southwest through the 102nd Avenue culvert and converges with East Fork Lewis River. The project area is within a relatively natural, gently sloping forested valley, except for the roadway and some residences just off-site to the west.

Dominant overstory vegetation within the study area includes red alder (*Alnus rubra*), Oregon ash (*Fraxinus latifolia*), western red cedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menzesii*), and big-leaf maple (*Acer macrophyllum*) trees, which form the riparian habitat along Mason Creek and surrounding slopes. Dominant shrub species include salmonberry (*Rubus spectabilis*), red elderberry (*Sambucus racemosa*), Nootka rose (*Rosa nutkana*), beaked hazelnut (*Corylus cornuta*), Pacific ninebark (*Physocarpus capitatus*), trailing blackberry (*Rubus ursinus*), and the ubiquitous Himalayan blackberry (*Rubus armeniacus/bifrons*). Dominant understory herbaceous vegetation includes sword fern (*Polystichum munitum*), lady fern (*Athyrium felix-femina*/cyclosorum), reed canarygrass (*Phalaris arundinacea*), piggy-back plant (*Tolmiea menziesii*), and field bindweed (*Convolvulus arvensis*).

A.4 Land Uses and Site Alterations

The study area to the west and east of NE 102nd Avenue is zoned Rural (R-20) and Forest-80 (FR-80), respectively, and contains undeveloped natural riparian areas adjacent to Mason Creek. Adjacent lots to the west and north are rural residential, single-family homes. Other parcels beyond the study area have been logged within the past 3 to 6 years. The general hydrologic condition of Mason Creek has been altered by NE 102nd Avenue, where the small culvert partially impounds the flows.

Section B. Methods

B.1 Existing Data Review

Prior to conducting the wetland site assessment, AECOM reviewed data from the following sources:

- National Wetland Inventory (NWI) mapping (USFWS 2019)
- Natural Resources Conservation Service (NRCS) Soil Survey of Clark County (NRCS 2019a)
- NRCS National Water and Climate Center (NRCS 2019b)
- Aerial photography (Google Earth; ArcGIS online)
- National Weather Service (NWS 2019)
- Washington Department of Natural Resources Natural Heritage program (WNHP 2019)

B.2 Precipitation Data and Analysis

Precipitation information was reviewed so that observed hydrology indicators could be assessed relative to the normal range of precipitation for the dates of fieldwork. Precipitation data were gathered from the National Weather Service data center in Vancouver, Washington, to characterize climatic conditions prior to and during the wetland delineation field work on October 10, 2019. Normal precipitation amounts are based on NRCS WETS data for station Vancouver 4 NNE (FIPS 53011) collected between 1981 and 2010 (NRCS 2019b).

B.3 Site-Specific Field Methodology

A site visit was conducted on October 1, 2019. Wetland presence was determined by a certified Professional Wetland Scientist (PWS) per the methods outlined in the 1987 U.S. Army Corps of Engineers (USACE) *Wetlands Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Regional Supplement) (USACE 2010). The delineated wetlands are described below, and representative photographs are provided in Appendix B.

Wetland Delineation

Wetland boundaries were determined by examining the vegetation, soils, and hydrology indicators at two formal sample plot locations in the study area. At each sample plot, dominant vegetation, soil profiles, and wetland hydrology indicators were recorded on standard Wetland Determination Data Forms sourced from the Regional Supplement (USACE 2010). These forms characterize the wetland or upland conditions and are provided in Appendix C. Numerous undocumented test pits were also examined throughout the study area to observe hydric soil and hydrology indicators, which helped refine the wetland boundary.

The wetland boundary was marked in the field using pink ribbon flagging tied to woody vegetation. Sample plot locations were marked using pink and blue ribbon flagging labeled with the sample plot number, the date, and “AECOM.”

Determining wetland presence requires evaluation of three metrics: hydrophytic vegetation, hydric soil, and wetland hydrology. Methods for assessing each metric are described below.

Vegetation

AECOM assessed the dominant plant species present within circular plots centered on each sample plot location. Unless recorded as otherwise, herbaceous, shrub, and vine species were assessed within a 5-foot radius; tree species were assessed within a 30-foot radius. Dominant plant species were determined using the 50/20 rule (Environmental Laboratory 1987). The wetland indicator status for each dominant species was assigned using the Washington subset of the National Wetland Plant List (Lichvar et al. 2016).[1] The Dominance Test was used to determine hydrophytic vegetation.

Soils

At each sample plot location, AECOM dug a soil pit to a depth of 16–20 inches below ground surface. Soil profile characteristics were examined to see if they met the definition of a hydric soil indicator per the 2010 Regional Supplement (USACE 2010). Soil characteristics were described using standards established by the National Technical Committee on Hydric Soils (NRCS 2006). Soil colors were determined using a Munsell Soil Color Chart (X-Rite 2009). Soils were also investigated for oxidized rhizospheres along living roots as an indicator of wetland hydrology.

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[1] **Indicator Status Ratings**

Indicator Status	Abrv.	Definitions - Short Version (ERDC/CRREL TN-12-1)
Obligate	OBL	Almost always occur in wetlands.
Facultative Wetland	FACW	Usually occur in wetlands, but may occur in non-wetlands.
Facultative	FAC	Occur equally in wetlands and non-wetlands.
Facultative Upland	FACU	Usually occur in non-wetlands, but may occur in wetlands.
Upland	UPL	Almost never occur in wetlands.

Hydrology

Common indicators of wetland hydrology (e.g., surface water, water table, or saturation within 12 inches of the ground surface) were investigated at each sample plot and test pit location. Wetland hydrology was also satisfied by observing at least two secondary indicators, including geomorphic condition and a positive result of the FAC-neutral test.

Waterways Delineation

Non-wetland waterways were delineated using field indicators of Ordinary High Water (OHW), which include a clear, natural scour line impressed on the bank, a break in the slope angle of the bank, the lower elevation of woody vegetation, and/or a textural change of depositional sediment. GPS points were collected along the left and right banks at OHW marks.

Wetland Classification and Rating

Wetland Classification

Wetlands were classified per the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). Under the Cowardin classification system, palustrine wetlands include all non-tidal wetlands dominated by vegetation, including forested (PFO), scrub-shrub (PSS), and emergent (PEM) based on the percent cover of woody vegetation. PFO wetlands have at least 30 percent canopy cover of trees over 20 feet tall; PSS wetlands have at least 30 percent cover of woody vegetation less than 20 feet tall; PEM wetlands are dominated by herbaceous species with less than 30 percent cover of woody vegetation. Modifiers are often included in the Cowardin classification to indicate water regime and other pertinent information.

Wetlands were also classified using the Hydrogeomorphic (HGM) method. The HGM method classifies wetlands based on the hydrologic and geomorphic characteristics that control many wetland functions. The HGM classification of each wetland was determined using the hydrologic criteria questions in the *Washington State Wetland Rating System for Western Washington—2014 Update* (Hruby 2014).

Wetland Rating and Categorization, and Buffer Determination

Wetlands were rated using the Wetland Rating System for Western Washington 2014 Update, published by Washington’s Department of Ecology (Ecology) (Hruby 2014). Clark County uses Ecology’s system for rating and categorizing wetlands to determine buffer sizes. Both Ecology and the county recognize four categories of wetlands: I, II, III, and IV. Categories are typically determined by an overall rating score that considers the functional capacity of the wetland to improve water quality, reduce flooding and stream erosion, and provide habitat; and the opportunity for each wetland to provide those general functions.

Wetland categories can also be assigned if they exhibit certain special characteristics, such as if the wetland is associated with a known Wetland of High Conservation Value. Category I wetlands are rare and of the highest value, while Category IV wetlands are typically very degraded and provide low wetland ecological functions and values. For rating purposes, the entire wetland is assessed, including the estimated areas that extend beyond the delineation study area. Based on wetland rating scores and categories, wetland buffers were determined and mapped following the procedures outlined in Clark County Code (CCC) Chapters 40.440 and 40.450.

Clark County assigns waterways a Riparian Priority Habitat buffer based on the Washington Department of Natural Resources (DNR) water types. Mason Creek is listed as a Type F (fish-bearing, perennial) stream by the DNR. Riparian habitat buffers for DNR Type F waters are 200 feet.

B.4 Mapping Methods

A Geo7x GPS unit with sub-meter positional accuracy was used to survey wetland boundary flags, sample plot locations, and photo point locations. Raw GPS point data were collected in the field. At each point, 30 GPS positions were collected and averaged. The data were post-processed in Trimble's GPS Pathfinder Office resulting in an estimated average positional accuracy of 1–3 feet. GPS survey data were exported to ArcMap 10.5.1 for figure production. Near the culvert, GPS positions were not always accurate, so Clark County surveyors returned to the site and collected several of the wetland and OHW flag points, which were used to improve delineation accuracy.

Section C. Results of Information Review

This section describes the existing wetland and soil inventories and precipitation data.

C.1 Wetland Inventories

Within the study area, the NWI classifies the area surrounding Mason Creek as a freshwater forested, temporarily flooded wetland (PFOA). East and west of the study area, it maps Mason Creek as riverine, unknown perennial, unconsolidated bottom, permanently flooded (R5UBH). Tributaries flowing into Mason Creek from the north and south are mapped as riverine, intermittent, streambed, seasonally flooded (R4SBC). Wetland inventories are shown on Figure 2.

C.2 Soil Survey

Table 1 lists the NRCS-mapped soil series along with their map unit symbol, acreage, and relative size within the study area. None of the mapped soils within the study area contain hydric components (hydric rating = 0). Mapped soils are shown on Figure 2.

Table 1: Soil Types within the Study Area

Map Unit Symbol	Map Unit Name	Acreage within Study Area	Percent of Study Area
HcB	Hesson clay loam, 0 to 8 percent slopes	0.6	21%
HcF	Hesson clay loam, 30 to 55 percent slopes	0.3	9%
OhF	Olequa silty clay loam, heavy variant, 20 to 45 percent slopes	0.9	31%
WgB	Washougal gravelly loam, 0 to 8 percent slopes	1.2	39%
	Total	**3.0**	**100%**

Source: NRCS 2019

Hesson clay loam is a well-drained soil formed from alluvium that occurs on terraces and escarpments. Olequa silty clay loam is a somewhat poorly drained soil formed from alluvium and found on terraces. Washougal gravelly loam is a somewhat excessively drained soil that also occurs on terraces but is formed from gravelly alluvium.

C.3 Precipitation Data

Climatic conditions for the study area are characterized by 41.63 inches of average annual rainfall, 40°F average winter air temperature, 64°F average summer air temperature, and typically about 234 frost-free days per year (NRCS 2019). As with most of western Washington, the highest monthly precipitation occurs between October 1 and March 31.

Table 2 and 3 provide antecedent rainfall recorded near the study area for the month-to-date, the 3 months preceding the site visit, and monthly averages and normal rainfall (30 and 70 percentiles).

Table 2: Recent Local Precipitation Summary

Site Visit Date	Total Precipitation (inches)	Month-To-Date (inches)	Normal Month-to-Date (inches)	Percent of Normal Month-to-Date
October 10	0.00	0.32	0.85	38%

Source: NWS 2019

Table 3: Summary of Monthly Recorded and Normal Precipitation

Category	July 2019 (inches)	August 2019 (inches)	September 2019 (inches)
Recorded Precipitation	0.43	1.49	5.20
Normal Precipitation[1]	0.69	0.74	1.61
Normal Range (30% – 70%)[1]	0.28 – 0.77	0.28 – 0.83	0.76 – 1.90
Condition[2]	Normal	Wet	Wet

[1] Data are for Vancouver 4 NNE, approximately 9 miles west of the study area.

[2] NRCS 1997

Data in Table 2 indicate dry conditions for the week prior to the October 10 site visit, while Table 3 indicates that precipitation in the 3 months prior to the site visit ranged from normal to wet.

Section D. Results of Field Investigation

Within the study area, one wetland (Wetland A) and one waterway (Mason Creek) were identified. Wetland A and Mason Creek are shown on Figure 3, and photographs of each feature are included in Appendix B. The wetland–upland boundary conditions are documented on two wetland determination data forms in Appendix C. The wetland is expected to fall under local (Clark County), state (Ecology), and federal (USACE) jurisdiction. A summary of the two features is provided in Table 4.

Table 4: Summary of Wetlands and Waters within the Mason Creek Fish Passage Study Area

Name	Acreage Within Study Area	Cowardin Classification[1]	HGM Classification[2]	Notes
Wetland A	0.017	PFOC	Riverine	SP-1 and 2; Photos 1 and 2
Mason Creek	0.174	R3UB1	Riverine	Photos 3, 4, and 6
TOTAL	**0.191**			

[1] Cowardin Classifications: PFOC – Palustrine Forested, Seasonally flooded; R3UB1 – Riverine, Unconsolidated bottom, Cobble-Gravel

[2] HGM Classifications were determined by the Wetland Rating System's hydrologic criteria questions

Wetland A

Wetland A occupies 0.017 acre (741 square feet) and is entirely contained within the study area. The Cowardin classification is PFOC, and the HGM classification is Riverine. It is south-sloping and connects to the northern (right) bank of Mason Creek just before the culvert inlet at NE 102nd Avenue. The wetland occurs within a topographic swale/valley that fans out slightly where it connects to Mason Creek—the creek regularly floods this southern portion of the wetland. The steep road embankment of NE 102nd Avenue defines the western edge of the wetland (see Photo 2).

Dominant trees in Wetland A include Oregon ash and western red cedar, which provide an overstory with approximately 30 percent cover. The shrub stratum provides 15 to 50 percent cover that is dominated by salmonberry, red elderberry, Nootka rose, Pacific ninebark, and some Himalayan blackberry. Dominant understory herbaceous vegetation includes sword fern, lady fern, reed canarygrass, piggy-back plant, and field bindweed.

Wetland A soils have a silt loam texture and consist of a very dark grayish-brown (10YR 3/2) topsoil over a depleted matrix subsoil layer (10YR 4/2) with distinct dark yellowish-brown (10YR 4/6) redoximorphic concentrations.

Wetland hydrology is primarily met by shallow groundwater and saturation. In addition, the wetland's geomorphic position adjacent to Mason Creek and its prevalence of FACW vegetation also satisfy the hydrology criterion. Roadside runoff and seeps in the northern portion of the wetland join the overbank flooding and shallow groundwater associated with Mason Creek in the southern portion.

The boundary conditions of Wetland A are documented on SP-1 and SP-2 in Appendix C and can be seen in Photos 1 and 2 in Appendix B.

Mason Creek

Mason Creek is a perennial waterway that runs approximately 334 feet (0.174 acre) through the study areas—this acreage includes the separate small study area approximately 750 feet northeast of the 102nd Avenue culvert, where a natural log barrier is proposed to be notched (see Photo 6). The creek is classified under Cowardin and HGM as R3UB1 and Riverine, respectively. It averages approximately 15 to 20 feet wide at OHW and contains a cobble/gravel substrate and relatively stable banks. It is mostly shaded by trees and shrubs and flows west through the existing culvert at NE 102nd Avenue. Bank conditions include overhanging native ferns, shrubs, trees, as well as invasive Himalayan blackberry, reed canarygrass, and field bindweed.

Mason Creek flows into East Bank Lewis River, mainstem Lewis River, and ultimately the Columbia River. It is classified as a F-type stream (fish-bearing, perennial) under CCC Chapter 40.440.010(C)(1)(a). According to WDFW's Priority Habitat and Species database, this section of Mason Creek is a breeding area for coho (*Oncorhynchus kisutch*) and occurrence/migration area for steelhead (*Oncorhynchus mykiss*)—both listed as federally threatened species.

Mason Creek is shown on Photos 3, 4, and 6 in Appendix B.

Section E. Functions, Ratings, and Buffers

Based on rating scores for water quality, hydrologic, and habitat functions, Wetland A received a rating of Category II. The wetland rating maps can be seen on Figures 5a–5e, and the forms are provided in Appendix D. Scores for each function and final rating category are shown in Table 5 and discussed briefly below.

Table 5: Wetland Rating Scores

	Functions				
Wetland Name	Water Quality	Hydrologic	Habitat	Total Score	Ecology Rating
A	6	6	8	20	II

The scores shown in Table 5 indicate that Wetland A functions at a moderate level for its abilities to improve water quality and reduce flooding, and a high level to provide wildlife habitat. Because Mason Creek contains occurrences of federally listed fish species, and there is a Total Maximum Daily Load in progress in the area (Figure 5e), the wetland is valuable to society for the functions it provides. The rating score is based on functions and not special characteristics.

The high percentages of dense, uncut vegetation trap pollutants, and the overbank connection to Mason Creek helps improve water quality and alleviate flooding. The tree and shrub canopies help shade the wetland and Mason Creek and provide habitat niches. Runoff from NE 102nd Avenue generates some pollution, giving the wetland an opportunity to provide water quality functions. The habitat potential of the surrounding landscape (within 1 kilometer) scored high, as there is a large percentage of accessible, relatively undisturbed habitat, and moderate and low-intensity land uses.

Clark County uses the scores from the wetland rating system and the estimated land use intensity to determine buffer widths. These buffer widths are intended to protect water quality and/or habitat around the wetland (Table 6). Per CCC Table 40.450.030-2, a 100-foot buffer is required to protect water quality functions in Category II wetlands undergoing a high-intensity use; however, per CCC Table 40.450.030-3, a 300-foot buffer is required to protect Category I, II, or III wetlands with a habitat rating score of 8 or 9 points and the proposed activity is a high-intensity land use.

Per Table 40.450.030-4, public road projects are called out as a high-intensity land use (road work on NE 102nd Avenue as needed for the culvert replacement). Clark County protection buffers are summarized in Table 6 and depicted on Figure 4.

Table 6: Clark County Buffers Required to Protect Water Quality and Habitat Functions

Feature	Wetland Rating Category	Estimated Land Use Intensity	Water Quality Protection Buffer (feet)	Habitat Protection Buffer (feet)
Wetland A	II	High	100	300
Mason Creek	N/A	---	---	200[1]

Source: Clark County Code (2019), Tables 40.450.030-2 through 40.450.030-4 and CCC 40.440.010.C
http://www.codepublishing.com/wa/clarkcounty.html

[1] Riparian Priority Habitat Buffer for a Type F stream per the Shoreline Master Program; CCC 40.440.010.C and 40.460.530

Section F. Conclusions

One wetland (A) and one waterway (Mason Creek) were documented within the Mason Creek Fish Passage Barrier Removal study area. Wetland A totals 0.017 acre (741 square feet) and Mason Creek totals 334 linear feet (0.174 acre, summed over two separate study area locations).

Figures are provided in Appendix A, Appendix B shows photographs of each feature, Appendix C contains the wetland determination forms completed during the field visits, and Appendix D contains the wetland rating forms. The wetland is expected to fall under Washington's state Water Pollution Control Act jurisdiction, as well as federal Clean Water Act jurisdiction, based on the role it plays in providing water storage, base flow support, and chemical/nutrient uptake for Mason Creek (a Water of the U.S.).

Section G. Disclaimer

This report documents the investigation, best professional judgment, and conclusions of the investigators. It is correct and complete to the best of our knowledge. It should be considered a Preliminary Jurisdictional Determination of wetlands and waterways, and should only be used at one's own risk until it has been reviewed and approved in writing by the U.S. Army Corps of Engineers.

Section H. Literature Citations

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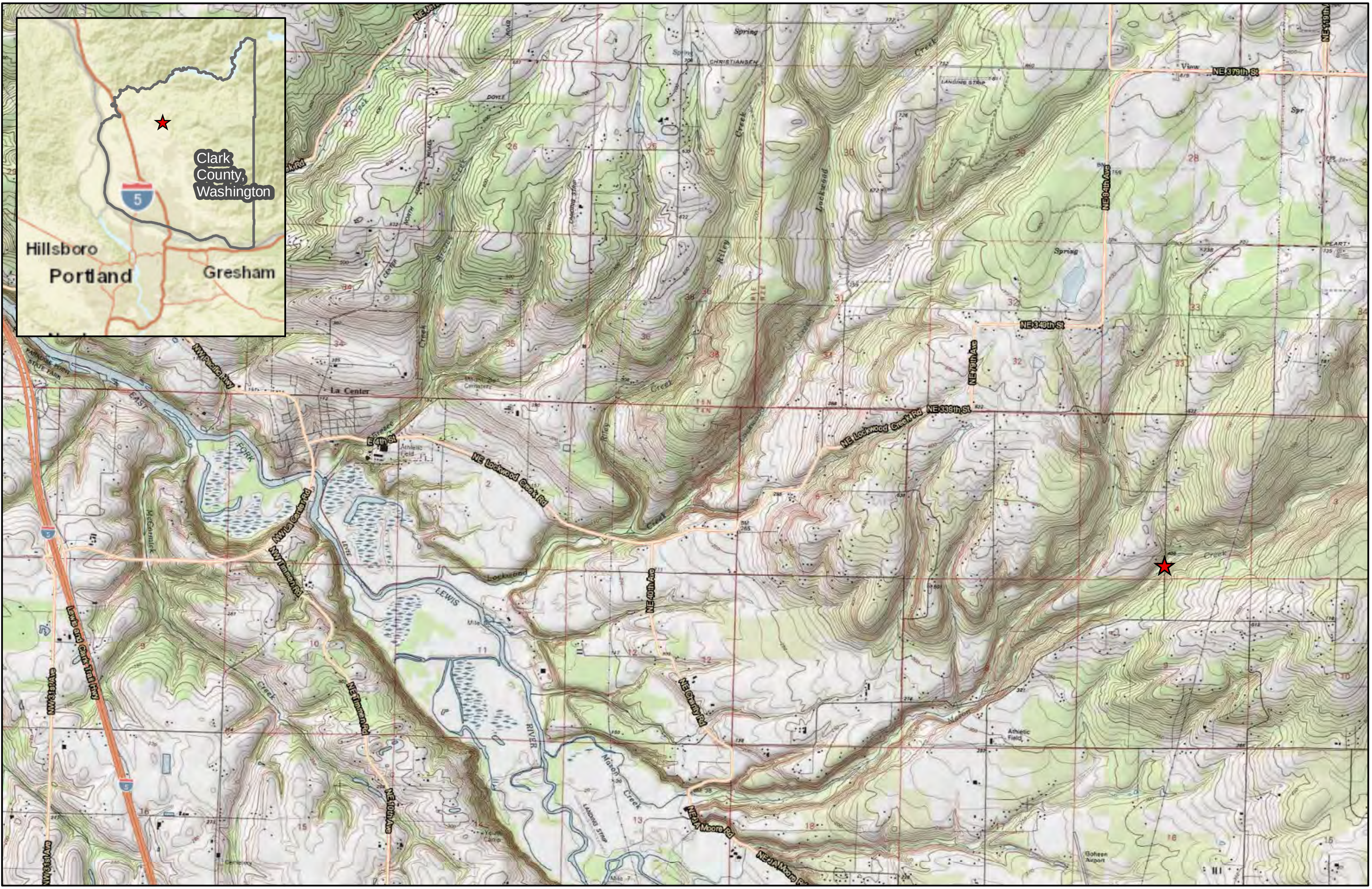
X-Rite. 2009. Munsell Soil Color Charts. Grand Rapids, Michigan.

Appendix A: Figures



K:\Clark_County\Mason_Creek\MXD\Delineation_2019\Fig1_Location_Map.mxd

Legend

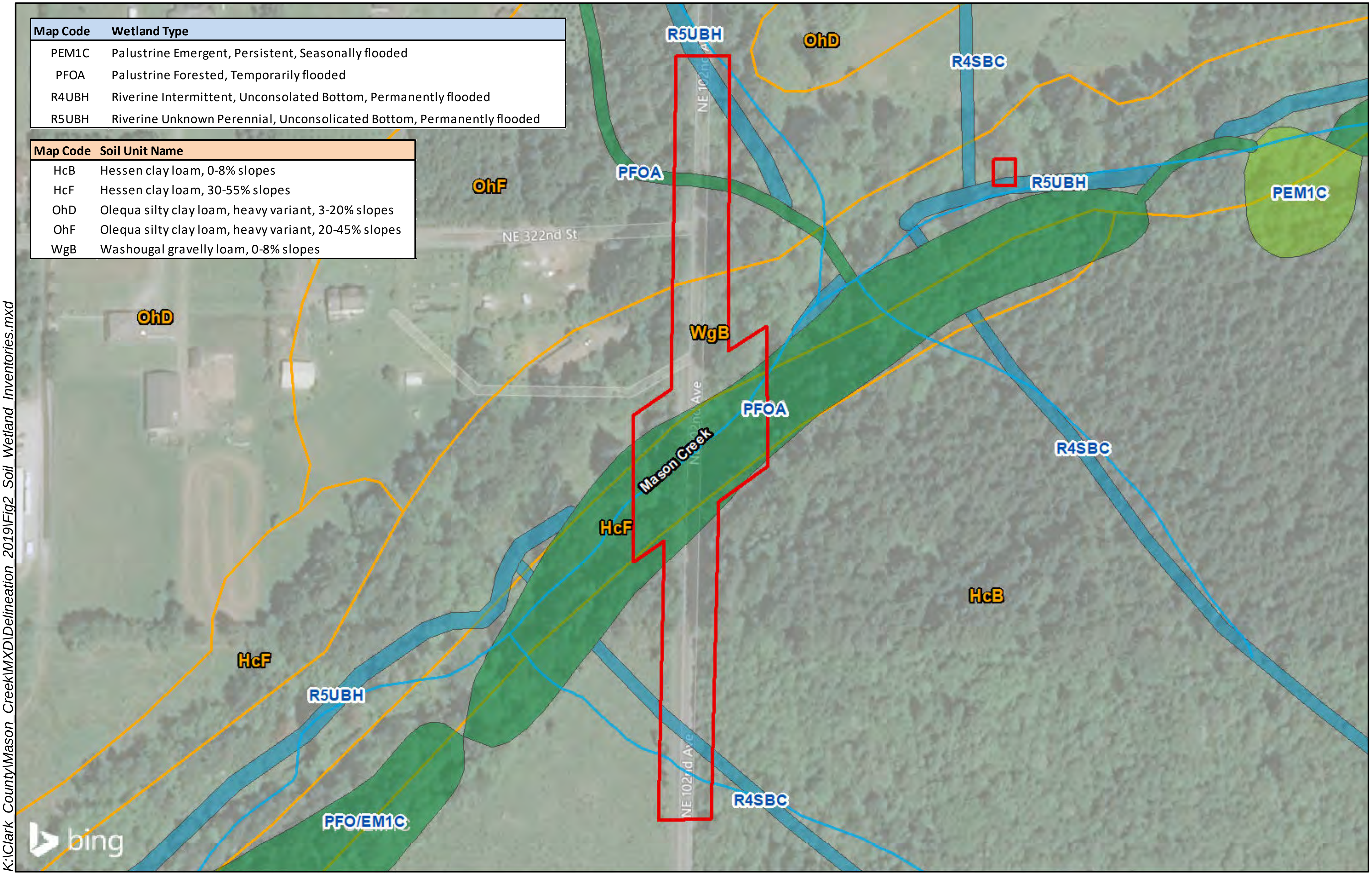
★ Project Location

FIGURE 1
LOCATION MAP

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December 2019

AECOM



Map Code	Wetland Type
PEM1C	Palustrine Emergent, Persistent, Seasonally flooded
PFOA	Palustrine Forested, Temporarily flooded
R4UBH	Riverine Intermittent, Unconsolated Bottom, Permanently flooded
R5UBH	Riverine Unknown Perennial, Unconsolicated Bottom, Permanently flooded

Map Code	Soil Unit Name
HcB	Hessen clay loam, 0-8% slopes
HcF	Hessen clay loam, 30-55% slopes
OhD	Olequa silty clay loam, heavy variant, 3-20% slopes
OhF	Olequa silty clay loam, heavy variant, 20-45% slopes
WgB	Washougal gravelly loam, 0-8% slopes

K:\Clark_County\Mason_Creek\MXD\Delineation_2019\Fig2_Soil_Wetland_Inventories.mxd

Legend

🟥 Wetland Delineation Study Areas

— Waterway (Clark County)

🟧 Soil Boundary (NRCS)

N
W E
S

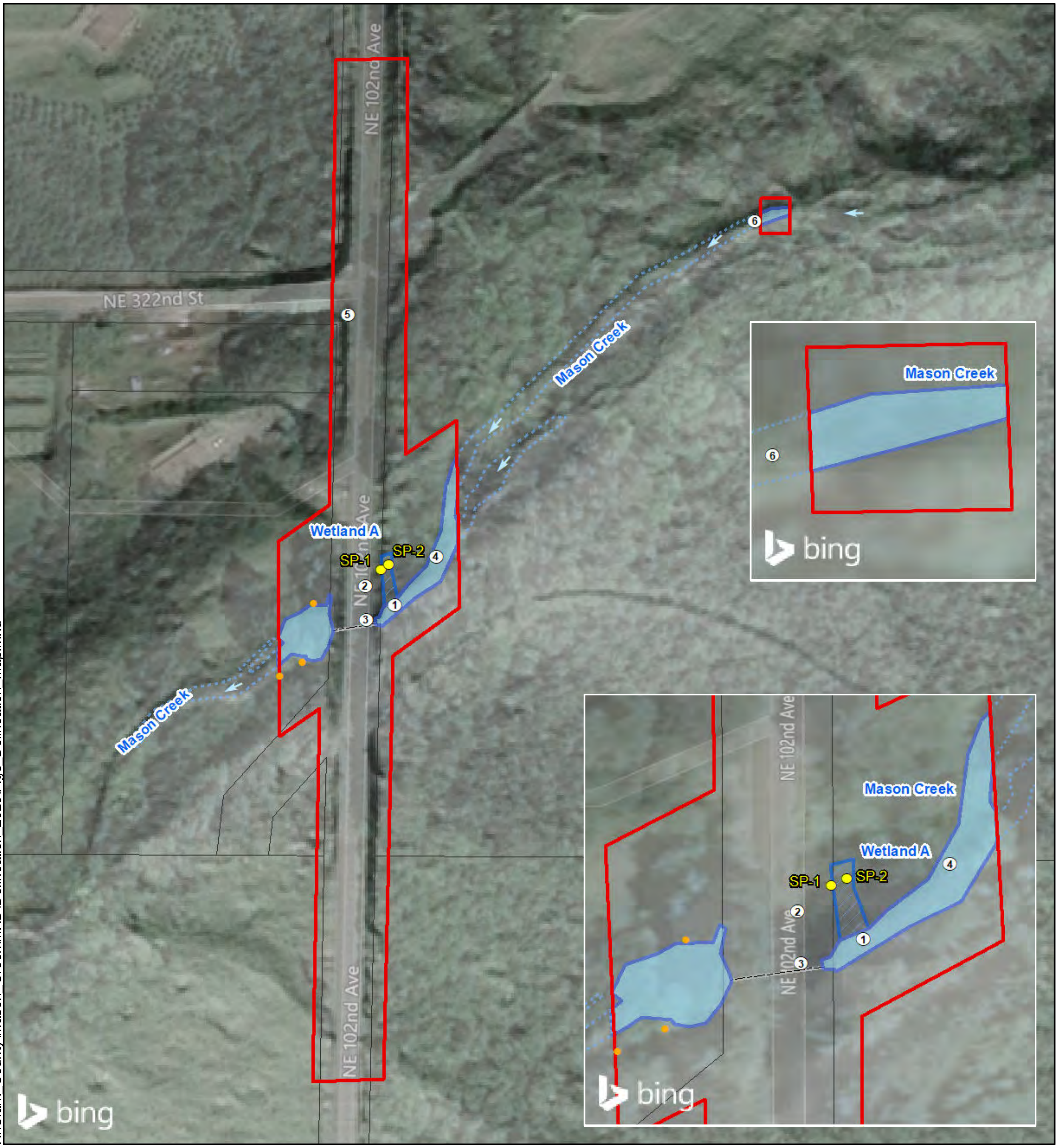
0 200 400
Feet

FIGURE 2
SOIL & WETLAND INVENTORIES

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

AECOM



K:\Clark_County\Mason_Creek\MXD\Delineation_2019\Fig3_Delineation_Map.mxd

Legend

🟥	Wetland Study Areas
☐	Tax Parcel
▨	Wetland
🟦	Water
⬚	Offsite Water (approx.)
↙	Flow Direction
⋯	Culvert
●	Sample Plot
●	Soil Check Pit
○	Photo

N
W E
S

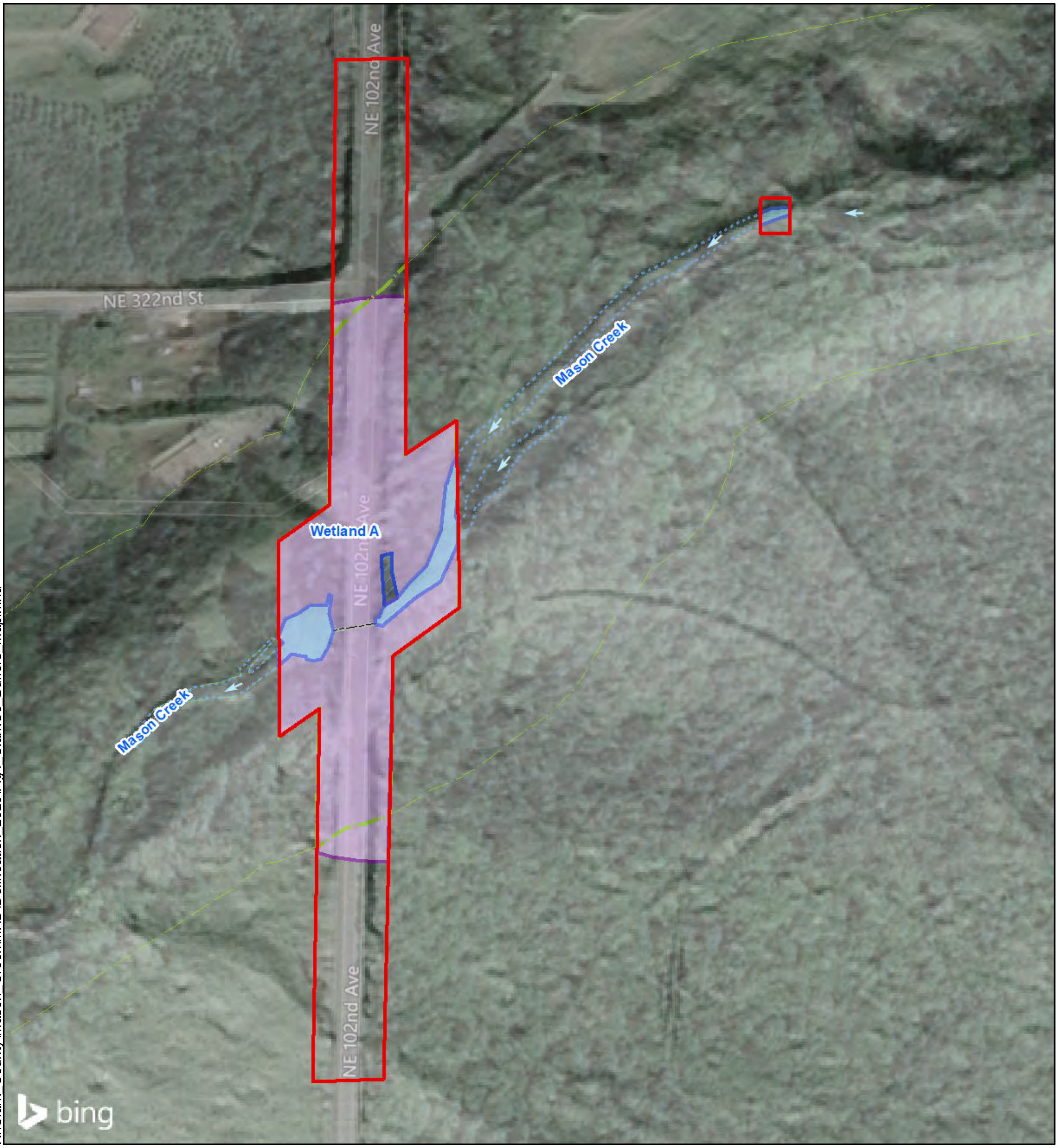
0 100 200
Feet

FIGURE 3
WETLAND DELINEATION MAP

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

AECOM



K:\Clark County\Mason Creek\MXD\Delineation 2019\Fig4 ClarkCo Buffers Map.mxd

Legend

- 🟥 Wetland Study Areas
- ▨ Wetland
- 🟦 Water
- ⬚ Offsite Water (approx.)
- 🟪 300-Foot Clark County Wetland Buffer
- 🟩 200-Foot Riparian Buffer
- ⬚ Offsite 200-Foot Riparian Buffer (approx.)
- ↙ Flow Direction
- ---- Culvert

N
W E
S

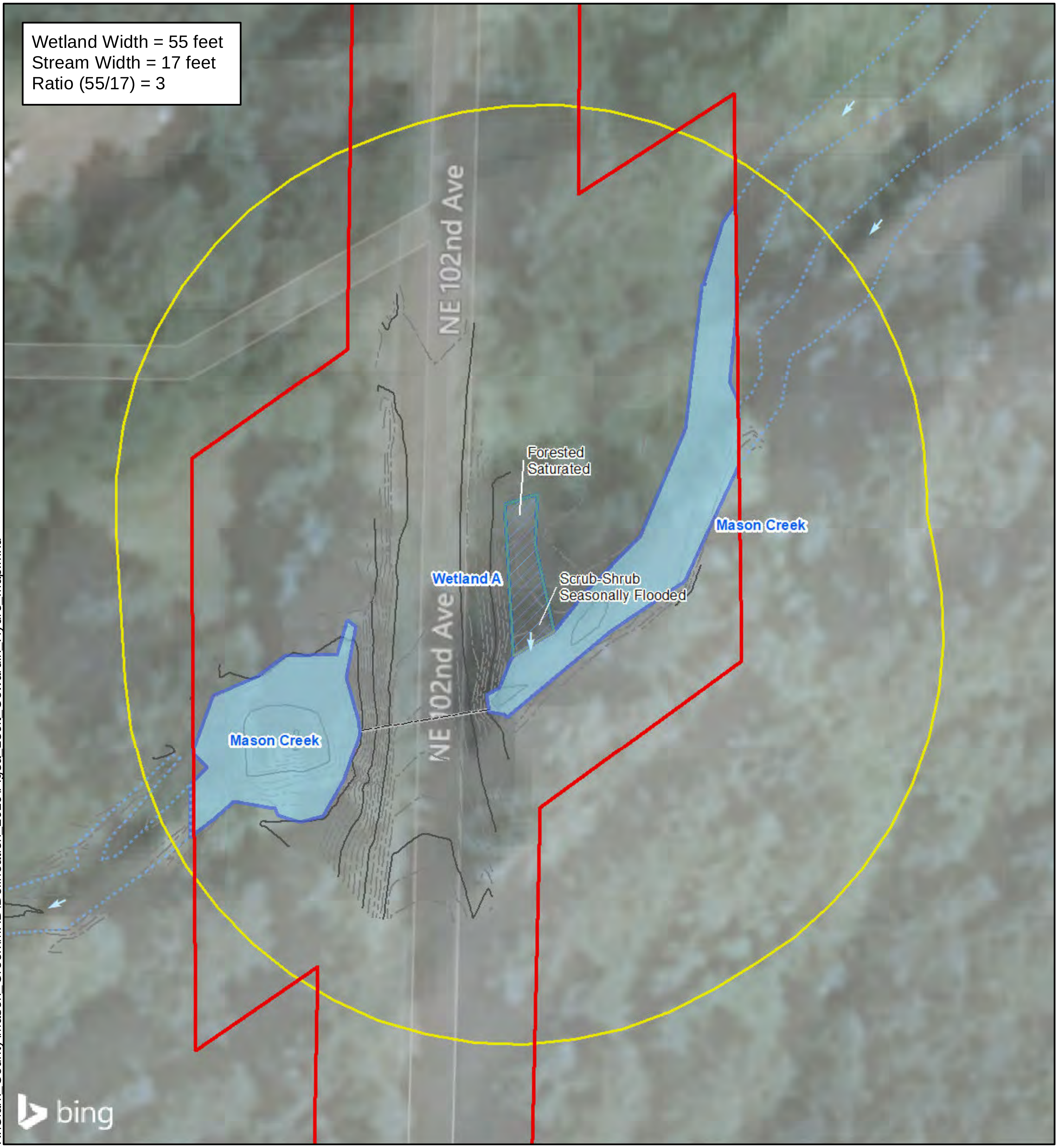
0 100 200
Feet

FIGURE 4
CLARK COUNTY BUFFERS MAP

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

AECOM



Legend

🟥 Wetland Delineation Study Area
▨ Wetland
🟦 Water
⬚ Offsite Water (approx.)
🟨 150-Foot Buffer
↙ Flow Direction
Culvert
Major Contour
Minor Contour

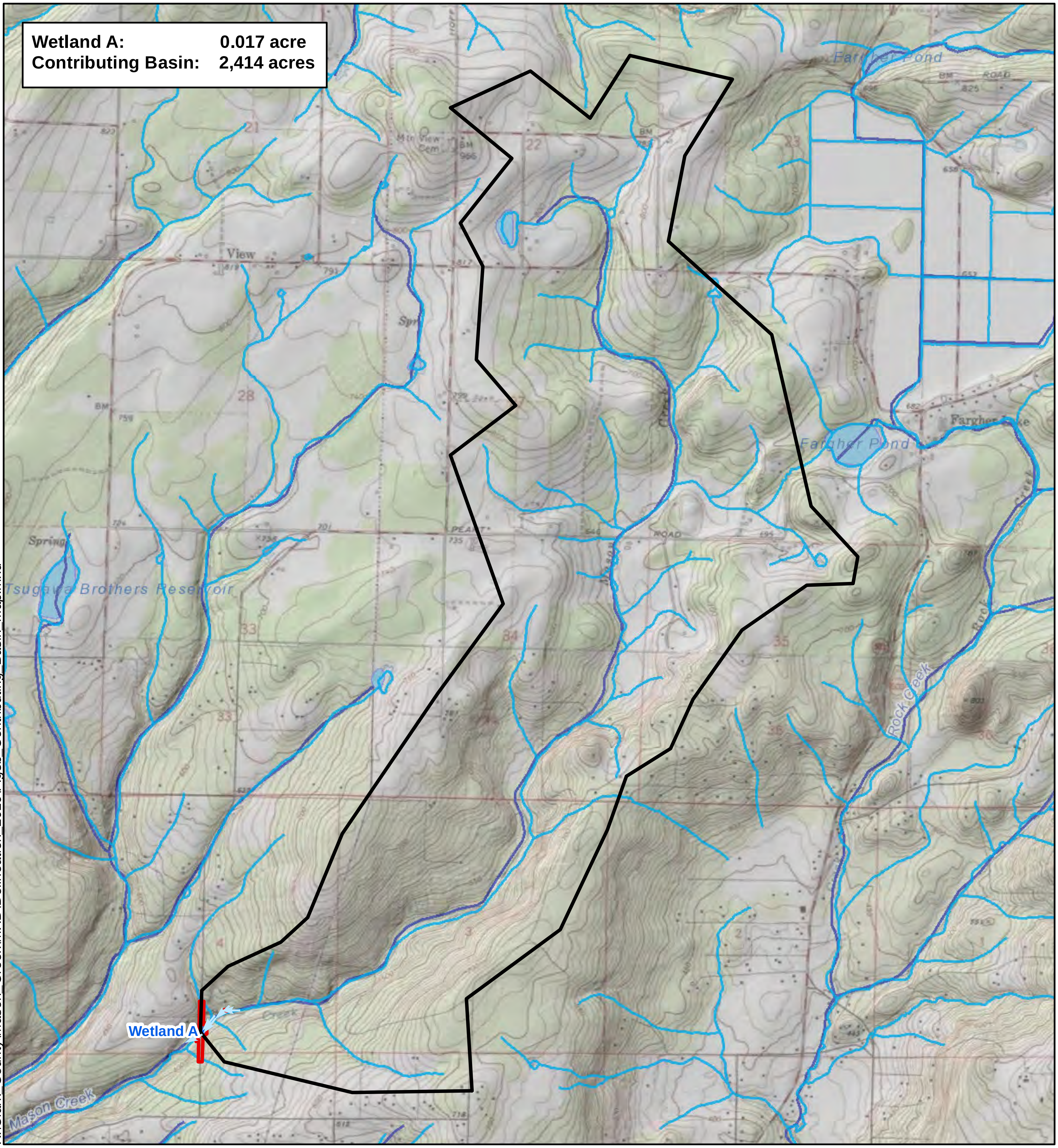
FIGURE 5a
WETLAND RATING MAP
150-Foot Buffer, Cowardin, Hydroperiods

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

AECOM

K:\Clark_County\Mason_Creek\MXD\Delineation_2019\Fig5b_Contributing_Basin_Map.mxd



Wetland A: **0.017 acre**
Contributing Basin: **2,414 acres**

Legend

🟥 Wetland Delineation Study Areas
▨ Wetland A
⬜ Contributing Basin
— Waterway (Clark County)
— NHD Line

N
W E
S

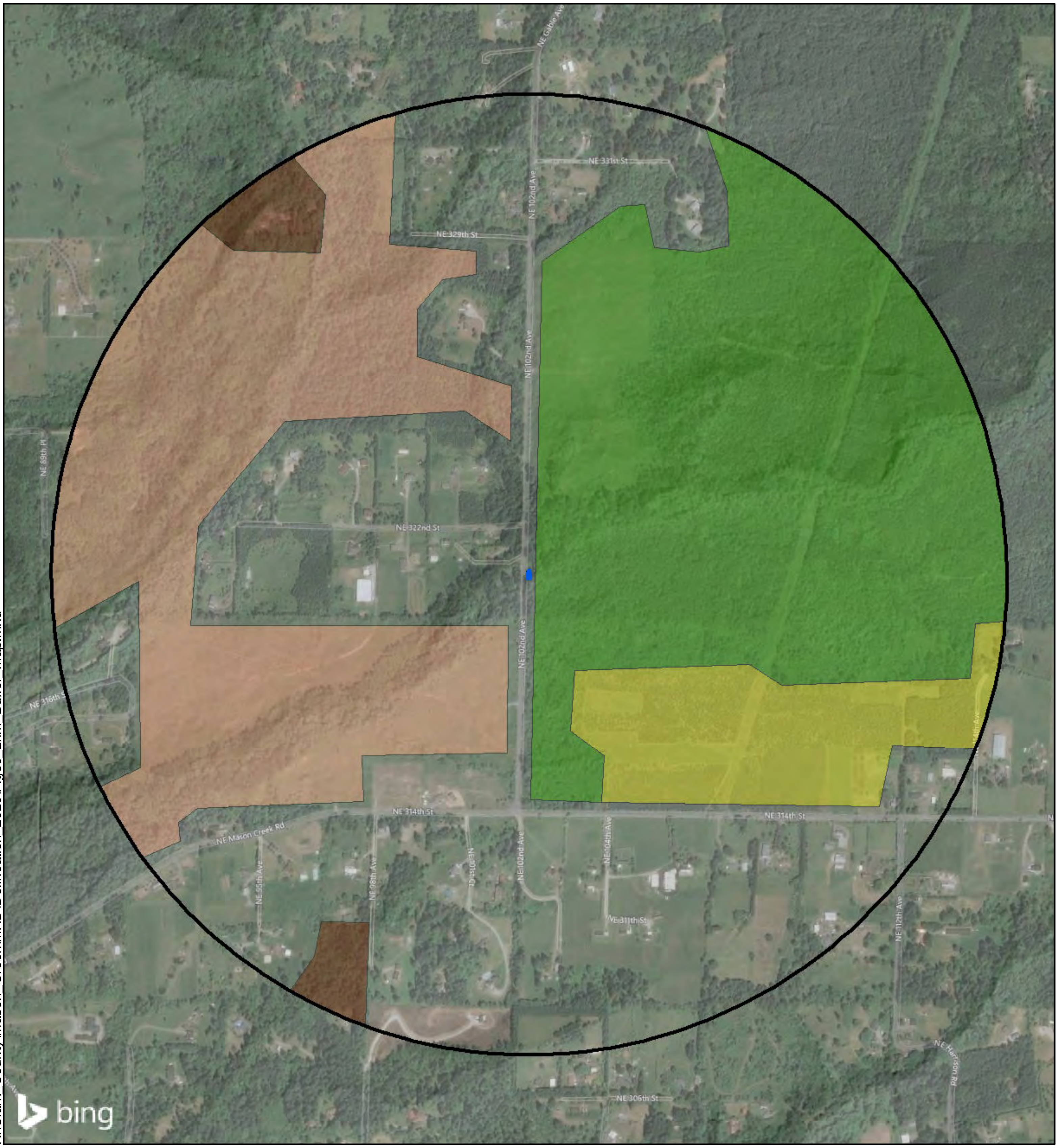
0 0.25 0.5
Miles

FIGURE 5b
WETLAND RATING MAP
Contributing Basin

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

AECOM



K:\Clark_County\Mason_Creek\MXD\Delineation_2019\Fig5c_1km_Buffer_Map.mxd

Legend

▨ Wetland A

Habitats Within 1 Kilometer (787 ac)

🟩 Accessible, Relatively Undisturbed (223 ac)

🟨 Accessible, Moderate and Low Intensity (52 ac)

🟧 Relatively Undisturbed (176 ac)

🟫 Moderate and Low Intensity (14 ac)

N
W E
S

0 0.1 0.2
Miles

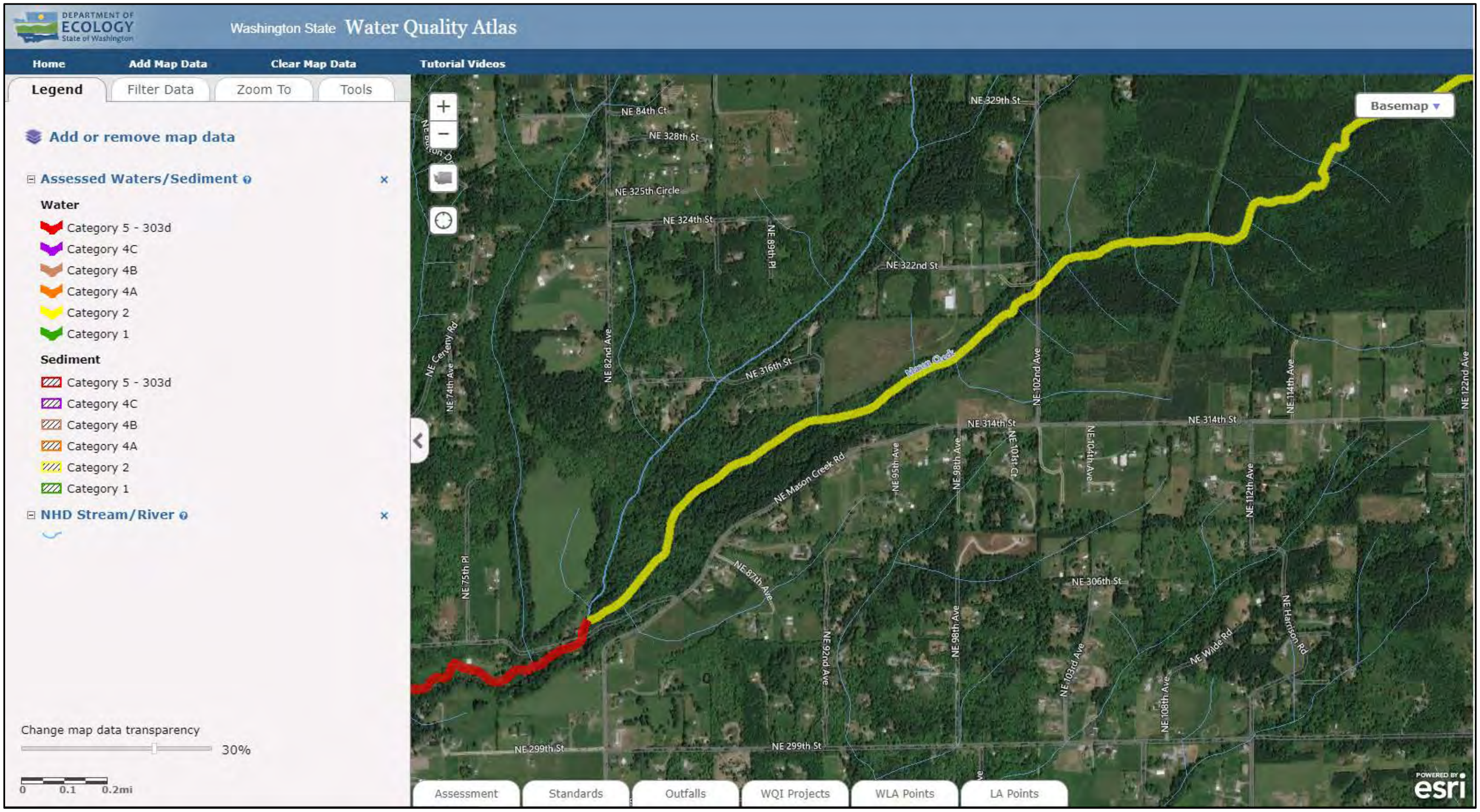
FIGURE 5c
WETLAND RATING MAP
1 Kilometer Buffer Habitats

Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

December, 2019

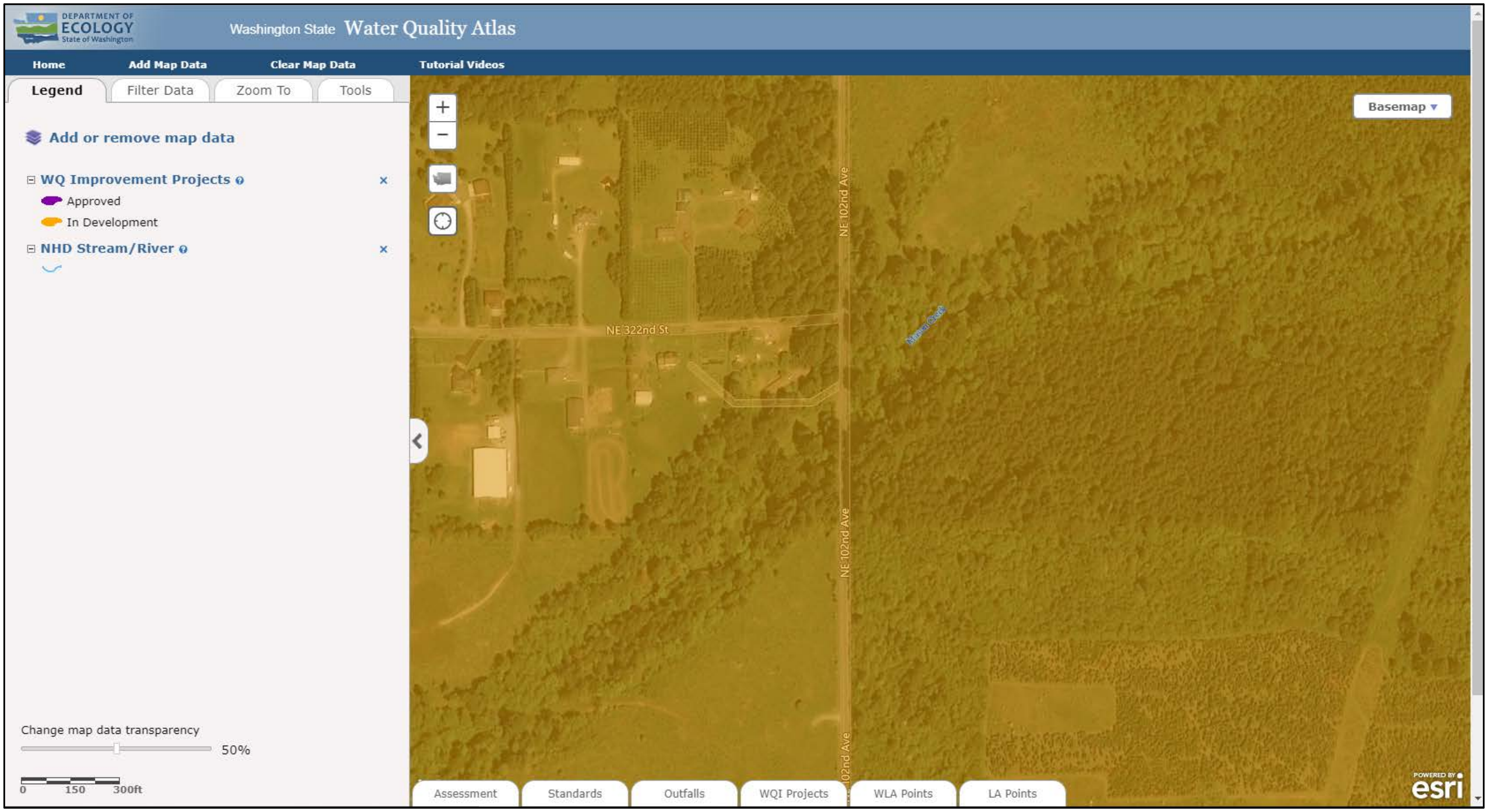
AECOM

Figure 5d – 303(d) Listed Waters Screenshot



Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

Figure 5e – TMDL Screenshot



Appendix B: Photographs

Project:

Mason Creek Fish Passage

SITE PHOTOS

AECOM Project No.

60615503

Photo No.
1

Date
10/10/19

Direction Photo Taken:

North

Description:

The southern portion of Wetland A connects to Mason Creek. This portion of the wetland is regularly flooded by Mason Creek and contains a mix of invasive (field bindweed, reed canarygrass, Himalayan blackberry) as well as native vegetation.

Photo No.
2

Date:
10/10/19

Direction Photo Taken:

Northeast

Description:

Photo shows the northern portion of Wetland A where it extends up a topographically defined swale. The steep road embankment of NE 102nd Avenue (bottom left) defines the western boundary of the wetland.

Photo No.
3

Date:
10/10/19

Direction Photo Taken:

East

Description:

Photo shows Mason Creek just before it enters the culvert inlet at NE 102nd Avenue (bottom). Trees and shrubs that make up the riparian area provide shade and habitat benefits to the creek.

Photo No.
4

Date:
10/10/19

Direction Photo Taken:

Northeast

Description:

Just upstream of the proposed culvert replacement project, a large fallen log straddles Mason Creek, providing shade and habitat complexity.

Photo No. 5

Date: 10/10/19

Direction Photo Taken:

North

Description:

NE 102nd Avenue slopes down toward Mason Creek from the north and south. Road runoff is conveyed to the creek via vegetated roadside ditches.

Photo No. 6

Date: 10/10/19

Direction Photo Taken:

East

Description:

In addition to replacing the culvert at NE 102nd Avenue, the Mason Creek Fish Passage Barrier Removal project also proposes to cut a large notch into the natural log barrier shown.

Appendix C: Wetland Determination Data Forms

Sample Plot #	Latitude	Longitude
SP-1	45.853616	-122.568547
SP-2	45.853635	-122.568506

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Mason Creek Culvert City/County: Clark Sampling Date: 10/9/2019
Applicant/Owner: County State: ~~OR~~ WA Sampling Point: 1
Investigator(s): N. Herlocker Section, Township, Range: ______
Landform (hillslope, terrace, etc.): swale in terrace Local relief (concave, convex, none): concave Slope (%): 5
Subregion (LRR): A Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: HcF - Hesson clay loam - 8-20% slope NWI classification: ______
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)
Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes X No ______
Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? N (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ______	Is the Sampled Area within a Wetland? Yes X No ______
Hydric Soil Present?	Yes X	No ______	
Wetland Hydrology Present?	Yes X	No ______	

Remarks: Swale at base of road embankment. Backwaters at lower end from Mason Creek.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30)			
1. Fraxinus latifolia	25	X	FACW
2.			
3.			
4.			
	25 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5)			
1. Rubus armeniacus	15	X	FAC
2.			
3.			
4.			
5.			
	15 = Total Cover		
Herb Stratum (Plot size: ______)			
1. Athyrium filix-femina	35	X	FAC
2. Tolmeia menziesii	45	X	FAC
3. Phalaris arundinacea	20	X	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 5)			
1. Convolvulus arvensis *	20	X	NOL
2.			
	20 = Total Cover		
% Bare Ground in Herb Stratum 0			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)
Total Number of Dominant Species Across All Strata: 7 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 86% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	______	x 1 = ______
FACW species	______	x 2 = ______
FAC species	______	x 3 = ______
FACU species	______	x 4 = ______
UPL species	______	x 5 = ______
Column Totals:	______ (A)	______ (B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:
* Rooted in embankment

SOIL

Sampling Point: 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-9	10YR 3/2	100	—				SiLm	
9-16	10YR 4/2	98	10YR 4/6	2	C	M	SiLm	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
X High Water Table (A2)
X Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) **(LRR A)**
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
X Geomorphic Position (D2)
___ Shallow Aquitard (D3)
X FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) **(LRR A)**
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes X No ___ Depth (inches): 12
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 10

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Mason Creek Culvert City/County: Clark Sampling Date: 10/9/2019
Applicant/Owner: County State: ~~OR~~ WA Sampling Point: 2
Investigator(s): N. Heslocker Section, Township, Range: ______
Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): minor slop Slope (%): 5
Subregion (LRR): A Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: HcF-Hessen clay loam, 8-20% slopes NWI classification: ______
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)
Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? N Are "Normal Circumstances" present? Yes X No ______
Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ______
Hydric Soil Present? Yes ______ No X
Wetland Hydrology Present? Yes ______ No X

Is the Sampled Area within a Wetland? Yes ______ No X

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Fraxinus latifolia	15	X	FACW
2.			
3.			
4.			
	15	= Total Cover	
Sapling/Shrub Stratum (Plot size: 5)			
1. Sambucus racemosa	15	X	FACU
2. Rosa nutkana	5		FAC
3. Rubus armeniacus	10	X	FAC
4. Rubus spectabilis	5		FAC
5.			
	35	= Total Cover	
Herb Stratum (Plot size: 5)			
1. Polystichum munitum	15		FACU
2. Tolmeia menziesii	60	X	FAC
3. Athyrium filix-femina	15		FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90	= Total Cover	
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum 1

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)
Total Number of Dominant Species Across All Strata: 4 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-20	10YR 3/2	100	—				SiLm	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)

___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ____ No X

Remarks: Consistent color/texture to 20" bgs; no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) **(LRR A)**
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) **(LRR A)**
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____________

Water Table Present? Yes ____ No X Depth (inches): ____________

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____________

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix D: Wetland Rating System Forms

RATING SUMMARY – Western Washington

Name of wetland (or ID #): A

Date of site visit: 10/10/2019

Rated by Brian Fletcher

Trained by Ecology? ☑ Yes ☐ No

Date of training 4/30/2015

HGM Class used for rating Riverine & Fresh Water Tidal

Wetland has multiple HGM classes? ☑ Yes ☐ No

NOTE: Form is not complete with out the figures requested (*figures can be combined*).

Source of base aerial photo/map Google Earth, Imagery ESRI Online

OVERALL WETLAND CATEGORY II (based on functions ☑ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

____ **Category I** - Total score = 23 - 27
X **Category II** - Total score = 20 - 22
____ **Category III** - Total score = 16 - 19
____ **Category IV** - Total score = 9 - 15

FUNCTION	**Improving Water Quality**	**Hydrologic**	**Habitat**	
List appropriate rating (H, M, L)				
Site Potential	M	M	H	
Landscape Potential	M	M	H	
Value	M	M	M	**Total**
Score Based on Ratings	6	6	8	**20**

Score for each function based on three ratings
(*order of ratings is not important*)

9 = H, H, H
8 = H, H, M
7 = H, H, L
7 = H, M, M
6 = H, M, L
6 = M, M, M
5 = H, L, L
5 = M, M, L
4 = M, L, L
3 = L, L, L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	**Category**
Estuarine	
Wetland of High Conservation Value	
Bog	
Mature Forest	
Old Growth Forest	
Coastal Lagoon	
Interdunal	
None of the above	**X**

Maps and Figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet (*can be added to map of hydroperiods*)	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	5a
Hydroperiods	H 1.2	5a
Ponded depressions	R 1.1	5a
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	R 2.4	5a
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	5a
Width of unit vs. width of stream (*can be added to another figure*)	R 4.1	5a
Map of the contributing basin	R 2.2, R 2.3, R 5.2	5b
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	5c
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	5d
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	5e

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to another figure*)	S 4.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number ____A__

HGM Classification of Wetland in Western Washington

For questions 1 -7, the criteria described must apply to the entire unit being rated.
If hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1 - 7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

☑ NO - go to 2　　☐ **YES** - the wetland class is **Tidal Fringe** - go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

☐ **NO - Saltwater Tidal Fringe (Estuarine)**　　☐ **YES - Freshwater Tidal Fringe**

If your wetland can be classified as a Freshwater Tidal Fringe use the forms for ***Riverine*** *wetlands. If it is Saltwater Tidal Fringe it is an* ***Estuarine*** *wetland and is not scored. This method* ***cannot*** *be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it.
Groundwater and surface water runoff are NOT sources of water to the unit.

☑ NO - go to 3　　☐ **YES -** The wetland class is **Flats**

If your wetland can be classified as a Flats wetland, use the form for ***Depressional*** *wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?

☐ The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
☐ At least 30% of the open water area is deeper than 6.6 ft (2 m).

☑ NO - go to 4　　☐ **YES** - The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?

☑ The wetland is on a slope (*slope can be very gradual*),
☑ The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.
☑ The water leaves the wetland **without being impounded.**

☐ NO - go to 5　　☑ **YES -** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?

☑ The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
☑ The overbank flooding occurs at least once every 2 years.

☐ NO - go to 6　　☑ **YES -** The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding.

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

☑ NO - go to 7 ☐ **YES** - The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

☑ NO - go to 8 ☐ **YES** - The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	[✓ Riverine]
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

NOTES and FIELD OBSERVATIONS:

Slope + Riverine = Riverine

Wetland name or number A

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

R 1.0. Does the site have the potential to improve water quality?		
R 1.1. Area of surface depressions within the Riverine wetland that can trap sediments during a flooding event:		2
Depressions cover >$^3/_4$ area of wetland	points = 8	
Depressions cover > ½ area of wetland	points = 4	
Depressions present but cover < ½ area of wetland	points = 2	
No depressions present	points = 0	
R 1.2. Structure of plants in the wetland (areas with >90% cover at person height, **not** Cowardin classes)		8
Trees or shrubs > $^2/_3$ area of the wetland	points = 8	
Trees or shrubs > $^1/_3$ area of the wetland	points = 6	
Herbaceous plants (> 6 in high) > $^2/_3$ area of the wetland	points = 6	
Herbaceous plants (> 6 in high) > $^1/_3$ area of the wetland	points = 3	
Trees, shrubs, and ungrazed herbaceous < $^1/_3$ area of the wetland	points = 0	
Total for R 1	Add the points in the boxes above	10

Rating of Site Potential If score is:**___12-16 = H _X_6-11 = M ___0-5 = L** *Record the rating on the first page*

R 2.0. Does the landscape have the potential to support the water quality function of the site?		
R 2.1. Is the wetland within an incorporated city or within its UGA?	Yes = 2 No = 0	0
R 2.2. Does the contributing basin to the wetland include a UGA or incorporated area?	Yes = 1 No = 0	0
R 2.3. Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years?	Yes = 1 No = 0	1
R 2.4. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants?	Yes = 1 No = 0	0
R 2.5. Are there other sources of pollutants coming into the wetland that are not listed in questions R 2.1-R 2.4 Other sources NE 102nd Road runoff	Yes = 1 No = 0	1
Total for R 2	Add the points in the boxes above	2

Rating of Landscape Potential If score is:**___3-6 = H _X_1 or 2 = M ___0 = L** *Record the rating on the first page*

R 3.0. Is the water quality improvement provided by the site valuable to society?		
R 3.1. Is the wetland along a stream or river that is on the 303(d) list or on a tributary that drains to one within 1 mi? (approximately 1.3 mile downstream)	Yes = 1 No = 0	0
R 3.2. Is the wetland along a stream or river that has TMDL limits for nutrients, toxics, or pathogens?	Yes = 1 No = 0	1
R 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? (*answer YES if there is a TMDL for the drainage in which the unit is found*)	Yes = 2 No = 0	0
Total for R 3	Add the points in the boxes above	1

Rating of Value If score is:**___2-4 = H _X_1 = M ___0 = L** *Record the rating on the first page*

Wetland name or number _A__

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Hydrologic Functions - Indicators that site functions to reduce flooding and stream erosion

R 4.0. Does the site have the potential to reduce flooding and erosion?	
R 4.1. Characteristics of the overbank storage the wetland provides: *Estimate the average width of the wetland perpendicular to the direction of the flow and the width of the stream or river channel (distance between banks). Calculate the ratio: (average width of wetland)/(average width of stream between banks).* If the ratio is more than 20 points = 9 If the ratio is 10-20 points = 6 If the ratio is 5-<10 points = 4 If the ratio is 1-<5 points = 2 If the ratio is < 1 points = 1	2
R 4.2. Characteristics of plants that slow down water velocities during floods: *Treat large woody debris as forest or shrub. Choose the points appropriate for the best description (polygons need to have >90% cover at person height. These are NOT Cowardin classes).* Forest or shrub for $>{}^{1}/_{3}$ area OR emergent plants $>{}^{2}/_{3}$ area points = 7 Forest or shrub for $>{}^{1}/_{10}$ area OR emergent plants $>{}^{1}/_{3}$ area points = 4 Plants do not meet above criteria points = 0	7
Total for R 4 Add the points in the boxes above	9

Rating of Site Potential If score is:____**12-16 = H** _X__**6-11 = M** ____**0-5 = L** *Record the rating on the first page*

R 5.0. Does the landscape have the potential to support the hydrologic functions of the site?	
R 5.1. Is the stream or river adjacent to the wetland downcut? Yes = 0 No = 1	1
R 5.2. Does the up-gradient watershed include a UGA or incorporated area? Yes = 1 No = 0	0
R 5.3. Is the up-gradient stream or river controlled by dams? Yes = 0 No = 1	0
Total for R 5 Add the points in the boxes above	1

Rating of Landscape Potential If score is:____**3 = H** _X__**1 or 2 = M** ____**0 = L** *Record the rating on the first page*

R 6.0. Are the hydrologic functions provided by the site valuable to society?	
R 6.1. Distance to the nearest areas downstream that have flooding problems? *Choose the description that best fits the site*. The sub-basin immediately down-gradient of the wetland has flooding problems that result in damage to human or natural resources (e.g., houses or salmon redds) points = 2 Surface flooding problems are in a sub-basin farther down-gradient points = 1 No flooding problems anywhere downstream points = 0	1
R 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for R 6 Add the points in the boxes above	1

Rating of Value If score is:____**2-4 = H** _X__**1 = M** ____**0 = L** *Record the rating on the first page*

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

☐ Aquatic bed	4 structures or more: points = 4
☐ Emergent	3 structures: points = 2
☑ Scrub-shrub (areas where shrubs have > 30% cover)	2 structures: points - 1
☑ Forested (areas where trees have > 30% cover)	1 structure: points = 0

If the unit has a Forested class, check if:

☑ The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

2

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

☐ Permanently flooded or inundated	4 or more types present: points = 3
☑ Seasonally flooded or inundated	3 types present: points = 2
☐ Occasionally flooded or inundated	2 types present: points = 1
☑ Saturated only	1 types present: points = 0
☑ Permanently flowing stream or river in, or adjacent to, the wetland	
☐ Seasonally flowing stream in, or adjacent to, the wetland	
☐ **Lake Fringe wetland**	**2 points**
☐ **Freshwater tidal wetland**	**2 points**

2

H 1.3. Richness of plant species

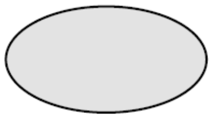
Count the number of plant species in the wetland that cover at least 10 ft^2.
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle***

If you counted:	> 19 species	points = 2
	5 - 19 species	points = 1
	< 5 species	points = 0

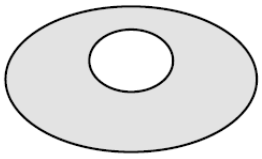
1

H 1.4. Interspersion of habitats

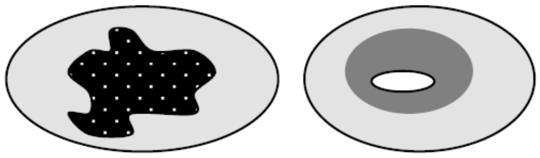
Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points

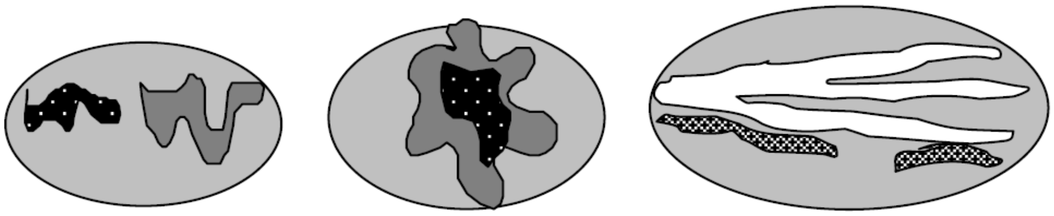


Low = 1 point



Moderate = 2 points

All three diagrams
in this row are
HIGH = 3 points



1

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ☑ Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long) ☑ Standing snags (dbh > 4 in) within the wetland ☑ Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present (*cut shrubs or trees that have not yet weathered where wood is exposed*) ☐ At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (*structures for egg-laying by amphibians*) ☑ Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	4
Total for H 1 Add the points in the boxes above	**10**

Rating of Site Potential If Score is: ☐ **15 - 18 = H** ☑ **7 - 14 = M** ☐ **0 - 6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat function of the site?	
H 2.1 Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* 28 % undisturbed habitat + (7 % moderate & low intensity land uses / 2) = 31.5% If total accessible habitat is: > $^1/_3$ (33.3%) of 1 km Polygon points = 3 20 - 33% of 1 km Polygon points = 2 10 - 19% of 1 km Polygon points = 1 < 10 % of 1 km Polygon points = 0	2
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* 51 % undisturbed habitat + (8 % moderate & low intensity land uses / 2) = 55% Undisturbed habitat > 50% of Polygon points = 3 Undisturbed habitat 10 - 50% and in 1-3 patches points = 2 Undisturbed habitat 10 - 50% and > 3 patches points = 1 Undisturbed habitat < 10% of 1 km Polygon points = 0	3
H 2.3 Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use points = (-2) ≤ 50% of 1km Polygon is high intensity points = 0	0
Total for H 2 Add the points in the boxes above	**5**

Rating of Landscape Potential If Score is: ☑ **4 - 6 = H** ☐ **1 - 3 = M** ☐ **< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?	
H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated*. Site meets ANY of the following criteria: points = 2 ☐ It has 3 or more priority habitats within 100 m (see next page) ☑ It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) ☐ It is mapped as a location for an individual WDFW priority species ☐ It is a Wetland of High Conservation Value as determined by the Department of Natural Resources ☐ It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) with in 100m points = 1 Site does not meet any of the criteria above points = 0	2

Rating of Value If Score is: ☑ **2 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE** : This question is independent of the land use between the wetland unit and the priority habitat.*

☐ **Aspen Stands**: Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

☐ **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

☐ **Herbaceous Balds**: Variable size patches of grass and forbs on shallow soils over bedrock.

☐ **Old-growth/Mature forests**: Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

☐ **Oregon White Oak**: Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

☑ **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

☐ **Westside Prairies**: Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

☐ **Instream**: The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

☐ **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page*).

☐ **Caves**: A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

☐ **Cliffs**: Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

☐ **Talus**: Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

☐ **Snags and Logs**: Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Wetland name or number A

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. List the category when the appropriate criteria are met.*	**Category**
SC 1.0. Estuarine Wetlands Does the wetland meet the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal, ☐ Vegetated, and ☐ With a salinity greater than 0.5 ppt ☐ Yes - Go to **SC 1.1** ☑ No = **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐ Yes = **Category I** ☐ No - Go to **SC 1.2**	
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina* , see page 25) ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. ☐ Yes = **Category I** ☐ No = **Category II**	
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ☐ Yes - Go to **SC 2.2** ☐ No - Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ☐ Yes = **Category I** ☐ No = **Not WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ☐ Yes - **Contact WNHP/WDNR and to SC 2.4** ☐ No = **Not WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ☐ Yes = **Category I** ☐ No = **Not WHCV**	
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions*** *.* SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ☐ Yes - Go to **SC 3.3** ☑ No - Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ☐ Yes - Go to **SC 3.3** ☑ No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ☐ Yes = **Is a Category I bog** ☑ No - Go to **SC 3.4** **NOTE**: If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ☐ Yes = **Is a Category I bog** ☑ No = **Is not a bog**	

SC 4.0. Forested Wetlands

Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.***

☐ **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more.

☐ **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80-200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm).

☐ Yes = **Category I** ☑ No = **Not a forested wetland for this section**

SC 5.0. Wetlands in Coastal Lagoons

Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?

☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks

☐ The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon (*needs to be measured near the bottom*)

☐ Yes - Go to **SC 5.1** ☑ No = **Not a wetland in a coastal lagoon**

SC 5.1. Does the wetland meet all of the following three conditions?

☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100).

☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland.

☐ The wetland is larger than $^1/_{10}$ ac (4350 ft^2)

☐ Yes = **Category I** ☐ No = **Category II**

SC 6.0. Interdunal Wetlands

Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.***

In practical terms that means the following geographic areas:

☐ Long Beach Peninsula: Lands west of SR 103

☐ Grayland-Westport: Lands west of SR 105

☐ Ocean Shores-Copalis: Lands west of SR 115 and SR 109

☐ Yes - Go to **SC 6.1** ☑ No = **Not an interdunal wetland for rating**

SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)?

☐ Yes = **Category I** ☐ No - Go to **SC 6.2**

SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger?

☐ Yes = **Category II** ☐ No - Go to **SC 6.3**

SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac?

☐ Yes = **Category III** ☐ No = **Category IV**

Category of wetland based on Special Characteristics

If you answered No for all types, enter "Not Applicable" on Summary Form

Figure 5d – 303(d) Listed Waters Screenshot

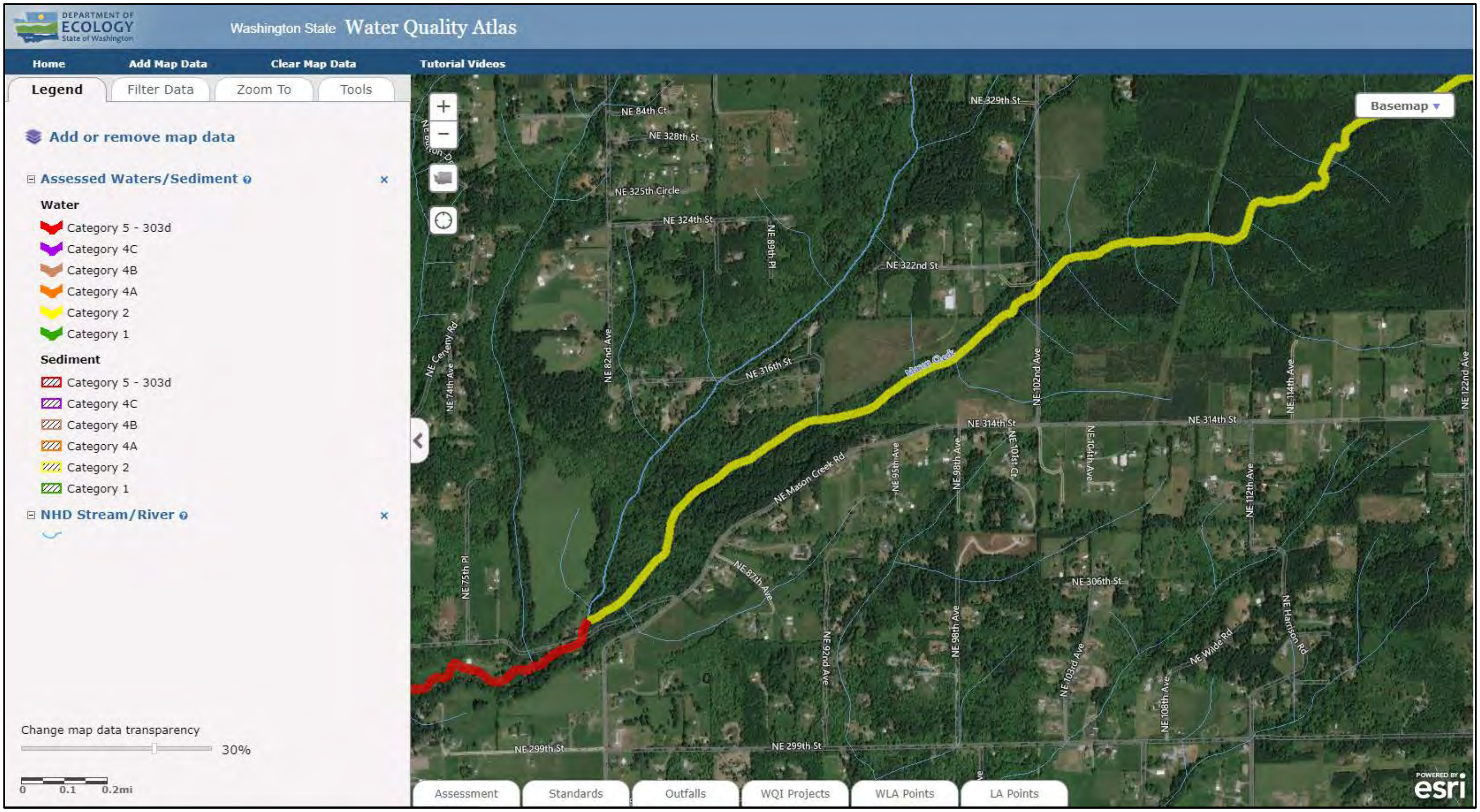


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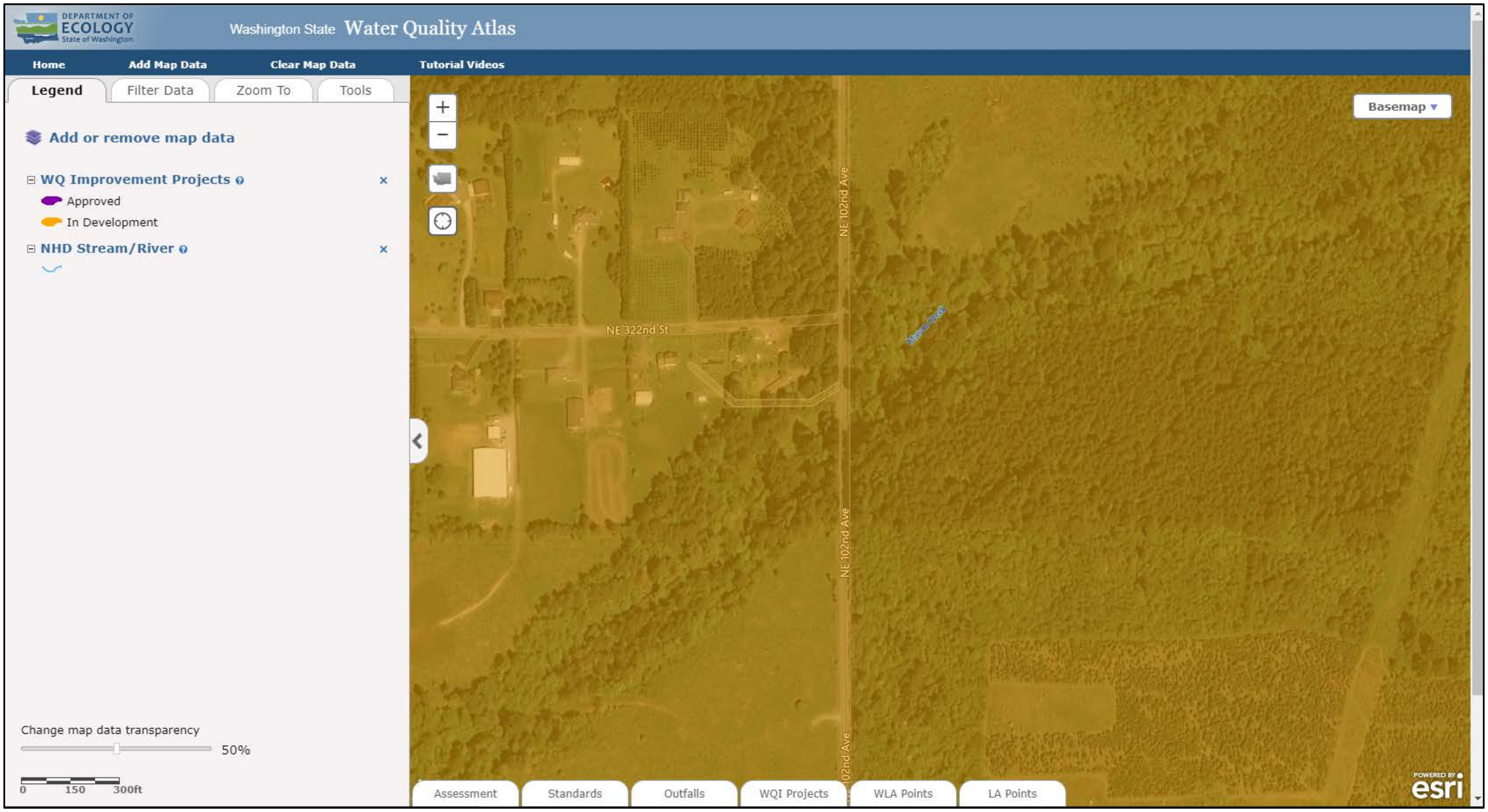
Figure 5e – TMDL Screenshot



Mason Creek Fish Passage Project
Wetland Delineation Report
Clark County, Washington

APEX

GEOTECHNICS

Geotechnical Investigation
Mason Creek Culvert Replacement
Clark County, Washington

Prepared for:
Clark County

July 6, 2020
2530-01

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Appendix

1.0 Introduction and Project Description

This report presents Apex Companies, LLC's (Apex's) geotechnical recommendations for the proposed Mason Creek culvert replacement Project in Clark County, Washington. André Maré of Geotechnics, LLC (Geotechnics) supported Apex as a subconsultant providing geotechnical review and laboratory services for the project.

The proposed project consists of planning, design, permitting, and construction for the replacement of the existing culvert beneath NE 102nd Avenue in Clark County, Washington. The site is located approximately five miles east of La Center and four miles north of Battleground, Washington (see Figure 1).

The purpose of the culvert replacement is to allow for passage of fish that head upstream to spawn, including coho salmon and steelhead. We understand that the existing 60-inch diameter culvert pipe will be replaced by a steel arch culvert having a height of approximately 13 feet and width of approximately 20 feet. The culvert will be partially gravel-filled. Embankment grades of 2H:1V or flatter will be maintained by constructing concrete headwalls that surround the culvert and extend beyond to the north and south. Additionally, gabion walls will be constructed on the slopes to the north of the culvert.

This report has been updated based on review of the 60% design drawings (Clark County / AECOM, 2020).

2.0 Scope of Services

Our scope of services for this project included the following:

- Surficial reconnaissance;
- Subsurface explorations;
- Geotechnical engineering analyses; and
- Preparation of this report.

3.0 Limitations of Our Work

This work was performed for the exclusive use of Clark County and their consultants for specific application to this project and site. We performed this work in accordance with generally accepted professional practices in the same or similar localities related to the nature of the work accomplished, at the time the services were performed. No other warranty, expressed or implied, is made. This report is presented with the assumption that Apex will be retained to review the project design to verify that the recommendations presented herein have been interpreted as intended.

4.0 Site Description

The general topography in the vicinity of the site is rolling, with the existing embankment spanning the width of the Mason Creek floodplain. A two-lane rural highway (NE 102nd Avenue) with no shoulders is on an approximately 14-foot high fill embankment. Mason Creek, a tributary of the East Fork Lewis River, currently flows through the base of the embankment from east to west.

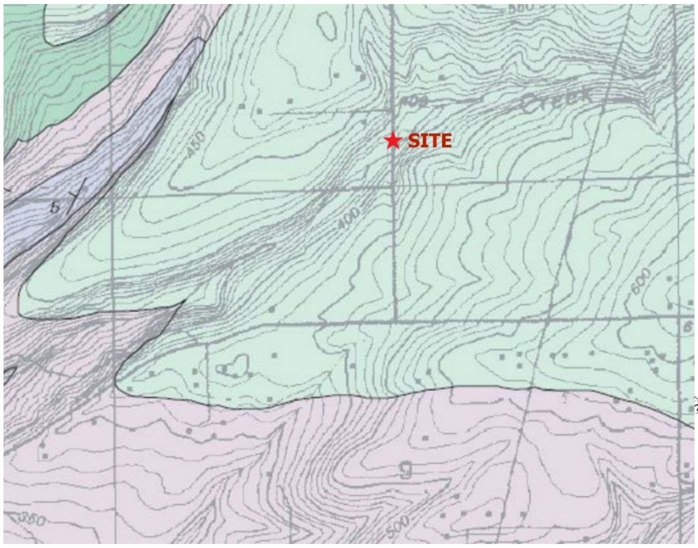
Recently surveyed invert elevations of the 5-foot diameter concrete pipe are 379.0' and 377.4', east and west respectively. A significant drop occurs beyond the west end pipe outlet, assumedly creating a fish passage barrier.

Embankment slopes are inclined at approximately 1.2H:1V (Horizontal:Vertical) on the west side and slightly flatter on the east side. During our reconnaissance, we noted no signs of slope instability, recent movement, or excessive erosion. Vegetation on the slopes is minimal, primarily grasses, ferns, and a few small saplings. Bedload in the stream consists generally of rounded gravel and cobbles to about 8-inch diameter. Some imported angular rock has been placed in the creek at the west end pipe outlet. At the time of our reconnaissance, the water level in the stream was moderate, with 3- to 4-inch deep water flowing through the culvert.

5.0 Site Geology

Geologic Overview. Much of Clark County is located within the Portland Basin, which was formed by a series of geologic events that included: Cascade Range building from a series of large fissures in the earth that emitted the Columbia River Basalt; torrential erosion of the Cascade Range generating alluvial deposits now identified as the Troutdale Formation; a second episode of volcanism resulting in a series of Boring Lava volcanic eruption centers; vast deposits of wind-blown silt (loess) termed the Portland Hills Silt, derived from denuded glacial plains to the east; a series of cataclysmic glacial floods generated in Montana and Idaho (Spokane or Missoula Flood Deposits) that scoured the lowland loess, alluvial plains, and volcanic cones; and more recent stream and river erosion and sedimentation that has shaped the lowlands as they appear today.

Geologic Mapping. In northeastern Clark County, the regional geologic composition also includes glacial features, including till and glaciofluvial deposits. In the vicinity of the site, Mason Creek is underlain by Quaternary glacial drift deposits. We reviewed the geologic map for the project area titled "*Geologic Map of the Battle Ground 7.5-Minute Quadrangle, Clark County, Washington*" (Howard 2002). The geologic unit underlying the site is labeled Qd and includes gravel and boulders 1-2 meters across. Unit thickness is at least 30 meters. Below are excerpts from the map and legend:



Qd **Glacial drift (Pleistocene)**—Amboy Drift of Mundorff (1984). Till and lesser stratified drift. Clasts largely intermediate and mafic volcanic rocks; rarer silicic volcanic rocks and rounded quartzite pebbles. Boulders 1-2 m across in places, such as in the north-central edge of the quadrangle (SE1/4 NW1/4 SW1/4 sec. 33, T. 5 N., R. 2 E.) and in the northeast part of the quadrangle west of Rock Creek (sec. 11, T. 4 N., R. 2 E). At east edge of this quadrangle along north bank of East Fork Lewis River, unit includes crossbedded sharpstone pebble gravel containing isolated blocks and boulders, gradationally overlain 3 m above river bed by angular boulders 1-3 m across, in turn overlain, on terrace 20 m higher, by boulder-cobble gravel. Thickness to at least 30 m (Mundorff, 1964, fig. 12; 1984) where lowest exposures reach down to about 210-230 ft (64-70 m) elevation along East Fork Lewis River near mouth of Rock Creek. Locally dissected by Mason Creek's middle fork, as indicated by till and boulder float present on interfluves, overlying Troutdale Formation. Diamict interpreted as drift exposed in valley of upper parts of Mason Creek's east fork suggests that drift coats the valley walls (SE1/4 SW1/4 sec. 4, T. 4 N., R. 2 E.; and SE1/4 SE1/4 sec. 34, T. 5 N., R. 2 E.). Southern part of drift underlies the basalt of Battle Ground, as identified where (1) poorly exposed bouldery and cobbly deposit (till?) is below basalt of Battle Ground outcrops along road 1 km northeast of Camp Lewis (NE1/4 SE1/4 sec. 14) and (2) float of subrounded to subangular boulders and cobbles derived from Skamania Volcanics veneer hills between mapped scoria and flows of basalt of Battle Ground and well logs show basalt is absent from subsurface (secs. 24, 25, T. 4 N., R. 2 E.). Overlies Troutdale Formation and Skamania Volcanics. Proposed by Mundorf (1984) to correlate with late Pleistocene Hayden Creek Drift based on average thickness (1-1.5 mm) of weathering rinds on volcanic clasts; Crandell (1987) suggested an older till also present based on greater thickness of weathering rinds (3 to 15 mm) on basalt clasts, as in till near Mason Creek (Crandell reported his outcrop as NW1/4 NE 1/4 sec. 9, T. 4 N., R. 2 E., but as exposure is lacking there, the location may be nearby roadcut exposure in NE1/4 SE1/4 SW1/4 sec. 4)

Soils Mapping. We reviewed the *Soil Survey of Clark County, Washington* (NRCS, 2011). The soils mapped within the ravine are *Washougal Gravelly Loam*. This soil unit is described as a ‘somewhat excessively drained’ gravelly loam transitioning at 30-inches depth to a very cobbly coarse sand. The soil parent material is described as gravelly alluvium. These soils are considered to have moderately high to high permeability.

6.0 Seismic Hazards

Regional Seismicity. The seismicity of the area and hence the potential for site ground shaking, is controlled by three separate fault mechanisms: the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. The maximum magnitude associated with events resulting from each of these mechanisms varies greatly, with lowest magnitude for the crustal faults and highest for the CSZ ruptures. Seismic and geologic parameters such as slip rate, horizontal and vertical offset, rupture length, and geologic age have not been determined for the majority of faults. This is primarily due to the lack of surface expressions or exposures of faulting because of urban development and the presence of late Quaternary soil deposits that overlie the faults. The low level of historical seismicity and lack of paleo-seismic data result in large uncertainties when evaluating individual crustal fault earthquakes and recurrence intervals. For the purposes of this study, we discuss general levels of seismic hazards related to anticipated code-based ground accelerations, without focusing on specific source faults or events.

Ground Shaking. Ground shaking is responsible for generating high inertial forces and excessive dynamic movements that can impart unacceptable damage to structures. Ground shaking will be mitigated by designing structures and their foundations using the code-based design acceleration value provided below.

Fault Displacement. The USGS online Fault and Fold database (USGS, 2006) shows no known active or potentially active faults passing through the vicinity of the site. No indications of the presence of faulting were noted during our field investigation. Based upon the mapping and great depth of sediments, we consider the possibility of fault rupture and displacement to be remote.

Liquefaction. The potential for soil liquefaction during seismic ground shaking is generally associated with loose, saturated, non-plastic sands and some silts. The embankment itself consists of soil types that could potentially liquefy if saturated, but these soils are not saturated. Soils below the embankment are too dense to be considered susceptible to liquefaction. For these reasons, the potential for liquefaction is remote.

Design Site Class. Soils consist of silts and sands overlying dense gravels at depth. In accordance with the Washington State Department of Transportation *Geotechnical Design Manual* (GDM) (WSDOT, 2019), the appropriate design Site Class is D.

Design Accelerations. In accordance with the GDM, we anticipate that the retaining walls constructed for this project will be designed for a no-collapse case based on a risk level of seven percent probability of exceedance in 75 years (approximately 1,000-year return period). Based on the GDM, we interpret the peak ground acceleration (PGA) on bedrock to be 0.25g. Modified for Class D soils, the site-specific design value is 0.34g. Seismic earth pressures on retaining walls were calculated and are included below in report section 8.7.

7.0 Subsurface Conditions

Our subsurface investigation for the project consisted of two borings, one near the center of both the north and southbound lanes of NE 102nd Avenue and within 10 feet horizontally of the existing culvert. The borings were completed on December 6, 2019 to depths of 26.5 feet below the existing asphalt surface. The approximate locations of our explorations are indicated on the accompanying site plan (Figure 2). A summary of soil conditions observed within our explorations is provided below. Detailed logs for each boring are included in Appendix A of this report.

A truck mounted CME 75 HT drill rig operated by Western States Soil Conservation, Inc (a WA -licensed driller) was used to advance the borings, using the mud-rotary method. Standard Penetration Tests (SPT) were used for data and sample collection. Borings were abandoned in accordance with Washington Department of Ecology requirements and the surface was restored to match original grade. Traffic control services were provided by D&H Flagging.

Samples were collected from the borings and returned to the Geotechnics soils laboratory for further examination and testing. Testing included Moisture Content (17 tests in accordance with ASTM D2216), Fines Content (three tests, ASTM D1140), and Grain-Size Distribution (two tests, ASTM D6913). Moisture content and fines content results are presented on the boring logs. Grain-size distribution plots are included as Figure A1.

Our findings were in general agreement with the geologic and soil mapping described above, with dense native gravelly deposits beneath the fill soils. For ease of interpretation, encountered subsurface conditions have been generalized into the major categories described below.

Asphalt Concrete Pavement and Base Rock. Our borings were advanced through the existing NE 102nd Avenue pavement section. Asphalt thickness and base rock sections at each of our boring locations are indicated on the accompanying boring logs. In general, the pavement section for NE 102nd Avenue on the embankment and adjacent the culvert consisted of a 6-inch thick asphalt and oil rock surfacing over a 12-inch thick gravel base.

Road Embankment Fill. The borings were completed through the existing embankment fills. Within our borings, the fills were encountered to a depth of 14.5 to 13.5 feet below the ground surface (bgs) at locations B-1 and B-2, respectively. The fill soil consistency was somewhat variable, but in general can be classified as medium stiff to very stiff, very moist, silt to silt with sand and gravel. Corrected SPT blow counts averaged 16.9 blows per foot (bpf). As shown in the cross-section (Figure 3), the base of the fill corresponds roughly with the level of the current culvert pipe.

Native Gravel. The deeper-seated soils beneath the embankment fills consist of dense, wet, silty gravel with sand. These gravel soils extend to depths of approximately 17 and 21.5 feet bgs at locations B-1 and B-2 respectively. These soils are dense, with corrected SPT blow counts ranging from 39 to 47 bpf based on three tests. Based on the encountered depths, we anticipate that these native gravels will form the foundation support for the proposed structure.

Glacial Drift. Beneath the surface fills and native gravel, our explorations encountered dense to very dense, semi lithified silt and sand with gravel of the Amboy Drift.

Groundwater. Groundwater was not observed in our borings; however, we anticipate that perched ground water depths will fluctuate several feet between the height of the wet season and the height of the dry season. Due to the proximity of the Creek, water levels will be heavily influenced by water elevations in the Creek.

8.0 Conclusions and Recommendations

Our recommendations are based on our current understanding of the project. If the nature or location of the planned construction changes, Apex should be contacted so that we may confirm or revise our recommendations.

8.1 Site Preparation

We have provided recommendations for wet weather and dry weather construction, as well as other geotechnical concerns and issues relative to the project site. Because of the moisture-sensitive embankment fills and near-surface soils, we strongly recommend dry weather construction. The optimum time for site earthwork generally falls between late June and late September.

Overexcavated soft areas should be backfilled with clean granular stabilization rock as specified in Section 8.2 below.

If wet weather construction is anticipated, or when adequate moisture control is not possible due to shallow groundwater or surface water, it will be necessary to install a granular working blanket to support construction equipment and provide a firm base on which to place subsequent fill and culvert construction. Commonly, the working blanket consists of Gravel Borrow or quarry spalls (see section 8.2). The material should be placed from an advancing pad of Gravel Borrow (or quarry spalls) with tracked equipment stripping topsoil while on top of the advancing gravel pad and bailing into dump trucks that have been restricted to access via the advancing gravel pad. It has been our experience that a minimum of 18 to 24 inches of working blanket is normally required, depending on the gradation and angularity of the working blanket material. This assumes the material is placed on a relatively undisturbed subgrade.

After installation, the working blanket should be compacted by a minimum of four complete passes with a moderately heavy (15,000 pounds) static steel drum or grid roller. We recommend that Apex be retained to observe granular working blanket installation and compaction. The working blanket must provide a firm base for subsequent fill installation, fill compaction, and culvert construction. Portions of the site used as haul routes for heavy construction equipment will require a thicker working blanket in order to protect the fine-grained subgrade.

By using tracked equipment and granular haul roads, the working blanket area can be minimized. If dump trucks and rubber-tired equipment are allowed random access across the site, a thicker working blanket will be required. Normally, the design, installation, and maintenance of a granular working blanket are the responsibilities of the earthwork contractor.

8.2 Structural Fill and Backfill Materials

The WSDOT GDM (WSDOT, 2019) defines soils in terms of their ability to function as embankment fill. WSDOT soil classifications are detailed in Chapter 5. A summary of the potential borrow material definitions is provided in the following table. Much of the existing embankment fills that will be excavated consist of sands and non-plastic silts. We consider these soils appropriate for use as common borrow and potentially for use as structural fill. However, the moisture contents in these soils may be too high for compaction at the point of excavation and soil drying will be very difficult given the limited project footprint. We anticipate that structural fills will be completed using imported soils.

WSDOT Standard Specification for Borrow Materials

Material	WSDOT Standard Specification*	Soil Type (USCS classification)	φ (degrees)	Cohesion (psf)	Total Unit Weight (pcf)
Common Borrow	9-03.14(3)	ML, SM, GM	30 to 34	0	115 to 130
Select Borrow	9-03.14(2)	GP, GP-GM, SP, SP-SM	34 to 38	0	120 to 135
Gravel Borrow	9-03.14(1)	GW, GW-GM, SW, SW-SM	36 to 40	0	130 to 145
Gravel Backfill for Walls	9-03.12(2)	GW, GP, SW, SP	36 to 40	0	125 to 135

* WSDOT, 2020 (see *References*)

The following are WSDOT definitions of the various borrow materials commonly employed as fill.

Waste. This includes soil types not detailed in the above table. It typically applies to soil types that such as topsoil, muck, or clay-rich soils that will not function well as embankment fill.

Common Borrow. Common Borrow may be virtually any soil or aggregate either naturally occurring or processed which is substantially free of organics or other deleterious material and is non-plastic. The specification allows for the use of more plastic Common Borrow when approved by the engineer. Common Borrow will likely have a high enough fines content to be moderately to highly moisture sensitive. This moisture sensitivity may affect the design property selection if it is likely that placement conditions are likely to be marginal due to the timing of construction (i.e. Common Borrow will only function as structural fill during extended periods of warm dry weather. In addition, Common Borrow is not usable in areas of standing water or shallow groundwater unless subgrade stabilization is first conducted).

Select Borrow. The requirements for Select Borrow ensure that the mixture will be granular and contain at least a minimal amount of gravel-sized material. The materials are likely to be poorly graded sand and contain enough fines to be moderately moisture sensitive (the specification allows up to 10 percent fines). Select Borrow is not an all-weather material. Much of the granular soil in Washington has been glacially derived, resulting in subangular to angular soil particles and, hence, high shear-strength values.

Gravel Borrow. The Gravel Borrow specification should ensure a reasonably well-graded sand and gravel mix. Because the fines content is under seven percent, the material is only slightly moisture sensitive. However, in very wet conditions, material with lower fines content should be used. In many cases, processed materials are used for Gravel Borrow and, in general, this processed material has been crushed, resulting in rather angular particles and very high soil friction angles. Its unit weight can approach that of concrete if very well graded.

Backfill for Walls. Gravel backfill for walls is a free-draining material that is generally used to facilitate drainage behind retaining walls. This material has similarities to Gravel Borrow, but generally contains fewer fines and is free draining.

Rock Embankment. Embankment material is considered rock embankment if 25 percent of the material is over 4 inches in diameter. Compactive effort is based on a method specification. Because of the nature of the material, compaction testing is generally not feasible. The specification allows for a broad range of material and properties such that the internal friction angle and unit weight can vary considerably based on the amount and type of rock in the fill.

Quarry Spalls and Rip-Rap. Quarry spalls; light, loose rip-rap; and heavy, loose rip-rap created from shot rock are often used as fill material below the water table or in shear keys in slope stability and landslide mitigation applications. WSDOT Standard Specification Section 9-13 provides minimum requirements for degradation and specific gravity for these materials. Therefore, sound rock must be used for these applications.

Gabion Stone. Fill for gabions should consist of generally angular stone in accordance with WSDOT Standard Specification Section 9-27.3(6) which requires the following gradation and angularity:

Sieve Size	Percent Passing
8”	100
6”	75 - 90
4”	0 - 10
% Fracture	75 min

Embankment Fills Placed During Summer Grading. During dry weather, road embankment fills and other structural fills may consist of virtually any relatively well-graded soil that meets the requirements for Common Borrow. However, if excess moisture causes the fill to pump or weave, those areas should be aerated and re-compacted or removed and backfilled with compacted granular fill. To achieve adequate compaction during wet weather, or if proper moisture content cannot be achieved by drying, we recommend fills consisting of well-graded, clean granular soils (sand or sand and gravel). Fill materials corresponding to WSDOT specifications for Select Borrow or Gravel Borrow will generally be appropriate for wet weather grading.

Wet Weather Grading and Subgrade Stabilization Fills. Because moisture levels are difficult to control in fine-grained soils and soil drying via aeration is not realistically an option, embankment fill and structural fill constructed during the wet season should consist of clean, durable crushed rock, or clean granular fill. This can include clean gravel borrow or clean granular select borrow. Typically, wet weather grading conditions should be assumed to exist between the months of mid-October through early to late June.

Working Pads for Marginal Subgrade Areas. The working pad for stabilizing marginal subgrade areas should consist of durable, clean, crushed rock. This material should be relatively clean, with a low percentage of fines by weight. Materials conforming to the WSDOT standards for either Gravel Borrow or Quarry Spalls are generally acceptable for this purpose. Typically, a separation geotextile is placed between the overexcavated subgrade and backfill.

8.3 Fill Placement and Compaction

Embankment and structural fills should be installed on a subgrade that has been prepared in accordance with the above recommendations. Fills should be installed in horizontal lifts and should be compacted in accordance with WSDOT Standard Specifications 2-03.3 (14B and C) and using Method B (WSDOT, 2020). Some of the soils available for borrow within the project limits – due to their intrinsic plasticity and/or organic content – would be classified as *Waste* and therefore subject to the approval of the engineer before reuse in embankment fills.

We recommend that compaction criteria for structural fills, embankment fills, and trench backfills be based upon WSDOT Standard Criteria for road embankment fills. Embankment fills, structural fills, and backfills should be compacted to 95 percent of the material's maximum dry density (MDD) as determined by Standard Proctor, ASTM D698. Landscape fills and nonstructural berms should be compacted to approximately 85 percent MDD.

Problems associated with meeting compaction specifications are most often directly associated with lift thickness, compaction equipment being employed, and application of moisture to the backfill material. Addition of water to dry granular backfill prior to its placement into excavations, use of heavy vibratory plate compactors, as well as maintaining lift thickness to less than 8 or 16 inches (thickness dependent upon actual compaction method), will typically result in satisfactory backfill density and minimize issues associated with backfill settlement.

In order to achieve acceptable levels of compaction, it is generally desirable to maintain moisture contents of typical Borrow soils to within the range of three to four percent of the optimum moisture content. Some site soils used as common borrow may require drying in accordance with the aeration requirements of the WSDOT Standard Specifications, Section 2-03.3(15).

Structural fills or embankment fills placed over ground with slopes in excess of 5H:1V should be keyed and benched into existing slopes. Seeps encountered during grading on sloping ground should be intercepted via area drains. Outfalls for such drains should be routed to the toe of such slopes and should not be allowed to drain freely over slopes. Area drains are typically field-designed on a case-by-case basis. Usually, seeps will be intercepted via 6-inch perforated drain pipes surrounded by clean crushed rock or drain-rock fill and design to drain by gravity flow to the storm water system.

Gabion Compaction: Compaction of gabion stone within constructed baskets should be performed in accordance with WSDOT Standard Specifications, Section 8-24.3(3)E.

8.4 Permanent Slopes and Erosion Control

Final fill and excavation slopes should not exceed finished gradients of 2H:1V. Cut and fill slopes should be protected immediately from erosion following completion of grading. Erosion protection can consist of placement of jute mesh and seeding with erosion-resistant vegetation or other engineer-approved erosion control methods. Water should not be allowed to flow over slope faces but should be collected and routed to storm water disposal systems. Rip-rap, gabion baskets, or similar erosion control methods may be necessary to reduce water velocity in ditches. Silt fences should be established and maintained throughout the construction period. Silt fence barriers should be established downslope from all construction areas to protect natural drainage channels from erosion and/or siltation. To decrease erosion potential, care should be taken to maintain native vegetation and organic soil cover in as much of the site as possible.

8.5 Trenching and Excavations

Based on our understanding of the project scope, we do not anticipate that substantial trenching or excavations below the water table will be required. If excavation below the water table are required, please contact us for dewatering recommendations. Our experience in the area indicates that attempting to excavate below the groundwater table without dewatering could lead to sidewall caving, project delays, significant increases in bedding and backfill quantities, and the possibility of heaving soil within trench base areas. Groundwater depths and the permeability of native soils below the groundwater table may preclude a typical "low-tech" (sumps or small pumps) approach to trench dewatering.

Subgrade soil at the base of trenches and excavations should be firm or dense prior to the placement of bedding or base material. The base of trenches and excavations should also be free of mud and muck and should be sufficiently stable to remain firm and intact under the feet of the workers. Where necessary, a layer of clean gravel should be placed at the base of excavations of sufficient strength and thickness to withstand subsequent construction activity; this will require installation below the specified subgrade elevation and thus will entail additional excavation below design subgrade elevations. Base stabilization gravel should consist of gravel material (1-inch or 3/4-inch [minus] crushed rock material containing less than six or seven percent fines content by weight). Fines are defined as silt- or clay-sized soil particles that pass a standard No. 200 sieve.

If projected temporary excavation slopes result in the excavation infringing upon adjacent structures, pavements, or utilities, excavation shoring will be required (Note: this projected line is not intended to preclude trench and excavation shoring requirements necessary to meet OSHA requirements). In these cases, it is possible that cantilever or braced shoring may be necessary to limit the excavation size. For these instances, we have provided recommendations for the design of this shoring.

Shoring Deflection. Numerous studies have shown that shoring pressures are directly related to lateral movement of the shoring. An average lateral deflection at the top of a wall of approximately 1/1,000 of the wall height should be adequate to mobilize the internal soil strength, thereby reducing the total lateral pressure to a semi-active state of stress (conventional design approach). With this level of deflection, the stress is distributed in a roughly parabolic shape, normally approximated as a rectangle. If lateral deflections are allowed to increase to within the range of 1/150 to 1/75 of the wall height, the pressure distribution starts to become triangular, with the greatest stress at the bottom of the wall. Quality construction procedures usually result in shoring deflections less than this.

Vertical deflections (settlements) immediately behind the wall may approach 2 to 3 inches, with settlements dissipating further from the wall. This assumes that good construction procedures are used. If unfilled voids are left behind the wall, or if walls are allowed to slough or cave before lagging is installed, the settlements can be far greater.

Design Shoring Pressures. Cantilever shoring should be designed for a triangular lateral earth pressure derived from an equivalent fluid weight of 37 pcf (Note: this is from soil load only; soil stockpiles, footing loads, etc. will result in additional lateral load effects upon shoring walls). Braced excavations should be designed for a uniform (rectangular) lateral earth pressure of H X 26 pcf, where H is the depth of the excavation in feet. These shoring pressures represent our best estimate of actual pressures that may develop against the shoring and do not contain a factor of safety. Adequate factors of safety must be incorporated in the design method.

These design pressures do not include seismic effects due to the low probability of a major seismic event occurring during the relatively short construction period.

Soldier Piles. Soldier piles must be designed for bending, vertical loads, and for passive kick-out at the pile toe. Toe kick-out can be resisted by passive pressure against the base of the pile. For a horizontal ground slope at the base of the wall, passive pressures may be designed as a 425 pcf equivalent fluid weight. In the case of isolated soldier piles (center-to-center spacing greater than three pile diameters), these pressures may be applied to a width equal to three pile diameters. This pressure is our best estimate of actual pressures that can be developed and does not contain a factor of safety. We recommend using a safety factor of at least 1.5 in design against kick-out. Apex should be consulted for review of contractor-designed soldier pile shoring walls.

Trench Excavation Backfill. In order to minimize the potential for post-construction backfill settlement, we recommend that all backfill within road alignment areas or other settlement-sensitive areas consist of clean, imported granular fill. Compaction standards using Standard Proctor values are provided in section 8.3 above.

8.6 Proposed Culvert Structure

Based on our understanding of the project, our exploration data, and review of likely foundation grades, we anticipate that the arch culvert will be founded on native soil deposits. The likely foundation-bearing soils consist of dense to very dense, silty gravel with sand. But if soft or otherwise unsuitable soils are encountered at foundation level or below, they should be removed and replaced with compacted crushed rock.

A steel arch culvert is proposed to replace the existing concrete pipe as per the 60% drawings (Clark County / AECOM, 2020). Based on the soil conditions encountered during our exploration program, we anticipate that foundation settlements will not exceed 1 inch if founded directly on native soils as anticipated. An allowable bearing pressure of 3 kips per square foot (ksf) should be used in culvert design.

Soil Surcharge: The arch culvert should be designed to accommodate the soil loading above the arch. We recommend using a soil unit weight of 125 pounds per cubic foot (pcf) for compacted soils above the culvert. In accordance with Chapter 12 of the AASHTO LRFD Specifications (AASHTO, 2017), this value should be adjusted for soil arching effects by a factor of 1.056 (VAF factor). So 132 pcf should be used to calculate the unfactored vertical soil load on the top of the structure. A load factor of 1.3 should be applied to the calculated vertical soil load In accordance with Table 3.4.1-1 of the AASHTO LRFD Specifications.

Foundation bearing surfaces should be prepared by proof rolling the exposed subgrade under the observation of the geotechnical engineer. Foundation bearing surfaces should not be exposed to standing water.

8.7 Retaining Walls

Concrete headwalls will support the upstream and downstream ends of the culvert and will extend beyond to the north and south as wing walls. Beyond the wing walls to the north, gabion walls will be constructed high up on the slope.

Our recommended parameters for use in designing gabion or concrete walls are included in the following table.

Retaining Wall Design Parameters

Parameter	Symbol	Units	Value
WSDOT Gravel Backfill for Walls			
Backfill Unit Weight	γ	Pcf	130
Backfill Friction Angle	φ	Degrees	36
Active Lateral Earth Pressure Coefficient (Coulomb with Friction)	K_a	-	0.3
Active Lateral Earth Pressure Coefficient – Ascending Slope	K_a*	-	0.43
Native Silty Gravel Foundation Soils			
Foundation Soils Unit Weight	γ	Pcf	125
Foundation Soils Friction Angle	φ	Degrees	34
Base Sliding Coefficient (Ultimate) – Concrete Wall	δ	-	0.45
Base Sliding Coefficient (Ultimate) – Gabion Wall	δ	-	0.55
Allowable Bearing Capacity for Footings Embedded at Least 2 feet	Q_{all}	Psf	3,000
Passive Lateral Earth Pressure Coefficient (unsaturated)	K_p	-	3.4
Passive Lateral Earth Pressure Coefficient – Descending Slope	K_p*	-	1.4

Note that lateral pressures (active and passive) will change depending on presence of a slope above and below walls. Walls should be designed to accommodate a differential settlement of ½-inch per 20 feet of wall length.

Gabion walls should be designed and constructed in general accordance with WSDOT Standard Specifications Sections 8-24.3(3) and 9-27.3, and the soil parameters in the table above. The designer is responsible for internal stability including sliding and overturning, and we have checked for global stability of the gabion wall systems shown on the 60% drawings. We are satisfied the wall design meets required factors of safety for static and seismic global slope stability.

Seismic Loading. Lateral earth pressure acting on retaining walls should be increased to account for seismic loading. The peak horizontal acceleration for a seven-percent-in-75-years event is 0.34g. We recommend using a design horizontal acceleration coefficient of K_h = 0.17g (equal to 1/2 of the peak horizontal ground acceleration). We evaluated seismic loads on retaining walls using Mononabe-Okabe methods. Seismic incremental loading of $7H^2$ lb per foot of wall should be added to the static active earth pressure, with its resultant acting at a point 0.33H from the bottom of the wall (Sitar *et al.*, 2012). This loading assumes a level backslope.

Drainage.

Concrete Walls: Backfill behind walls should consist of gravel or crushed rock that meets the criteria for WSDOT Standard 9-03.12(2), Gravel Backfill for Walls. Retaining wall designs should feature a full-height drainage layer and conveyance system to eliminate hydrostatic pressures. At the foundation level, a 4-inch diameter perforated pipe should be wrapped in clean drain rock (WSDOT 9-03.12(4)) and a nonwoven geotextile for filtration and separation. Or alternatively, conveyance can be assisted with the use of weep-holes.

Gabion Walls: These walls are free draining so the only additional drainage necessary is a geotextile behind the wall for separation. We recommend using a non-woven separation geotextile in accordance with Table 3 in WSDOT Standard Specifications 9-33.2(1).

Quality Assurance. As with culvert foundations, we should be retained to evaluate the prepared retaining wall foundation subgrades prior to placing concrete forms, steel reinforcement, or gabion baskets. Gabion foundations will likely be within existing fill soils, so these site evaluations are particularly important. During our visits, subsurface conditions observed will be compared with those encountered during the exploration program, verifying our geotechnical design and construction recommendations.

9.0 Closing

This report presented our geotechnical engineering evaluation and recommendations for the proposed project. We trust this report meets your needs. If you have any questions, or if we can be of further assistance, please call. We look forward to working with you in the future.

10.0 References

American Association of State Highway and Transportation Officials (AASHTO), 2017. *LRFD Bridge Design Specifications, 8th Edition*.

Clark County Public Works and AECOM, *Mason Creek Barrier Improvements, Plans for the Construction of Roadway and Culvert Replacement*, 60-percent design plans, dated April 20, 2020, 25 pgs.

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Howard, K.A., 2002, *Geologic Map of the Battle Ground 7.5-Minute Quadrangle, Clark County, Washington*", USGS Miscellaneous Field Studies MF-2395, map scale 1:24,000.

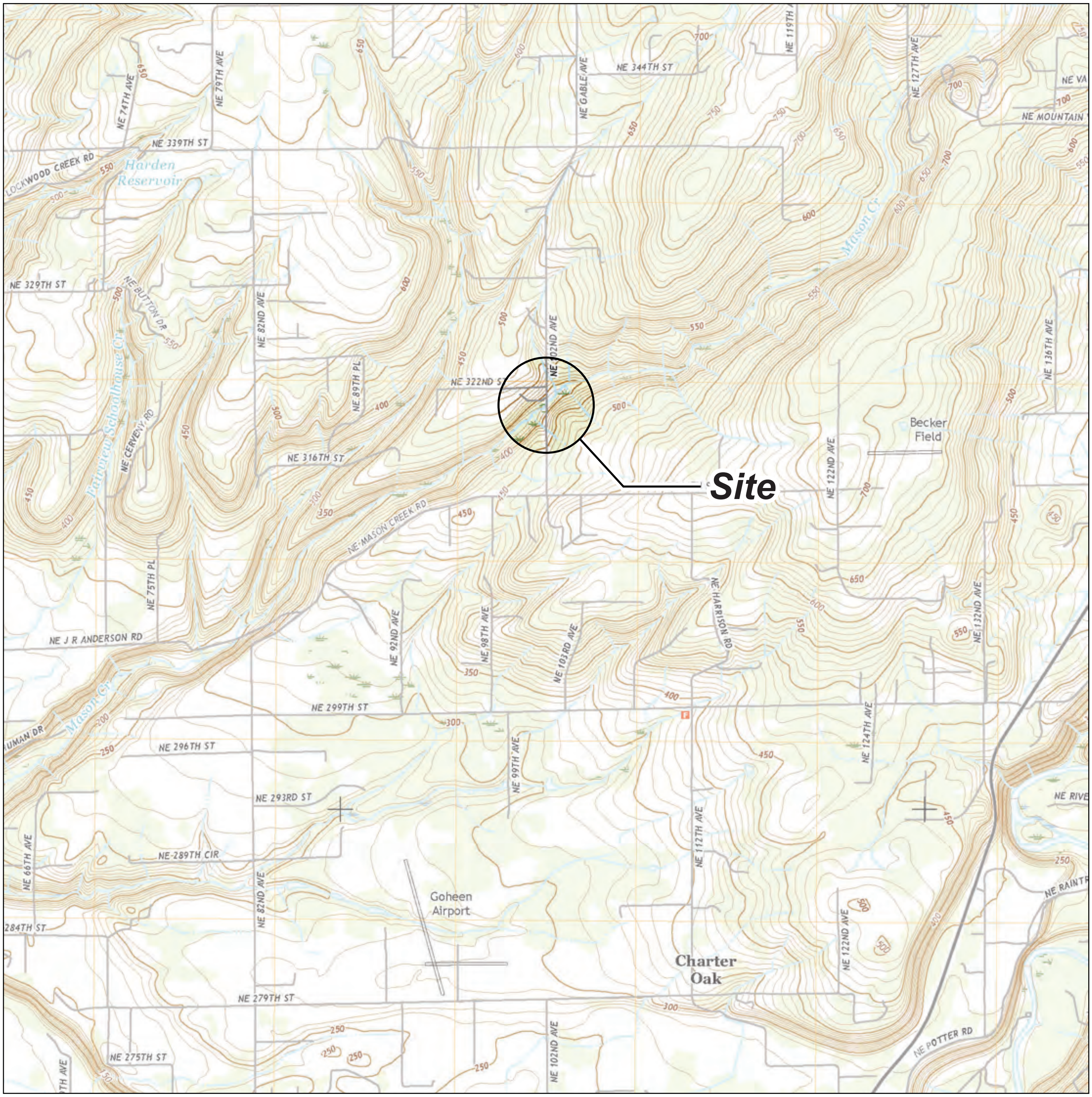
National Resources Conservation Service (NRCS), 2011, *Web Soil Survey*, website accessed December 23, 2019, https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

Sitar, N., Mikola, R.G., and Candia, G., 2012, *Seismically Induced Lateral Earth Pressures on Retaining Structures and Basement Walls*, published in GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering, March 2012, Oakland, CA, pp. 335-360.

U.S. Geological Survey, 2006, *Quaternary fault and fold database for the United States*, website: http://earthquake.usgs.gov/hazards/qfaults/.

Washington State Department of Transportation (WSDOT), 2019, *Geotechnical Design Manual*, Publication No. M46-03.12, dated July 2019, 896 pgs.

WSDOT, 2020, *Standard Specifications for Road, Bridge, and Municipal Construction 2020* (WSS), Publication No. M41-10.



Note: Base map prepared from USGS 7.5-minute quadrangle of Battle Ground, WA, dated 2017 as provided by USGS.gov.

0 2,000 4,000
Approximate Scale in Feet

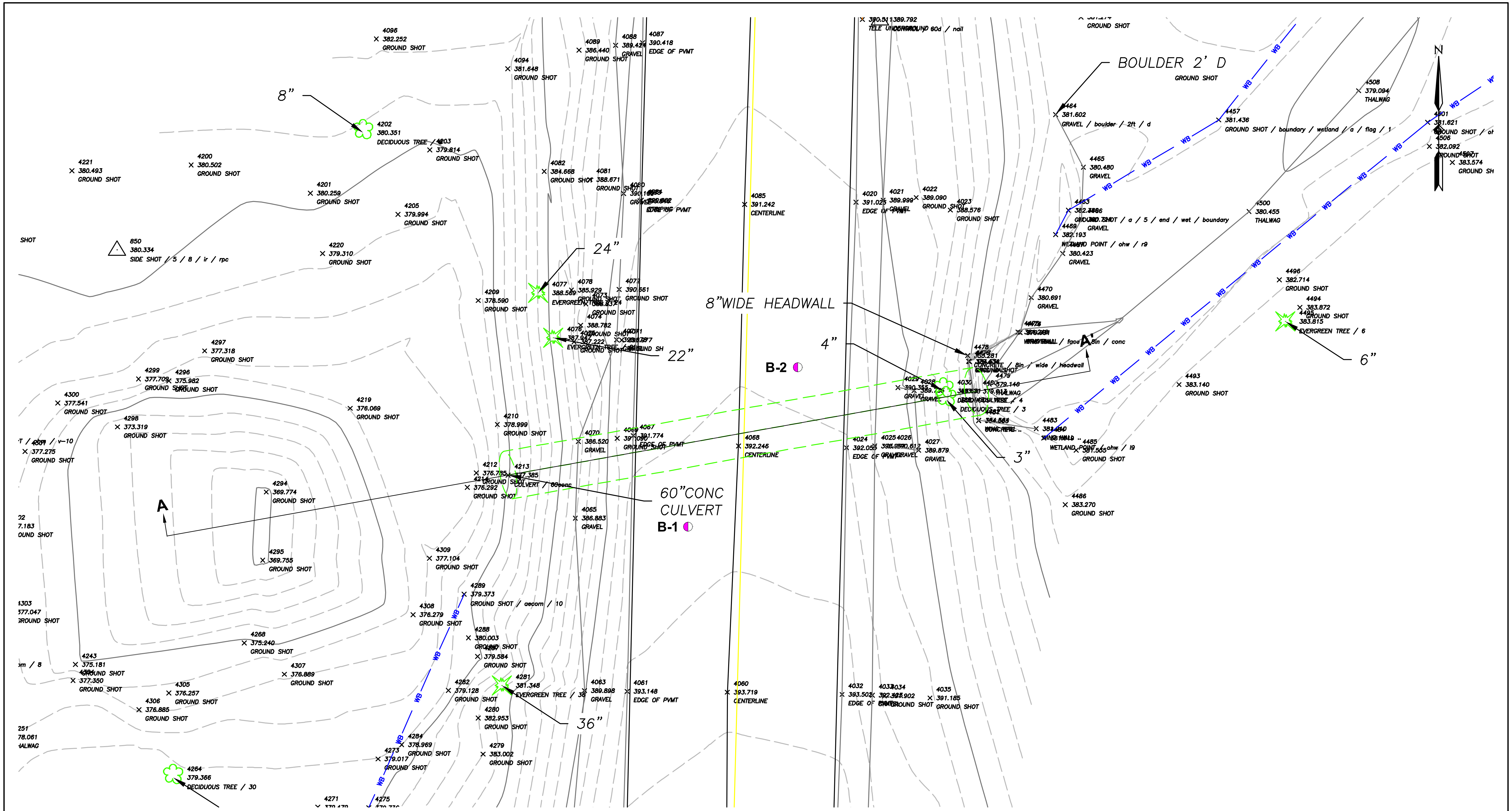
N

Site Location Map

Clark County
Mason Creek Culvert
Battle Ground, Washington

APEX GEOTECHNICS

Project Number	2530-01	Figure
December 2019		1



Legend:

B-1 ◐ Boring Location

A **A'** Cross-Section Location

Base map prepared from 0000287-MasonCreek-Topo-Oct2019.dwg

0 10 20

Scale in Feet

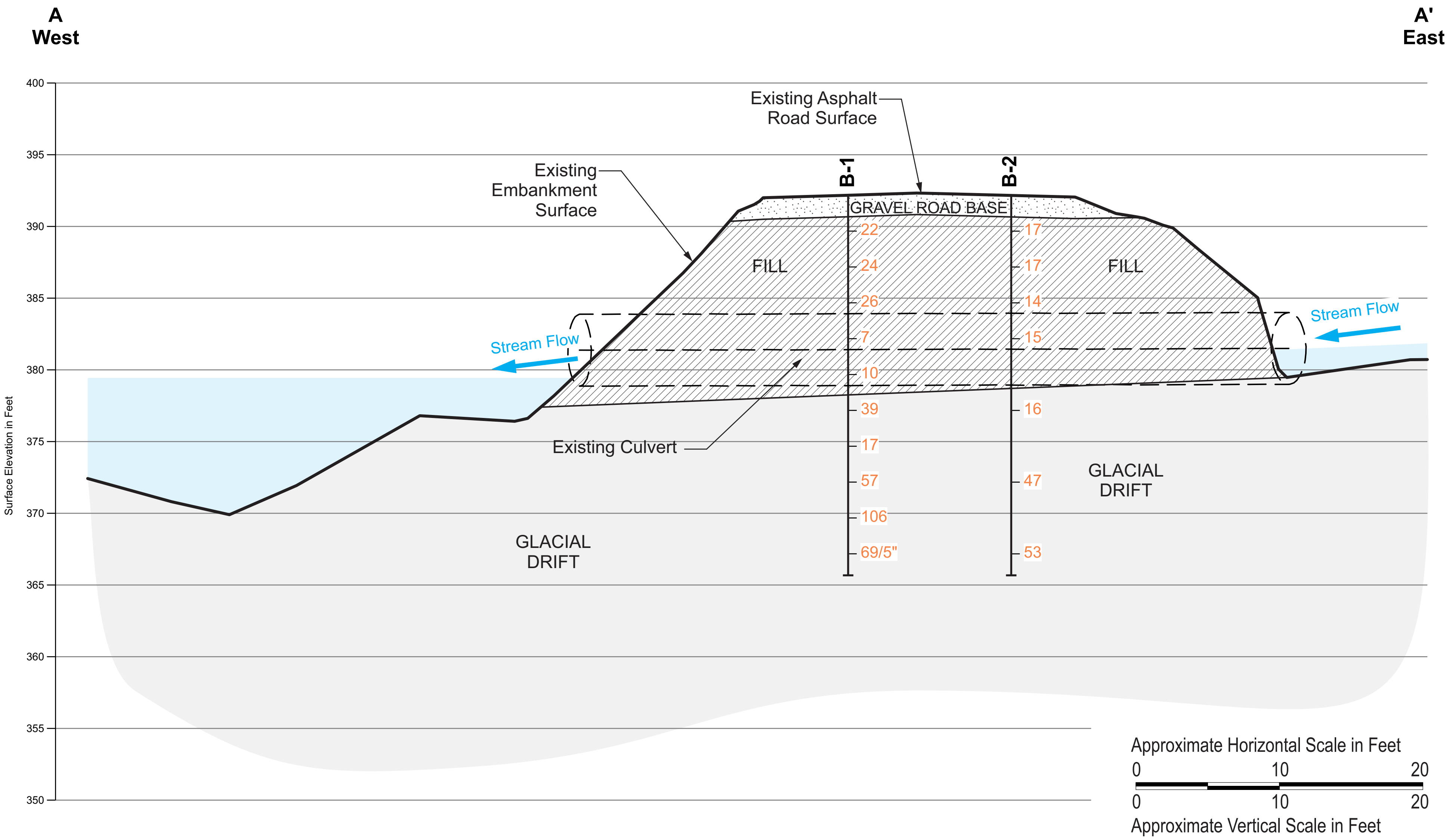
Site Plan

Clark County
Mason Creek Culvert
Battle Ground, Washington

APEX GEOTECHNICS

Project Number	2530-01
December 2019	

Figure
2



Legend:

B-1 Boring Location

10 SPT Values Corrected to N60*

NOTE: *Auto-hammer on drill rig had a hammer energy ratio of 83% and a calibration factor of 1.383. Based on "Report of SPT Hammer Energies" by GeoDesign, Inc., dated January 7, 2019.

Cross-Section A-A'

Clark County
Mason Creek Culvert
Battle Ground, Washington

APEX
GEOTECHNICS

Project Number	2406-00	Figure
December 2019		3

Appendix A

Field Exploration and Laboratory Testing

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, and grain size, and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
MAJOR CONSTITUENT with additional remarks; color, moisture, minor constituents, density/consistency.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and Geoprobe® explorations is estimated based on visual observation and is presented parenthetically on test pit and Geoprobe® exploration logs.

SAND and GRAVEL Density	Standard Penetration Resistance in Blows/Foot
Very loose	0 - 4
Loose	4 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	>50

SILT or CLAY Density	Standard Penetration Resistance in Blows/Foot
Very soft	0 - 2
Soft	2 - 4
Medium stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	>30

Moisture

Dry	Little perceptible moisture.
Sl. Moist	Some perceptible moisture, probably below optimum.
Moist	Probably near optimum moisture content.
Wet	Much perceptible moisture, probably above optimum.

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Sampling Symbols

BORING AND PUSH-PROBE SYMBOLS

☒	Split Spoon
⧄	Sonic
⧅	Tube (Shelby, Push-Probe)
▥	Cuttings
◫	Core Run
*	No Sample Recovery
SSA	Solid Stem Auger
HSA	Hollow Stem Auger
MR	Mud Rotary

TEST PIT SOIL SAMPLES

☒	Grab
⧄	Bag
⧅	Shelby Tube

Key to Exploration Logs

Clark County
Mason Creek Culvert
Battle Ground, Washington

APEX GEOTECHNICS

Project Number 2530-01
December 2019

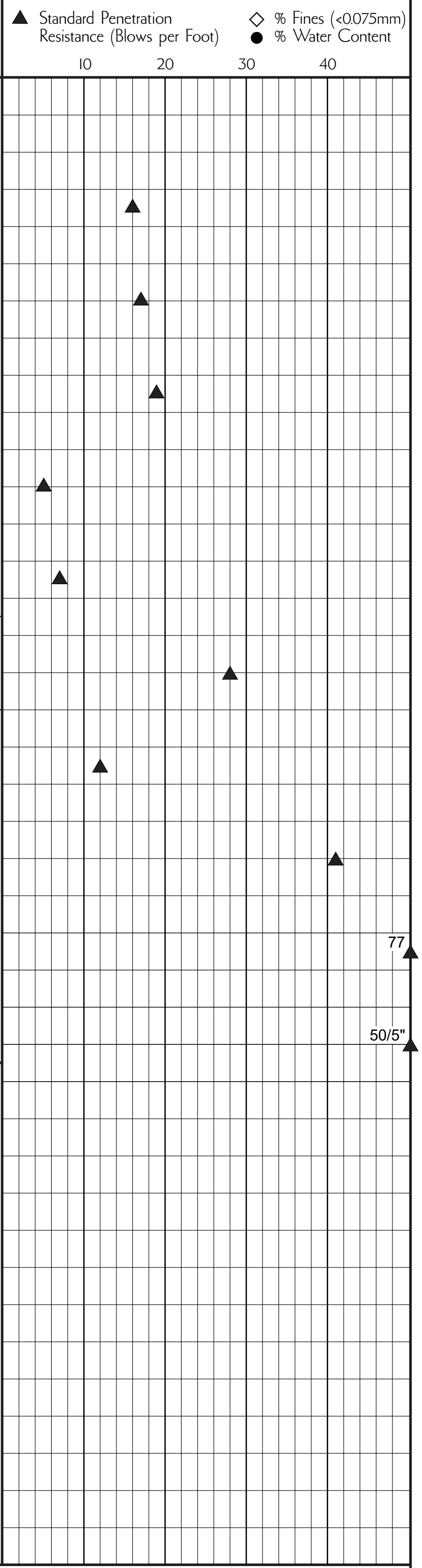
Figure
Key

Clark County
Mason Creek Culvert
Battle Ground, Washington

Boring Number: **B-1**
Project Number: **2530-01**
Logged By: J. Munsey
Date: December 6, 2019
Site Conditions: --
Drilling Contractor: Western States Soil
Drilling Equipment: CME75HT
Sampler Type: Split Spoon, Mud Rotary
Depth to Water (ATD): --
Surface Elevation: 392.2'

Depth, feet	Sample ID	Sample	Liquid Limit	Plastic Limit	Pocket Pen/Torvane (t.s.f.)	N60	Lithologic Description
							Asphalt cover (6") over base gravel (12").
		☒				22	SILT with sand and gravel (ML); medium brown mottled black, gray, and reddish brown, very moist, non-plastic, very stiff.
5		☒				24	**FILL**
		☒				26	Poor recovery. Some dark gray organic silt; organic odor.
10		☒				7	Gravelly SILT (ML); very dark grayish-brown mottled black, moist, non-plastic, medium stiff, trace organics and gravel.
		☒				10	Sandy SILT (ML); gray, moist, medium stiff. Some fine gravels. Some organics; organic odor.
15		☒				39	Silty GRAVEL with sand (GM); medium brown mottled dark reddish brown and black, wet, well graded, medium dense, well rounded.
		☒				17	Sandy SILT (ML); gray mottled reddish brown, moist, non-plastic, stiff. Fine-grained sand fraction.
20		☒				57	SILT with sand and gravel (ML); medium brown, moist, non-plastic, hard, weathered, semi-lithified.
		☒				106	
25		☒				69/5"	Becomes bluish gray.
							Bottom of Boring at 26.5' BGS.
30							
35							

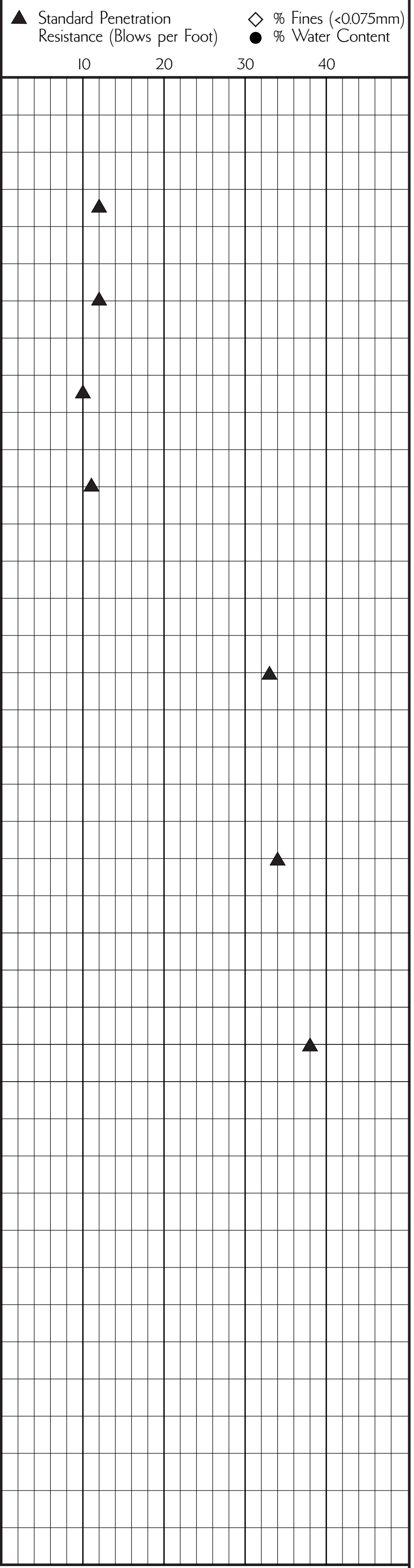
Note: SPT values corrected to N60. Auto-hammer on drill rig had a hammer energy ratio of 83% and a calibration factor of 1.383. Based on "Report of SPT Hammer Energies" by GeoDesign, Inc., dated January 7, 2019.



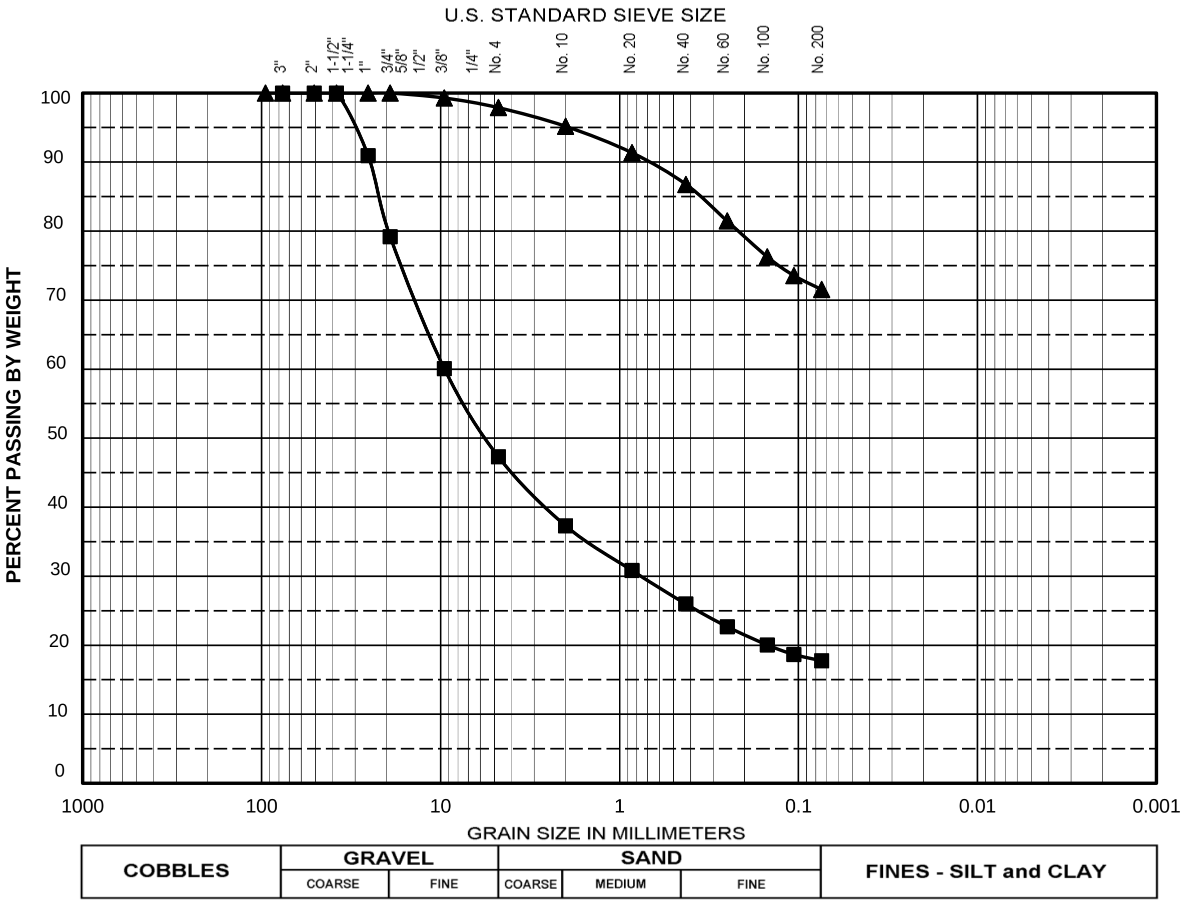
Clark County
Mason Creek Culvert
Battle Ground, Washington

Boring Number: **B-2**
Project Number: **2530-01**
Logged By: J. Munsey
Date: December 6, 2019
Site Conditions: --
Drilling Contractor: Western States Soil
Drilling Equipment: CME75HT
Sampler Type: Split Spoon, Mud Rotary
Depth to Water (ATD): --
Surface Elevation: 392.2'

Depth, feet	Sample ID	Sample	Liquid Limit	Plastic Limit	Pocket Pen/Torvane (t.s.f.)	N60	Lithologic Description
							Asphalt cover (6") over base gravel (12"). SILT with sand (ML); brown mottled gray, black, and reddish brown, very moist, non-plastic, stiff. Some gravel.
		☒				17	**FILL**
5		☒				17	Becomes reddish brown mottled black.
		☒				14	
10							Zones of organics, with organic odor.
		☒				15	Becomes SILT (ML); dark brown, moist, non plastic, stiff.
							Hard drilling. Silty GRAVEL with sand (GM), medium brown mottled dark reddish brown and black, wet, well graded, dense, well rounded.
15		☒				46	1.5-foot-diameter boulder encountered.
20		☒				47	
							Silty SAND (SM); medium brown, wet, poorly graded.
							Sandy SILT (ML) to SILT with sand and gravel (ML); medium brown, moist, non-plastic, hard, semi-lithified.
25		☒				53	
							Bottom of Boring at 26.5' BGS.
30							
35							



Note: SPT values corrected to N60. Auto-hammer on drill rig had a hammer energy ratio of 83% and a calibration factor of 1.383. Based on "Report of SPT Hammer Energies" by GeoDesign, Inc., dated January 7, 2019.



Symbol	Sample Location	% MC	% Gravel	% Sand	%Fines	Classification
■	B-1/B-2 ; @ 15.0' - 16.5'ft	21.1	53	30	18	Silty GRAVEL with Sand (GM)
▲	B-2 ; @ 7.5' - 11.5'ft	32.3	2	26	72	SILT with Sand (ML)

Grain Size Distribution determined in accordance with ASTM D-6913

GRAIN SIZE DISTRIBUTION

Mason Creek Culvert
Battle Ground, Washington

Project No. 2530-01

Figure A1