HENDERSON BLVD APARTMENTS & PRELIMINARY PLAT

TUM #23-0604

Preliminary Drainage Report

Prepared for: **Allito Properties**
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Report Date: **January 24, 2025**

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Project No: 16-036

Project Name: HENDERSON BLVD APARTMENTS
H:\Office\JOBS\2016\16-036 Henderson Blvd Residential Subdivison\LAND USE\Reports & Calculations\DRAINAGE

I hereby state that this Preliminary Drainage Control Plan for, Henderson Blvd Apartments & Preliminary Plat located at 7501 Henderson Blvd SE, Tumwater, WA 98501, Thurston County, Washington, has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the CITY OF TUMWATER does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Signature

1/27/25

Date

Seal

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DRAINAGE REPORT

Section 1 – Project Description

The Henderson Blvd Apartments and Preliminary Plat project is located northwest of the intersection of Henderson Boulevard SE and Trails End Drive SE in the City of Tumwater in Section 11, Township 17, Range 2 West, W.M. on tax parcel number 12711110300. The project proposes to construct an 11-lot plat comprised of 9.22 acres zoned Multi-Family Medium Density Residential (MFM) and 10 town home lots. The development will have approximately 54,000 sf of building area, 6,750 sf covered parking area, 158,200 sf of hard surfaces (Sidewalk, pavement and frontage improvement along the Henderson Blvd. SE) with 167 apartment parking stalls. The current assessed value of the parcel is $290,100. See proposed Site Plan on Page 3.

The proposed project will require grading, encroachment, building, and utility permits. Water and sewer will be provided via connections to the City of Tumwater's utilities. Zoning for the property is Medium Density Residential (MFM).

Stormwater runoff from the developed site will be 100% infiltrated in three different types of infiltration facilities, one trench and two ponds. Runoff from the on-site parking, sidewalks, and landscaping will be collected by catch basins and piped to a BioPod (Ecology Emerging Technology) and then an infiltration basin (Ecology BMP T7.10). All of 'A' Road and a portion of Henderson Blvd along with town homes will be routed to a second BioPod for treatment and then an infiltration trench (Ecology BMP T7.20). 'B' Road and the remainder of Henderson Blvd frontage will be routed to a third BioPod and then to an infiltration basin (Ecology BMP T7.10).

The basin areas are described below. Reference attached Basin Map on page 5

On-Site Basin includes apartment parking, sidewalks, and landscaping. This basin is assigned as Onsite Basin in WWHM.

West Basin ('A' Road and Townhomes) consists of the townhomes, runoff from 2 apartment building roof areas, 'A' Road and a portion of Henderson Blvd. This basin is assigned as the West Basin in WWHM.

Offsite Basin: 'B' Road and balance of Henderson Blvd. assigned in WWHM as Offsite Basin.

By Pass Basin: Northerly area composed of wetland buffer, totaling 1.43 acres. This basin will remain undisturbed and therefore excluded from pre- developed and post- developed WWHM analysis.

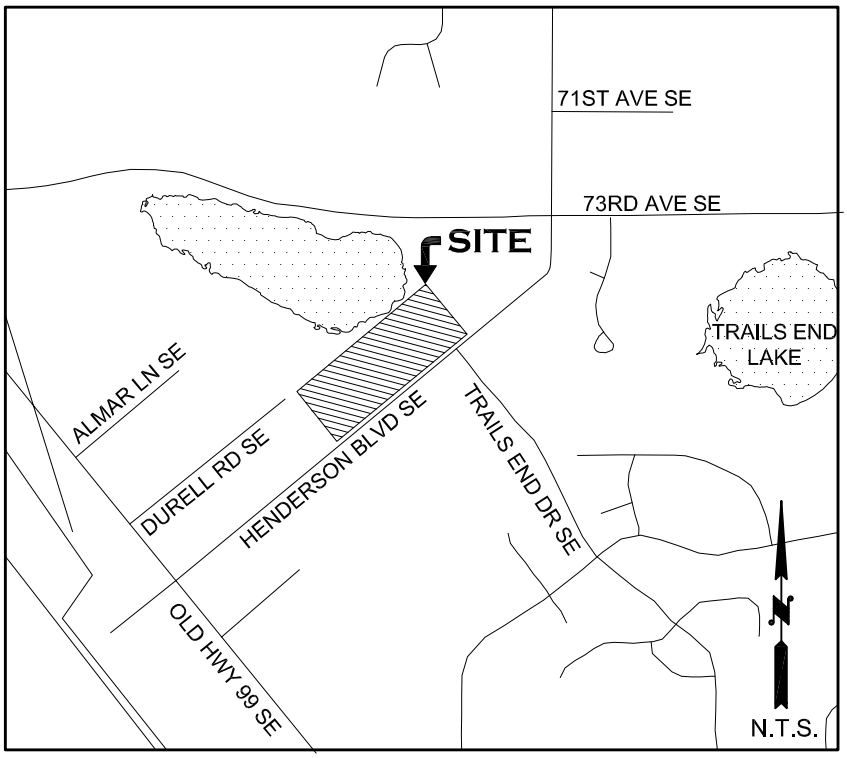
*Table 1.1 - Area Summary All areas measured in acres					
Pre-Developed	**Pre-Developed**		**Off-site**		**Total**
Forest (A/B Flat)	9.22		0.26		9.48
Existing Road	-		0.25		0.25
Total	9.22		0.51		9.73
100-Year Pre-Developed Flow Rate	0.48 cfs				
Developed	**Onsite Basin**	**West Basin (A Road & Townhomes)**	**Offsite Basin**	**Bypass Basin****	**Total**
Roof (Including Garages)	0.78	0.61	-	-	1.39
Sidewalk	0.41	0.09	0.18	-	0.68
Road	-	0.34	0.61	-	0.95
Parking (Drive Paths)	1.90	-	-	-	1.90
Driveway	-	0.10	-	-	0.10
Pond	0.26	-	0.14	-	0.40
Landscape (Pasture A/B)	1.95	0.45	0.47	-	2.87
Forest (A/B Flat)	-	-	-	1.43	1.43
Total	5.30	1.59	1.40	1.43	9.72
100-Year Developed Flow Rate	100% infiltration				0.0 cfs

*Area in this table contains rounding errors.

**1.43 Acres is the wetland buffer area remaining undisturbed and excluded from developed WWHM analysis.

HENDERSON BLVD APARTMENTS

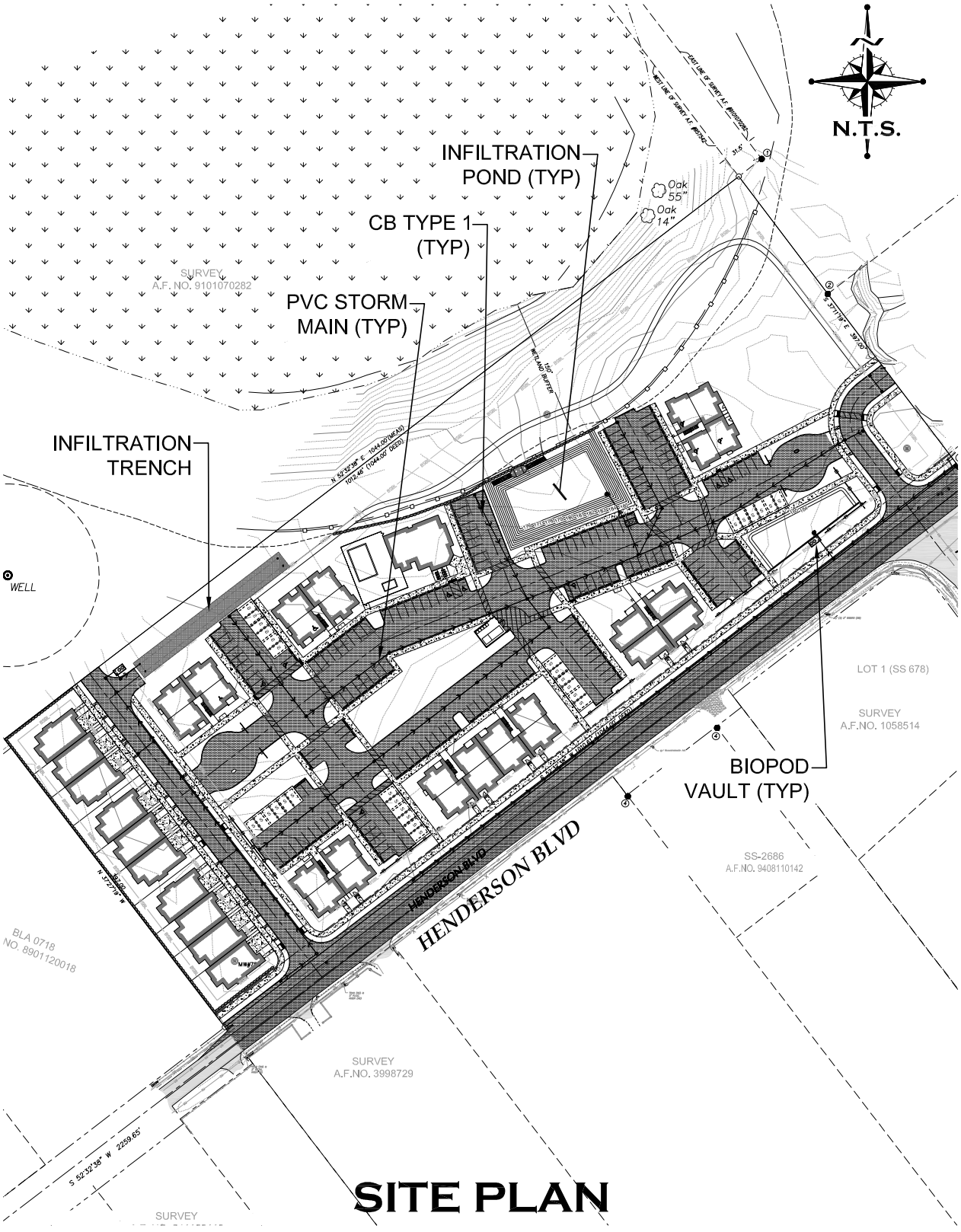
7501 HENDERSON BLVD SE, TUMWATER,WA 98501



VICINITY MAP

HENDERSON BLVD APARTMENTS

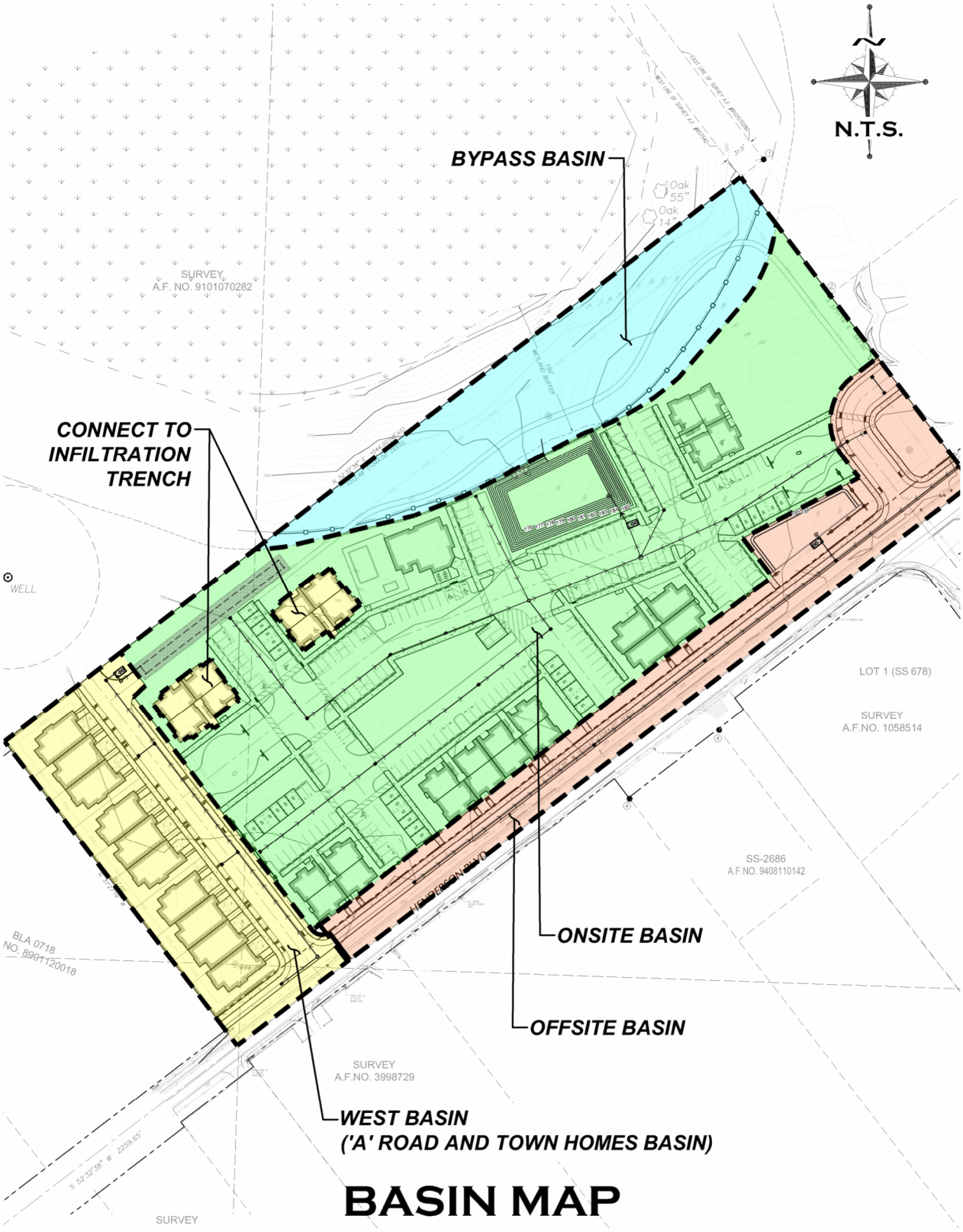
7501 HENDERSON BLVD SE, TUMWATER, WA 98501



SITE PLAN

HENDERSON BLVD APARTMENTS

7501 HENDERSON BLVD SE, TUMWATER, WA 98501



BASIN MAP

Table 1.2 – Schedule of Structures				
Catch Basin / Manhole Number	**Stationing *or* Northing / Easting**	**Street Name**	**Catch Basin / Manhole Type and Size**	**Connected Pipes Invert Elevation & Diameter**
To be provided with permit set.				

The City of Tumwater 2022 Drainage Design and Erosion Control Manual (DDECM) summarizes the thresholds which determine the applicability of the minimum requirements for each project. All new development projects are required to comply with Minimum Requirement #2; Construction Stormwater Pollution Prevention and Minimum Requirement #4; Preservation of Natural Drainage Systems and Outfalls. Table 1.3 summarizes the thresholds which trigger compliance with the remaining minimum requirements.

Table 1.3 – Thresholds for Minimum Requirement Applicability		
	Required to comply with Minimum Requirements #1 through #5 & #11	**Required to comply with Minimum Requirements #1 through #11**
≥ 2,000 ft^2 of new, replaced, or new + replaced hard surface area	X	
≥ 7,000 ft^2 land disturbing activity	X	
≥ 5,000 ft^2 new + replaced hard surface area		X
Converts ≥ 0.75 acre of vegetation to lawn or landscape		X
Coverts ≥ 2.5 acres of native vegetation to pasture		X

This project adds 218,950 square feet of impervious area including the frontage improvement along the Henderson Blvd. SE; therefore, all minimum requirements apply.

The applicable minimum requirements are:

- Minimum Requirement #1: Preparation of Stormwater Site Plans
- Minimum Requirement #2: Construction Stormwater Pollution Prevention
- Minimum Requirement #3: Source Control of Pollution
- Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
- Minimum Requirement #5: On-Site Stormwater Management

- Minimum Requirement #6: Runoff Treatment
- Minimum Requirement #7: Flow Control
- Minimum Requirement #8: Wetlands Protection
- Minimum Requirement #9: Operation and Maintenance
- Minimum Requirement #10: Financial Liability
- Minimum Requirement #11: Off-Site Analysis

Addressing these eleven minimum requirements, it is anticipated that the proposed project will have little or no adverse effects on the downstream and surrounding hydrology. Each of the minimum requirements is discussed below.

Minimum Requirement #1: Preparation of Stormwater Site Plans

The main components of Stormwater Site Planning are Construction Stormwater Pollution Prevention Planning and Permanent Stormwater Control Planning. This Drainage Report is submitted as part of the Henderson Blvd Apartments and preliminary plat review.

Minimum Requirement #2: Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (C-SWPPP) addresses erosion and sediment control anticipated during construction. A Construction NPDES permit will be obtained prior to construction. The C-SWPPP will address all thirteen elements as required by the Department of Ecology, and will be submitted with permit drawings at final design.

Minimum Requirement #3: Source Control of Pollution

Source control BMPs are used to prevent stormwater from coming in contact with pollutants and are used as a cost-effective means of reducing pollutants in stormwater. The selection of permanent source control BMPs is based on the activities likely to occur on the site and the pollutants associated with those activities.

Methods to address source control of pollution from the post-developed project site will be provided in the Maintenance and Source Control Manual to be submitted as part of the final permit level Drainage Control Plan for this project.

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

Low-impact development techniques will be used to preserve existing site runoff patterns to the maximum extent feasible. In the existing condition, stormwater runoff from the site sheet flows from Henderson Boulevard SE to the northwest. Runoff generated from proposed roof areas will be infiltrated onsite via an onsite infiltration trench sized per BMP LID.04. Runoff from the parking lot, sidewalks, frontage improvements and other associated impervious areas will be infiltrated in an infiltration basin BMP T7.10. Soil in the disturbed lawn/landscape areas will be amended per BMP LID.02 to increase treatment and infiltration capacity and to reduce runoff from the site. Stormwater runoff from the preserved native areas and wetland buffer of the project will continue to sheet flow onto adjacent properties, matching existing conditions.

Minimum Requirement #5: On-Site Stormwater Management

The 2022 DDECM summarizes the requirements for employing on-site stormwater management BMPs, providing treatment, and flow control in decision charts. This project proposes to satisfy Minimum Requirement #5 by meeting the LID Performance Standard as defined in the 2022 DDECM.

This project proposes implementing Postconstruction Soil Quality and Depth (Ecology BMP T5.13) in all new and disturbed lawn/landscape areas to retain greater stormwater functions, including increased infiltration potential and treatment of pollutants and sediments resulting from development. This project also proposes the use of BioPods (Ecology Emerging Technology) to treat stormwater runoff proposed frontage and site improvements. Roof basin does not require treatment. The roof and frontage improvements will be infiltrated in by infiltration galleries and infiltration trenches (Ecology BMP T7.20). The site basin will be infiltrated in an infiltration basin (Ecology BMP T7.10). The infiltration facilities will provide 100% infiltration of tributary stormwater runoff from the improvements. The combination of stormwater BMPs used for this project results in the site meeting the Low Impact Development Performance Standard as illustrated on page 23, of “Site Analysis” WWHM report. See attached report in Appendix 1.

Minimum Requirement #6: Runoff Treatment

Table 1.4 – Thresholds for Minimum Requirement #6: Runoff Treatment

	Required to Comply
< 5,000 sf of total effective pollution-generating hard surface (PGHS)	
≥ 5,000 sf of total effective pollution-generating hard surface (PGHS)	X
< ¾ acres of pollution-generating pervious surface (PGPS) from which there will be a surface discharge in a natural or artificial conveyance system from the site	
≥ ¾ acres of pollution-generating pervious surface (PGPS) from which there will be a surface discharge in a natural or artificial conveyance system from the site	X

Table 1.4 above summarizes the thresholds for construction of stormwater treatment facilities. This project will add approximately 158,200 PGHS including the frontage improvement along the Henderson Blvd. SE; therefore, treatment is required.

This project proposes to provide phosphorus and enhanced treatment by routing stormwater through BioPods. See further explanation of water quality facility sizing in Section 4 of this Drainage Report.

Minimum Requirement #7: Flow Control

Table 1.5 – Thresholds for Minimum Requirement #7: Flow Control	
	Required to Comply
< ¾ acres of native vegetation converted to lawn/landscape or < 2.5 acres converted to pasture from which there is a surface discharge in a natural or artificial conveyance system from the site	
≥ ¾ acres of native vegetation converted to lawn/landscape or ≥ 2.5 acres converted to pasture from which there is a surface discharge in a natural or artificial conveyance system from the site	X
< 10,000 sf of effective impervious area	
≥ 10,000 sf of effective impervious area	X
≥ 0.10 cfs increase in the 100-year storm flow frequency using 1-hour time steps or ≥ 0.15 cfs increase in the 100-year storm flow frequency using 15-minute time steps	X

Table 1.5 above summarizes the thresholds for achievement of the standard flow control requirement for Western Washington. This project will add 218,950 sf of effective impervious surface. Flow control is required.

This project proposes to provide flow control through the use of infiltration basin BMP T7.10 and infiltration trench (Ecology BMP T7.20). See further explanation of flow control facility sizing in Section 4 of this Drainage Report.

Minimum Requirement #8: Wetlands Protection

This project does not propose to discharge stormwater to a wetland. A Category III wetland is located to the north side of the property.

This project proposes to infiltrate 100% of tributary stormwater runoff from developed areas as well as the frontage improvement along Henderson Blvd. SE. Stormwater runoff generated from PGHS areas will be conveyed via catch basins and piping to BioPod treatment structures improving water quality. The delineated standard 150 ft wetland buffer will not be disturbed and will continue to flow to the wetland as in the predeveloped state. See the attached Critical Areas Report in Appendix 3.

Minimum Requirement #9: Operation and Maintenance

Proper operation and maintenance of proposed stormwater facilities is a vital component to the success of stormwater mitigation. A Maintenance and Source Control Manual as well as Operation and Maintenance Agreement will be prepared and submitted as part of the Drainage Control Plan for the Henderson Blvd Apartments and Preliminary Plat project at the time permits are submitted

Minimum Requirement #10: Financial Liability

Financial guarantees will be provided to ensure that:

1. The project will operate according to the design approved by the project engineer, and

2. Operation of erosion control facilities will provide protection against siltation of surface water, erosion, damage to permanent stormwater BMPs, and damage to adjacent properties.

Minimum Requirement #11: Off-Site Analysis and Mitigation

An off-site analysis was conducted to determine any potential water quality, erosion, slope stability, or drainage impacts that may be caused or aggravated by the proposed improvements. This project will provide 100% infiltration by using infiltration trenches (Ecology BMP T7.20) and two infiltration basins (Ecology BMP T7.10). See detailed analysis of off-site impacts in Section 3 of this report.

Section 2 – Existing Conditions Description

Section 2.1 Topography

The project area is relatively flat sloping to the northeast.

Section 2.2 Ground Cover

The existing ground cover consists of forest with a mix of fir and deciduous trees.

Section 2.3 Drainage

Drainage in the project vicinity is via sheet flow. Currently offsite flows to the site include the existing north half of Henderson Blvd SE and small areas along the existing southwest property line. No existing drains, channels, or swales within or immediately adjacent to the site were found.

Drainage currently exits from the site in a broad drainage way located approximately in the middle of the north property line that sheet flows through forested areas northerly to the wetland located to the north side of the property.

No flooding or erosion issues are known to exist in the project vicinity.

Section 2.4 Soils

The soils on site consist of Indianola loamy Sand type A soil and Nisqually loamy fine sand type B soil. Both soils are from sandy glacial outwash and are typically considered fast infiltrating. Indianola loamy sand (soil codes 046 and 047) predominates on the northeast side of the site and the Nisqually Sand (soil code 073) on the southwest side.

Soil logs and borings are reported in the soils report prepared by Quality Geo NW. See Appendix 3. Soil testing indicated the infiltration rate varies across the site. The soils report recommends a design infiltration rate of 10.18 in/hr in the proposed infiltration trench, and 9.03 in/hr in Site infiltration basin, and 5.17 in/hr for the off-site infiltration basin. In this preliminary design, a conservative rate of 4 in/hr has been used for sizing the infiltration facilities.

Ground water is estimated to be approximately 21.75 feet deep.

Section 2.5 Critical Areas

There is a wetland located North of the project that will be protected by a 150-foot buffer. The project is also located within a Category I critical aquifer recharge area as well as a 10-year time travel zone for a wellhead (Group A ID #0835901).

Section 2.6 Adjacent Areas

The adjacent properties consist of a mix of commercial, duplexes and undeveloped land.

Southwest mini storage (Airport Mini Storage).

Southeast commercial (Southgate fence), undeveloped, and duplexes.

Northeast – undeveloped.

Northwest – undeveloped with a wetland.

Section 2.8 Reports and Studies

Relevant reports and studies to the drainage in the vicinity of the project include.

WRIA 13 Watershed Plan (includes Deschutes Water Shed)
Deschutes Watershed Land Use Analysis funded by US Environmental Protection Agency
Deschutes Watershed Characterization Study
Henderson Blvd Apartments Geotechnical Investigation by Quality Geo NW revised 1/15/2025
Henderson Property Critical Areas Report by Enviro Vector June 27, 2023.
Tree Plan by Professional Forestry Services, Inc. December 5, 2024.

Section 2.9 – Wells and Septic Systems

Records at Thurston County and the Department of Ecology were searched to locate the presence of wells and septic systems that may be located within the setback distances from the infiltration trenches and infiltration basin. In addition, the Project Engineer, or someone under his/her direct supervision, has visited the site to verify the presence or absence of wells and septic systems as best can be done visually without trespassing onto other properties. All wells and septic systems found to be located within the setback distances from the stormwater facilities have been shown on the plans.

Section 2.10 – Fuel Tanks

Records at Thurston County and the Department of Ecology were searched in order to locate the presence of above and below ground fuel storage tanks that may be located within the setback distances from the infiltration trenches and infiltration basin. In addition, the Project Engineer, or someone under his/her direct supervision, has visited the site to verify the presence or absence of fuel tanks as best can be done visually without trespassing onto other properties. No fuel tanks were found to be located within setback distances from the stormwater facilities.

Section 2.11 – Analysis of 100-Year Flood

The Federal Emergency Management Agency prepares maps for all areas within Thurston County, including the incorporated cities therein. Panel #0282 depicts the areas, if any, subjected to flooding in the vicinity of this proposal. By inspection of this map, this proposal appears to be located in Zone X, an area of minimal flooding. This area, therefore, is not located within the 100-year flood plain.

HENDERSON BLVD APARTMENTS

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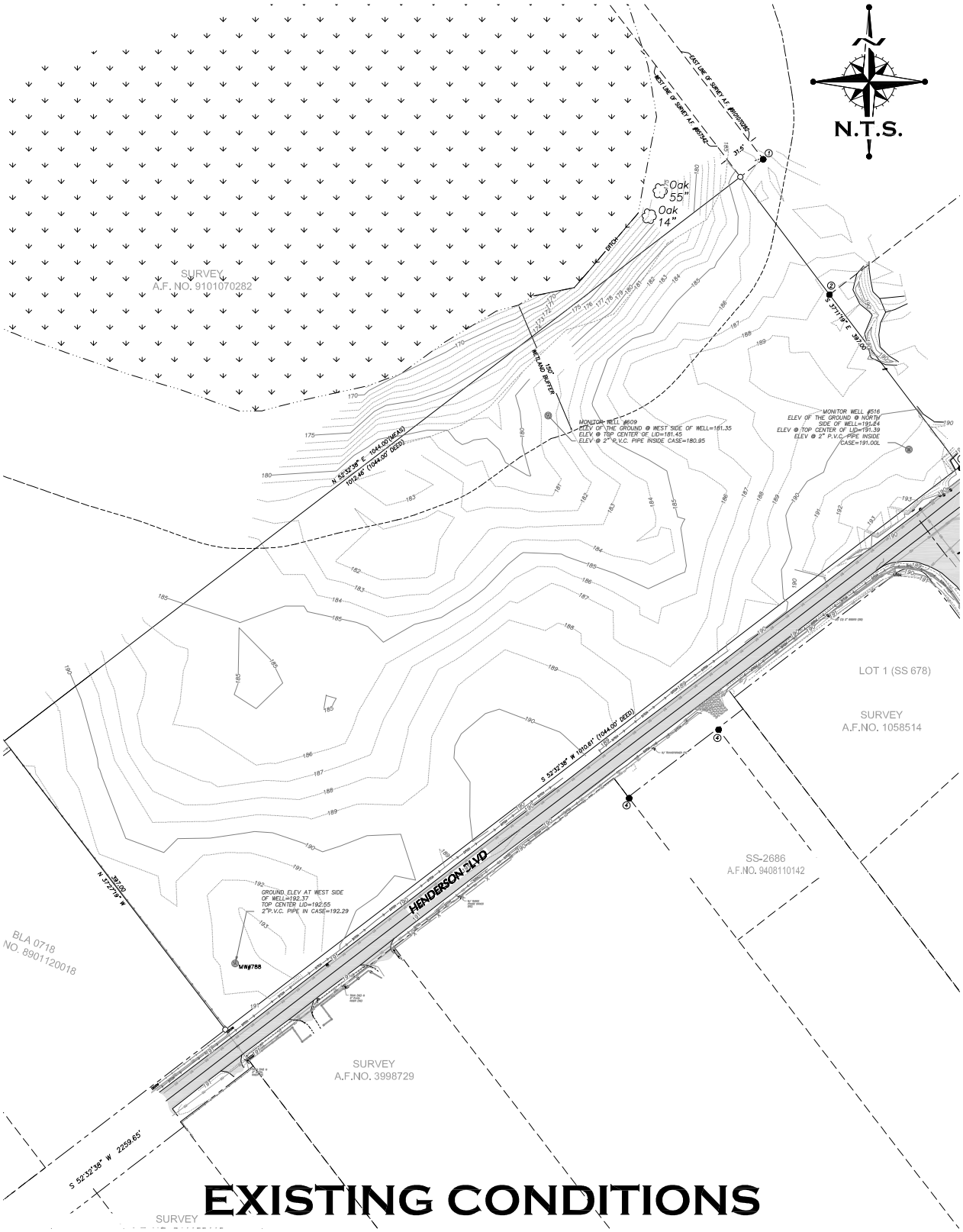


EXISTING CONDITIONS

Section 3 – Vicinity Analysis and Sub-Basin Description

Three basins were developed to model the site pre and post developed stormwater flow.

On-Site Basin consists of the parking, sidewalks and landscaping associated with apartment buildings. Runoff from this basin will be treated by BioPods and an infiltration basin for 100% infiltration.

West Basin (‘A’ Road and Town Homes) includes the public road improvements (‘A’ Road and a portion of Henderson Blvd SE), and the Townhomes. The Townhome impervious area is based on the preliminary plat.

Offsite Basin includes ‘B’ Road and balance of Henderson Blvd SE.

The only off-site tributary area is the northwest half of Henderson Blvd SE sheet flows on to the project and is included in the Henderson Blvd and Townhomes basin. Based on county Geodata mapping the contours along the Southwest and Northeast property lines are generally perpendicular to the property line. The area northwest of the site slopes away from the site and has no tributary areas.

As discussed in Section 2 – Existing Conditions Description the project is located within the 10-yr travel time of a Group A water source and located within a Critical Aquafer I area. No additional requirement for the conditions.

No conveyance systems are in the area. Stormwater generally sheet flows from Henderson Blvd SE across the site.

No known upland erosion or slope stability issues have been identified on the site.

Section 4 – Flow Control and Water Quality Facility Sizing

Table 4.1 – Onsite Basin (Infiltration Pond) Stage-Storage Table			
Storm Recurrence Interval	Stage (ft)		Storage (ac-ft)
	Depth	Elevation	
2-Year	0.92	176.92	0.13
5-Year	1.70	177.70	0.25
10-Year	2.35	178.35	0.37
25-Year	3.30	179.30	0.56
50-Year	4.12	180.12	0.74
100-Year	5.03	181.03	0.97

Table 4.3 – Offsite Basin (Infiltration Pond) Stage-Storage Table			
Storm Recurrence Interval	Stage (ft)		Storage (ac-ft)
	Depth	Elevation	
2-Year	1.63	185.63	0.004
5-Year	2.50	186.50	0.006
10-Year	3.12	189.12	0.011
25-Year	3.93	187.93	0.014
50-Year	4.55	188.55	0.019
100-Year	5.19	189.19	0.025

Flow Control Facility Sizing

This project generates more than 10,000 square feet of effective hard surfaces and is therefore required to provide flow control.

The project uses infiltration systems, and per Volume I, Section 2.4.8 of the 2022 DDECM; the site requires a Category B analysis. The infiltration systems include an infiltration basin or infiltration trenches. The townhomes impervious area is based on the preliminary plat map and combined with the runoff from a portion of Henderson Blvd and routed to a BioPod for treatment prior to infiltration in an infiltration trench (Ecology BMP T7.20). The off-site portion of Henderson Blvd and ‘B’ Road. The on-site parking and drive isles will be routed to a BioPod prior to the infiltration basin (Ecology BMP T7.10). All apartment buildings and storage building roof areas will be routed to downspout infiltration systems (Ecology BMP T5.10A)

WWHM was utilized to size the infiltration systems. A copy of the WWHM report is included in Appendix 1 showing 100% infiltration.

Water Quality Treatment Facility Sizing

This project generates more than 5,000 square feet of pollution-generating hard surfaces and is therefore required to provide stormwater runoff treatment.

All apartment buildings and storage buildings will be routed to infiltration trenches (Ecology BMP T7.20) and treatment not required for the roof areas.

The townhomes impervious area is based on the preliminary plat map and combined with the runoff from a portion of Henderson Blvd and Townhomes Basin and routed to a BioPod for treatment and discharged to infiltration trenches (Ecology BMP T7.20). The onsite parking and drive isles will be routed to a BioPod prior to the infiltration basin (Ecology BMP T7.10) and the frontage improvements for the remainder of Henderson Blvd and ‘B’ Road will be routed to a BioPod and infiltration basin (Ecology BMP T7.10).

The BioPod vaults are designed to meet the WA DOE requirements for enhanced treatment and include an internal bypass system. See Appendix 1 for sizing calculations.

Section 5 – Aesthetic Considerations for Facilities

All above ground stormwater facilities will be hydroseeded upon completion. Additional landscaping shall also be provided throughout the project in conformance with the approved landscaping and tree restoration plan, as applicable, and as otherwise required by the approving authority.

Signage provided by the City of Tumwater will be installed for all aboveground stormwater facilities and stormwater facilities.

Section 6 – Conveyance System Analysis and Design

The conveyance system was sized to convey the 25-year event estimated by WWHM. See Appendix 1 for calculations and table for the minimum slope for a 12-inch pipe to convey the flow. The permit set will have pipes with slopes equal to or greater than the minimum calculated slopes.

Section 7 – Covenants, Dedications and Easement

All stormwater facilities located on private property shall be owned, operated, and maintained by the property owners, their heirs, successors, and assigns. The property owners shall enter into an agreement with the governing body, a copy of which agreement is included in the Maintenance and Source Control Manual of the Drainage Control Plan. The agreement requires maintenance of the stormwater facilities in accordance with the maintenance plan provided and shall grant easement for access to the governing body to inspect the stormwater facilities. The agreement also makes provisions for the governing body to make repairs, after due notice is given to the owners, if repairs are necessary to ensure proper performance of the stormwater system and if the owners fail to make the necessary repairs. The cost of said repairs shall be borne by the property owners, their heirs, successors, and assigns.

Proposed utilities for the project are shown on the site plan and have been designed to accommodate the drainage design.

Section 8 – Agreements and Guarantees

The property owner is required to enter into a Stormwater Maintenance Agreement to maintain stormwater facilities and implement a Pollution Source Control Plan. A copy of the maintenance agreement will be included in the final Maintenance and Source Control Manual.

The owner is required to provide a financial guarantee to the Administrator to ensure satisfactory maintenance of drainage facilities for a minimum of 2 years from final plat acceptance or acceptance of the project, whichever is later. The guarantee shall be 15 percent of the construction cost of the drainage facilities.

Section 9 – Other Permits or Conditions Place on the Project

City of Tumwater	Site Development Permit
City of Tumwater	Grading Permit
City of Tumwater	Building Permit
City of Tumwater	Right-of-Way Access Permit

APPENDIX 1 – Design Calculations

Flow Control Sizing

Attached WWHM printout shows the infiltration systems provide 100%.

Treatment Sizing and Areas

See modeling in Appendix.

Old Castle BioPod® lists assorted sizes of treatment vaults with both treatment and overflow rates.

BioPods® proposed do not have drain down devices and do not require the 1.05 multiplier.

West Basin treatment area is 1.39 acres, buildings 6 and 4 roof runoff bypass the BioPod treatment vault and connects directly to the infiltration trench.

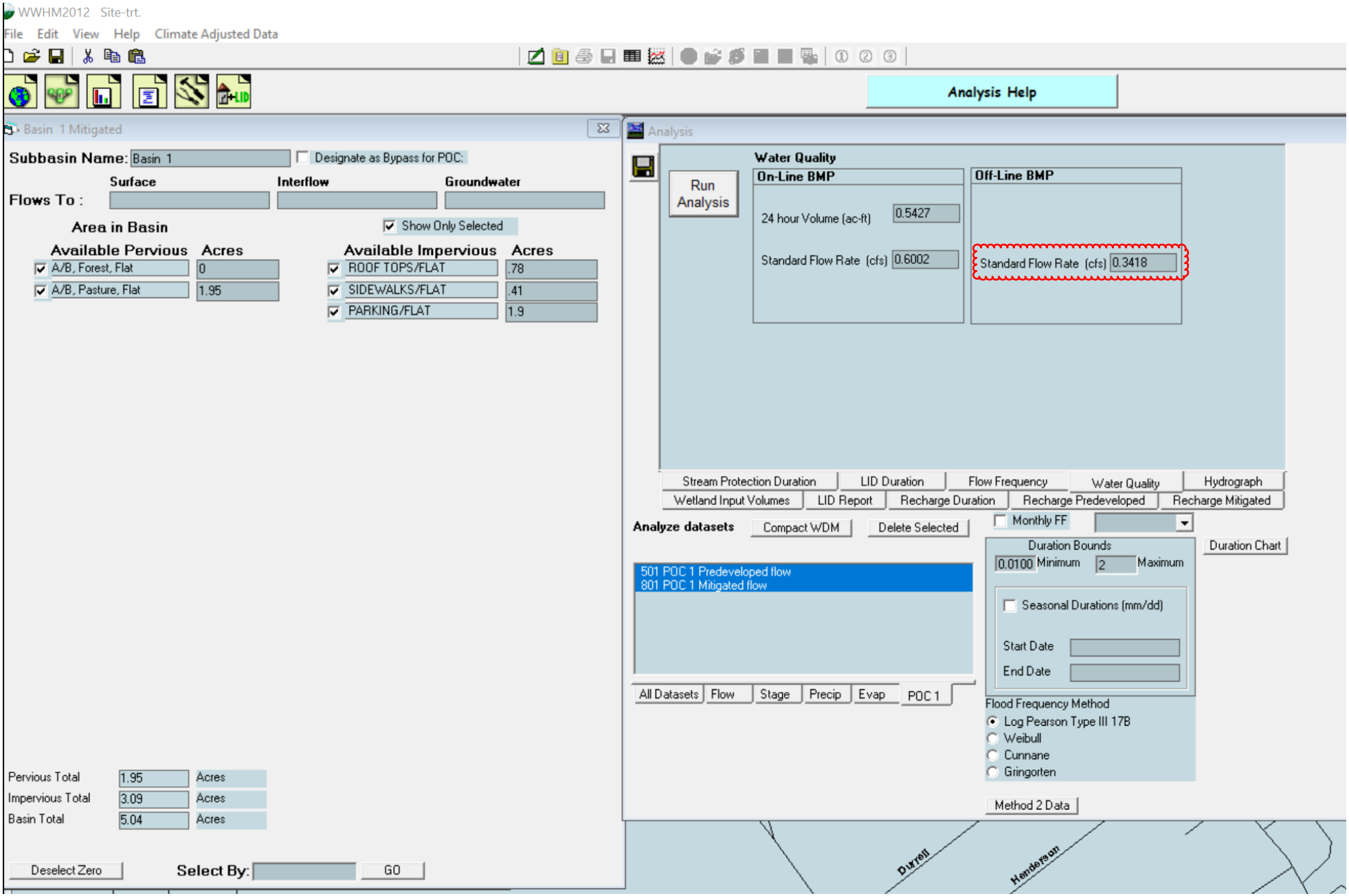
Treatment Areas	Total (ac)	Required Treatment Flow Rate Off-Line (cfs)	Provided Treatment Flow Rate (cfs)
Onsite Basin – BioPod #1 Model: BOU-816IB	5.30	0.342	0.384
West Basin – BioPod #2 Model: BOU-68IB	1.39	0.103	0.128
Offsite Basin – BioPod #3 Model: BOU-68IB	1.40	0.087	0.128

Conveyance Sizing

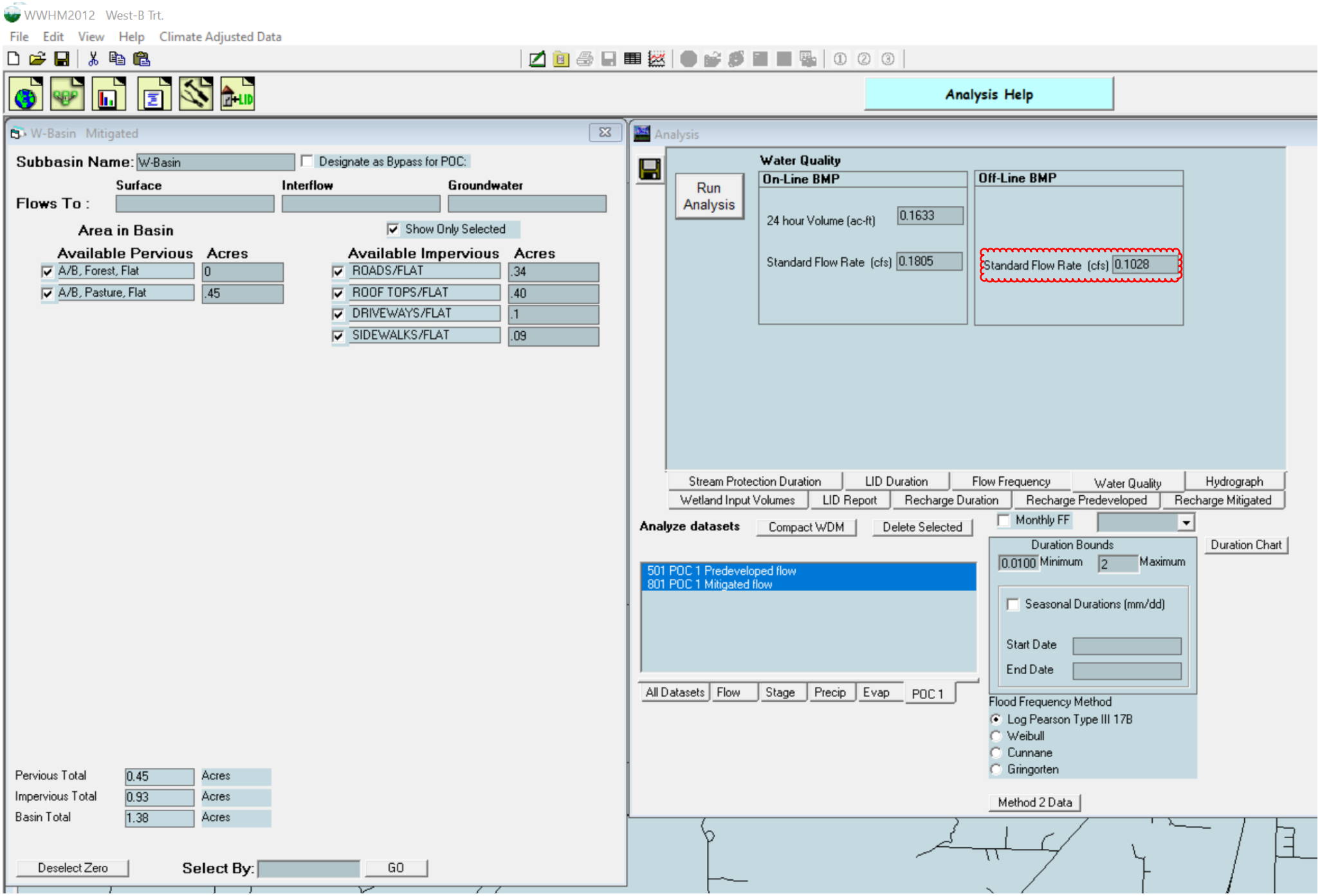
For conveyance sizing, the flows from each subbasin were compared to the capacity of the inflow to the infiltration trench from that subbasin.

Basin	25-yr flow (cfs)	Pipe Size and Slope
Onsite	2.292	12-inch at 0.5%; 2.74 cfs
West (Henderson Blvd. SE & Townhomes)	0.830	12-inch at 0.3%: 2.12 cfs
Offsite	0.585	12-inch at 0.3%: 2.12 cfs

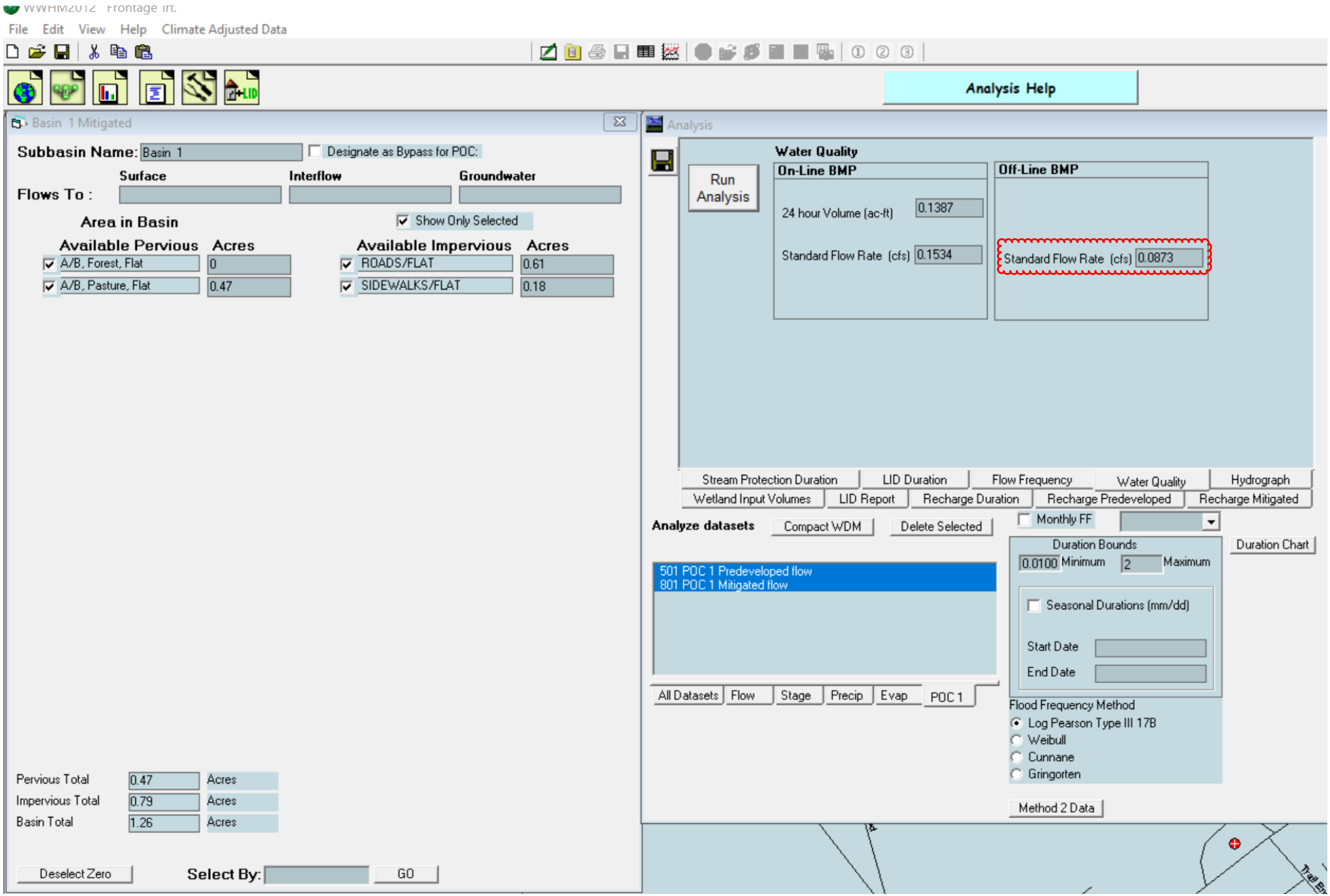
Onsite Basin Treatment Flow Rate



West Basin ('A' Road & Town-homes) Treatment Flow Rate



Offsite Basin Treatment Flow Rate



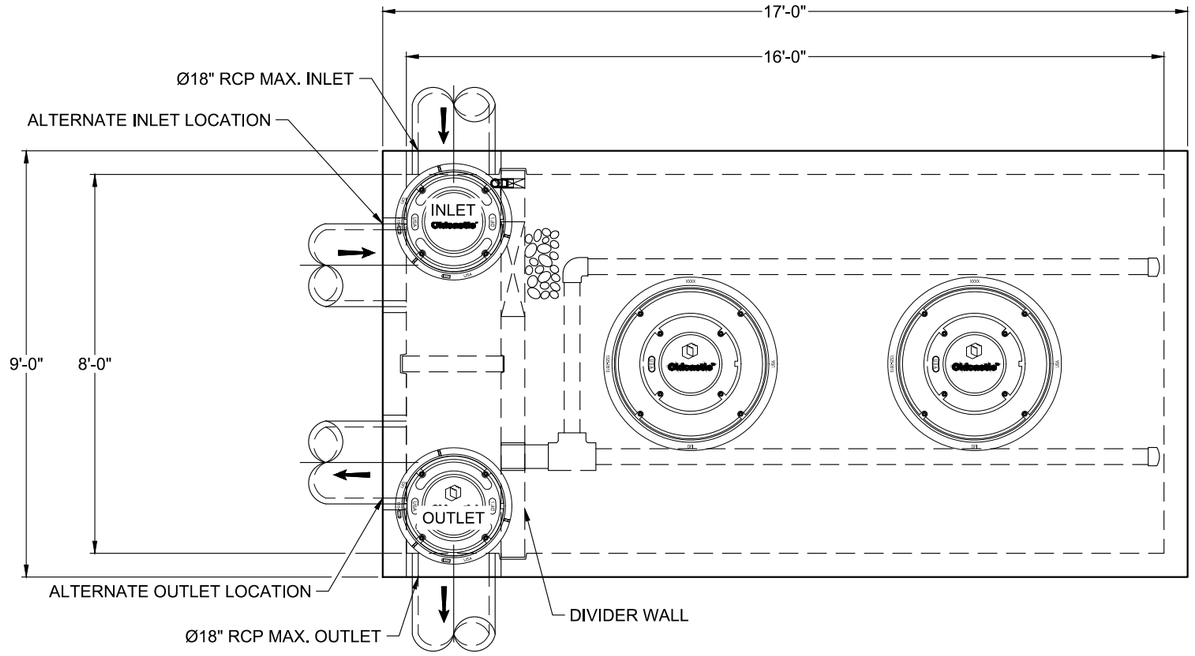
SITE SPECIFIC DATA	
Structure ID	ID
Treatment Flow Rate (cfs)	-
Peak Flow Rate (cfs)	-
Rim Elevation	-
Top of Vault Elevation	-

Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-

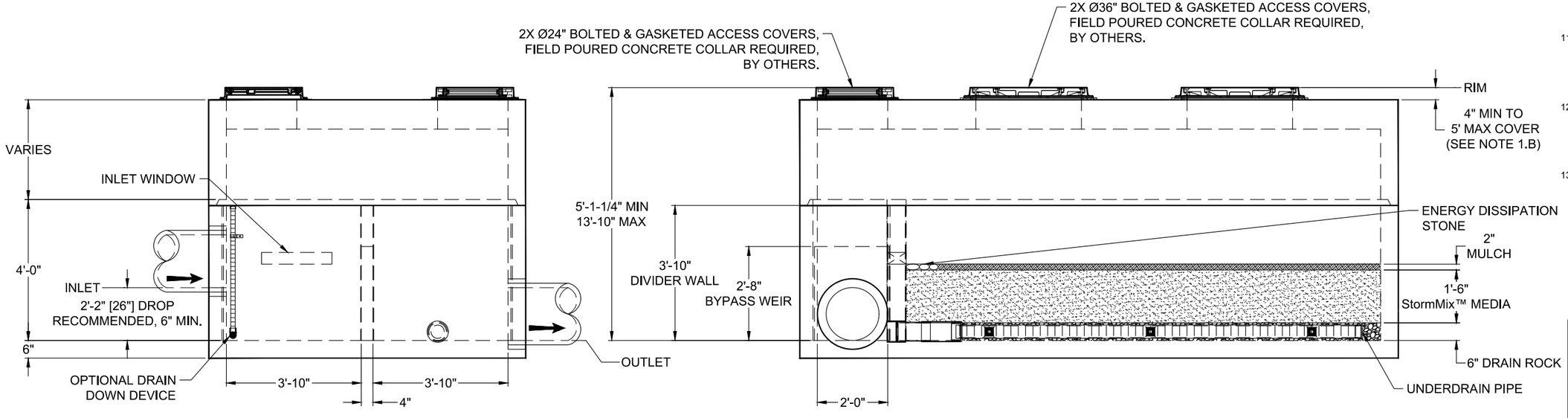
Notes:

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.432 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.384 cfs
Bypass Capacity	6.5 cfs

*Contact Oldcastle for alternative treatment flow capacities.



PLAN VIEW



LEFT END VIEW

ELEVATION VIEW

NOTES:

1. DESIGN LOADINGS:
   A. AASHTO HS-20-44 (WITH IMPACT)
   B. DESIGN SOIL COVER: 5'-0" MAXIMUM
   C. ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
   D. LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
   E. LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
   F. NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
2. CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
3. REINFORCING: REBAR, ASTM A615/A706, GRADE 60
4. CEMENT: ASTM C150
5. REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
6. REFERENCE STANDARD:
   A. ASTM C890
   B. ASTM C913
   C. ACI 318-14
7. THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY FY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW.
8. INLET AND OUTLET HOLES WILL BE FACTORY CORED/CAST PER PLANS AND CUSTOMER REQUIREMENTS. INLET AND OUTLET LOCATIONS CAN BE MIRRORED.
9. CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
10. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
11. SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
12. MAXIMUM PICK WEIGHTS":
   A. TOP: XX,XXX LBS
   B. BASE: XX,XXX LBS*
   (* COMBINED WEIGHT OF BASE INCLUDES BYPASS WEIR, DIVIDER WALL, ROCK & MEDIA)
13. INTERNALS SHALL CONSIST OF UNDERDRAIN PIPE, ROCK, STORMMIX™ MEDIA, MULCH, DIVIDER WALL, BYPASS WEIR AND OPTIONAL DRAIN DOWN.

Bioretention/ Biofiltration

Oldcastle Infrastructure™ A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

BioPod™ Biofilter System (STANDARD)

Underground Vault with Internal Bypass

CUSTOMER: -

PROJECT NAME: -

SHEET NAME	REVISION	SHEET
Specifier Drawing BPU-816IB	-	1 OF 1
	REV DATE: -	

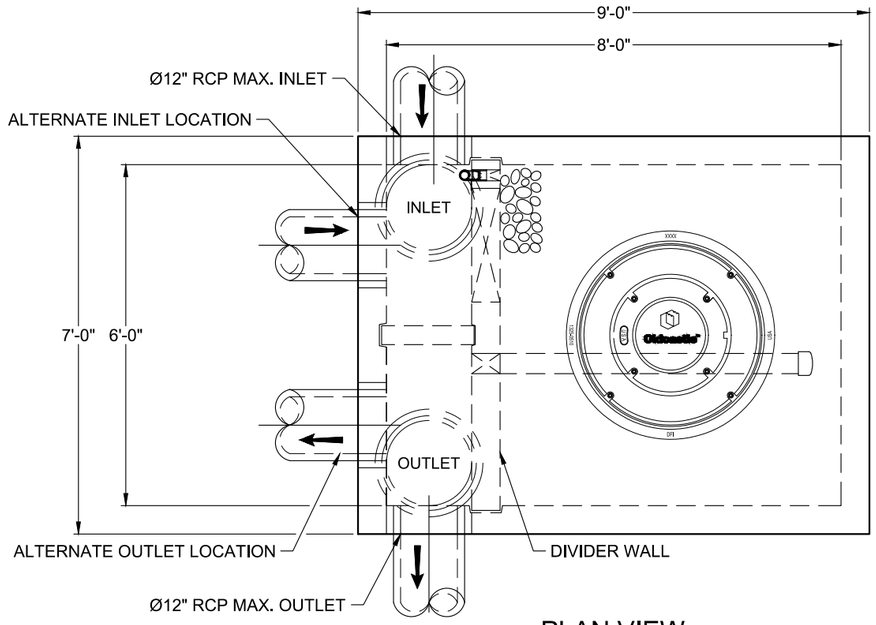
SITE SPECIFIC DATA	
Structure ID	ID
Treatment Flow Rate (cfs)	-
Peak Flow Rate (cfs)	-
Rim Elevation	-
Top of Vault Elevation	-

Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-

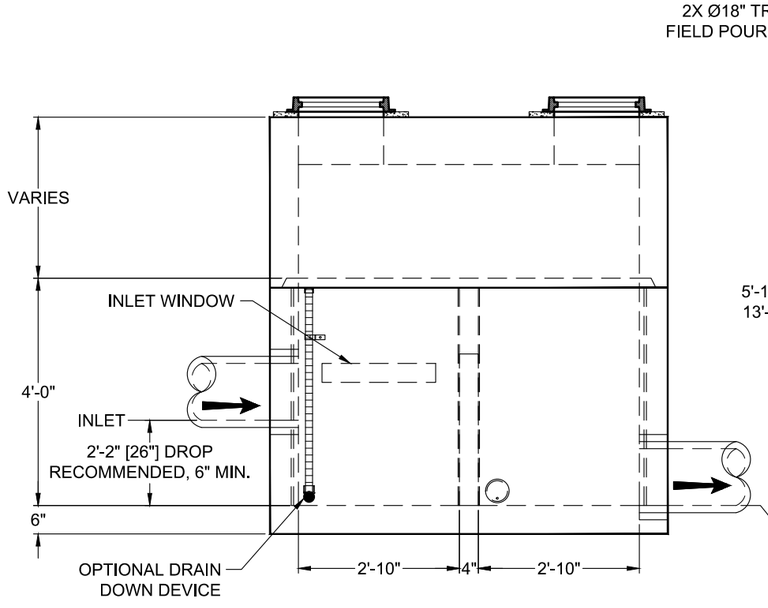
Notes:

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.144 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.128 cfs
Bypass Capacity	5.0 cfs

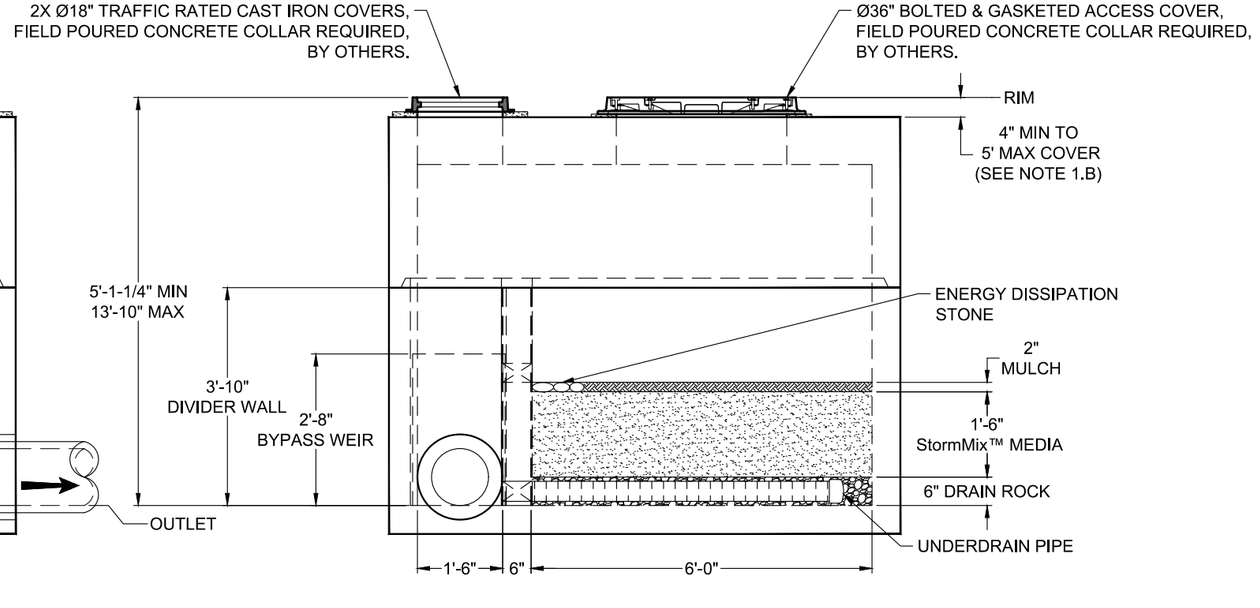
*Contact Oldcastle for alternative treatment flow capacities.



PLAN VIEW



LEFT END VIEW



ELEVATION VIEW

NOTES:

1. DESIGN LOADINGS:
   A. AASHTO HS-20-44 (WITH IMPACT)
   B. DESIGN SOIL COVER: 5'-0" MAXIMUM
   C. ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
   D. LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
   E. LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
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2. CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
3. REINFORCING: REBAR, ASTM A615/A706, GRADE 60
4. CEMENT: ASTM C150
5. REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
6. REFERENCE STANDARD:
   A. ASTM C890
   B. ASTM C913
   C. ACI 318-14
7. THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY FY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW.
8. INLET AND OUTLET HOLES WILL BE FACTORY CORED/CAST PER PLANS AND CUSTOMER REQUIREMENTS. INLET AND OUTLET LOCATIONS CAN BE MIRRORED.
9. CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
10. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
11. SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
12. MAXIMUM PICK WEIGHTS":
    A. TOP: XX,XXX LBS
    B. BASE: XX,XXX LBS*
    (* COMBINED WEIGHT OF BASE INCLUDES BYPASS WEIR, DIVIDER WALL, ROCK & MEDIA)
13. INTERNALS SHALL CONSIST OF UNDERDRAIN PIPE, ROCK, STORMMIX™ MEDIA, MULCH, DIVIDER WALL, BYPASS WEIR AND OPTIONAL DRAIN DOWN.

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BioPod™ Biofilter System (STANDARD)

Underground Vault with Internal Bypass

CUSTOMER
-

PROJECT NAME
-

SHEET NAME	REVISION	SHEET
Specifier Drawing BPU-68IB	-	1 OF 1
	REV DATE -	

Site Analysis

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Site Analysis
Site Name:
Site Address:
City:

Report Date:	1/23/2025
Gage:	Olympia Airport
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2024/09/10
Version:	4.3.1

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Pre-Developed Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Flat	9.48
Pervious Total	9.48

Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	9.73

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

Onsite Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	1.95
Pervious Total	1.95

Impervious Land Use	acre
ROOF TOPS FLAT	0.78
SIDEWALKS FLAT	0.41
PARKING FLAT	1.9
POND	0.26
Impervious Total	3.35
Basin Total	5.3

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Onsite Pond	Onsite Pond

West Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	0.45
Pervious Total	0.45

Impervious Land Use	acre
ROADS FLAT	0.34
ROOF TOPS FLAT	0.61
DRIVEWAYS FLAT	0.1
SIDEWALKS FLAT	0.09
Impervious Total	1.14
Basin Total	1.59

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Infiltration Trench	Infiltration Trench	

Offsite Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	0.47
Pervious Total	0.47

Impervious Land Use	acre
ROADS FLAT	0.61
SIDEWALKS FLAT	0.18
POND	0.14
Impervious Total	0.93
Basin Total	1.4

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Offsite Pond	Offsite Pond	

Routing Elements
Predeveloped Routing

Mitigated Routing

Onsite Pond

Bottom Length:	113.00 ft.	
Bottom Width:	50.00 ft.	
Depth:	5 ft.	
Volume at riser head:	0.7290 acre-feet.	
Infiltration On		
Infiltration rate:	4	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft.):		642.98
Total Volume Through Riser (ac-ft.):		0
Total Volume Through Facility (ac-ft.):		642.98
Percent Infiltrated:		100
Total Precip Applied to Facility:		0
Total Evap From Facility:		0
Side slope 1:	3 To 1	
Side slope 2:	3 To 1	
Side slope 3:	3 To 1	
Side slope 4:	3 To 1	
Discharge Structure		
Riser Height:	4 ft.	
Riser Diameter:	10 in.	
Element Outlets:		
Outlet 1	Outlet 2	
Outlet Flows To:		

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.129	0.000	0.000	0.000
0.0556	0.131	0.007	0.000	0.523
0.1111	0.132	0.014	0.000	0.523
0.1667	0.133	0.021	0.000	0.523
0.2222	0.134	0.029	0.000	0.523
0.2778	0.136	0.036	0.000	0.523
0.3333	0.137	0.044	0.000	0.523
0.3889	0.138	0.052	0.000	0.523
0.4444	0.139	0.059	0.000	0.523
0.5000	0.141	0.067	0.000	0.523
0.5556	0.142	0.075	0.000	0.523
0.6111	0.143	0.083	0.000	0.523
0.6667	0.145	0.091	0.000	0.523
0.7222	0.146	0.099	0.000	0.523
0.7778	0.147	0.107	0.000	0.523
0.8333	0.149	0.116	0.000	0.523
0.8889	0.150	0.124	0.000	0.523
0.9444	0.151	0.132	0.000	0.523
1.0000	0.153	0.141	0.000	0.523
1.0556	0.154	0.149	0.000	0.523
1.1111	0.155	0.158	0.000	0.523
1.1667	0.157	0.167	0.000	0.523
1.2222	0.158	0.175	0.000	0.523
1.2778	0.159	0.184	0.000	0.523
1.3333	0.161	0.193	0.000	0.523
1.3889	0.162	0.202	0.000	0.523

1.4444	0.163	0.211	0.000	0.523
1.5000	0.165	0.220	0.000	0.523
1.5556	0.166	0.230	0.000	0.523
1.6111	0.168	0.239	0.000	0.523
1.6667	0.169	0.248	0.000	0.523
1.7222	0.170	0.258	0.000	0.523
1.7778	0.172	0.267	0.000	0.523
1.8333	0.173	0.277	0.000	0.523
1.8889	0.175	0.286	0.000	0.523
1.9444	0.176	0.296	0.000	0.523
2.0000	0.177	0.306	0.000	0.523
2.0556	0.179	0.316	0.000	0.523
2.1111	0.180	0.326	0.000	0.523
2.1667	0.182	0.336	0.000	0.523
2.2222	0.183	0.346	0.000	0.523
2.2778	0.185	0.356	0.000	0.523
2.3333	0.186	0.367	0.000	0.523
2.3889	0.188	0.377	0.000	0.523
2.4444	0.189	0.388	0.000	0.523
2.5000	0.191	0.398	0.000	0.523
2.5556	0.192	0.409	0.000	0.523
2.6111	0.194	0.420	0.000	0.523
2.6667	0.195	0.430	0.000	0.523
2.7222	0.196	0.441	0.000	0.523
2.7778	0.198	0.452	0.000	0.523
2.8333	0.200	0.463	0.000	0.523
2.8889	0.201	0.475	0.000	0.523
2.9444	0.203	0.486	0.000	0.523
3.0000	0.204	0.497	0.000	0.523
3.0556	0.206	0.509	0.000	0.523
3.1111	0.207	0.520	0.000	0.523
3.1667	0.209	0.532	0.000	0.523
3.2222	0.210	0.543	0.000	0.523
3.2778	0.212	0.555	0.000	0.523
3.3333	0.213	0.567	0.000	0.523
3.3889	0.215	0.579	0.000	0.523
3.4444	0.216	0.591	0.000	0.523
3.5000	0.218	0.603	0.000	0.523
3.5556	0.220	0.615	0.000	0.523
3.6111	0.221	0.627	0.000	0.523
3.6667	0.223	0.640	0.000	0.523
3.7222	0.224	0.652	0.000	0.523
3.7778	0.226	0.665	0.000	0.523
3.8333	0.227	0.677	0.000	0.523
3.8889	0.229	0.690	0.000	0.523
3.9444	0.231	0.703	0.000	0.523
4.0000	0.232	0.716	0.000	0.523
4.0556	0.234	0.729	0.115	0.523
4.1111	0.236	0.742	0.323	0.523
4.1667	0.237	0.755	0.575	0.523
4.2222	0.239	0.768	0.835	0.523
4.2778	0.240	0.781	1.067	0.523
4.3333	0.242	0.795	1.242	0.523
4.3889	0.244	0.808	1.355	0.523
4.4444	0.245	0.822	1.458	0.523
4.5000	0.247	0.836	1.546	0.523
4.5556	0.249	0.849	1.630	0.523
4.6111	0.250	0.863	1.709	0.523

4.6667	0.252	0.877	1.785	0.523
4.7222	0.254	0.891	1.858	0.523
4.7778	0.255	0.906	1.929	0.523
4.8333	0.257	0.920	1.996	0.523
4.8889	0.259	0.934	2.062	0.523
4.9444	0.260	0.949	2.125	0.523
5.0000	0.262	0.963	2.187	0.523
5.0556	0.264	0.978	2.247	0.523

Infiltration Trench

Bottom Length:	160.00 ft.
Bottom Width:	18.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.4
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	4
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	218.668
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	218.668
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	10 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.066	0.000	0.000	0.000
0.0556	0.066	0.001	0.000	0.266
0.1111	0.066	0.002	0.000	0.266
0.1667	0.066	0.004	0.000	0.266
0.2222	0.066	0.005	0.000	0.266
0.2778	0.066	0.007	0.000	0.266
0.3333	0.066	0.008	0.000	0.266
0.3889	0.066	0.010	0.000	0.266
0.4444	0.066	0.011	0.000	0.266
0.5000	0.066	0.013	0.000	0.266
0.5556	0.066	0.014	0.000	0.266
0.6111	0.066	0.016	0.000	0.266
0.6667	0.066	0.017	0.000	0.266
0.7222	0.066	0.019	0.000	0.266
0.7778	0.066	0.020	0.000	0.266
0.8333	0.066	0.022	0.000	0.266
0.8889	0.066	0.023	0.000	0.266
0.9444	0.066	0.025	0.000	0.266
1.0000	0.066	0.026	0.000	0.266
1.0556	0.066	0.027	0.000	0.266
1.1111	0.066	0.029	0.000	0.266
1.1667	0.066	0.030	0.000	0.266
1.2222	0.066	0.032	0.000	0.266
1.2778	0.066	0.033	0.000	0.266
1.3333	0.066	0.035	0.000	0.266

1.3889	0.066	0.036	0.000	0.266
1.4444	0.066	0.038	0.000	0.266
1.5000	0.066	0.039	0.000	0.266
1.5556	0.066	0.041	0.000	0.266
1.6111	0.066	0.042	0.000	0.266
1.6667	0.066	0.044	0.000	0.266
1.7222	0.066	0.045	0.000	0.266
1.7778	0.066	0.047	0.000	0.266
1.8333	0.066	0.048	0.000	0.266
1.8889	0.066	0.050	0.000	0.266
1.9444	0.066	0.051	0.000	0.266
2.0000	0.066	0.052	0.000	0.266
2.0556	0.066	0.054	0.000	0.266
2.1111	0.066	0.055	0.000	0.266
2.1667	0.066	0.057	0.000	0.266
2.2222	0.066	0.058	0.000	0.266
2.2778	0.066	0.060	0.000	0.266
2.3333	0.066	0.061	0.000	0.266
2.3889	0.066	0.063	0.000	0.266
2.4444	0.066	0.064	0.000	0.266
2.5000	0.066	0.066	0.000	0.266
2.5556	0.066	0.067	0.000	0.266
2.6111	0.066	0.069	0.000	0.266
2.6667	0.066	0.070	0.000	0.266
2.7222	0.066	0.072	0.000	0.266
2.7778	0.066	0.073	0.000	0.266
2.8333	0.066	0.074	0.000	0.266
2.8889	0.066	0.076	0.000	0.266
2.9444	0.066	0.077	0.000	0.266
3.0000	0.066	0.079	0.000	0.266
3.0556	0.066	0.080	0.000	0.266
3.1111	0.066	0.082	0.000	0.266
3.1667	0.066	0.083	0.000	0.266
3.2222	0.066	0.085	0.000	0.266
3.2778	0.066	0.086	0.000	0.266
3.3333	0.066	0.088	0.000	0.266
3.3889	0.066	0.089	0.000	0.266
3.4444	0.066	0.091	0.000	0.266
3.5000	0.066	0.092	0.000	0.266
3.5556	0.066	0.094	0.000	0.266
3.6111	0.066	0.095	0.000	0.266
3.6667	0.066	0.097	0.000	0.266
3.7222	0.066	0.098	0.000	0.266
3.7778	0.066	0.099	0.000	0.266
3.8333	0.066	0.101	0.000	0.266
3.8889	0.066	0.102	0.000	0.266
3.9444	0.066	0.104	0.000	0.266
4.0000	0.066	0.105	0.000	0.266
4.0556	0.066	0.109	0.115	0.266
4.1111	0.066	0.113	0.323	0.266
4.1667	0.066	0.116	0.575	0.266
4.2222	0.066	0.120	0.835	0.266
4.2778	0.066	0.124	1.067	0.266
4.3333	0.066	0.127	1.242	0.266
4.3889	0.066	0.131	1.355	0.266
4.4444	0.066	0.135	1.458	0.266
4.5000	0.066	0.138	1.546	0.266
4.5556	0.066	0.142	1.630	0.266

4.6111	0.066	0.146	1.709	0.266
4.6667	0.066	0.149	1.785	0.266
4.7222	0.066	0.153	1.858	0.266
4.7778	0.066	0.157	1.929	0.266
4.8333	0.066	0.160	1.996	0.266
4.8889	0.066	0.164	2.062	0.266
4.9444	0.066	0.168	2.125	0.266
5.0000	0.066	0.171	2.187	0.266

Offsite Pond

Bottom Length:	92.58 ft.	
Bottom Width:	12.00 ft.	
Depth:	6 ft.	
Volume at riser head:	0.3420 acre-feet.	
Infiltration On		
Infiltration rate:	4	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft.):		178.44
Total Volume Through Riser (ac-ft.):		0
Total Volume Through Facility (ac-ft.):		178.44
Percent Infiltrated:		100
Total Precip Applied to Facility:		0
Total Evap From Facility:		0
Side slope 1:	3 To 1	
Side slope 2:	3 To 1	
Side slope 3:	3 To 1	
Side slope 4:	3 To 1	
Discharge Structure		
Riser Height:	5 ft.	
Riser Diameter:	10 in.	
Element Outlets:		
Outlet 1	Outlet 2	
Outlet Flows To:		

Pond Hydraulic Table

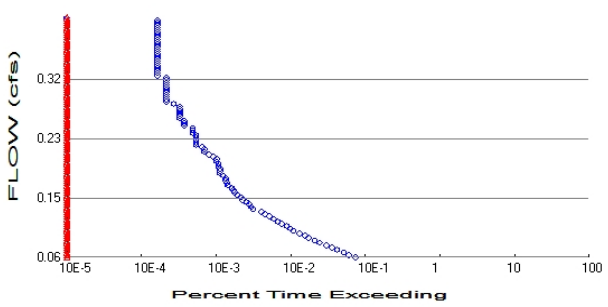
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.025	0.000	0.000	0.000
0.0667	0.026	0.001	0.000	0.102
0.1333	0.027	0.003	0.000	0.102
0.2000	0.028	0.005	0.000	0.102
0.2667	0.029	0.007	0.000	0.102
0.3333	0.030	0.009	0.000	0.102
0.4000	0.031	0.011	0.000	0.102
0.4667	0.032	0.013	0.000	0.102
0.5333	0.033	0.015	0.000	0.102
0.6000	0.034	0.018	0.000	0.102
0.6667	0.035	0.020	0.000	0.102
0.7333	0.036	0.022	0.000	0.102
0.8000	0.037	0.025	0.000	0.102
0.8667	0.038	0.027	0.000	0.102
0.9333	0.039	0.030	0.000	0.102
1.0000	0.040	0.033	0.000	0.102
1.0667	0.041	0.035	0.000	0.102
1.1333	0.042	0.038	0.000	0.102
1.2000	0.044	0.041	0.000	0.102
1.2667	0.045	0.044	0.000	0.102
1.3333	0.046	0.047	0.000	0.102
1.4000	0.047	0.050	0.000	0.102
1.4667	0.048	0.053	0.000	0.102
1.5333	0.049	0.057	0.000	0.102
1.6000	0.050	0.060	0.000	0.102
1.6667	0.051	0.063	0.000	0.102
1.7333	0.053	0.067	0.000	0.102
1.8000	0.054	0.070	0.000	0.102

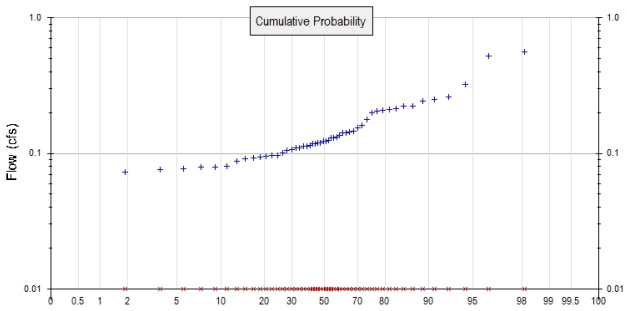
1.8667	0.055	0.074	0.000	0.102
1.9333	0.056	0.078	0.000	0.102
2.0000	0.057	0.082	0.000	0.102
2.0667	0.058	0.085	0.000	0.102
2.1333	0.060	0.089	0.000	0.102
2.2000	0.061	0.093	0.000	0.102
2.2667	0.062	0.098	0.000	0.102
2.3333	0.063	0.102	0.000	0.102
2.4000	0.064	0.106	0.000	0.102
2.4667	0.066	0.110	0.000	0.102
2.5333	0.067	0.115	0.000	0.102
2.6000	0.068	0.119	0.000	0.102
2.6667	0.069	0.124	0.000	0.102
2.7333	0.071	0.129	0.000	0.102
2.8000	0.072	0.133	0.000	0.102
2.8667	0.073	0.138	0.000	0.102
2.9333	0.074	0.143	0.000	0.102
3.0000	0.076	0.148	0.000	0.102
3.0667	0.077	0.153	0.000	0.102
3.1333	0.078	0.159	0.000	0.102
3.2000	0.080	0.164	0.000	0.102
3.2667	0.081	0.169	0.000	0.102
3.3333	0.082	0.175	0.000	0.102
3.4000	0.084	0.180	0.000	0.102
3.4667	0.085	0.186	0.000	0.102
3.5333	0.086	0.192	0.000	0.102
3.6000	0.088	0.198	0.000	0.102
3.6667	0.089	0.203	0.000	0.102
3.7333	0.090	0.209	0.000	0.102
3.8000	0.092	0.216	0.000	0.102
3.8667	0.093	0.222	0.000	0.102
3.9333	0.094	0.228	0.000	0.102
4.0000	0.096	0.234	0.000	0.102
4.0667	0.097	0.241	0.000	0.102
4.1333	0.099	0.247	0.000	0.102
4.2000	0.100	0.254	0.000	0.102
4.2667	0.102	0.261	0.000	0.102
4.3333	0.103	0.268	0.000	0.102
4.4000	0.104	0.275	0.000	0.102
4.4667	0.106	0.282	0.000	0.102
4.5333	0.107	0.289	0.000	0.102
4.6000	0.109	0.296	0.000	0.102
4.6667	0.110	0.303	0.000	0.102
4.7333	0.112	0.311	0.000	0.102
4.8000	0.113	0.318	0.000	0.102
4.8667	0.115	0.326	0.000	0.102
4.9333	0.116	0.334	0.000	0.102
5.0000	0.118	0.342	0.000	0.102
5.0667	0.119	0.350	0.151	0.102
5.1333	0.121	0.358	0.420	0.102
5.2000	0.122	0.366	0.733	0.102
5.2667	0.124	0.374	1.024	0.102
5.3333	0.125	0.382	1.242	0.102
5.4000	0.127	0.391	1.372	0.102
5.4667	0.128	0.399	1.494	0.102
5.5333	0.130	0.408	1.597	0.102
5.6000	0.132	0.417	1.694	0.102
5.6667	0.133	0.425	1.785	0.102

5.7333	0.135	0.434	1.873	0.102
5.8000	0.136	0.444	1.956	0.102
5.8667	0.138	0.453	2.036	0.102
5.9333	0.140	0.462	2.113	0.102
6.0000	0.141	0.471	2.187	0.102
6.0667	0.143	0.481	2.259	0.102

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 9.48
Total Impervious Area: 0.25

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.87
Total Impervious Area: 5.42

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.129647
5 year	0.196161
10 year	0.250293
25 year	0.331574
50 year	0.402419
100 year	0.482916

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.123	0.000
1957	0.155	0.000
1958	0.097	0.000
1959	0.114	0.000
1960	0.130	0.000
1961	0.200	0.000
1962	0.096	0.000
1963	0.224	0.000
1964	0.205	0.000
1965	0.118	0.000

1966	0.080	0.000
1967	0.120	0.000
1968	0.077	0.000
1969	0.079	0.000
1970	0.088	0.000
1971	0.093	0.000
1972	0.177	0.000
1973	0.080	0.000
1974	0.135	0.000
1975	0.141	0.000
1976	0.122	0.000
1977	0.160	0.000
1978	0.129	0.000
1979	0.143	0.000
1980	0.096	0.000
1981	0.145	0.000
1982	0.131	0.000
1983	0.207	0.000
1984	0.141	0.000
1985	0.094	0.000
1986	0.118	0.000
1987	0.523	0.000
1988	0.076	0.000
1989	0.110	0.000
1990	0.242	0.000
1991	0.322	0.000
1992	0.092	0.000
1993	0.072	0.000
1994	0.071	0.000
1995	0.107	0.000
1996	0.210	0.000
1997	0.222	0.000
1998	0.113	0.000
1999	0.251	0.000
2000	0.125	0.000
2001	0.100	0.000
2002	0.109	0.000
2003	0.119	0.000
2004	0.212	0.000
2005	0.106	0.000
2006	0.564	0.000
2007	0.259	0.000
2008	0.113	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.5638	0.0000
2	0.5225	0.0000
3	0.3216	0.0000
4	0.2593	0.0000
5	0.2513	0.0000
6	0.2420	0.0000
7	0.2244	0.0000
8	0.2217	0.0000
9	0.2124	0.0000
10	0.2097	0.0000
11	0.2074	0.0000

12	0.2045	0.0000
13	0.1996	0.0000
14	0.1771	0.0000
15	0.1601	0.0000
16	0.1550	0.0000
17	0.1450	0.0000
18	0.1432	0.0000
19	0.1414	0.0000
20	0.1412	0.0000
21	0.1353	0.0000
22	0.1311	0.0000
23	0.1304	0.0000
24	0.1292	0.0000
25	0.1245	0.0000
26	0.1228	0.0000
27	0.1221	0.0000
28	0.1195	0.0000
29	0.1193	0.0000
30	0.1184	0.0000
31	0.1183	0.0000
32	0.1144	0.0000
33	0.1132	0.0000
34	0.1126	0.0000
35	0.1099	0.0000
36	0.1093	0.0000
37	0.1072	0.0000
38	0.1055	0.0000
39	0.1002	0.0000
40	0.0968	0.0000
41	0.0960	0.0000
42	0.0959	0.0000
43	0.0940	0.0000
44	0.0929	0.0000
45	0.0916	0.0000
46	0.0876	0.0000
47	0.0804	0.0000
48	0.0797	0.0000
49	0.0789	0.0000
50	0.0771	0.0000
51	0.0760	0.0000
52	0.0723	0.0000
53	0.0711	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0648	1379	0	0	Pass
0.0682	1102	0	0	Pass
0.0716	950	0	0	Pass
0.0751	771	0	0	Pass
0.0785	662	0	0	Pass
0.0819	556	0	0	Pass
0.0853	454	0	0	Pass
0.0887	388	0	0	Pass
0.0921	319	0	0	Pass
0.0955	288	0	0	Pass
0.0989	244	0	0	Pass
0.1023	201	0	0	Pass
0.1057	184	0	0	Pass
0.1092	163	0	0	Pass
0.1126	139	0	0	Pass
0.1160	124	0	0	Pass
0.1194	110	0	0	Pass
0.1228	95	0	0	Pass
0.1262	83	0	0	Pass
0.1296	75	0	0	Pass
0.1330	58	0	0	Pass
0.1364	55	0	0	Pass
0.1398	51	0	0	Pass
0.1433	47	0	0	Pass
0.1467	42	0	0	Pass
0.1501	40	0	0	Pass
0.1535	36	0	0	Pass
0.1569	33	0	0	Pass
0.1603	32	0	0	Pass
0.1637	30	0	0	Pass
0.1671	27	0	0	Pass
0.1705	26	0	0	Pass
0.1739	25	0	0	Pass
0.1774	25	0	0	Pass
0.1808	23	0	0	Pass
0.1842	21	0	0	Pass
0.1876	21	0	0	Pass
0.1910	21	0	0	Pass
0.1944	20	0	0	Pass
0.1978	20	0	0	Pass
0.2012	19	0	0	Pass
0.2046	19	0	0	Pass
0.2080	17	0	0	Pass
0.2115	15	0	0	Pass
0.2149	13	0	0	Pass
0.2183	13	0	0	Pass
0.2217	12	0	0	Pass
0.2251	10	0	0	Pass
0.2285	10	0	0	Pass
0.2319	10	0	0	Pass
0.2353	10	0	0	Pass
0.2387	10	0	0	Pass
0.2421	9	0	0	Pass

0.2456	9	0	0	Pass
0.2490	9	0	0	Pass
0.2524	7	0	0	Pass
0.2558	7	0	0	Pass
0.2592	7	0	0	Pass
0.2626	6	0	0	Pass
0.2660	6	0	0	Pass
0.2694	6	0	0	Pass
0.2728	6	0	0	Pass
0.2762	6	0	0	Pass
0.2797	6	0	0	Pass
0.2831	5	0	0	Pass
0.2865	4	0	0	Pass
0.2899	4	0	0	Pass
0.2933	4	0	0	Pass
0.2967	4	0	0	Pass
0.3001	4	0	0	Pass
0.3035	4	0	0	Pass
0.3069	4	0	0	Pass
0.3103	4	0	0	Pass
0.3138	4	0	0	Pass
0.3172	4	0	0	Pass
0.3206	4	0	0	Pass
0.3240	3	0	0	Pass
0.3274	3	0	0	Pass
0.3308	3	0	0	Pass
0.3342	3	0	0	Pass
0.3376	3	0	0	Pass
0.3410	3	0	0	Pass
0.3444	3	0	0	Pass
0.3479	3	0	0	Pass
0.3513	3	0	0	Pass
0.3547	3	0	0	Pass
0.3581	3	0	0	Pass
0.3615	3	0	0	Pass
0.3649	3	0	0	Pass
0.3683	3	0	0	Pass
0.3717	3	0	0	Pass
0.3751	3	0	0	Pass
0.3785	3	0	0	Pass
0.3820	3	0	0	Pass
0.3854	3	0	0	Pass
0.3888	3	0	0	Pass
0.3922	3	0	0	Pass
0.3956	3	0	0	Pass
0.3990	3	0	0	Pass
0.4024	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Onsite Pond POC	☐	585.11			☐	100.00			
Infiltration Trench POC	☐	198.99			☐	100.00			
Offsite Pond POC	☐	162.38			☐	100.00			
Total Volume Infiltrated		946.48	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

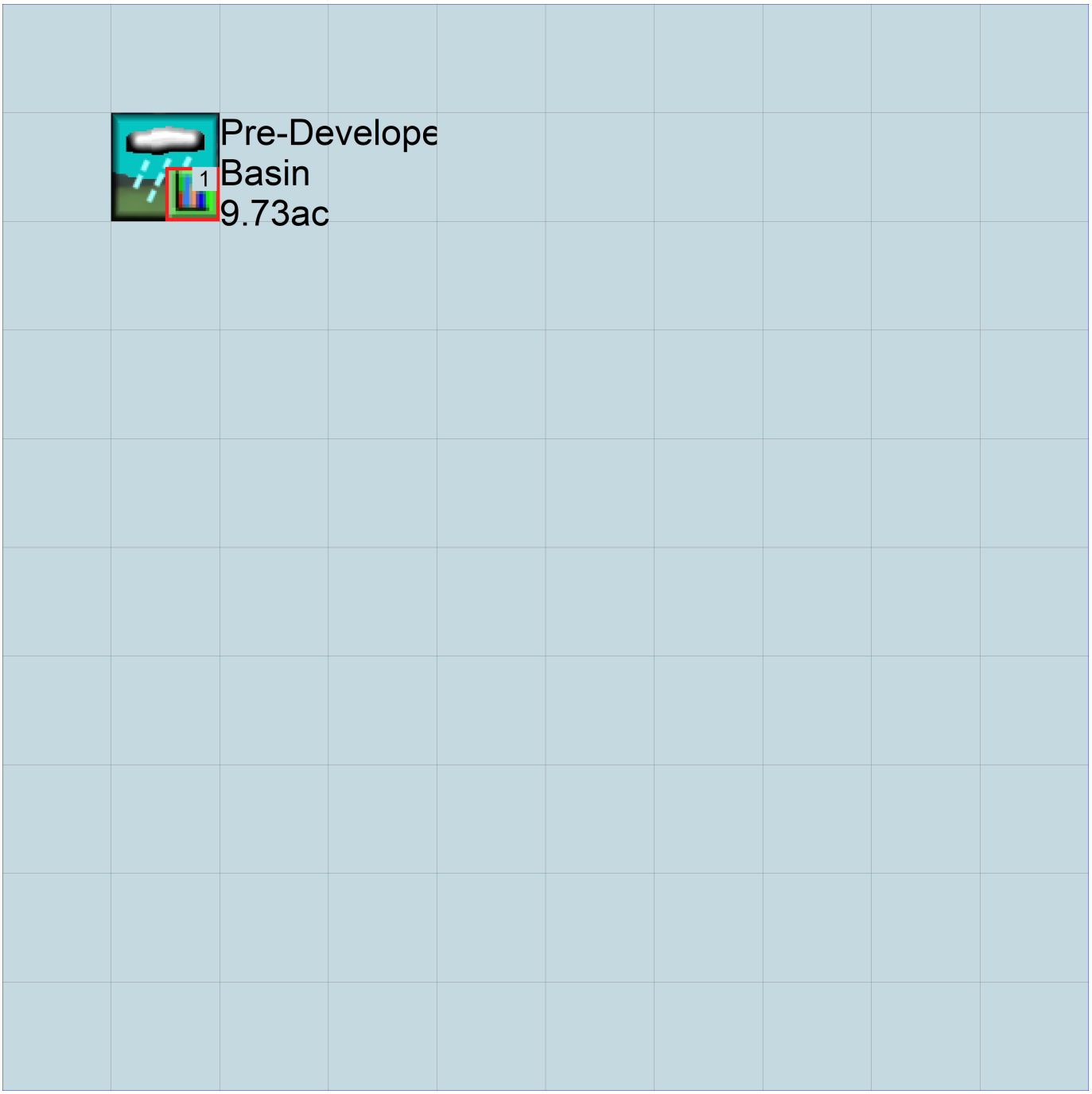
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Site Analysis.wdm
MESSU       25   PreSite Analysis.MES
            27   PreSite Analysis.L61
            28   PreSite Analysis.L62
            30   POCSite Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       1
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Pre-Developed Basin         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    1     A/B, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    1         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    1         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    1         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    1             0         5         2       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    1             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    1          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    1             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1           400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->    <-Target->   MBLK   ***
<Name>   #                  <-factor->    <Name>   #   Tbl#   ***
Pre-Developed Basin ***
PERLND   1                        9.48    COPY   501     12
PERLND   1                        9.48    COPY   501     13
IMPLND   1                        0.25    COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Site Analysis.wdm
MESSU       25   MitSite Analysis.MES
            27   MitSite Analysis.L61
            28   MitSite Analysis.L62
            30   POCSite Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      IMPLND       4
      IMPLND       8
      IMPLND      11
      IMPLND      14
      IMPLND       1
      IMPLND       5
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Onsite Pond                MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    4     A/B, Pasture, Flat      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    4         0    0    1    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    4         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    4               0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4               0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                            ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4          0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    4               0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
   14      POND                   1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
   14         0    0    1    0    0    0
    1         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
```

```
    4         0    0    4    0    0    4    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
   14         0    0    4    0    0    0    1    9
    1         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
   14         0    0    0    0    0
    1         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
   14            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4               0         0
    8               0         0
   11               0         0
   14               0         0
    1               0         0
    5               0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4               0         0
    8               0         0
   11               0         0
   14               0         0
    1               0         0
    5               0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Onsite Basin  ***
PERLND   4                       1.95     RCHRES   1      2
PERLND   4                       1.95     RCHRES   1      3
IMPLND   4                       0.78     RCHRES   1      5
IMPLND   8                       0.41     RCHRES   1      5
IMPLND  11                        1.9     RCHRES   1      5
IMPLND  14                       0.26     RCHRES   1      5
West Basin ***
PERLND   4                       0.45     RCHRES   2      2
PERLND   4                       0.45     RCHRES   2      3
IMPLND   1                       0.34     RCHRES   2      5
IMPLND   4                       0.61     RCHRES   2      5
IMPLND   5                        0.1     RCHRES   2      5
```

```
IMPLND   8                        0.09     RCHRES   2      5
Offsite Basin  ***
PERLND   4                        0.47     RCHRES   3      2
PERLND   4                        0.47     RCHRES   3      3
IMPLND   1                        0.61     RCHRES   3      5
IMPLND   8                        0.18     RCHRES   3      5
IMPLND  14                        0.14     RCHRES   3      5

******Routing******
PERLND   4                        1.95     COPY     1     12
IMPLND   4                        0.78     COPY     1     15
IMPLND   8                        0.41     COPY     1     15
IMPLND  11                         1.9     COPY     1     15
IMPLND  14                        0.26     COPY     1     15
PERLND   4                        1.95     COPY     1     13
PERLND   4                        0.45     COPY     1     12
IMPLND   1                        0.34     COPY     1     15
IMPLND   4                        0.61     COPY     1     15
IMPLND   5                         0.1     COPY     1     15
IMPLND   8                        0.09     COPY     1     15
PERLND   4                        0.45     COPY     1     13
PERLND   4                        0.47     COPY     1     12
IMPLND   1                        0.61     COPY     1     15
IMPLND   8                        0.18     COPY     1     15
IMPLND  14                        0.14     COPY     1     15
PERLND   4                        0.47     COPY     1     13
RCHRES   1                           1     COPY   501     17
RCHRES   2                           1     COPY   501     17
RCHRES   3                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
    1     Onsite Pond            2    1    1    1   28    0    1
    2     Infiltration Tre-007   2    1    1    1   28    0    1
    3     Offsite Pond           2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
    2       0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.02       0.0       0.0       0.5       0.0
    2              2      0.03       0.0       0.0       0.5       0.0
    3              3      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPECT-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.129706  0.000000  0.000000  0.000000
  0.055556  0.130956  0.007241  0.000000  0.523148
  0.111111  0.132211  0.014551  0.000000  0.523148
  0.166667  0.133471  0.021931  0.000000  0.523148
  0.222222  0.134736  0.029381  0.000000  0.523148
  0.277778  0.136007  0.036902  0.000000  0.523148
  0.333333  0.137282  0.044493  0.000000  0.523148
  0.388889  0.138562  0.052155  0.000000  0.523148
  0.444444  0.139848  0.059889  0.000000  0.523148
  0.500000  0.141139  0.067694  0.000000  0.523148
  0.555556  0.142434  0.075571  0.000000  0.523148
  0.611111  0.143735  0.083520  0.000000  0.523148
  0.666667  0.145041  0.091542  0.000000  0.523148
  0.722222  0.146352  0.099636  0.000000  0.523148
  0.777778  0.147669  0.107803  0.000000  0.523148
  0.833333  0.148990  0.116044  0.000000  0.523148
  0.888889  0.150316  0.124358  0.000000  0.523148
  0.944444  0.151648  0.132746  0.000000  0.523148
  1.000000  0.152984  0.141208  0.000000  0.523148
  1.055556  0.154326  0.149744  0.000000  0.523148
  1.111111  0.155673  0.158355  0.000000  0.523148
  1.166667  0.157025  0.167041  0.000000  0.523148
  1.222222  0.158382  0.175803  0.000000  0.523148
  1.277778  0.159744  0.184640  0.000000  0.523148
  1.333333  0.161111  0.193552  0.000000  0.523148
  1.388889  0.162483  0.202541  0.000000  0.523148
  1.444444  0.163861  0.211606  0.000000  0.523148
  1.500000  0.165243  0.220748  0.000000  0.523148
  1.555556  0.166631  0.229967  0.000000  0.523148
  1.611111  0.168024  0.239263  0.000000  0.523148
  1.666667  0.169421  0.248636  0.000000  0.523148
  1.722222  0.170824  0.258087  0.000000  0.523148
  1.777778  0.172232  0.267617  0.000000  0.523148
  1.833333  0.173646  0.277224  0.000000  0.523148
  1.888889  0.175064  0.286911  0.000000  0.523148
  1.944444  0.176487  0.296676  0.000000  0.523148
```

```
2.000000  0.177916  0.306521  0.000000  0.523148
2.055556  0.179349  0.316445  0.000000  0.523148
2.111111  0.180788  0.326448  0.000000  0.523148
2.166667  0.182231  0.336532  0.000000  0.523148
2.222222  0.183680  0.346696  0.000000  0.523148
2.277778  0.185134  0.356941  0.000000  0.523148
2.333333  0.186593  0.367267  0.000000  0.523148
2.388889  0.188057  0.377674  0.000000  0.523148
2.444444  0.189527  0.388162  0.000000  0.523148
2.500000  0.191001  0.398733  0.000000  0.523148
2.555556  0.192480  0.409385  0.000000  0.523148
2.611111  0.193965  0.420120  0.000000  0.523148
2.666667  0.195455  0.430937  0.000000  0.523148
2.722222  0.196949  0.441837  0.000000  0.523148
2.777778  0.198449  0.452820  0.000000  0.523148
2.833333  0.199954  0.463887  0.000000  0.523148
2.888889  0.201464  0.475037  0.000000  0.523148
2.944444  0.202979  0.486272  0.000000  0.523148
3.000000  0.204500  0.497591  0.000000  0.523148
3.055556  0.206025  0.508994  0.000000  0.523148
3.111111  0.207555  0.520483  0.000000  0.523148
3.166667  0.209091  0.532056  0.000000  0.523148
3.222222  0.210632  0.543715  0.000000  0.523148
3.277778  0.212177  0.555460  0.000000  0.523148
3.333333  0.213728  0.567290  0.000000  0.523148
3.388889  0.215284  0.579207  0.000000  0.523148
3.444444  0.216845  0.591211  0.000000  0.523148
3.500000  0.218411  0.603302  0.000000  0.523148
3.555556  0.219983  0.615479  0.000000  0.523148
3.611111  0.221559  0.627744  0.000000  0.523148
3.666667  0.223140  0.640097  0.000000  0.523148
3.722222  0.224727  0.652538  0.000000  0.523148
3.777778  0.226319  0.665067  0.000000  0.523148
3.833333  0.227916  0.677684  0.000000  0.523148
3.888889  0.229517  0.690391  0.000000  0.523148
3.944444  0.231124  0.703186  0.000000  0.523148
4.000000  0.232736  0.716071  0.000000  0.523148
4.055556  0.234354  0.729046  0.115525  0.523148
4.111111  0.235976  0.742111  0.323094  0.523148
4.166667  0.237603  0.755266  0.575411  0.523148
4.222222  0.239236  0.768511  0.835581  0.523148
4.277778  0.240873  0.781848  1.067215  0.523148
4.333333  0.242516  0.795275  1.242541  0.523148
4.388889  0.244164  0.808794  1.355566  0.523148
4.444444  0.245817  0.822405  1.458162  0.523148
4.500000  0.247475  0.836107  1.546614  0.523148
4.555556  0.249138  0.849902  1.630275  0.523148
4.611111  0.250806  0.863789  1.709847  0.523148
4.666667  0.252479  0.877770  1.785876  0.523148
4.722222  0.254158  0.891843  1.858799  0.523148
4.777778  0.255841  0.906009  1.928967  0.523148
4.833333  0.257530  0.920270  1.996671  0.523148
4.888889  0.259224  0.934624  2.062153  0.523148
4.944444  0.260922  0.949073  2.125618  0.523148
5.000000  0.262626  0.963616  2.187243  0.523148
END FTABLE  1
FTABLE      2
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.066116  0.000000  0.000000  0.000000
0.055556  0.066116  0.001469  0.000000  0.266667
0.111111  0.066116  0.002938  0.000000  0.266667
0.166667  0.066116  0.004408  0.000000  0.266667
0.222222  0.066116  0.005877  0.000000  0.266667
0.277778  0.066116  0.007346  0.000000  0.266667
0.333333  0.066116  0.008815  0.000000  0.266667
0.388889  0.066116  0.010285  0.000000  0.266667
0.444444  0.066116  0.011754  0.000000  0.266667
0.500000  0.066116  0.013223  0.000000  0.266667
```

0.555556	0.066116	0.014692	0.000000	0.266667
0.611111	0.066116	0.016162	0.000000	0.266667
0.666667	0.066116	0.017631	0.000000	0.266667
0.722222	0.066116	0.019100	0.000000	0.266667
0.777778	0.066116	0.020569	0.000000	0.266667
0.833333	0.066116	0.022039	0.000000	0.266667
0.888889	0.066116	0.023508	0.000000	0.266667
0.944444	0.066116	0.024977	0.000000	0.266667
1.000000	0.066116	0.026446	0.000000	0.266667
1.055556	0.066116	0.027916	0.000000	0.266667
1.111111	0.066116	0.029385	0.000000	0.266667
1.166667	0.066116	0.030854	0.000000	0.266667
1.222222	0.066116	0.032323	0.000000	0.266667
1.277778	0.066116	0.033792	0.000000	0.266667
1.333333	0.066116	0.035262	0.000000	0.266667
1.388889	0.066116	0.036731	0.000000	0.266667
1.444444	0.066116	0.038200	0.000000	0.266667
1.500000	0.066116	0.039669	0.000000	0.266667
1.555556	0.066116	0.041139	0.000000	0.266667
1.611111	0.066116	0.042608	0.000000	0.266667
1.666667	0.066116	0.044077	0.000000	0.266667
1.722222	0.066116	0.045546	0.000000	0.266667
1.777778	0.066116	0.047016	0.000000	0.266667
1.833333	0.066116	0.048485	0.000000	0.266667
1.888889	0.066116	0.049954	0.000000	0.266667
1.944444	0.066116	0.051423	0.000000	0.266667
2.000000	0.066116	0.052893	0.000000	0.266667
2.055556	0.066116	0.054362	0.000000	0.266667
2.111111	0.066116	0.055831	0.000000	0.266667
2.166667	0.066116	0.057300	0.000000	0.266667
2.222222	0.066116	0.058770	0.000000	0.266667
2.277778	0.066116	0.060239	0.000000	0.266667
2.333333	0.066116	0.061708	0.000000	0.266667
2.388889	0.066116	0.063177	0.000000	0.266667
2.444444	0.066116	0.064646	0.000000	0.266667
2.500000	0.066116	0.066116	0.000000	0.266667
2.555556	0.066116	0.067585	0.000000	0.266667
2.611111	0.066116	0.069054	0.000000	0.266667
2.666667	0.066116	0.070523	0.000000	0.266667
2.722222	0.066116	0.071993	0.000000	0.266667
2.777778	0.066116	0.073462	0.000000	0.266667
2.833333	0.066116	0.074931	0.000000	0.266667
2.888889	0.066116	0.076400	0.000000	0.266667
2.944444	0.066116	0.077870	0.000000	0.266667
3.000000	0.066116	0.079339	0.000000	0.266667
3.055556	0.066116	0.080808	0.000000	0.266667
3.111111	0.066116	0.082277	0.000000	0.266667
3.166667	0.066116	0.083747	0.000000	0.266667
3.222222	0.066116	0.085216	0.000000	0.266667
3.277778	0.066116	0.086685	0.000000	0.266667
3.333333	0.066116	0.088154	0.000000	0.266667
3.388889	0.066116	0.089624	0.000000	0.266667
3.444444	0.066116	0.091093	0.000000	0.266667
3.500000	0.066116	0.092562	0.000000	0.266667
3.555556	0.066116	0.094031	0.000000	0.266667
3.611111	0.066116	0.095500	0.000000	0.266667
3.666667	0.066116	0.096970	0.000000	0.266667
3.722222	0.066116	0.098439	0.000000	0.266667
3.777778	0.066116	0.099908	0.000000	0.266667
3.833333	0.066116	0.101377	0.000000	0.266667
3.888889	0.066116	0.102847	0.000000	0.266667
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4.055556	0.066116	0.109458	0.115525	0.266667
4.111111	0.066116	0.113131	0.323094	0.266667
4.166667	0.066116	0.116804	0.575411	0.266667
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4.277778	0.066116	0.124151	1.067215	0.266667
4.333333	0.066116	0.127824	1.242541	0.266667
4.388889	0.066116	0.131497	1.355566	0.266667

```
4.444444  0.066116  0.135170  1.458162  0.266667
4.500000  0.066116  0.138843  1.546614  0.266667
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4.611111  0.066116  0.146189  1.709847  0.266667
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4.833333  0.066116  0.160882  1.996671  0.266667
4.888889  0.066116  0.164555  2.062153  0.266667
4.944444  0.066116  0.168228  2.125618  0.266667
5.000000  0.066116  0.171901  2.187243  0.266667
5.055556  0.066116  0.175574  2.247179  0.266667
END FTABLE  2
FTABLE      3
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.025504  0.000000  0.000000  0.000000
0.066667  0.026468  0.001732  0.000000  0.102867
0.133333  0.027439  0.003529  0.000000  0.102867
0.200000  0.028418  0.005391  0.000000  0.102867
0.266667  0.029404  0.007319  0.000000  0.102867
0.333333  0.030398  0.009312  0.000000  0.102867
0.400000  0.031398  0.011372  0.000000  0.102867
0.466667  0.032406  0.013499  0.000000  0.102867
0.533333  0.033422  0.015693  0.000000  0.102867
0.600000  0.034445  0.017955  0.000000  0.102867
0.666667  0.035475  0.020286  0.000000  0.102867
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2.666667  0.069794  0.124454  0.000000  0.102867
2.733333  0.071052  0.129149  0.000000  0.102867
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2.866667  0.073590  0.138792  0.000000  0.102867
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3.133333  0.078754  0.159102  0.000000  0.102867
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```

```
  3.533333  0.086719  0.192188  0.000000  0.102867
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  3.933333  0.094950  0.228513  0.000000  0.102867
  4.000000  0.096347  0.234890  0.000000  0.102867
  4.066667  0.097752  0.241359  0.000000  0.102867
  4.133333  0.099164  0.247923  0.000000  0.102867
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  5.200000  0.122757  0.366115  0.732975  0.102867
  5.266667  0.124294  0.374350  1.024723  0.102867
  5.333333  0.125838  0.382687  1.242541  0.102867
  5.400000  0.127390  0.391128  1.372649  0.102867
  5.466667  0.128949  0.399673  1.494171  0.102867
  5.533333  0.130516  0.408322  1.597336  0.102867
  5.600000  0.132089  0.417075  1.694231  0.102867
  5.666667  0.133670  0.425934  1.785876  0.102867
  5.733333  0.135259  0.434898  1.873043  0.102867
  5.800000  0.136855  0.443969  1.956330  0.102867
  5.866667  0.138458  0.453146  2.036212  0.102867
  5.933333  0.140068  0.462430  2.113078  0.102867
  6.000000  0.141686  0.471822  2.187243  0.102867
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1         1      WDM   1000 FLOW     ENGL       REPL
RCHRES   1 HYDR   O      1 1         1      WDM   1001 FLOW     ENGL       REPL
RCHRES   1 HYDR   O      2 1         1      WDM   1002 FLOW     ENGL       REPL
RCHRES   1 HYDR   STAGE  1 1         1      WDM   1003 STAG     ENGL       REPL
COPY     1 OUTPUT MEAN   1 1      48.4      WDM    701 FLOW     ENGL       REPL
COPY   501 OUTPUT MEAN   1 1      48.4      WDM    801 FLOW     ENGL       REPL
RCHRES   2 HYDR   RO     1 1         1      WDM   1004 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      1 1         1      WDM   1005 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      2 1         1      WDM   1006 FLOW     ENGL       REPL
RCHRES   2 HYDR   STAGE  1 1         1      WDM   1007 STAG     ENGL       REPL
RCHRES   3 HYDR   RO     1 1         1      WDM   1008 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      1 1         1      WDM   1009 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      2 1         1      WDM   1010 FLOW     ENGL       REPL
RCHRES   3 HYDR   STAGE  1 1         1      WDM   1011 STAG     ENGL       REPL
END EXT TARGETS
```

```
MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK         2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK     2

  MASS-LINK         3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK     3

  MASS-LINK         5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK     5

  MASS-LINK        12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK    12

  MASS-LINK        13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK    13

  MASS-LINK        15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK    15

  MASS-LINK        17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK    17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

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APPENDIX 2 – Soil Management Plan

Soil Management site Plan to be provided with permit set.

APPENDIX 3 – Supplemental Reports and Information

8/2/2024 *(Revised 1/15/2025)*

Allito Properties
Attn: David Litowitz

Subject: **Henderson Blvd Apartments Geotechnical Investigation**
TPN: 12711110300; 7501 Henderson Blvd. SE., Tumwater, WA
Project Number: QG24-097

Dear Client,

At your request, Quality Geo NW, PLLC (QG) has completed a soils investigation of the above-referenced project. The investigation was performed in accordance with our proposal for professional services.

We would be pleased to continue our role as your geotechnical consultant of record during the project planning and construction phases, as local inspection firms have not been found to be as familiar or reliably experienced with geotechnical design. This may include soil subgrade inspections, periodic review of special inspection reports, or supplemental recommendations if changes occur during construction. We will happily meet with you at your convenience to discuss these and other additional *Time & Materials* services.

We thank you for the opportunity to be of service on this project and trust this report satisfies your project needs currently. QG wishes you the best while completing the project.

Respectfully Submitted,
Quality Geo NW, PLLC

Luke Preston McCann, L.E.G.
Owner + Principal

Ray Gean II
Staff Geologist/Project Manger

SOILS REPORT

HENDERSON BLVD APARTMENTS GEO
TPN: 12711110300; 7501 HENDERSON BLVD SE
TUMWATER, WA

Allito Properties
Attn: David Litowitz

Prepared by:

Jason Cross
Staff Geologist

Approved by:

State of Washington
Engineering Geologist
19110623
Licensed Geologist
LUKE PRESTON MCCANN

8/2/2024 *(Revised 1/15/2025)*

Luke Preston McCann, L.E.G.
Principal Licensed Engineering Geologist

Quality Geo NW, PLLC
Geotechnical Investigation & Engineering Consultation
Phone: 360-878-9705 | Web: qualitygeonw.com
Mail: 4631 Whitman Ln SE, Ste D, Lacey, WA 98513

8/2/2024 *(Revised 1/15/2025)*

QG Project # QG24-097

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the findings and recommendations of Quality Geo NW's (QG) soil investigation conducted in support of new site surface improvements.

1.1 PROJECT DESCRIPTION

QG understands the project entails new construction within a presently undeveloped parcel. QG has been contracted to complete a soils investigation of the proposed site from a previous report, and to provide foundation, stormwater, and earthwork recommendations. Initially, GeoResources, LLC was subcontracted by the client to complete the geotechnical fieldwork for the project. We understand they are no longer involved with the project. We were provided with their complete field results, and soil analysis. Based on our review of the logs and data, it appears that a satisfactory level of testing and exploration were completed by GeoResources, requiring no additional field testing at this time. The relevant information has been included within our report.

1.2 FIELD WORK

Site exploration activities were initially subcontracted by the client to GeoResources, LLC and performed on 10/9/2023 & 10/25/2023. We understand that GeoResources is no longer involved with the project. GeoResources directed the advancement of 14 excavated test pits (TP) and 3 Hollow Stem Auger borings with standard penetration testing (SPT) at defined intervals. The test pits were advanced within the vicinity of the anticipated development footprint areas, to maximum depths of 10.0 feet below present grade (BPG) in general accordance with the specified contract depth. The boreholes (BH) were advanced within the vicinity of the anticipated development footprint areas, to a depth of 26.5 or 41.5 feet below present grade. SPT blow counts were recorded during borehole advancement. Disturbed soil samples were collected by split-spoon at 2.5 and 5.0 -foot intervals. Exploration locations were marked in the field by GeoResources with respect to the provided map and cleared for public conductible utilities.

During explorations GeoResources logged each soil horizon we encountered, and field classified them in accordance with the Unified Soil Classification System (USCS). Representative soil samples were collected from each unit, identified according to boring location and depth, placed in plastic bags to protect against moisture loss, and were transported to the soil laboratory for supplemental classification and other tests.

2.0 EXISTING SITE CONDITIONS

2.1 AREA GEOLOGY

QG reviewed available map publications to assess known geologic conditions and hazards present at the site location. The Washington Geologic Information Portal (WGIP), maintained by the Department of Natural Resources Division of Geology and Earth Resources, provides 1:24,000-scale geologic mapping of the region. The geology of the site location and vicinity consists of Pleistocene continental glacial drift (Qgos). The sediment deposits on site are described as "Sand and silt with minor gravel interbeds; tan to brown; clasts moderately to well rounded; generally well sorted; clasts and grains consist of northern-source plutonic and metamorphic rocks and polycrystalline quartz carried by Vashon ice, and porphyritic volcanic rock from the Cascade Range 60 mi to the east; thickness varies from about 4 to 20 ft."

The WGIP Map also offers layers of mapped geohazard conditions within the state. According to the regional-scale interactive map, no landslides or known geohazards are mapped for the site. Available LiDAR imagery of the site did not reveal any obvious over-steepened or slumped areas of the slope.

The United States Department of Agriculture portal (USDA) provides a soil mapping of the region. The soils in the vicinity are mapped as Nisqually loamy fine sand (73) and Indianola loamy sand (46, 47). The Nisqually loam fine sand formed as terraces and was derived from sandy glacial outwash. The soils are described as loamy fine sand from 0 to 31 inches, and loamy sand from 31 to 60 inches. The depth to restrictive feature is more than 80 inches. The capacity of the most limiting layer to transmit water (ksat) is listed as high (1.98 to 5.95 in/hr). The depth to water table is more than 80 inches. The Indianola loamy sand formed as terraces, kames, and eskers and was derived from sandy glacial outwash. The soils are described as slightly decomposed plant material from 0 to 1 inch, loamy sand from 1 to 17 inches, and sand from 17 to 60 inches. The depth to restrictive feature is more than 80 inches. The capacity of the most limiting layer to transmit water (ksat) is listed as high to very high (5.95 to 99.90 in/hr). The depth to water table is more than 80 inches.

2.2 SITE & SURFACE CONDITIONS

The project area is a rectangular in shape parcel that is relatively flat, and near the same elevation as the adjacent Henderson Blvd. The northern corner of the site features a pond and wetland area. The pond and wetland area continue into the neighboring parcel to the north and northeast. To the northwest and west are residential homes while to the west and south are businesses and the Olympia Regional Airport. The site is currently undeveloped and is covered by vegetation in the

form of grasses, brambles, shrubs, and trees both young and mature.

2.3 SOIL LOG

Site soil conditions were generally consistent across the property in all 14 test pits and 3 bore holes. Representative lab samples were taken from TP-1, TP-2, TP-13, B-1, and B-2. General soil conditions on site were as follows:

- **0' to 0.5' – Forest Duff**

  A layer of decaying forest debris and organic matter laying on top of the surface.

- **0.5' to 6.0' – Silty Sand (SM)**

  A 5.5-foot layer of dark brown to brown to tan, loose silty sand was encountered at the surface of the site. This layer features a high amount of organic matter and no mottling. No cobbles were found within this layer across the site. The top 2 feet of this layer are inferred to be topsoil.

- **6.0' to 41.0' – Poorly Graded Sand with Silt (SP-SM)**
  Beneath silty topsoil, the soil column was composed of poorly graded sand with variable fines content. Overall, it was brown and moist in a medium dense condition. There was minor mottling observed beginning at approximately 20-feet below the surface at B-2, but the other boreholes did not show any mottling. No groundwater was encountered in any of the test pits, but groundwater was encountered at about 25 feet in B-2 and 38 feet in B-3.

2.4 SURFACE WATER AND GROUNDWATER CONDITIONS

In the northern corner of the parcel, an unnamed pond exists. Additionally, Munn Lake and Trails End Lake are approximately 1500 feet to the east of the site. During our test pit explorations, no pervasive groundwater table was encountered, but during borehole drilling, groundwater was encountered at about 25 and 38 feet in B-2 and B-3 during the drilling. Additionally, groundwater monitoring was performed by GeoResources during the wet season, where groundwater was observed as high as 21.75 feet below the surface. Based on well logs made publicly available by the WA Department of Ecology the groundwater table is reported to exist at depths greater than 16 feet beneath the entire site.

2.5 GROUNDWATER MONITORING & EVALUATION

The purpose of the water monitoring has been to document seasonal site conditions to provide information on shallow stormwater flux and perched water conditions through the wet season at the project location. Over the 2023-2024 wet season, GeoResources conducted a limited

groundwater characterization & monitoring program. The monitoring program was conducted from November 2023, through April 30, 2024, for a limited wet season monitoring period.

2.5.1 GROUNDWATER MONITORING METHODOLOGY & RESULTS

Over the course of the wet season GeoResources visited the site on a regular basis to collect direct measurements of groundwater within the monitoring portals. Piezometers were placed in each well throughout the duration of the monitoring period to monitor groundwater levels. Monitoring portals were installed in November 2023, to depths ranging from 26.5 to 41.5 feet below present grade (BPG) as access & soil conditions allowed. A pervasive water table was encountered during installation between approximately 25 and 38 feet BPG in B-2 and B-3 locations. GeoResources returned on subsequent site visits to directly measure water levels. Piezometer data was collected at the end of the monitoring period and processed using software. Summarized results of the groundwater monitoring measurements are shown below in the image and Table 1.

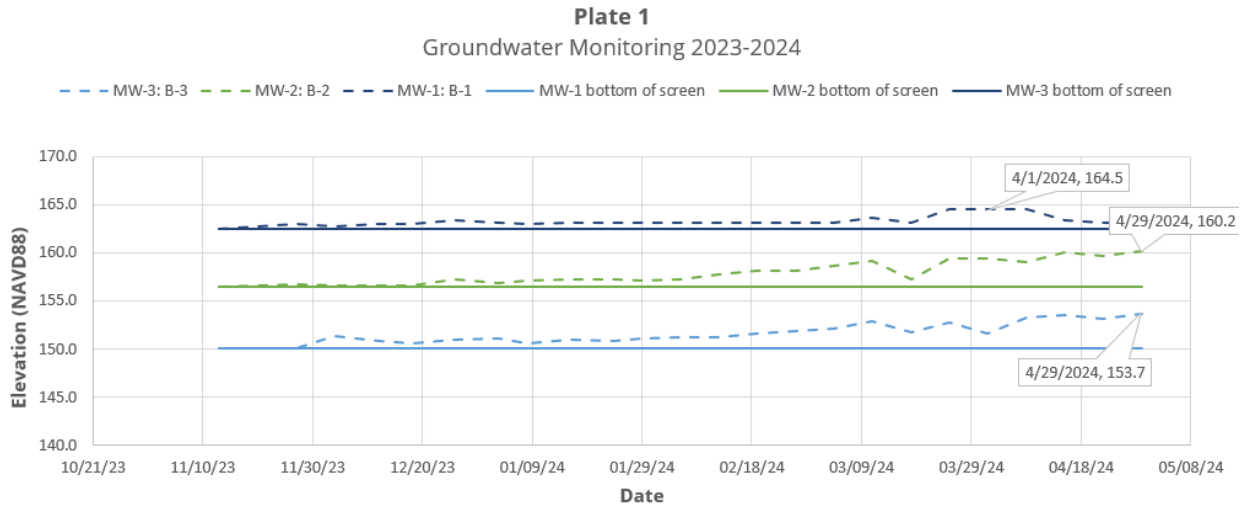


Table 1. Groundwater Monitoring Results

Monitoring Portal ID	Depth to Groundwater (feet)	Elevation of Groundwater (feet)	Date Observed
B-1	23.50	164.5	3/25/2024
B-2	21.75	160.25	4/29/2024
B-3	36.33	153.67	4/29/2024

2.5.2 INTERPRETATION OF FINDINGS & PERCHED GROUNDWATER

In general, monitoring portals appeared to experience an increase in head around mid-February to early April as the rainy season progressed. Peak groundwater elevations between monitoring portals varied by 14.58 feet. This is likely due to the elevation difference between locations, with the parcel grading to lower elevations from southeast to northwest, and the proximity of the pond on the project site and neighboring parcel to the northwest. Monitoring portals experienced

seasonal groundwater highs in March and April, where groundwater reached 21.75 feet below the surface at the shallowest recorded depth, and its highest elevation at 164.5-feet-elevation. Based on these results of seasonal groundwater monitoring, both conventional in-ground infiltration and shallow infiltration appear suitable across the site due to the year-round lack of shallow groundwater table.

3.0 GEOTECHNICAL RECOMMENDATIONS

3.1 SHALLOW FOUNDATION RECOMMENDATIONS

Assuming site preparation is completed as described below, we recommend the following:

- **Subgrade Preparation**

  QG recommends excavating and clearing any loose or organic cover soils, including the overriding layer of topsoil where necessary, from areas of proposed pavement construction, down to firm bearing conditions and benching the final bottom of subgrade elevation flat. Excavations should be performed with a smooth blade bucket to limit disturbance of subgrade soils. Vibratory compaction methods are suitable for densification of the non-organic native soils.

  After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the periodic guidance of a QG representative. Any areas that are identified as being soft or yielding during subgrade evaluation should be brought to the attention of the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over-excavated areas should be backfilled with properly compacted structural fill.

  The proposed buildings may utilize either stepped or continuous footings with slab-on-grade elements. For continuous footing elements, upon reaching bearing strata, we recommend benching foundation lines flat. Continuous perimeter and strip foundations may be stepped as needed to accommodate variations in final subgrade level. We also recommend maximum steps of 18 inches with spacing of at least 5 feet be constructed unless specified otherwise by the design engineer. Structural fill may then be placed as needed to reestablish final foundation grade.

- **Allowable Bearing Capacity:**

  Up to 1,500 pounds per square foot (psf) for foundations placed on 24 inches of compacted import structural fill placed in accordance with the recommendations of *Section 4.2*. Bearing capacities, at or below 1,500 psf may eliminate the need for additional inspection requirements if approved by the county. The allowable bearing capacity may be increased by 1/3 for transient loading due to wind and seismic events.

- **Minimum Footing Depth:**

  For a shallow perimeter and spread footing system, all exterior footings shall be embedded a minimum of 18 inches and all interior footings shall be embedded a minimum of 12 inches

below the lowest adjacent finished grade, but not less than the depth required by design. However, all footings must also penetrate to the prescribed bearing stratum cited above. Minimum depths are referenced per IBC requirements for frost protection; other design concerns may dictate greater values be applied.

- **Minimum Footing Width:**

  Footings should be proportioned to meet the stated bearing capacity and/or the IBC 2018 (or current) minimum requirements. For a shallow perimeter and spread footing system, continuous strip footings should be a minimum of 16 inches wide and interior or isolated column footings should be a minimum of 24 inches wide.

- **Estimated Settlements:**

  All concrete settles after placement. We estimate that the maximum settlements will be on the order of 0.5 inch, or less, with a differential settlement of ½ inch, or less, over 50 linear feet. Settlement is anticipated to occur soon after the load is applied during construction.

3.2 LATERAL SOIL & CONCRETE FOUNDATION CONSIDERATIONS

The results of QG's investigation indicate shallow subsurface conditions at the proposed building area consist of generally silty sands.

The finished grade is assumed to be similar to the existing grade. In general, native soils are not considered suitable for use as backfill against new in-ground structures or direct bearing. QG understands that the building structures may likely incorporate continuous perimeter grade beams as well as isolated footings, incorporating soil amendment as determined by the structural design team. For lateral support of these structures, the following soil parameters should be considered regarding any structural fill against these features (ignoring the upper 18 inches, due to freeze/thaw softening, unless covered in concrete or asphalt).

Table 2. Lateral Earth Pressures

Soil Type	Active Pressure (PSF*H)	At-Rest Pressure (PSF*H)	Seismic Surcharge (PSF*H)	Grade Beam Passive Equivalent Fluid Weight (PCF)	Grade Beam Coefficient of Friction
Existing Soils (SM)	45	60	9	187*	0.35**
New Structural Fill	35	55	10	200	0.35

*Factor of Safety: 2.0
**Factor of Safety: 1.5

All concrete foundation elements must bear on approved, imported, granular, structural fill per the requirements of *Section 4.2 Structural Fill Materials and Compaction*. To ensure adequate friction,

no fabric shall be placed between the structural fill and native soils when placed under primary building foundations & grade beams.

The proposed buildings may utilize continuous grade beams with slab-on-grade, where appropriate, depending on the chosen development style. For continuous footing elements, upon reaching bearing strata, we recommend benching foundation lines flat.

3.3 SEISMIC DESIGN PARAMETERS AND LIQUEFACTION

According to the Liquefaction Susceptibility Map of Seismic Design Maps Portal, the site is identified as having low to moderate susceptibility. This is generally consistent with the findings of QG's investigation to date. Liquefaction is a phenomenon typically associated with a subsurface profile of relatively loose, cohesionless soils saturated by groundwater. Under seismic shaking the pore pressure can exceed the soil's shear resistance and the soil 'liquefies', which may result in excessive differential settlements that are damaging to structures and disruptive to exterior improvements. *The Washington Interactive Geologic Map - Seismic Site Class Map* classifies the project regional vicinity as *Site Class D.*

The USGS Seismic Design Map Tool was used to determine seismic design coefficients and spectral response accelerations assuming Site Class D, representing a generally stiff soil profile (upper 100 feet). Parameters in Table 3 were calculated using 2014 USGS hazard data and ASCE 7-16 was referenced for site Peak Ground Acceleration.

Table 3. Seismic Design Parameters

Seismic Design Category		D	D	D-Default
Reference		ASCE 7-10	ASCE 7-16	ASCE 7-16
Risk Category		II	II	II
MCE_R ground motion (period=0.2s)	S_S	1.302	1.375	1.375
MCER ground motion (period=1.0s)	S_1	0.537	0.514	0.514
Site-modified spectral acceleration value	S_{MS}	1.302	1.375	1.65
Site-modified spectral acceleration value	S_{M1}	0.805	NULL	NULL
Numeric seismic design value at 0.2s SA	S_{DS}	0.868	0.917	1.1
Numeric seismic design value at 1.0s SA	S_{D1}	0.537	NULL	NULL
Site amplification factor at 0.2s	F_a	1.0	1.0	1.2
Site amplification factor at 1.0s	F_v	1.5	NULL	NULL
Site modified peak ground acceleration	PGA_M	0.5	0.652	0.712

Based on the findings of this study, the site is generally considered to have a low to moderate risk of liquefaction-induced settlement.

3.4 BUILDING SLAB ON GRADE FLOOR

QG anticipates that slab-on-grade floors are planned for the interior of the proposed building. Based on typical construction practices, we assume finished slab grade will be similar to or marginally above present grade for the below recommendations. If floor grades are planned to be substantially raised or lowered from existing grade, QG should be contacted to provide revised or alternative recommendations.

- **Capillary Break:**

  A capillary break will be helpful to maintain a dry slab floor and reduce the potential for floor damage resulting from shallow perched water inundation. To provide a capillary moisture break, a 6-inch thick, properly compacted granular mat consisting of open-graded, free-draining angular aggregate is recommended below floor slabs. To provide additional slab structural support, or to substitute for a structural fill base pad where specified, QG recommends the capillary break should consist of crushed rock all passing the 1-inch sieve and no more than 3 percent (by weight) passing the U.S. No. #4 sieve, compacted in accordance with *Section 5.2.2* of this report.

- **Vapor Barrier:**

  A vapor retarding membrane such as 10 mil polyethylene film should be placed beneath all floor slabs to prevent transmission of moisture where floor coverings may be affected. Care should be taken during construction not to puncture or damage the membrane. To protect the membrane, a layer of sand no more than 2 inches thick may be placed over the membrane if desired. If excessive relict organic fill material is discovered at any location, additional sealant or more industrial gas barriers may be required to prevent off-gassing of decaying material from infiltrating the new structure. These measures shall be determined by the structural engineer to meet local code requirements as necessary.

- **Structural Design Considerations:**

  QG assumes the design and specifications of slabs will be assessed by the project design engineer. We suggest a minimum unreinforced concrete structural section of 4.0 inches be considered to help protect against cracking and localized settlement, especially where larger equipment or localized loads are anticipated. It is generally recommended that any floor slabs and annular exterior concrete paving subject to vehicular loading be designed to incorporate reinforcing. Additionally, some level of reinforcing, such as a wire mesh may be desirable to prolong slab life due to the overwhelming presence of such poor underlying soils. It should be noted that QG does not offer any guarantee or warranty for proposed slab sections.

3.5 INFILTRATION RATE DETERMINATION

QG understands the design of on-site stormwater controls are pending the results of this study to confirm design parameters and interpreted depths to perched seasonal groundwater and restrictive soil features.

3.5.1 GRADATION ANALYSIS METHODS & RESULTS

During test pit excavations for general site investigation, GeoResources additionally collected representative samples of native soil deposits among potential infiltration strata and depths. Representative soil samples were selected from test pits and boreholes on the site (TP-1, TP-2, TP-13, B-2, and B-3) to characterize the local infiltration conditions.

QG understand the project will be subject to infiltration design based on the Washington Department of Ecology Stormwater Management Manual for Western Washington (DoE SMMWW). For initial site infiltration characterization within the scope of this study, laboratory gradation analyses were completed including sieve and hydrometer tests for stormwater design characterization and rate determination to supplement field observations. Results of laboratory testing in terms of rate calculation are summarized below.

Laboratory results were interpreted to recommended design inputs in accordance with methods of the 2019 DoE SMMWW. Gradation results were applied to the Massmann (2003) equation (1) to calculate Ksat representing the initial saturated hydraulic conductivity.

(1) $\log10(Ksat) = -1.57 + 1.90*D10 + 0.015*D60 - 0.013*D90 - 2.08*ff$

Corrected Ksat values presented below are a product of the initial Ksat and correction factor CFT. For a generalized site-wide design situation, we have applied a site variability factor of CFv = 0.7 along with typical values of CFt = 0.4 (for the Grain Size Method) and CFm = 0.9 (assuming standard influent control).

(2) $CFT = CFv \times CFt \times CFm = 0.7 \times 0.4 \times 0.9 = 0.25$

Results were cross-referenced with test pit logs to determine the validity and suitability of unique materials as an infiltration receptor. Additional reduction factors were applied for practical rate determination based on our professional judgement.

Table 4. Results Of Massmann Analysis

TP #	Sample Depth *(BPG)*	Unit Extent *(ft)*	Soil Type	D10	D60	D90	Fines (%)	Ksat *(in/hr)*	Corrected Ksat *(in/hr)*	LT Design Infiltration Rate*(in/hr)*
1	0.5-3.0ft	0.5 to 3.0’	SM	0.001	0.24	0.39	12.8	20.69	5.17	**5.17**
2	6.0ft	0.5 to 7.5’	SM	0.001	0.19	0.30	13.4	20.12	5.03	**5.03**
2	9.0-10.0ft	9.0 to 10.0’+	SM	0.001	0.14	0.30	40.7	5.43	1.36	**1.36**
13	9.0ft	6.0 to 10.0’	SP-SM	0.084	0.18	0.24	6.3	40.70	10.18	**10.18**
B-1	15.0ft	15.0 to 26.5’	SM	0.001	0.14	0.21	16.9	17.03	4.26	**4.26**
B-2	15.0ft	5.0 to 26.5’	SP-SM	0.080	0.22	0.33	8.4	36.12	9.03	**9.03**

Beneath topsoil, the SM and SP-SM soils were observed to exhibit a variable amount of fines content. In B-2, minimal oxidation patterns in the form of mottling at depths greater than 20 feet. In-ground infiltration structures are required to maintain a minimum of 5-feet separation from restrictive soil & perched water features. Available well logs did not indicate the potential for shallow ground water. The required separation appears generally achievable across the site. At this time, QG does not recommend mounding analysis due to the generally suitable site conditions.

Due to some underlying lenses of more fine-grained-rich sediments across the site, the design rates will vary depending on location. **For in-ground infiltration galleries, QG recommends location specific maximum design rates of 10.18 in/hour for the northwest (near TP-10 & 13), 9.03 in/hour in the center (near BH-2), and 5.17 in/hour for the southeast (near TP-1) be considered.** For any shallow infiltration features such as rain gardens, pervious pavement, or swales, we recommend the designer consider a reduced rate of 1.0 inches per hour which is typically suitable and considers potential reductions from compaction during construction. In-situ infiltration verification testing during construction shall be completed prior to completion of the infiltration features, in each of the proposed locations.

QG recommends the facility designer review these results and stated assumptions per reference literature to ensure applicability with the proposed development, level of anticipated controls, and long- term maintenance plan. The designer may make reasonable adjustments to correction factors and the resulting design values based on these criteria to ensure design and operational intent is met. We recommend that we be contacted if substantial changes to rate determination are considered.

3.5.2 TREATMENT POTENTIAL

Depending on stormwater and runoff sources, some stormwater features, such as rain gardens or pervious pavements may require treatment. Stormwater facilities utilizing native soils as treatment media typically require Cation Exchange Capacities (CEC) of greater than 5 milliequivalents per 100grams (meq/100g) and organic contents greater than 1% (this may vary depending on local code). CEC and LOI analyses were not conducted by GeoResources. The import of traditional treatment media may be required within infiltration receptors, unless further testing is required for permitting or design.

3.5.3 DRAINAGE RECOMMENDATIONS

QG recommends proper drainage controls for stormwater runoff during and after site development to protect the site. The ground surface adjacent to structures should be sloped to drain away at a 5% minimum to prevent ponding of water adjacent to them.

Foundations shall incorporate a wraparound footing drain composed of imported clean granular drain rock. There shall be a perforated drainpipe connected around the perimeter of the footing drain (within the rock) graded to gravity drain to an outfall pipe, to allow any accumulated water to be released to an approved drainage feature or location. The outfall point must be lower in elevation than the lowest point of possible water accumulation in the mat fill, so as to allow any captured water within the mat or crawlspace to completely drain away from the building footprint preventing standing water from accumulating. QG recommends all stormwater catchments (new or existing) be tightlined (piped) away from structures to an existing catch basin, stormwater system, established channel, or approved outfall to be released using appropriate energy-dissipating features at the outfall to minimize point erosion. Roof and footing drains should be tightlined separately or should be gathered in an appropriately sized catch basin structure and redistributed collectively. If storm drains are incorporated for impervious flatworks (driveways, sidewalks, etc.) collected waters should also be discharged according to the above recommendations. Appropriate measures should be taken by the site designer to consider and allow for an adequate emergency outfall location in the event of a future record stormwater fall that cannot be anticipated.

4.0 CONSTRUCTION RECOMMENDATIONS

4.1 EARTHWORK

4.1.1 GRADING & EXCAVATION

A grading plan was not available to QG at the time of this report. However, based on provided conceptual plans, this study assumes finished site grade will approximate current grade. Therefore, depths referred to in this report are considered roughly equivalent to final depths. Excavations can generally be performed with conventional earthmoving equipment such as bulldozers, scrapers, and excavators.

4.1.2 SUBGRADE EVALUATION & PREPARATION

After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the part-time observation and guidance of a QG representative.

The special inspection firm should continuously evaluate all backfilling. Any areas that are identified as being soft or yielding during subgrade evaluation should be over excavated to a firm and unyielding condition or to the depth determined by the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over-excavated areas should be backfilled with properly compacted structural fill.

4.1.3 SITE PREPARATION, EROSION CONTROLL, WET WEATHER

Any silty or organic rich native soils may be moisture-sensitive and become soft and difficult to traverse with construction equipment when wet. During wet weather, the contractor should take measures to protect any exposed soil subgrades, limit construction traffic during earthwork activities, and limit machine use only to areas undergoing active preparation.

Once the geotechnical engineer has approved the subgrade, further measures should be implemented to prevent degradation or disturbance of the subgrade. These measures could include, but are not limited to, placing a layer of crushed rock or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tarp and keeping construction traffic off the subgrade. Once the subgrade has been approved, any disturbance because the subgrade was not protected should be repaired by the contractor at no cost to the owner.

During wet weather, earthen berms or other methods should be used to prevent runoff from draining into excavations. All runoffs should be collected and disposed of properly. Measures may

also be required to reduce the moisture content of on-site soils in the event of wet weather. These measures can include, but are not limited to, air drying and soil amendment, etc.

QG recommends earthwork activities take place during the summer dry season.

4.2 STRUCTURAL FILL MATERIALS AND COMPACTION

4.2.1 MATERIALS

All material placed below structures or pavement areas should be considered structural fill. Excavated native soils are not considered suitable for reuse as structural fill. Imported material should be used as structural fill. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials. Frozen soil is not suitable for use as structural fill. Fill material may not be placed on frozen soil.

Structural fill material shall be free of deleterious materials, have a maximum particle size of 4 inches, and be compactable to the required compaction level. Imported structural fill material should conform to the WSDOT manual Section 9-03.14(1) Gravel Borrow, or an approved alternative import material. Controlled-density fill (CDF) or lean mix concrete can be used as an alternative to structural fill materials, except in areas where free-draining materials are required or specified.

Imported materials utilized for trench back fill shall conform to Section 9-03.19, Trench Backfill, of the most recent edition (at the time of construction) of the State of Washington Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*. Imported materials utilized as grade fill beneath roads shall conform to WSDOT Section 9-03.10, Gravel Base.

Pipe bedding material should conform to the manufacturer's recommendations and be worked around the pipe to provide uniform support. Cobbles exposed in the bottom of utility excavations should be covered with pipe bedding or removed to avoid inducing concentrated stresses on the pipe.

Soils with fines content near or greater than 10% fines content may likely be moisture sensitive and become difficult to use during wet weather. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials.

The contractor should submit samples of each of the required earthwork materials to the materials testing lab for evaluation and approval prior to delivery to the site. The samples should be

submitted **at least 5 days prior to their delivery** and sufficiently in advance of the work to allow the contractor to identify alternative sources if the material proves unsatisfactory.

4.2.2 FILL PLACEMENT AND COMPACTION

For lateral and bearing support, structural fill placement below footings shall extend at minimum a distance past each edge of the base of the footing equal to the depth of structural fill placed below the footing [i.e., extending at least a 1H:1V past both the interior and the exterior of the concrete footing].

Prior to placement and compaction, structural fill should be moisture conditioned to within 3 percent of its optimum moisture content. Loose lifts of structural fill shall not exceed 12 inches in thickness. All structural fill shall be compacted to a firm and unyielding condition and to a minimum percent compaction based on its modified Proctor maximum dry density as determined per ASTM D1557. Structural fill placed beneath each of the following shall be compacted to the indicated percent compaction:

- Foundation and Floor Slab Subgrades: 95 Percent
- Pavement Subgrades & wall backfill (upper 2 feet): 95 Percent
- Pavement Subgrades & wall backfill (below 2 feet): 90 Percent
- Utility Trenches (upper 4 feet): 95 Percent
- Utility Trenches (below 4 feet): 90 Percent

A sufficient number of tests should be performed to verify the compaction of each lift. The number of tests required will vary depending on the fill material, its moisture condition and the equipment being used. Initially, more frequent tests will be required while the contractor establishes the means and methods required to achieve proper compaction.

Jetting or flooding is not a substitute for mechanical compaction and should not be allowed.

4.3 TEMPORARY EXCAVATIONS AND TRENCHES

All excavations and trenches must comply with applicable local, state, and federal safety regulations. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing soil type information solely as a service to our client for planning purposes. Under no circumstances should the information be interpreted to mean that QG is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred. The contractor shall be responsible for the safety of personnel working in utility trenches. Given that steep excavations in native soils may be prone to caving, we recommend all utility trenches, but particularly those greater than 4 feet in depth, be supported in

accordance with state and federal safety regulations. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation.

Temporary excavations and trenches should be protected from the elements by covering them with plastic sheeting or some other similar impermeable material. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soils under the sheeting.

5.0 SPECIAL INSPECTION

The recommendations made in this report assume that an adequate program of tests and observations will be made throughout construction to verify compliance with these recommendations. Testing and observations performed during construction should include, but not necessarily be limited to, the following:

- Geotechnical plan review and engineering consultation as needed prior to construction phase,
- Observations and testing during site preparation, earthwork, structural fill, and pavement section placement,
- Consultation on temporary excavation cutslopes and shoring if needed,
- Consultation as necessary during construction.

QG recommends that we be retained for construction phase soils testing and periodic earthwork observation in accordance with the local code requirements. We also strongly recommend that QG be retained as the project Geotechnical Engineering Firm of Record (GER) during the construction of this project to perform periodic supplementary geotechnical observations and review the special inspectors reports during construction.

Our knowledge of the project site and the design recommendations contained herein will be of great benefit in the event that difficulties arise and either modifications or additional geotechnical engineering recommendations are required or desired. We can also, in a timely fashion observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

We would be pleased to meet with you at your convenience to discuss the *Time & Materials* scope and cost for these services.

6.0 LIMITATIONS

Upon acceptance and use of this report, and its interpretations and recommendations, the user shall agree to indemnify and hold harmless QG, including its owners, employees and subcontractors, from any adverse effects resulting from development and occupation of the subject site. Ultimately, it is the owner's choice to develop and live in such an area of possible geohazards (which exist in perpetuity across the earth in one form or another), and therefore the future consequences, both anticipated and unknown, are solely the responsibility of the owner. By using this report for development of the subject property, the owner must accept and understand that it is not possible to fully anticipate all inherent risks of development. The recommendations provided above are intended to reduce (but may not eliminate) such risks.

This report does not represent a construction specification or engineered plan and shall not be used or referenced as such. The information included in this report should be considered supplemental to the requirements contained in the project plans & specifications and should be read in conjunction with the above referenced information. The selected recommendations presented in this report are intended to inform only the specific corresponding subjects. All other requirements of the above-mentioned items remain valid, unless otherwise specified.

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, field observations and explorations, and laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, or if the scope of the proposed construction changes from that described in this report, QG should be notified immediately in order to review and provide supplemental recommendations.

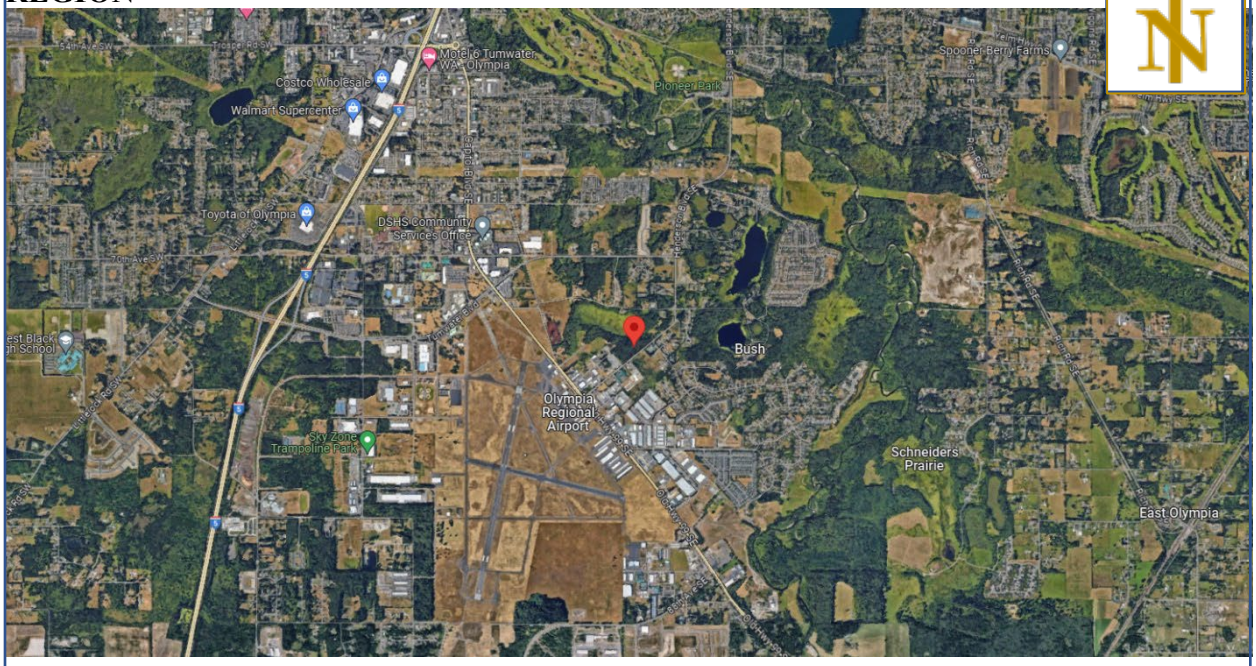
The findings of this study are limited by the level of scope applied. We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the subject region. No warranty, expressed or implied, is made. The recommendations provided in this report assume that an adequate program of tests and observations will be conducted by a WABO approved special inspection firm during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and their design consultants and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. It is the Client's responsibility to ensure that the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. Note that if another firm assumes Geotechnical Engineer of Record responsibilities, they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation.

Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required. Based on the intended use of the report, QG may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release QG from any liability resulting from the use of this report. The Client, the design consultants, and any unauthorized party, agree to defend, indemnify, and hold harmless QG from any claim or liability associated with such unauthorized use or non-compliance. We recommend that QG be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

Appendix A. Region & Vicinity Maps

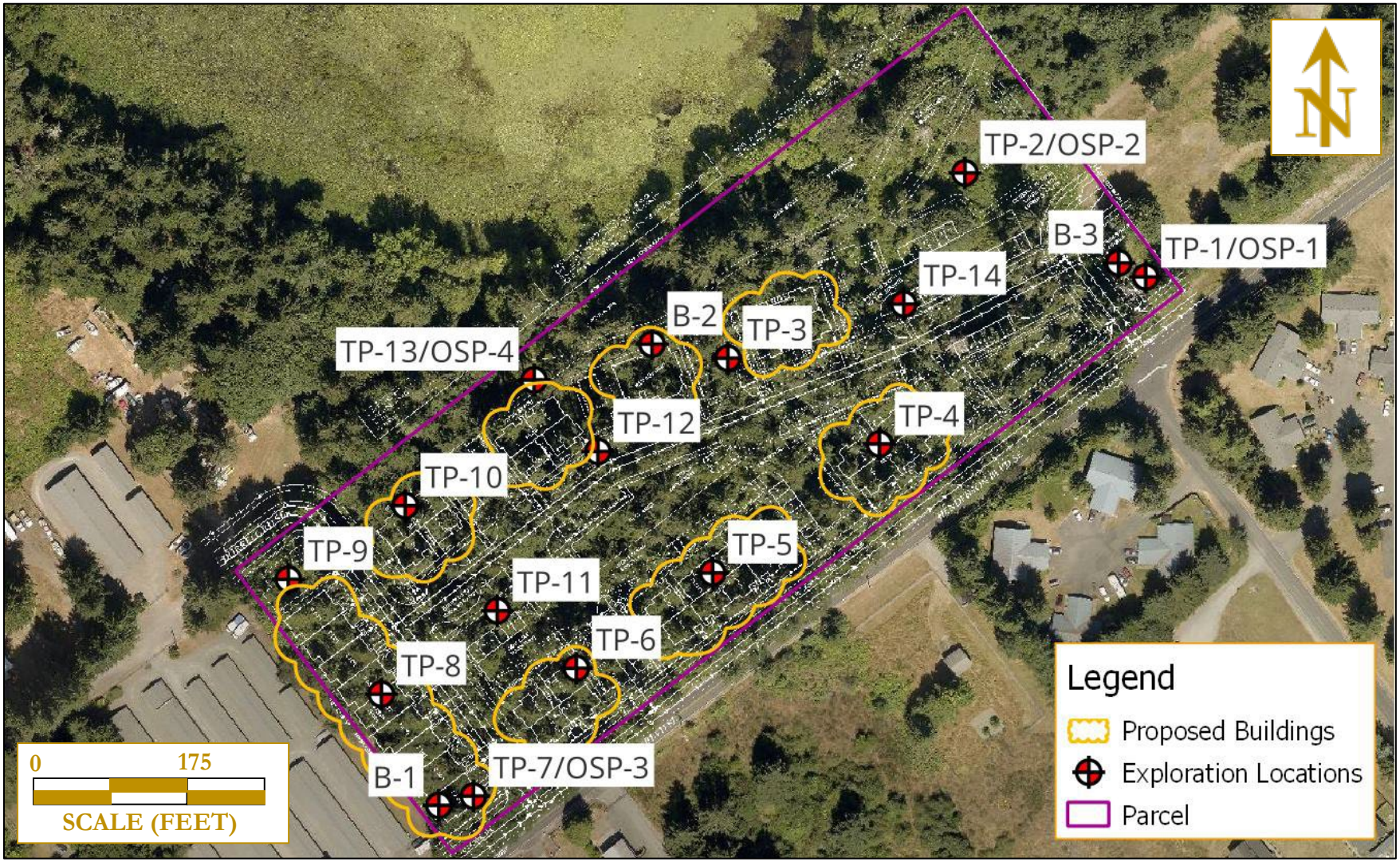
REGION



VICINITY

Quality Geo NW, PLLC	**Site Region** Henderson Blvd Apts Geo	Source: Google Imagery, 2024 **Scale & Locations are approx.** **Not for Construction**	**Figure 1**

Appendix B. Exploration Map



Quality Geo NW, PLLC	**Site Map** Henderson Blvd Apts Geo	Source: Thusrton Co. GIS, 2024 **Scale & Locations are approx.** **Not for Construction**	**Figure 2**

Appendix C. Exploration Logs

Test Pit TP-1

Location: Proposed stormwater facility, NE area of site
Approximate Elevation: 188 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	1.5	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
1.5	-	3.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
3.0	-	6.0	SP-SM	Tan silty SAND (medium dense, moist) (weathered recessional outwash)
6.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
Piezometer set to 9.5 feet below existing grades.

Test Pit TP-2

Location: Proposed stormwater facility, N area of site
Approximate Elevation: 184 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	1.5	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
1.5	-	6.0	SM	Brown silty fine SAND (loose to medium dense, moist) (weathered recessional outwash)
6.0	-	7.5	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
7.5	-	9.0	SP	Gray fine SAND with silt (medium dense, moist) (recessional outwash)
9.0	-	10.0	SM	Golden brown silty fine SAND (dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
Piezometer set to 9.5 feet below existing grades.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
Proposed Multi-Family Development
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Tumwater, Washington
PN: 12711110300

DocID: DJLInvestments.HendersonMF.F	Jun 2024	Figure A-2

Test Pit TP-3

Location: Proposed 3-story building, N area of site
Approximate Elevation: 184 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	3.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
3.0	-	6.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
6.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-4

Location: Proposed 3-story building, E area of site
Approximate Elevation: 187 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	5.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
5.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
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Tumwater, Washington
PN: 12711110300

DocID: DJLInvestments.HendersonMF.F | Jun 2024 | Figure A-3

Test Pit TP-5

Location: Proposed 3-story building, E central area of site
Approximate Elevation: 189 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	5.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
5.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-6

Location: Proposed 3-story building, S area of site
Approximate Elevation: 189 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	3.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
3.0	-	7.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
7.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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DocID: DJLInvestments.HendersonMF.F | Jun 2024 | Figure A-4

Test Pit TP-7

Location: Proposed stormwater facility, SW area of site
Approximate Elevation: 190 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	7.5	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
7.5	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
Piezometer set to 9.5 feet below existing grades.

Test Pit TP-8

Location: Proposed single story building, SW area of site
Approximate Elevation: 189 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	7.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
7.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
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PN: 12711110300

DocID: DJLInvestments.HendersonMF.F	Jun 2024	Figure A-5

Test Pit TP-9

Location: Proposed open space, SW area of site
Approximate Elevation: 189 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	6.5	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
6.5	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-10

Location: Proposed 3-story building, W area of site
Approximate Elevation: 188 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	6.5	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
6.5	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
Proposed Multi-Family Development
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PN: 12711110300

DocID: DJLInvestments.HendersonMF.F | Jun 2024 | Figure A-6

Test Pit TP-11

Location: Proposed 2-story building
Approximate Elevation: 189 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	6.5	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
6.5	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-12

Location: Near proposed clubhouse/pool building, central area of site
Approximate Elevation: 186 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	7.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
7.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
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PN: 12711110300

DocID: DJLInvestments.HendersonMF.F | Jun 2024 | Figure A-7

Test Pit TP-13

Location: Proposed stormwater facility, W area of site
Approximate Elevation: 183 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	2.0	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
2.0	-	4.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
4.0	-	6.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
6.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
Piezometer set to 9.5 feet below existing grades.

Test Pit TP-14

Location: E area of site
Approximate Elevation: 186 feet

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Forest duff
0.5	-	1.5	SM	Dark brown silty fine SAND, rootzone (loose, moist) (weathered recessional outwash)
1.5	-	3.0	SM	Brown silty fine SAND (loose, moist) (weathered recessional outwash)
3.0	-	5.0	SM	Tan silty fine SAND (medium dense, moist) (weathered recessional outwash)
5.0	-	10.0	SP-SM	Gray fine SAND with silt (medium dense, moist) (recessional outwash)

Terminated at 10.0 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: AES **Excavated on: October 9, 2023**

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Test Pit Logs
Proposed Multi-Family Development
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LOG OF BORING — B-1

Proposed Multi-Family Residence

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company:	Boretec1, Inc.	Logged By:	AES
Drilling Method:	HSA	Drilling Date:	10/25/2023
Drilling Rig:	EC 95 Track Drill	Datum:	NAVD 88
Sampler Type:	Split Spoon	Elevation:	190
Hammer Type:	Cathead	Termination Depth:	26.5
Hammer Weight:	140 lbs	Latitude:	46.9780937
		Longitude:	-122.8919362

Notes: Well Tag: BNV 640

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results	Groundwater
0	190		Forest Duff				Plastic Limit — Liquid Limit; % Fines (<0.075mm) ◇; % Water Content ●; Penetration - ▲ (blows per foot)	NE
			Dark brown silty SAND (loose, moist) (SM) (weathered recessional outwash)					
			Brown silty SAND (loose, moist) (SM) (weathered recessional outwash)	4 4 5				
5	185		Tan silty SAND (medium dense, moist) (SM) (weathered recessional outwash)	6 7 8				
			Gray poorly graded SAND with silt (medium dense, moist) (SP-SM) (recessional outwash)					
10	180			7 7 6				
15	175	Becomes dense	Silty SAND (SM)	10 15 13				
20	170			9 13 15				
25	165	density decreases		5 8 7				
			(Termination Depth - 10/25/2023)					
30	160							

Topsoil | Silty sand | Poorly graded sand with silt

Sheet 1 of 1 | JOB: DJLInvestments.HendersonMF | FIG.

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LOG OF BORING — B-2

Proposed Multi-Family Residence

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company:	Boretec1, Inc.	Logged By:	AES
Drilling Method:	HSA	Drilling Date:	10/25/2023
Drilling Rig:	EC 95 Track Drill	Datum:	NAVD 88
Sampler Type:	Split Spoon	Elevation:	182
Hammer Type:	Cathead	Termination Depth:	26.5
Hammer Weight:	140 lbs	Latitude:	46.9797802
		Longitude:	-122.8906705

Notes: Well Tag: BNV 641

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol
0	180		Forest Duff			
			Dark brown silty SAND (loose, moist) (SM) (weathered recessional outwash)			
			Brown silty SAND (loose, moist) (SM) (weathered recessional outwash)	4 3 5		
5	175		Tan silty SAND (loose, moist) (SM) (weathered recessional outwash)	4 6 6		
			Gray poorly graded SAND with silt (medium dense, moist) (SP-SM) (recessional outwash)	5 6 7		
10	170			6 7 8		
15	165		Golden brown poorly graded SAND with silt (medium dense, moist) (SP-SM) (recessional outwash)	5 6 7		
20	160		Gray, orange iron oxide stained coarse SAND with silt (medium dense, moist) (SP-SM) (recessional outwash)	6 8 10		
25	155	becomes wet		7 8 5		
			(Termination Depth - 10/25/2023)			
30	150					

Test Results: Plastic Limit — Liquid Limit; % Fines (<0.075mm) ◇; % Water Content ●

Penetration - ▲ (blows per foot) 0 10 20 30 40

Groundwater: ATD

Topsoil | Silty sand | Poorly graded sand with silt

Sheet 1 of 1 | JOB: DJLInvestments.HendersonMF | FIG.

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LOG OF BORING — B-3

Proposed Multi-Family Residence

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company:	Boretec1, Inc.	Logged By:	AES
Drilling Method:	HSA	Drilling Date:	10/25/2023
Drilling Rig:	EC 95 Track Drill	Datum:	NAVD 88
Sampler Type:	Split Spoon	Elevation:	188
Hammer Type:	Cathead	Termination Depth:	41.5
Hammer Weight:	140 lbs	Latitude:	46.9780937
		Longitude:	-122.8919362

Notes: Well Tag: BNV 642

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results: Plastic Limit — Liquid Limit; % Fines (<0.075mm) ◇; % Water Content ●; Penetration - ▲ (blows per foot)	Groundwater
0	188		Forest Duff					
			Dark brown silty SAND (loose, moist) (SM) (weathered recessional outwash)	4 4 3				
5	185		Tan silty SAND (loose, moist) (SM) (weathered recessional outwash)	4 4 4				
			Gray poorly graded SAND with silt (medium dense, moist) (SP-SM) (recessional outwash)	4 5 8				
10	180			3 4 6				
15	175			7 8 7				
20	170			7 6 8				
25	165			5 9 9				
30	160							

Topsoil | Silty sand | Poorly graded sand with silt

Sheet 1 of 2 | JOB: DJLInvestments.HendersonMF | FIG.

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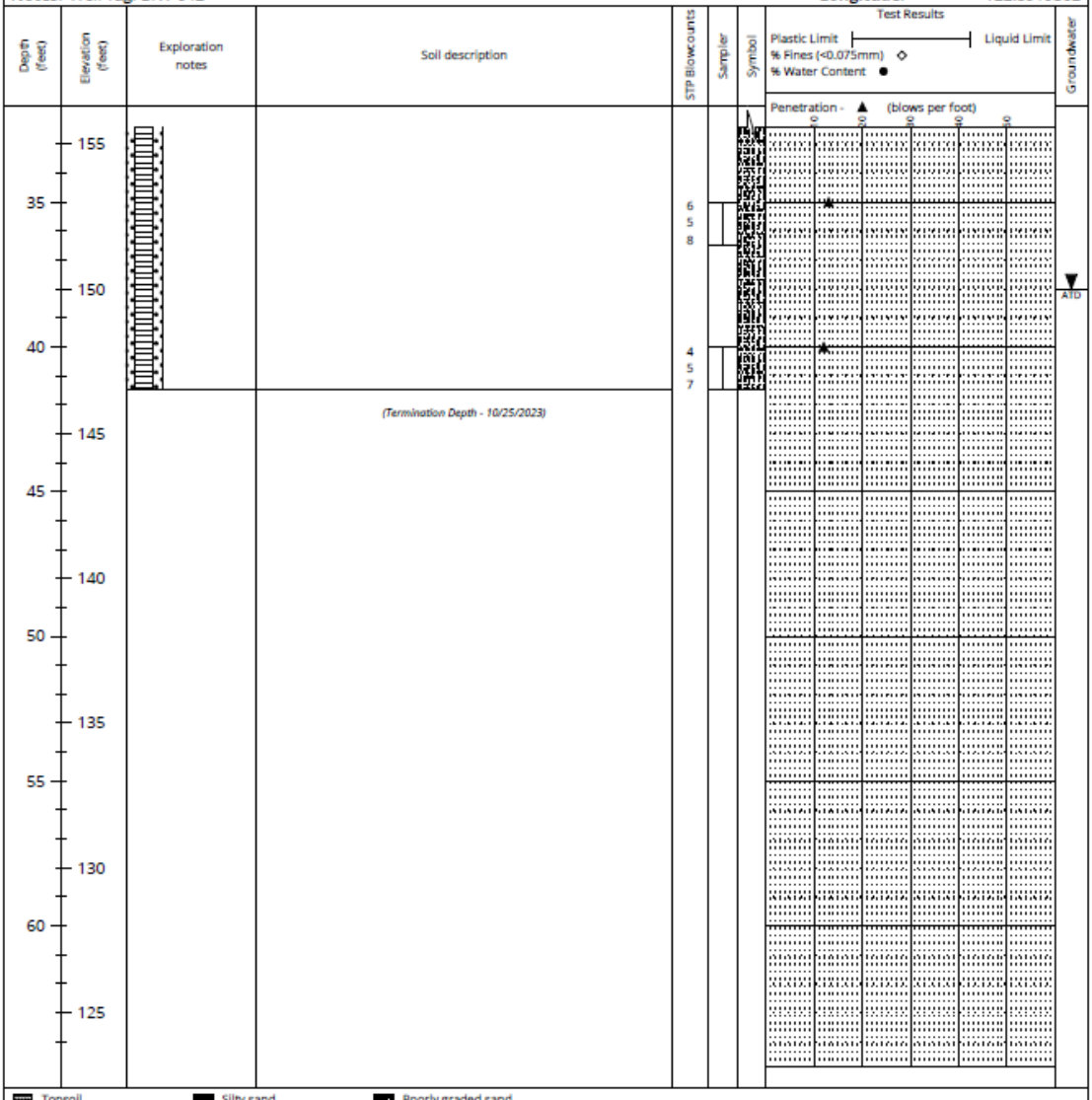
LOG OF BORING — B-3

Proposed Multi-Family Residence

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company:	Boretec1, Inc.	Logged By:	AES
Drilling Method:	HSA	Drilling Date:	10/25/2023
Drilling Rig:	EC 95 Track Drill	Datum:	NAVD 88
Sampler Type:	Split Spoon	Elevation:	188
Hammer Type:	Cathead	Termination Depth:	41.5
Hammer Weight:	140 lbs	Latitude:	46.9780937
		Longitude:	-122.8919362

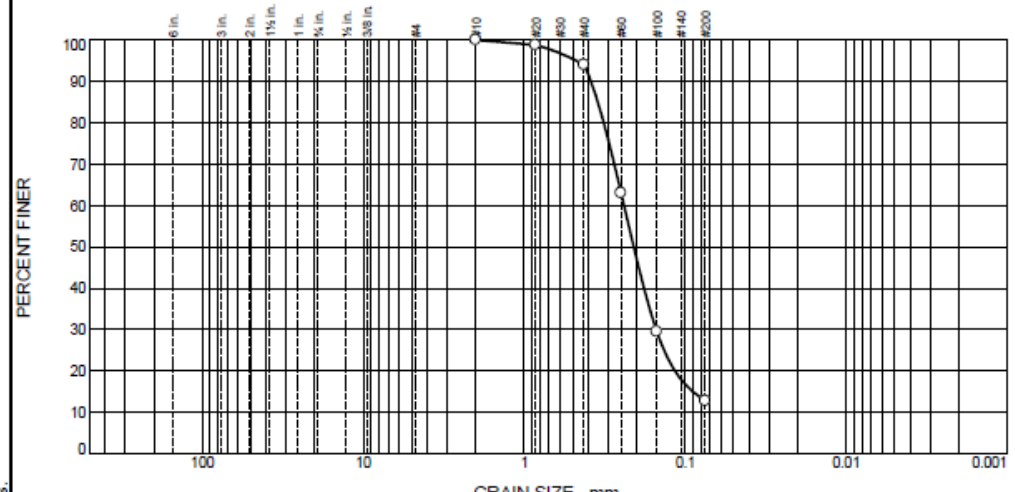
Notes: Well Tag: BNV 642



Sheet 2 of 2 | JOB: DJLInvestments.HendersonMF | FIG.

Appendix D. Laboratory Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	6.0	81.2	12.8	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	98.8		
#40	94.0		
#60	63.0		
#100	29.5		
#200	12.8		

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 0.3849 D_{85}= 0.3490 D_{60}= 0.2397
D_{50}= 0.2087 D_{30}= 0.1515 D_{15}= 0.0893
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 9.1%

Date Received: 10/9/23 Date Tested: 10/19/23
Tested By: MAW
Checked By: KSS
Title: PM

Location: TP-1, S-1 Date Sampled: 10/9/23
Sample Number: 104412 Depth: 0.5-3'

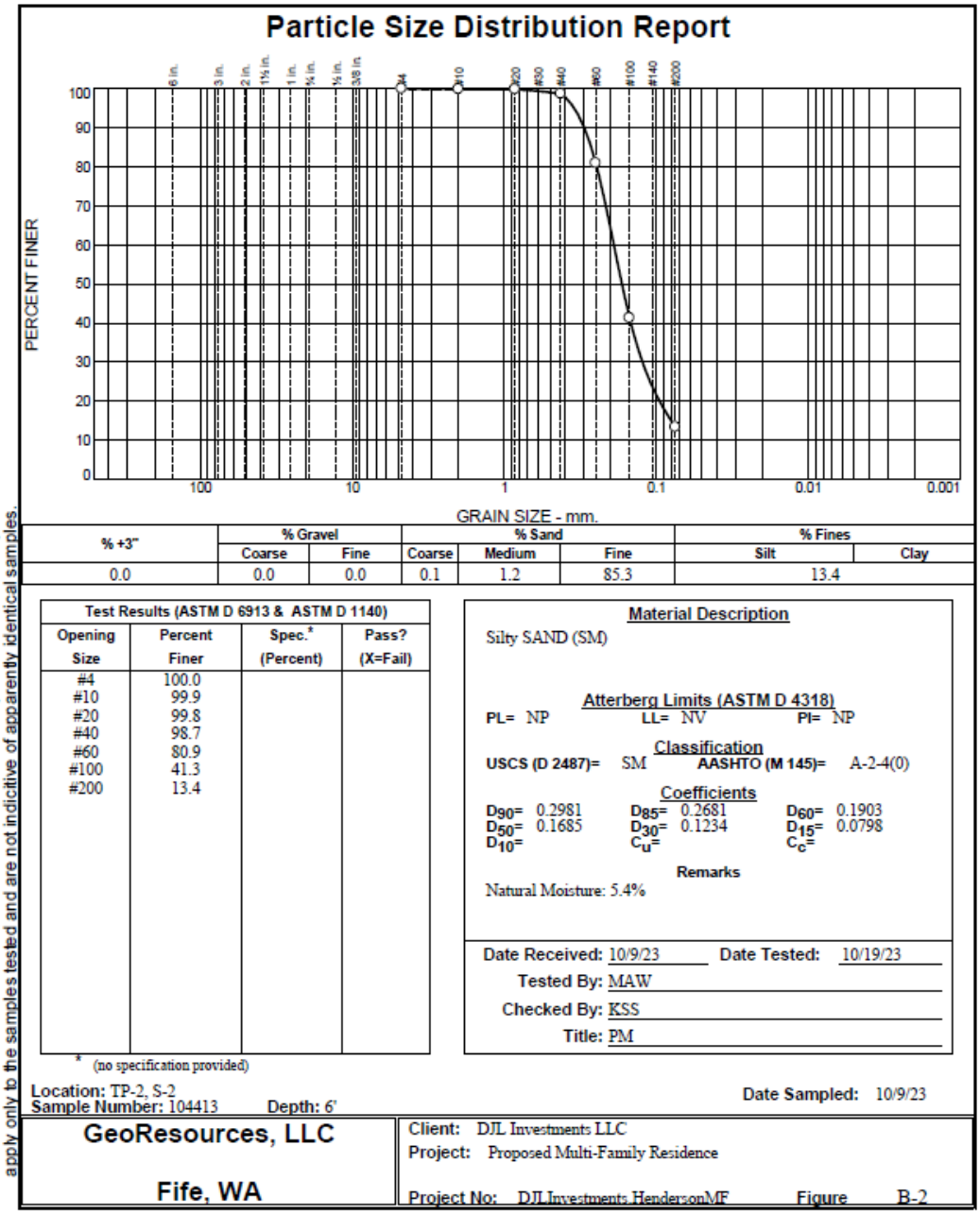
GeoResources, LLC

Fife, WA

Client: DJL Investments LLC
Project: Proposed Multi-Family Residence
Project No: DJLInvestments.HendersonMF Figure B-1

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.2	85.3	13.4	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	99.8		
#40	98.7		
#60	80.9		
#100	41.3		
#200	13.4		

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 0.2981 D_{85}= 0.2681 D_{60}= 0.1903
D_{50}= 0.1685 D_{30}= 0.1234 D_{15}= 0.0798
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 5.4%

Date Received: 10/9/23 Date Tested: 10/19/23
Tested By: MAW
Checked By: KSS
Title: PM

Location: TP-2, S-2 Date Sampled: 10/9/23
Sample Number: 104413 Depth: 6'

GeoResources, LLC

Fife, WA

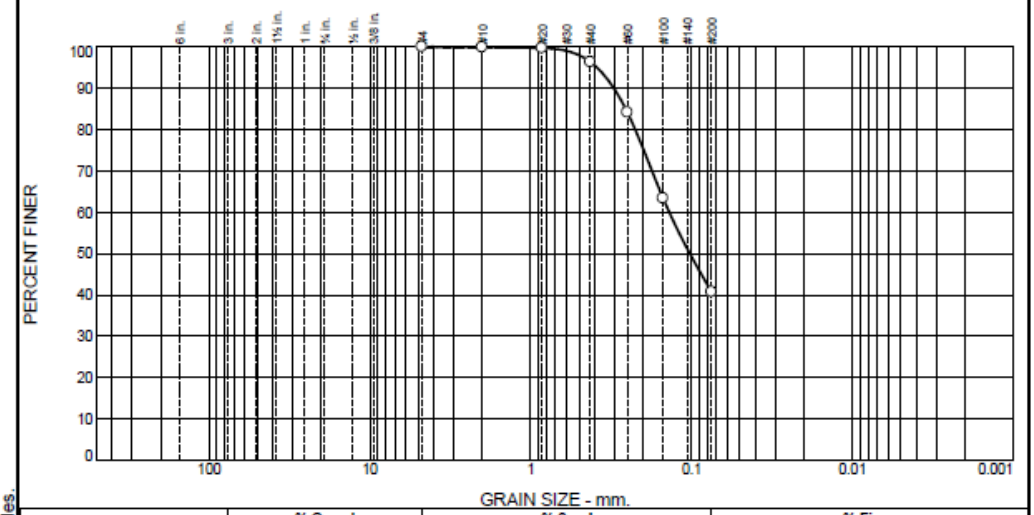
Client: DJL Investments LLC
Project: Proposed Multi-Family Residence

Project No: DJLInvestments HendersonMF Figure B-2

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.6	55.6	40.7	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	99.7		
#40	96.3		
#60	84.1		
#100	63.3		
#200	40.7		

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D_{90}= 0.3041 D_{85}= 0.2566 D_{60}= 0.1375
D_{50}= 0.1024 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 16.3%

Date Received: 10/9/23 Date Tested: 10/19/23

Tested By: MAW

Checked By: KSS

Title: PM

Location: TP-2, S-4 Date Sampled: 10/9/23
Sample Number: 104414 Depth: 9-10'

GeoResources, LLC

Fife, WA

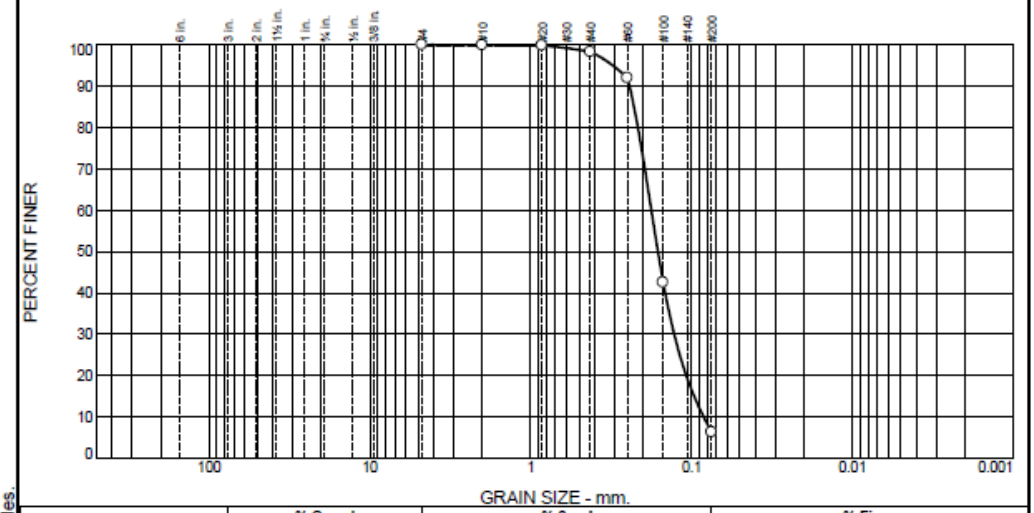
Client: DJL Investments LLC
Project: Proposed Multi-Family Residence

Project No: DJLInvestments HendersonMF Figure B-3

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.6	92.0	6.3	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	99.8		
#40	98.3		
#60	92.0		
#100	42.5		
#200	6.3		

* (no specification provided)

Material Description

Poorly graded SAND with silt (SP-SM)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

Coefficients

D_{90}= 0.2426 D_{85}= 0.2274 D_{60}= 0.1778
D_{50}= 0.1619 D_{30}= 0.1282 D_{15}= 0.0963
D_{10}= 0.0839 C_u= 2.12 C_c= 1.10

Remarks

Natural Moisture: 6%

Date Received: 10/9/23 Date Tested: 10/19/23
Tested By: MAW
Checked By: KSS
Title: PM

Location: TP-13, S-3 Date Sampled: 10/9/23
Sample Number: 104415 Depth: 9'

GeoResources, LLC

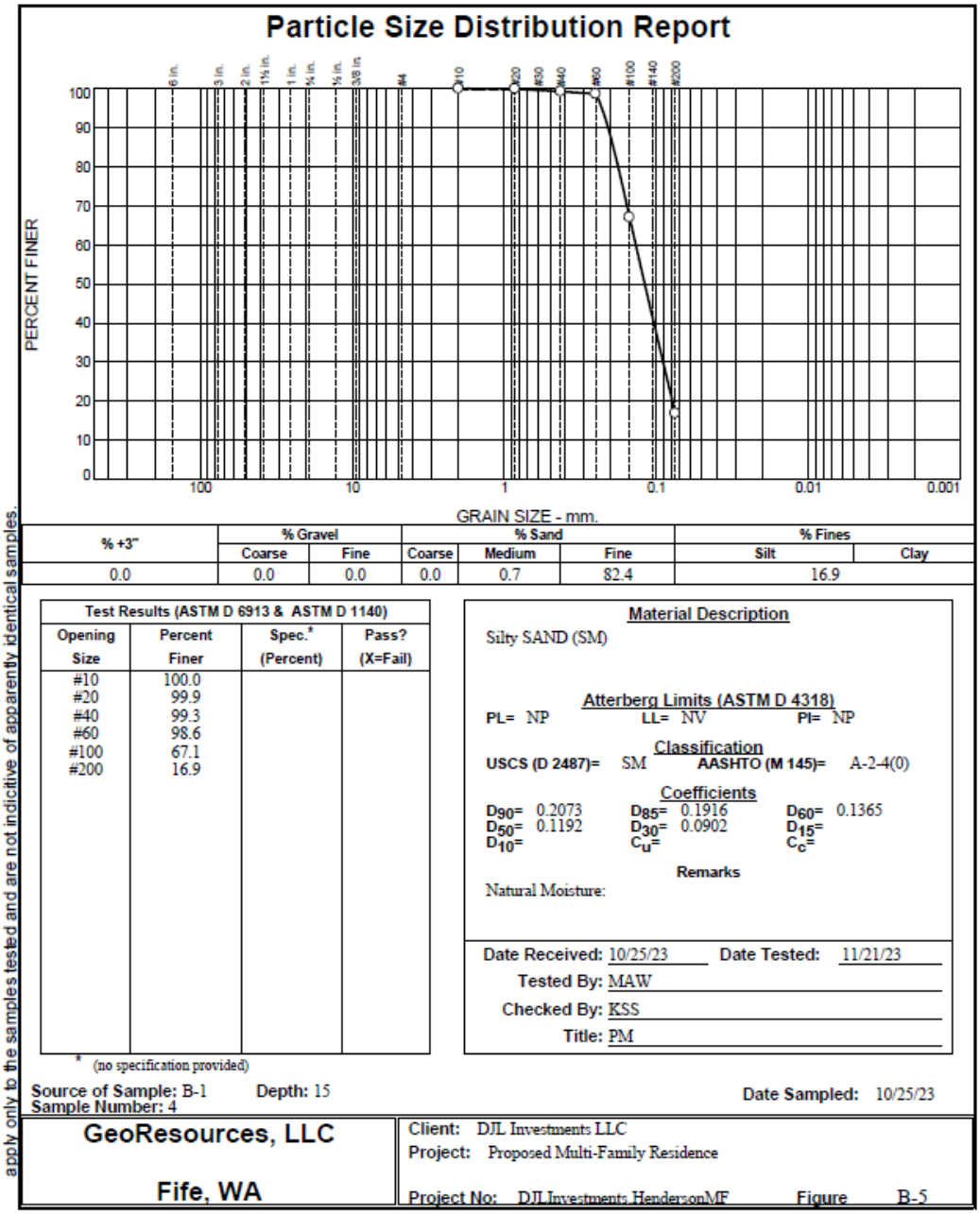
Fife, WA

Client: DJL Investments LLC
Project: Proposed Multi-Family Residence

Project No: DJLInvestments HendersonMF Figure B-4

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.7	82.4	16.9	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.9		
#40	99.3		
#60	98.6		
#100	67.1		
#200	16.9		

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 0.2073 D_{85}= 0.1916 D_{60}= 0.1365
D_{50}= 0.1192 D_{30}= 0.0902 D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture:

Date Received: 10/25/23 Date Tested: 11/21/23
Tested By: MAW
Checked By: KSS
Title: PM

Source of Sample: B-1 Depth: 15
Sample Number: 4

Date Sampled: 10/25/23

GeoResources, LLC

Fife, WA

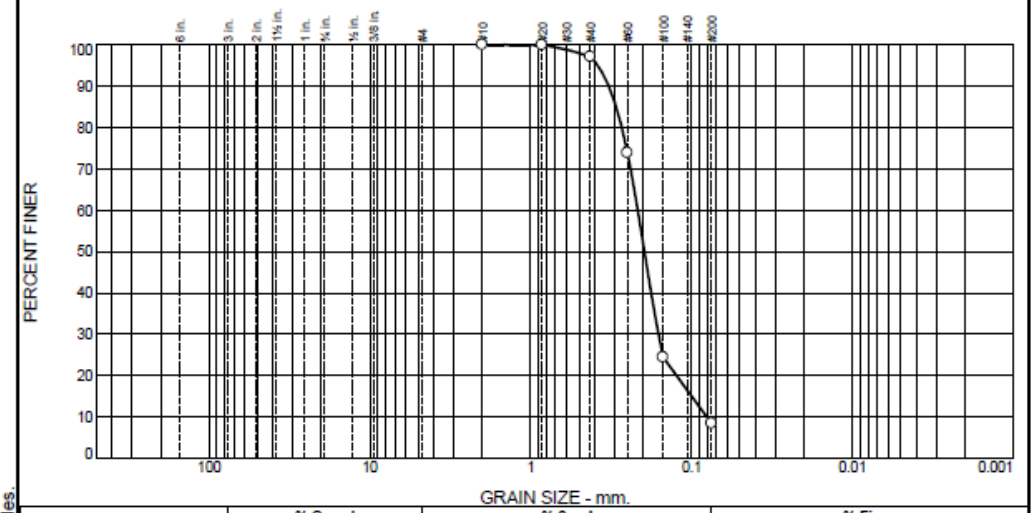
Client: DJL Investments LLC
Project: Proposed Multi-Family Residence

Project No: DJLInvestments HendersonMF Figure B-5

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.9	88.7	8.4	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.9		
#40	97.1		
#60	73.9		
#100	24.5		
#200	8.4		

* (no specification provided)

Material Description

Golden brown poorly graded silty SAND (medium dense, moist) (SP-SM) (recessional outwash)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

Coefficients

D_{90}= 0.3270 D_{85}= 0.2943 D_{60}= 0.2158
D_{50}= 0.1961 D_{30}= 0.1605 D_{15}= 0.0996
D_{10}= 0.0802 C_u= 2.69 C_c= 1.49

Remarks

Natural Moisture: 6.7%

Date Received: 10/25/23 Date Tested: 11/21/23
Tested By: MAW
Checked By: KSS
Title: PM

Source of Sample: B-2 Depth: 15
Sample Number: 5
Date Sampled: 10/25/23

GeoResources, LLC

Fife, WA

Client: DJL Investments LLC
Project: Proposed Multi-Family Residence
Project No: DJLInvestments HendersonMF Figure B-6

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Tested By: _____ Checked By: _____

HENDERSON PROPERTY

CITY OF TUMWATER, WASHINGTON

CRITICAL AREAS REPORT

Prepared By:

Curtis Wambach, M.S.
Senior Biologist and Principal

EnviroVector
OPTIMIZE USABLE LAND

27 June 2023

360-790-1559

www.envirovector.com

HENDERSON PROPERTY

CRITICAL AREAS REPORT

Prepared For:

Jeff Pantier

Prepared By:

Curtis Wambach, M.S.,
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www.envirovector.com

27 June 2023

Table of Contents

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Critical Areas Report is to identify and map Critical Areas on the subject property, satisfying City of Tumwater regulatory requirements under Critical Areas. Potential wetlands, streams, steep slopes, and their buffers were evaluated on the subject property and within three hundred (≤300) feet of the subject property.

1.2 Property Location

The subject property is located in the City of Tumwater, WA (**Figure 1; Table 1**).

Table 1. Subject Property

No#	Address	Parcel Number	Map Coordinates	Area
1	7501 HENDERSON BLVD SE	12711110300	S11 T17N R2W	10
1 Parcel	Total Size			10 acres

The permitting jurisdiction is the City of Tumwater.

1.3 Site Evaluation

A wetland and stream evaluation was performed on the subject property on 15 June 2023

1.4 Site Description

The entire subject property is forested by Douglas fir (*Pseudotsuga menzeisii*, FACU), Big leaf maple (*Acer macrophyllum*, FACU), and red alder (*Alnus rubra*, FAC) with a dense understory of non-wetland plants (**Appendix A, Photos 1 & 2**). Henderson Boulevard SE borders the southeastern property boundary. An off-site large, shallow lake is located at the northwestern property line (**Appendix A, Photos 9 & 10**).

2.0 METHODOLOGY

This report is based on a review of existing information and field investigations. The goal of these efforts is to collect and document existing information that reflects current site conditions for assessing potential impacts.

2.1 Review of Existing Literature

Prior to conducting fieldwork, biologists reviewed existing information to identify wetlands, streams, vegetation patterns, topography, soils, wildlife habitats, and other natural resources on the subject property. Existing data sources that were reviewed for this report included but were not limited to the following:

- Washington. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Soil Survey
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI), online wetlands mapper
- Washington Department of Fish and Wildlife (WDFW) Salmonscape Database
- Washington Department of Fish and Wildlife (WDFW) Priority and Habitat Species Database
- Washington State Department of Natural Resources (DNR) Natural Heritage Database
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies

2.2 Field Investigation

A wetland evaluation was performed onsite as well as offsite of the subject property to determine if wetlands, streams, or their buffers extend onto the subject property. The routine on-site determination method was used to identify potential wetlands using the procedures outlined in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987) and the 2010 USACE Regional Wetland Supplement.

2.3 Wetland Identification

Prior to 2010, biologists delineated wetlands according to the methods specified in the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (Environmental Laboratory 1987). At that time, these methods complied with those in the Washington State Wetland Identification and Delineation Manual (Washington State Department of Ecology [Ecology] 1997).

Following 2010, biologists evaluate wetlands according to the methods specified in the USACE's Wetlands Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0) (USACE 2010). These methods comply with those adopted by Washington State pursuant to Washington Administrative Code (WAC) 173-22-035, Revised Code of Washington (RCW) 90.58.380.

2.3.1 Vegetation

The dominant plants and their wetland indicator status were evaluated to determine whether the vegetation is hydrophytic. Hydrophytic vegetation is generally defined as vegetation adapted to prolonged saturated soil conditions. To meet the hydrophytic vegetation criterion, more than 50 percent of the dominant plants must be facultative, facultative wetland, or obligate, according to the plant indicator status category assigned to each plant species by the USACE National Wetland Plant List. **Table 2** provides the definitions of the indicator status categories. The scientific and common names for plants follow the currently accepted nomenclature. Dominant plant species were observed and recorded on wetland determination data forms for each data plot (**Appendix L**).

Table 2. Key to Plant Indicator Status Categories

Plant Indicator Status Category	Symbol	Description
Obligate Wetland Plants	OBL	Plants that almost always (>99% of the time) occur in wetlands but may rarely (<1% of the time) occur in non-wetlands
Facultative Wetland Plants	FACW	Plants that often (67% to 99% of the time) occur in wetlands but sometimes (1% to 33% of the time) occur in non-wetlands
Facultative Plants	FAC	Plants with a similar likelihood (33% to 66% of the time) of occurring in both wetlands and non-wetlands
Facultative Upland Plants	FACU	Plants that sometimes (1% to 33% of the time) occur in wetlands but occur more often (67% to 99% of the time) in non-wetlands
Upland Plants	UPL	Plants that rarely (<1% of the time) occur in wetlands and almost always (> 99% of the time) occur in non-wetlands

2.3.2 Soils

Soils were excavated to 18 inches or more below the surface within test pits to evaluate soil characteristics and hydrological conditions throughout the property. Soil chroma (color) is evaluated using the *Munsell Color Chart* (Munsell Color, 1988). Generally, an area must have hydric soils to be considered a wetland. Hydric soil forms when soils are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper portion. Biological activities in saturated soil result in reduced concentrations of oxygen that in turn result in a preponderance of organisms that use anaerobic processes for metabolism. Over time, anaerobic biological processes result in certain soil color patterns, which are used as indicators of hydric soil. Typically, low-chroma colors are formed in the matrix of hydric soil. Bright-colored redoximorphic features form within the matrix under a fluctuating water table. Other important hydric soil indicators include organic matter accumulations in the surface layer, reduced sulfur odors, and organic matter staining in the subsurface.

2.3.3 Hydrology

The subject property was examined for evidence of hydrology. The U.S. Army Corps of Engineers (2005) provides a technical standard for monitoring hydrology on such sites. This standard requires 14 or more consecutive days of flooding or ponding, or a water table 12 in. (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability). The USACE 2010 Regional Supplement provides a list of hydrology indicators to evaluate whether the hydrology standard is satisfied. If wetland hydrology, including pooling, ponding, and soil saturation, is not clearly evident, hydrological conditions may be observed through surface or soil indicators. Indicators of hydrological conditions include oxidized root channels, drainage patterns, drift lines, sediment deposition, watermarks, historic records, visual observation of saturated soils, and visual observation of inundation.

2.4 Wetland Classification and Rating

Delineated wetlands, if identified, would be classified according to the USFWS Classification of Wetlands and Deepwater Habitats of the United States. Hydrogeomorphic classifications were assigned to wetlands using USACE methods established in 'A Hydrogeomorphic Classification for Wetlands.' Wetlands were rated using the revised Washington State Wetland Rating System for Western Washington.

3.0 STUDY RESULTS

3.1 Background Information

3.1.1 NRCS Soil Survey for Thurston County

Three (3) non-hydric soils were mapped on the subject property by the NRCS Soil Survey (**Table 3; Appendix B**).

Table 3. NRCS Soils Survey

Soil Unit	Hydric	Comments
Indianola loamy sand 3-15% slopes	No	Central portion of the property
Nisqually loamy fine sand 3-15% slopes	No	Northern portion of the property
Indianola loamy sand 0-3% slopes	No	Southern portion of the property

3.1.2 City of Tumwater Critical Areas Database

No wetlands or high groundwater hazard areas are mapped on the subject property by the City of Tumwater GIS database (**Appendix C**). A potential wetland and high groundwater hazard area are mapped northwest of the subject property.

3.1.3 Thurston County Geodata Center Wetlands

A wetland and open water have been mapped northwest of the subject property by the Thurston County Geodata Center database (**Appendix D**). A small portion of this wetland is mapped on the northern corner of the subject property.

3.1.4 Thurston County Geodata Center Contours

The majority of the subject property is mapped relatively flat by the Thurston County Geodata Center database (**Appendix E**). Slopes are mapped on the northwestern edge of the subject property declining approximately ten (10) feet in elevation to off-site water body.

3.1.5 Department of Natural Resources (DNR) Water Typing Database

No streams are mapped on the subject property or within three hundred (≤300) feet of the subject property by the State Department of Natural Resources (DNR) Water Typing Database (**Appendix F**). One (1) off-site Type F stream is located more than three hundred (>300) feet northwest of the subject property.

3.1.6 The WDFW PHS Database

No priority species have been mapped on the subject property by the Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) database (**Appendix G**). Wood duck is mapped in a water body northwest of the subject property.

Two (2) off-site wetlands are mapped north and south of the subject property. Mazama pocket gophers are mapped south of the subject property and at the Port of Olympia Airport.

3.1.7 303(d) Water

One (1) 303(d) listed water has been mapped in the Deschutes River greater than one (>1) mile (6,600 feet) downgradient of the water feature north of the subject property (**Appendix H**).

3.1.8 TMDL

TMDL is mapped on the subject property by the Department of Ecology Water Quality Atlas Database (**Appendix I**).

3.1.9 Potential Flooding

An off-site High Groundwater Hazard Area is mapped northwest of the subject property by the Thurston County Geodata Center database (**Appendix J**).

3.2 Field results

A summary of findings is found in **Table 4**.

No wetlands or streams were identified on the subject property during the site evaluation. One (1) wetland, labeled Wetlands A, was identified, and GNSS-located north to northwest of the subject property (**Figures 2 & 3; Appendix A, Photos 5-16**). Wetland A is a very shallow lake containing an aquatic bed and thick scrub-shrub vegetation on the periphery. Wetland A is a shallow depression containing permanent water. An unnamed stream flows into the western portion of Wetland A. A small stream forms an outlet on the western portion of wetland A before flowing to the Deschutes River greater than one (>1) mile (6,600 feet) downgradient.

Table 4. Summary of Critical Areas Results

Wetlands	Area of Wetland		Veg Class Hydroperiod	Buffer Condition	Habitat Features	Comments
	Onsite	Total				
Wetland A	0 sf (0 acre)	790,073 sf (18 acres)	PABH[1] PSSC[2]	Roads, residential, Forest	Logs, snags, Amphibian habitat	Shallow lake dominated by Aquatic bed with scrub shrub periphery

1. PABH: Palustrine Aquatic Bed Permanently-flooded
2. PSSC: Palustrine Scrub-shrub Seasonally-flooded

3.2.1 Wetland A

The Wetland A boundary has been GNSS located at points A-1 through A-16 using a Trimble Geo 7x with sub-foot accuracy (**Figure 4**). No wetland flags were installed because the wetland is located entirely offsite on a property not controlled by the applicant.

Conditions

Wetland A and its buffer are relatively undisturbed.

The Cowardin (1979) classification of Wetland A is (**Table 4**):

- PABH: Palustrine Aquatic Bed Permanently-flooded
- PSSC: Palustrine Scrub-shrub Seasonally-flooded

The wetland boundary on Wetland A is well-defined and consistent throughout.

Greater than ten percent (>10%) of the area within one hundred fifty (150) feet of Wetland A contains potential sources of pollutants (**Figure 7**). Habitat within one (1) kilometer is shown in **Figure 8**. Greater than fifty percent (>50%) of the area within one (1) kilometer of Wetland A consists of high intensity land uses. Based on Thurston County contours, the contributing basin is between ten (10) and one hundred times (10-100x) the size of the wetland (**Figure 8)**.

Hydrology

Hydrology derives from local precipitation, high groundwater, and a small stream. A small stream forms on outlet on the western end of the wetland (**Figure 6**). Water at TP-A1 was saturated to the surface during the site evaluation (**Appendix L**). The majority of the wetland contains permanent ponding.

Vegetation

Two (2) vegetation classes consist of aquatic bed, which covers the main body of the wetland, and of scrub shrub, which occurs as a thin band along the periphery of the wetland (**Figure 6**). The aquatic bed plant species primarily consists of yellow pond lily (*Nuphar polysepalum*, OBL) (**Appendix L**).

The scrub-shrub portion of Wetland A is dominated by Douglas spirea (*Spiraea douglasii*; FACW) and red osier dogwood (*Cornus stolonifera*, FACW) (**Appendix L**).

Areas adjacent to Wetland A are forested by Douglas fir (*Pseudotsuga menzeisii*, FACU), big leaf maple (*Acer macrophyllum*, FACU), and red alder (*Alnus rubra*, FAC) with a dense understory of non-wetland plants. (**Appendix L**).

Dominant plant species identified in the aquatic bed vegetation community in Wetland A include:

- yellow pond lily (*Nuphar polysepalum*, OBL)
- Watershield (*Brasenia schreberi*, OBL)

Dominant plant species identified in the Wetland A scrub shrub vegetation community include:

- Douglas spirea (*Spiraea douglasii*; FACW)
- Red osier dogwood (*Cornus stolonifera*, FACW)
- Himalayan blackberry (*Rubus armeniacus*; FAC)
- Pacific crabapple (*Malus fusca*, FACW)
- Reed canarygrass (*Phalaris arundinacea*, FACW)
- Salmonberry (*Rubus spectabilis*; FAC)
- Vine maple (*Acer circinatum*, FAC)
- Spotted jewelweed (*Impatiens capensis*, FACW)
- Slough sedge (*Carex obnupta*, OBL)
- Skunk cabbage (*Lysichiton americanus*, OBL)
- Field mint (*Mentha arvensis*, FACW)

Dominant buffer plants include:

- Douglas fir (*Pseudotsuga menzeisii*, FACU)
- Big-leaf maple (*Acer macrophyllum*, FACU)
- Red alder (*Alnus rubra*, FAC)
- Bitter cherry (*Prunus emarginata*; FACU)
- Salal (*Gaultheria shallon*, FACU)
- Sword fern (*Polystichum munitum*, FACU)
- Himalayan blackberry (*Rubus armeniacus*; FAC)
- Snowberry (*Physocarpus albus*, FACU)
- Serviceberry (*Amelanchier alnifolia*, FACU)
- Osoberry (*Oemleria cerasiformis*, FACU)
- Mock orange (*Philadelphus lewisii*, NL)
- Beaked hazelnut (*Corylus cornuta*, FACU)
- English laurel (*Prunus laurocerasus*; NL)
- English Ivy (*Hedera helix*, FACU)
- Trailing blackberry (*Rubus ursinus*, FACU)
- Scotch broom (*Cytisus scoparius*, FACU)

Soils

Soils in Wetland A consist of a black (10YR 2/1) sandy muck from zero (0) to twenty (20) inches in depth (**Appendix L**).

Soils adjacent to the wetland consist of a very dark brown (10YR 2/2) sandy silt from zero (0) to twenty (20) inches in depth.

Habitat Features

Habitat features in Wetland A are minimal, but include some minor fallen logs from the buffer area, standing water, and aquatic bed.

4.0 REGULATORY CONSIDERATIONS

Wetland regulatory considerations have been summarized in **Table 5**.

Table 5. Summary of Regulatory Considerations

Wetlands								
Wetland	Area of Wetland		Category	Habitat Score	Total Rating Score	Standard Buffer	Reduced Buffer	Comments
	Onsite	Total						
Wetland A	0 sf (0 acre)	790,073 sf (18 acres)	III	6 (MLH)	19	150 ft	110 ft	Wetland buffers can be reduced from 150’ to 110’.

4.1 Wetlands

4.1.1 Wetland A

Wetland A has been classified as a Category III wetland by the Department of Ecology (2014) Wetland Rating Form for Western Washington as required under Chapter 16.28.090---*Wetlands Rating System*. Wetland A is a depressional wetland under the 2014 Department of Ecology Wetland Rating System.

Under City of Tumwater Municipal Code (TMC) Title 16---*Environment*, Chapter 16.28.090---*Wetlands Rating System*, wetland buffers are calculated based on category of wetland and the habitat score determined by the Washington State Department of Ecology (2014) Wetland Rating System publication 14-06-029, effective January 2015), as revised. Wetland A scored for habitat a “Medium (M)” potential to provide habitat, a “Low (L)” landscape potential to support habitat, and a “High (H)” potential value to society. Wetlands that rate as an M, L, H receive a score of six (6) points for total habitat functions (**Appendix K**).

The standard buffer for Category III wetlands that score between five (5) and Seven (7) points for Habitat Functions require a buffer width of one hundred fifty (150) feet (TMC Chapter 16.28.170---*Wetland buffers*, Table 16.28.170(2)---*Category II Wetland Buffer Widths*) (**Figure 5, Table 5**).

The one hundred fifty (150)-foot buffer on Wetland A could be reduced to one hundred ten (110) feet pursuant to compliance with criteria under TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction* (See Section 4.3 of this report).

4.2 Wetland Buffer Reduction (TCC 16.28.170(C))

Under TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction*, the buffer widths recommended for land uses with high-intensity impacts to wetlands can be reduced to those widths recommended for moderate-intensity impacts under the following conditions:

1. For wetlands that score moderate or high for habitat (five [5] points or more), the width of the buffer around the wetland can be reduced if both the following criteria are met:
    a. A relatively undisturbed vegetated corridor at least one hundred feet wide is protected between the wetland and any other priority habitats as defined by the Washington State Department of Fish and Wildlife. The corridor must be protected for the entire distance between the wetland and the priority habitat via some type of legal protection such as a conservation easement; and
    b. Measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5), are applied.

Table 16.28.170(5): Measures to Minimize Impacts to Wetlands

Examples of Disturbance	Examples of Measures to Minimize Impacts	Activities That Cause the Disturbance
Lights	Direct lights away from wetland	Parking lots, warehouses, manufacturing, residential
Noise	Locate activity that generates noise away from wetland	Manufacturing, residential
Toxic runoff (1)	*Route all new runoff away from wetland while ensuring that wetland is not dewatered *Establish covenants limiting use of pesticides within 150 ft of wetland *Apply integrated pest management	Parking lots, roads, manufacturing, residential areas, application of agricultural pesticides, landscaping
Stormwater runoff	*Retrofit stormwater detention and treatment for roads and existing adjacent development *Prevent channelized flow from lawns that directly enters the buffer	Parking lots, roads, manufacturing, residential areas, commercial, landscaping
Change in water regime	Infiltrate or treat, detain, and disperse into buffer new runoff from impervious surfaces and new lawns	Impermeable surfaces, lawns, tilling
Pets and human disturbance	*Use privacy fencing *Plant dense vegetation to delineate buffer edge and to discourage disturbance using vegetation appropriate for the ecoregion *Place wetland and its buffer in a separate tract	Residential areas
Dust	Utilize best management practices to control dust	Tilled fields

The proposed project would reduce buffers in compliance with TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction* by 1) reducing the high land use intensity buffer to the moderate land use intensity, 2) protect a relatively undisturbed vegetated corridor at least one hundred (≥100) feet wide, and by 3) applying measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5).

4.3 Buffer Averaging

Under TMC 16.28.170(E)---*Standard Wetland Buffer Width Averaging*, standard wetland buffer zones may be modified by averaging buffer widths if it will improve the protection of wetland functions, or if it is the only way to allow for reasonable use of a parcel. Averaging cannot be used in conjunction with the provisions for reductions in buffer widths. Wetland buffer width averaging shall be allowed to improve wetland protection only where a qualified wetlands professional demonstrates all of the following:

1. The wetland has significant differences in characteristics that affect its habitat functions, such as a wetland with a forested component adjacent to a degraded emergent component or a "dual-rated" wetland with a category I area adjacent to a lower rated area;
2. The buffer is increased adjacent to the higher functioning area of habitat or more sensitive portion of the wetland and decreased adjacent to the lower functioning or less sensitive portion;
3. The total area contained in the buffer area after averaging is not less than that which would be contained within the standard buffer; and
4. The buffer at its narrowest point is never less than three-fourths of the required width.

4.4 Permitted Uses in a Wetland Buffer Zone

Under TMC 16.28.170(H)---Permitted Uses in a Wetland Buffer Zone. Regulated activities shall not be allowed in a buffer zone except for the following:

1. Activities having minimal adverse impacts on buffers and no adverse impacts on regulated wetlands. These may include low-intensity, passive recreational activities such as pervious trails, nonpermanent wildlife watching blinds, short-term scientific or educational activities, and sports fishing or hunting.
2. With respect to category III and IV wetlands, surface level stormwater management facilities may be allowed in the outer twenty-five percent of the wetland buffer using best management practices; provided the community development director makes all of the following determinations:
    a. No other location is feasible.
    b. The location of such facilities will not degrade the functions or values of the wetland.
3. Stormwater management facilities are not allowed in buffers of category I or II wetlands.

Under TMC 16.28.170(I)---*Signs and Fencing of Wetlands*:

1. Temporary Markers.

    The outer perimeter of the wetland or buffer and the limits of those areas to be disturbed pursuant to an approved permit or authorization shall be marked in the field in such a way as to ensure that no unauthorized intrusion will occur and is subject to inspection by the community development director prior to the commencement of permitted activities. This temporary marking shall be maintained throughout construction and shall not be removed until permanent signs, if required, are in place.

2. Permanent Signs.

   As a condition of any permit or authorization issued pursuant to these requirements, the community development director may require the applicant to install permanent signs along the boundary of a wetland or buffer. Permanent signs shall be made of an enamel coated metal face and attached to a metal post, or another untreated material of equal durability. Signs must be posted at an interval of one per lot or every fifty feet, whichever is less, and must be maintained by the property owner in perpetuity. The sign shall be worded as follows or with alternative language approved by the community development director:

   Protected Wetland Area

   Do Not Disturb

   Contact Tumwater Community Development 754-4180

   Regarding Uses and Restrictions

3. Fencing.

   The community development director shall determine if fencing is necessary to protect the functions and values of the critical area. If found to be necessary, the community development director shall condition any permit or authorization issued pursuant to these regulations to require the applicant to install a permanent fence at the edge of the wetland buffer, when fencing will prevent future impacts to the wetland. The applicant will be required to install a permanent fence around the wetland or buffer when domestic grazing animals are present or may be introduced on site.

4.5 Avoiding Wetland Impacts

Under TMC 16.28.180---*Avoiding wetland impacts*:

A. Regulated activities shall not be authorized in a regulated wetland or wetland buffer except where it can be demonstrated that the impact is both unavoidable and necessary or that all reasonable economic uses are denied.

B. With respect to category I wetlands, an applicant must demonstrate that denial of the permit would impose an extraordinary hardship on the part of the applicant brought about by circumstances peculiar to the subject property.

C. With respect to category II and III wetlands, the following provisions shall apply:

   1. For water-dependent activities, unavoidable and necessary impacts can be demonstrated where there are no practicable alternatives which would not involve a wetland or which would not have less adverse impact on a wetland, and would not have other significant adverse environmental consequences;

   2. Where non-water-dependent activities are proposed, it shall be presumed that adverse impacts are avoidable. This presumption may be rebutted upon a demonstration that:

      a. The basic project purpose cannot reasonably be accomplished utilizing one or more other sites in the general region that would avoid, or result in less, adverse impact on a regulated wetland;

b. A reduction in the size, scope, configuration, or density of the project as proposed and all alternative designs of the project as proposed that would avoid, or result in less, adverse impact on a regulated wetland or its buffer will not accomplish the basic purpose of the project; and

c. In cases where the applicant has rejected alternatives to the project as proposed due to constraints such as zoning, deficiencies of infrastructure, or parcel size, the applicant has made reasonable attempt to remove or accommodate such constraints.

D. With respect to category IV wetlands, unavoidable and necessary impacts can be demonstrated where the proposed activity is the only reasonable alternative which will accomplish the applicant's objectives.

E. If the city determines that alteration of a wetland and/or wetland buffer is necessary and unavoidable, the city shall set forth in writing its findings with respect to each of the items listed in this section.

4.6 Conditions for Wetland Permits

Under TMC 16.28.210---Acting on the application:

A. Land Division Conditions for Wetland Permits.

1. Sensitive Area Tracts/Easements.

As a condition of any permit issued pursuant to this section, the permit holder shall be required to create a separate sensitive area tract(s)/easement(s) containing the areas determined to be wetland and/or wetland buffer in field investigations performed pursuant to TMC 16.28.080. Sensitive area tracts/easements are legally created tracts/easements containing wetlands and their buffers that shall remain undeveloped as long as wetland functions and values are present. Loss of wetland functions due to human impacts will result in sensitive area tracts/easements being maintained.

a. Protection of Sensitive Area Tracts/Easements.

The city shall require, as a condition of any permit issued pursuant to this section, that the sensitive area tract or tracts created pursuant to this section be protected by one of the following methods:

i. The permit holder shall convey an irrevocable offer to dedicate to the city of Tumwater or other public or nonprofit entity specified by the city an easement for the protection of native vegetation within a wetland and/or its buffer; or

ii. The permit holder shall establish and record a permanent and irrevocable deed restriction on the property title of all lots containing a sensitive area tract or tracts created as a condition of this permit. Such deed restriction(s) shall prohibit, as long as wetland function exists, the development, alteration, or disturbance of vegetation within the sensitive area except for purposes of habitat enhancement as part of an enhancement project which has received prior written approval from the city of Tumwater, and any other agency with jurisdiction over such activity.

2. The deed restriction shall also contain the following language:

    a. "Before, beginning, and during the course of any grading, building construction, or other development activity on a lot or development site subject to this deed restriction, the common boundary between the area subject to the deed restriction and the area of development activity must be fenced or otherwise marked to the satisfaction of City of Tumwater."

    b. Regardless of the legal method of protection chosen by the city, responsibility for maintaining tracts shall be held by a property owner's association, adjacent lot owners, the permit applicant or designee, or other appropriate entity as approved by the city.

    c. The following note shall appear on the face of all plats, short plats, PUDs, or other approved site plans containing separate sensitive area tracts/easements, and shall be recorded on the title of record for all affected lots:

NOTE: All lots adjoining separate sensitive areas identified as Native Vegetation Protection Easements or protected by deed restriction are responsible for maintenance and protection. Maintenance includes insuring that no alterations occur within the separate tract and that all vegetation remains undisturbed unless the express written authorization of the City of Tumwater has been received.

The common boundary between a separate sensitive area tract/easement and the adjacent land must be permanently identified. This identification shall include permanent wood or metal signs on treated or metal posts.

Sign locations and size specifications shall be approved by the city. The city shall require permanent fencing of the sensitive area when there is a substantial likelihood of the presence of domestic grazing animals within the development proposal. The city shall also require as a permit condition that such fencing be provided if, subsequent to approval of the development proposal, domestic grazing animals are in fact introduced.

3. Additional Conditions.

    a. The location of the outer extent of the wetland buffer and the areas to be disturbed pursuant to an approved permit shall be marked in the field, and such field marking shall be approved by the city prior to the commencement of permitted activities. Such field markings shall be maintained throughout the duration of the permit.

    b. The city may attach such additional conditions to the granting of a wetland permit as deemed necessary to assure the preservation and protection of affected wetlands and to assure compliance with the purposes and requirements of this chapter.

B. Bonding.

1. Performance Bonds.

The city may require the applicant of a development proposal to post a cash performance bond or other security acceptable to the city in an amount and with surety and conditions

sufficient to fulfill the requirements of this section. In addition, the city may secure compliance with other conditions and limitations set forth in the permit. The amount and the conditions of the bond shall be consistent with the purposes of this chapter. In the event of a breach of any condition of any such bond, the city may institute an action in a court of competent jurisdiction upon such bond and prosecute the same to judgment and execution. The city shall release the bond upon determining that:

a. All activities, including any required compensatory mitigation, have been completed in compliance with the terms and conditions of the permit and the requirements of this chapter;

b. Upon the posting by the applicant of a maintenance bond.

Until such written release of the bond, the principal or surety cannot be terminated or canceled.

2. Maintenance Bonds.

The city may require the holder of a wetland permit issued pursuant to this chapter to post a cash performance bond or other security acceptable to the city in an amount and with surety and conditions sufficient to guarantee that structures, improvements, and mitigation required by the permit or by this chapter perform satisfactorily for a minimum of two years after they have been completed. The city shall release the maintenance bond upon determining that performance standards established for evaluating the effectiveness and success of the structures, improvements, and/or compensatory mitigation have been satisfactorily met for the required period. For compensation projects, the performance standards shall be those contained in the mitigation plan developed and approved during the permit review process to TMC 16.28.220. The maintenance bond applicable to a compensation project shall not be released until the city determines that performance standards established for evaluating the effect and success of the project have been met.

C. Other Laws and Regulations.

No permit granted pursuant to this chapter shall remove an applicant’s obligation to comply in all respects with the applicable provisions of any other federal, state, or local law or regulation, including but not limited to the acquisition of any other required permit or approval.

D. Suspension, Revocation.

In addition to other penalties provided for elsewhere, the city may suspend or revoke a permit if it finds that the applicant or permittee has not complied with any or all of the conditions or limitations set forth in the permit, has exceeded the scope of work set forth in the permit, or has failed to undertake the project in the manner set forth in the approved application.

4.7 Compensating for Wetland Impacts

Under TMC 16.28.220---*Compensating for wetlands impacts*:

A. As a condition of any permit allowing alteration of wetland and/or wetland buffers, or as an enforcement action pursuant to TMC 16.28.280, the city shall require that the applicant demonstrate that wetland impact avoidance is not possible and engage in the restoration, creation or enhancement of wetlands and their buffers in order to offset the impacts resulting from the applicant's or violator's actions. Mitigation for alterations to wetlands shall achieve equivalent or greater biologic functions. Mitigation plans shall be consistent with the Washington State Department of Ecology "Wetland Mitigation in Washington State – Part 2: Developing Mitigation Plans," 2006, as revised. The applicant shall develop a plan that provides for land acquisition, construction, maintenance and monitoring of replacement wetlands that recreate as nearly as possible the original wetlands in terms of acreage, function, geographic location and setting, and that are larger than the original wetlands. Compensatory mitigation shall be completed prior to wetland destruction, where possible. Mitigation shall result in no net loss of wetlands function and acreage and seeks a net resource gain in wetlands over present conditions with the exception of enforcement actions.

B. Mitigation actions shall address functions affected by the alteration in order to achieve functional equivalency or improvement and shall provide similar wetland functions as those lost except when the lost wetland provides minimal functions as determined by a site-specific function assessment and the proposed mitigation action(s) will provide equal or greater functions.

C. Mitigation actions that require compensation mitigation by replacing, enhancing, or substitution shall occur in the following order of preference:

    1. Restoring wetlands on upland sites that were formerly wetlands.

    2. Creating wetlands on disturbed upland sites such as those with vegetative cover consisting primarily of nonnative introduced species. This should only be attempted when there is a consistent source of hydrology and it can be shown that the surface and subsurface hydrologic regime is conducive for the wetland community that is being designed.

    3. Enhancing significantly degraded wetlands in combination with restoration or creation. Such enhancement should be part of a mitigation package that includes replacing the impacted area meeting appropriate ratio requirements.

D. Mitigation actions shall be conducted within the same subdrainage basin and on the same site as the alteration except when all of the following apply:

    1. There are no reasonable on-site or in-subdrainage-basin opportunities or on-site and in-subdrainage-basin opportunities do not have a high likelihood of success due to development pressures, adjacent land uses, or on-site buffers or connectivity are inadequate;

    2. Off-site mitigation has a greater likelihood of providing equal or improved wetland functions than the impacted wetland; and

3. Off-site locations shall be in the same subdrainage basin and the same water resource inventory area unless:

   a. The impact is located near the boundary of a water resource inventory area;

   b. Established regional or watershed goals for water quality, flood or conveyance, habitat or other wetland functions have been established and strongly justify location of mitigation at another site; or

   c. Credits from a state certified wetland mitigation bank are used as mitigation and the use of credits is consistent with the terms of the bank's certification.

E. Mitigation projects, where feasible, shall be completed prior to activities that will disturb wetlands. In all other cases, mitigation shall be completed immediately following disturbance and prior to use or occupancy of the activity or development. Construction of mitigation projects shall be timed to reduce impacts to existing wildlife and flora. The community development director may authorize a one-time temporary delay, up to one hundred twenty days, in completing minor construction and landscaping when environmental conditions could produce a high probability of failure or significant construction difficulties. The delay shall not create or perpetuate hazardous conditions or environmental damage or degradation, and the delay shall not be injurious to the health, safety and general welfare of the public. The request for temporary delay must include a written justification that documents the environmental constraints that preclude implementation of the mitigation plan. The justification must be verified and approved by the city and include a financial guarantee.

F. Surface Area Replacement Ratio. The ratios in Table 16.28.220(6) apply to creation or restoration which is in kind, on site, timed prior to or concurrent with alteration, and has a high probability of success. These ratios do not apply to remedial actions resulting from illegal alterations. The first number specifies the area of wetlands requiring replacement and the second specifies the area of wetlands altered.

   The ratios in Table 16.28.220(6) are based on the type of compensatory mitigation proposed, such as restoration, creation, and enhancement. In its Regulatory Guidance Letter 02-02, the U.S. Army Corps of Engineers provided definitions for these types of compensatory mitigation, which the Washington State Department of Ecology used in their Guidance on Buffers and Ratios for Western Washington as part of the Wetlands in Washington State Volume 2 – Protecting and Managing Wetlands in October 2014 and are provided below.

   1. Restoration.

      The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural or historic functions to a former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into two categories:

      a. Reestablishment.

         The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural or historic functions to a former wetland. Reestablishment results in a gain in wetland acres (and functions). Activities could include removing fill material, plugging ditches, or breaking drain tiles.

b. Rehabilitation.

The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural or historic functions of a degraded wetland. Rehabilitation results in a gain in wetland function but does not result in a gain in wetland acres. Activities could involve breaching a dike to reconnect wetlands to a floodplain or return tidal influence to a wetland.

2. Creation (Establishment).

The manipulation of the physical, chemical, or biological characteristics present to develop a wetland on an upland or deep-water site where a wetland did not previously exist. Establishment results in a gain in wetland acres. Activities typically involve excavation of upland soils to elevations that will produce a wetland hydroperiod, create hydric soils, and support the growth of hydrophytic plant species.

3. Enhancement.

The manipulation of the physical, chemical, or biological characteristics of a wetland site to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for specified purposes such as water quality improvement, flood water retention, or wildlife habitat. Enhancement results in a change in some wetland functions and can lead to a decline in other wetland functions, but does not result in a gain in wetland acres. Activities typically consist of planting vegetation, controlling non-native or invasive species, modifying site elevations or the proportion of open water to influence hydroperiods, or some combination of these activities.

Table 16.28.220(6): Mitigation Ratios for Projects in Western Washington

Category and Type of Wetland Impacts (1)	Reestablishment or Creation	Rehabilitation (2)	Enhancement (2)
Category I – bogs or wetlands of high conservation value	Not considered possible (3)	6:1	Case-by-case
Category I – mature forested	6:1	12:1	24:1
Category I based on score for functions	4:1	8:1	16:1
All category II	3:1	6:1	12:1
All category III	2:1	4:1	8:1
All category IV	1.5:1	3:1	6:1

Table 16.28.220(6) Explanatory Notes:

(1) Preservation is discussed in subsection J of this section.

(2) These ratios are based on the assumption that the rehabilitation or enhancement actions implemented represent the average degree of improvement possible for the site. Proposals to implement more effective rehabilitation or enhancement actions may result in a lower ratio, while less effective actions may result in a higher ratio. The distinction between rehabilitation and enhancement is not clear-cut. Instead, rehabilitation and enhancement actions span a continuum. Proposals that fall within the gray area between rehabilitation and enhancement will result in a ratio that lies between the ratios for rehabilitation and the ratios for enhancement.

(3) Wetlands of high conservation value and bogs are considered irreplaceable wetlands because they perform some special functions that cannot be replaced through compensatory mitigation. Impacts to such wetlands would therefore result in a net loss of some functions no matter what kind of compensation is proposed.

4. Increased Replacement Ratio. The city may increase the ratios under any of the following circumstances:

   a. Uncertainty as to the probable success of the proposed restoration or creation;

   b. Significant period of time between destruction and replication of wetland functions at the mitigation site;

   c. Proposed mitigation will result in a lower category wetland or reduced functions relative to the wetland being impacted; or

   d. The impact was unauthorized.

5. Decreased Replacement Ratio.

The city may decrease these ratios for category II, III, and IV wetlands under the following circumstances:

   a. Documentation by a qualified wetlands specialist demonstrates that the proposed mitigation actions have a very high likelihood of success based on prior experience;

   b. Documentation by a qualified wetlands specialist demonstrates that the proposed mitigation actions will provide functions and values that are significantly greater than the wetland being impacted;

   c. The proposed mitigation actions are conducted in advance of the impact and have been shown to be successful.

6. In wetlands where several hydrogeomorphic classes are found within one delineated boundary, the areas of the wetlands within each hydrogeomorphic class can be scored and rated separately and the ratios adjusted accordingly, if all of the following apply:
    a. The wetland does not meet any of the criteria for wetlands with "special characteristics" as defined in the rating system;
    b. The rating and score for the entire wetland are provided along with the scores and ratings for each area with a different hydrogeomorphic class;
    c. Impacts to the wetland are all within an area that has a different hydrogeomorphic class from the one used to establish the initial category; and
    d. The proponents provide adequate hydrologic and geomorphic data to establish that the boundary between hydrogeomorphic classes lies at least fifty feet outside of the footprint of the impacts.
7. In all cases, a minimum acreage replacement ratio of one-to-one shall be required.

G. Replacement Ratios for Temporal Impacts and Conversions.

1. When impacts to wetlands are not permanent, the city will require compensation for the temporal loss of wetland functions. Temporal impacts refer to impacts to those functions that will eventually be replaced but cannot achieve similar functionality in a short time.
2. In addition to restoring the affected wetland to its previous condition, the city will require compensation to account for the risk and temporal loss of wetland functions. The ratios for temporal impacts to forested and scrub-shrub wetlands are one-quarter of the recommended ratios for permanent impacts found in Table 16.28.220(6); provided, that the following measures are satisfied:
    a. An explanation of how hydric soil, especially deep organic soil, is stored and handled in the areas where the soil profile will be severely disturbed for a fairly significant depth or time;
    b. Surface and groundwater flow patterns are maintained or can be restored immediately following construction;
    c. A ten-year monitoring and maintenance plan is developed and implemented for the restored forest and scrub-shrub wetlands;
    d. Disturbed buffers are revegetated and monitored; and
    e. Where appropriate, the hydroseed mix to be applied on reestablishment areas is identified.
3. When impacts are to a native emergent community and there is a potential risk that its reestablishment will be unsuccessful, compensation for temporal loss and the potential risk will be required in addition to restoring the affected wetland and monitoring the site. If the impacts are to wetlands dominated by nonnative vegetation, such as blackberry, reed canarygrass, or pasture grasses, restoration of the affected wetland with native species and monitoring after construction is required.

4. Loss of functions due to the permanent conversion of wetlands from one type to another requires compensation. When wetlands are not completely lost but are converted to another type, such as a forested wetland converted to an emergent or shrub wetland, such as for a utility right-of-way, some functions are lost or reduced.

5. The ratios for conversion of wetlands from one type to another will vary based on the degree of the alteration, but they are generally one-half of the recommended ratios for permanent impacts found in Table 16.28.220(6).

H. Wetlands Enhancement.

1. Any applicant proposing to alter wetlands may propose to enhance existing significantly degraded wetlands in order to compensate for wetland losses. Applicants proposing to enhance wetlands must produce a critical area report that identifies how enhancement will increase the functions of the degraded wetland and how this increase will adequately mitigate for the loss of wetland area and function at the impact site. An enhancement proposal must also show whether existing wetland functions will be reduced by the enhancement actions.

2. A wetlands enhancement compensation project shall be determined pursuant to this section; provided, that enhancement for one function and value will not degrade another function or value and that acreage replacement ratios shall be in accordance with Table 16.28.220(6).

I. Wetland Type.

In-kind compensation shall be provided except where the applicant can demonstrate that:

1. The wetland system is already significantly degraded and out-of-kind replacement will result in a wetland with greater functional value;

2. Scientific problems such as exotic vegetation and changes in watershed hydrology make implementation of in-kind compensation impossible;

3. Out-of-kind replacement will best meet identified regional goals, such as replacement of historically diminished wetland types;

4. Where out-of-kind replacement is accepted, greater acreage replacement ratios may be required to compensate for lost functional values.

J. Wetland Preservation as Mitigation.

Impacts to wetlands may be mitigated by preservation of wetland areas, in a separate tract or easement when used in combination with other forms of mitigation such as creation, restoration, or enhancement at the preservation site or at a separate location. Preservation may also be used by itself, but more restrictions as outlined below will apply.

Preservation as mitigation is acceptable when done in combination with restoration, creation, or enhancement providing that a minimum of one-to-one acreage replacement is provided by restoration or creation and the criteria below are met:

1. The impact area is small, and impacts are to a category III or IV wetland;
2. Preservation of a high-quality system occurs in the same water resource inventory area or watershed basin as the wetland impact;
3. Acceptable sites for preservation include those that are important due to their landscape position, are rare or limited wetland types, and provide high levels of functions;
4. Preservation sites include buffer areas adequate to protect the habitat and its functions from encroachment and degradation; and
5. Mitigation ratios for preservation in combination with other forms of mitigation shall range from ten-to-one to twenty-to-one, as determined on a case-by-case basis by the city, depending on the quality of the wetlands being mitigated and the quality of the wetlands being preserved. Specific ratios will depend upon the significance of the preservation project and the quality of the wetland resources lost.

K. Cooperative Restoration, Creation or Enhancement Projects.

1. The city may encourage, facilitate, and approve cooperative projects wherein a single applicant or other organization with demonstrated capability may undertake a compensation project with funding from other applicants under the following circumstances:
   a. Restoration, creation, or enhancement at a particular site may be scientifically difficult or impossible; or
   b. Creation of one or several larger wetlands may be preferable to many small wetlands.
2. Persons proposing cooperative compensation projects shall:
   a. Submit a joint permit application;
   b. Demonstrate compliance with all standards;
   c. Demonstrate the organizational and fiscal capability to act cooperatively; and
   d. Demonstrate that long-term management can and will be provided.

5.0 LAND USE ACTION

No land use action is proposed in this report.

Although no Critical Areas were identified on the subject property, a wetland buffer extends onto the subject property from the off-site Wetland A. The wetland buffer would cover an area of approximately fifty-four thousand four hundred thirty (~54,430) sf (~1.25 acres) of the subject property. Area outside of wetlands and buffers totals approximately eight and three-fourths (~8.75) acres of the ten (10) acre subject property. These estimates are not based on a survey, rather the estimates are measured using the Thurston County parcel GIS layer.

With respect to category III and IV wetlands, surface level stormwater management facilities may be allowed in the outer twenty-five percent of the wetland buffer using best management practices; provided the community development director makes all of the following determinations:

a. No other location is feasible.

b. The location of such facilities will not degrade the functions or values of the wetland.

Under TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction*, the buffer widths recommended for land uses with high-intensity impacts to wetlands can be reduced to those widths recommended for moderate-intensity impacts under the following conditions:

1. For wetlands that score moderate or high for habitat (five [5] points or more), the width of the buffer around the wetland can be reduced if both the following criteria are met:

    a. A relatively undisturbed vegetated corridor at least one hundred feet wide is protected between the wetland and any other priority habitats as defined by the Washington State Department of Fish and Wildlife. The corridor must be protected for the entire distance between the wetland and the priority habitat via some type of legal protection such as a conservation easement; and

    b. Measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5), are applied.

The proposed project would reduce buffers in compliance with TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction* by:

1) Reducing the high land use intensity buffer to the moderate land use intensity,

2) Protect a relatively undisturbed vegetated corridor at least one hundred (≥100) feet wide, and by

3) Applying measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5).

Under TMC 16.28.170(E)---*Standard Wetland Buffer Width Averaging*, standard wetland buffer zones may be modified by averaging buffer widths if it will improve the protection of wetland functions, or if it is the only way to allow for reasonable use of a parcel. Averaging cannot be used in conjunction with the provisions for reductions in buffer widths. Wetland buffer width averaging shall be allowed to improve wetland protection only where a qualified wetlands professional demonstrates all of the following:

1. The wetland has significant differences in characteristics that affect its habitat functions, such as a wetland with a forested component adjacent to a degraded emergent component or a "dual-rated" wetland with a category I area adjacent to a lower rated area;

2. The buffer is increased adjacent to the higher functioning area of habitat or more sensitive portion of the wetland and decreased adjacent to the lower functioning or less sensitive portion;

3. The total area contained in the buffer area after averaging is not less than that which would be contained within the standard buffer; and

4. The buffer at its narrowest point is never less than three-fourths of the required width.

9.0 SUMMARY & CONCLUSION

The purpose of this Critical Areas Report is to identify and map Critical Areas on the subject property, satisfying City of Tumwater regulatory requirements under Critical Areas. Potential wetlands, streams, steep slopes, and their buffers were evaluated on the subject property and within three hundred (≤300) feet of the subject property.

The entire subject property is forested by Douglas fir (*Pseudotsuga menzeisii*, FACU), Big leaf maple (*Acer macrophyllum*, FACU), and red alder (*Alnus rubra*, FAC) with a dense understory of non-wetland plants (**Appendix A, Photos 1 & 2**). Henderson Boulevard SE borders the southeastern property boundary. An off-site large, shallow lake is located at the northwestern property line (**Appendix A, Photos 9 & 10**).

No wetlands or streams were identified on the subject property during the site evaluation. One (1) wetland, labeled Wetlands A, was identified, and GNSS-located north to northwest of the subject property (**Figures 2 & 3; Appendix A, Photos 5-16**). Wetland A is a very shallow lake containing an aquatic bed and thick scrub shrub vegetation on the periphery. Wetland A is a shallow depression containing permanent water. An unnamed stream flows into the western portion of Wetland A. A small stream forms an outlet on the western portion of wetland A before flowing to the Deschutes River greater than one (>1) mile (6,600 feet) downgradient.

Wetland A has been classified as a Category III wetland by the Department of Ecology (2014) Wetland Rating Form for Western Washington as required under Chapter 16.28.090---*Wetlands Rating System*. Wetland A is a depressional wetland under the 2014 Department of Ecology Wetland Rating System.

Under City of Tumwater Municipal Code (TMC) Title 16---*Environment*, Chapter 16.28.090---*Wetlands Rating System*, wetland buffers are calculated based on category of wetland and the habitat score determined by the Washington State Department of Ecology (2014) Wetland Rating System publication 14-06-029, effective January 2015), as revised. Wetland A scored for habitat a "Medium (M)" potential to provide habitat, a "Low (L)" landscape potential to support habitat, and a "High (H)" potential value to society. Wetlands that rate as an M, L, H receive a score of six (6) points for total habitat functions (**Appendix K**).

The standard buffer for Category III wetlands that score between five (5) and Seven (7) points for Habitat Functions require a buffer width of one hundred fifty (150) feet (TMC Chapter 16.28.170---*Wetland buffers*, Table 16.28.170(2)---*Category II Wetland Buffer Widths*) (**Figure 5, Table 2**).

The one hundred fifty (150)-foot buffer on Wetland A could be reduced to one hundred ten (110) feet pursuant to compliance with criteria under TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction* (See Section 4.3 of this report).

No land use action is proposed in this report.

Although no Critical Areas were identified on the subject property, a wetland buffer extends onto the subject property from the off-site Wetland A. The wetland buffer would cover an area of approximately fifty-four thousand four hundred thirty (~54,430) sf (~1.25 acres) of the subject property. Area outside of wetlands and buffers totals approximately eight and three-fourths (~8.75) acres of the ten (10) acre subject property. These estimates are not based on a survey, rather the estimates are measured using the Thurston County parcel GIS layer.

With respect to category III and IV wetlands, surface level stormwater management facilities may be allowed in the outer twenty-five percent of the wetland buffer using best management practices; provided the community development director makes all of the following determinations:

a. No other location is feasible.

b. The location of such facilities will not degrade the functions or values of the wetland.

Under TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction*, the buffer widths recommended for land uses with high-intensity impacts to wetlands can be reduced to those widths recommended for moderate-intensity impacts under the following conditions:

1. For wetlands that score moderate or high for habitat (five [5] points or more), the width of the buffer around the wetland can be reduced if both the following criteria are met:

    a. A relatively undisturbed vegetated corridor at least one hundred feet wide is protected between the wetland and any other priority habitats as defined by the Washington State Department of Fish and Wildlife. The corridor must be protected for the entire distance between the wetland and the priority habitat via some type of legal protection such as a conservation easement; and

    b. Measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5), are applied.

The proposed project would reduce buffers in compliance with TMC Chapter 16.28.170---*Wetland buffers*, Subsection (C)---*Buffer Width Reduction* by:

1) Reducing the high land use intensity buffer to the moderate land use intensity,

2) Protect a relatively undisturbed vegetated corridor at least one hundred (≥100) feet wide, and by

3) Applying measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 16.28.170(5).

Under TMC 16.28.170(E)---*Standard Wetland Buffer Width Averaging*, standard wetland buffer zones may be modified by averaging buffer widths if it will improve the protection of wetland functions, or if it is the only way to allow for reasonable use of a parcel. Averaging cannot be used in conjunction with the provisions for reductions in buffer widths. Wetland buffer width averaging shall be allowed to improve wetland protection only where a qualified wetlands professional demonstrates all of the following:

1. The wetland has significant differences in characteristics that affect its habitat functions, such as a wetland with a forested component adjacent to a degraded emergent component or a "dual-rated" wetland with a category I area adjacent to a lower rated area;

2. The buffer is increased adjacent to the higher functioning area of habitat or more sensitive portion of the wetland and decreased adjacent to the lower functioning or less sensitive portion;

3. The total area contained in the buffer area after averaging is not less than that which would be contained within the standard buffer; and

4. The buffer at its narrowest point is never less than three-fourths of the required width.

10.0 REFERENCES

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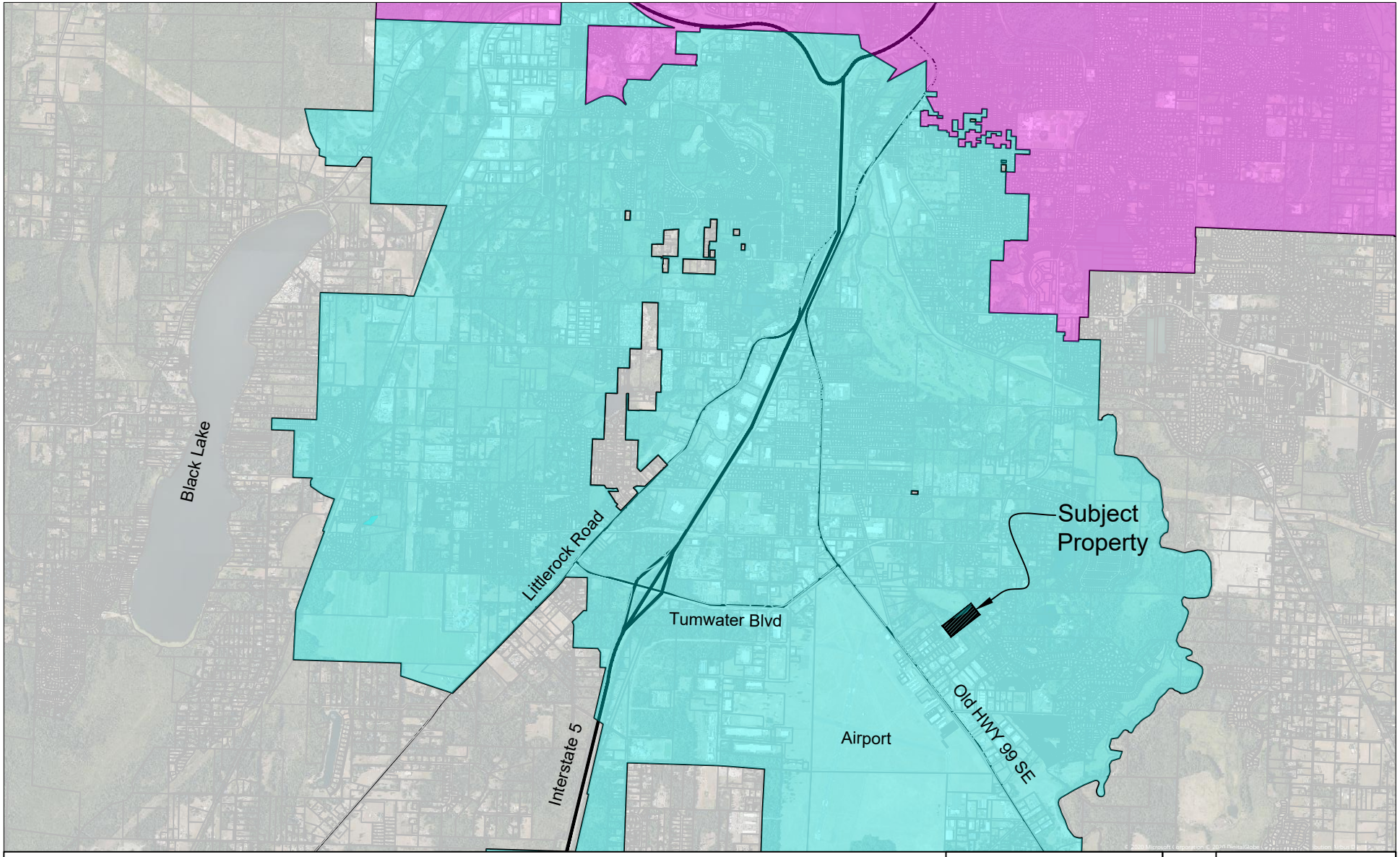
FIGURES



EnviroVector
OPTIMIZE USABLE LAND
curtis@envirovector.com
www.envirovector.com
360-790-1559

City of Tumwater

City of Olympia

Figure 1

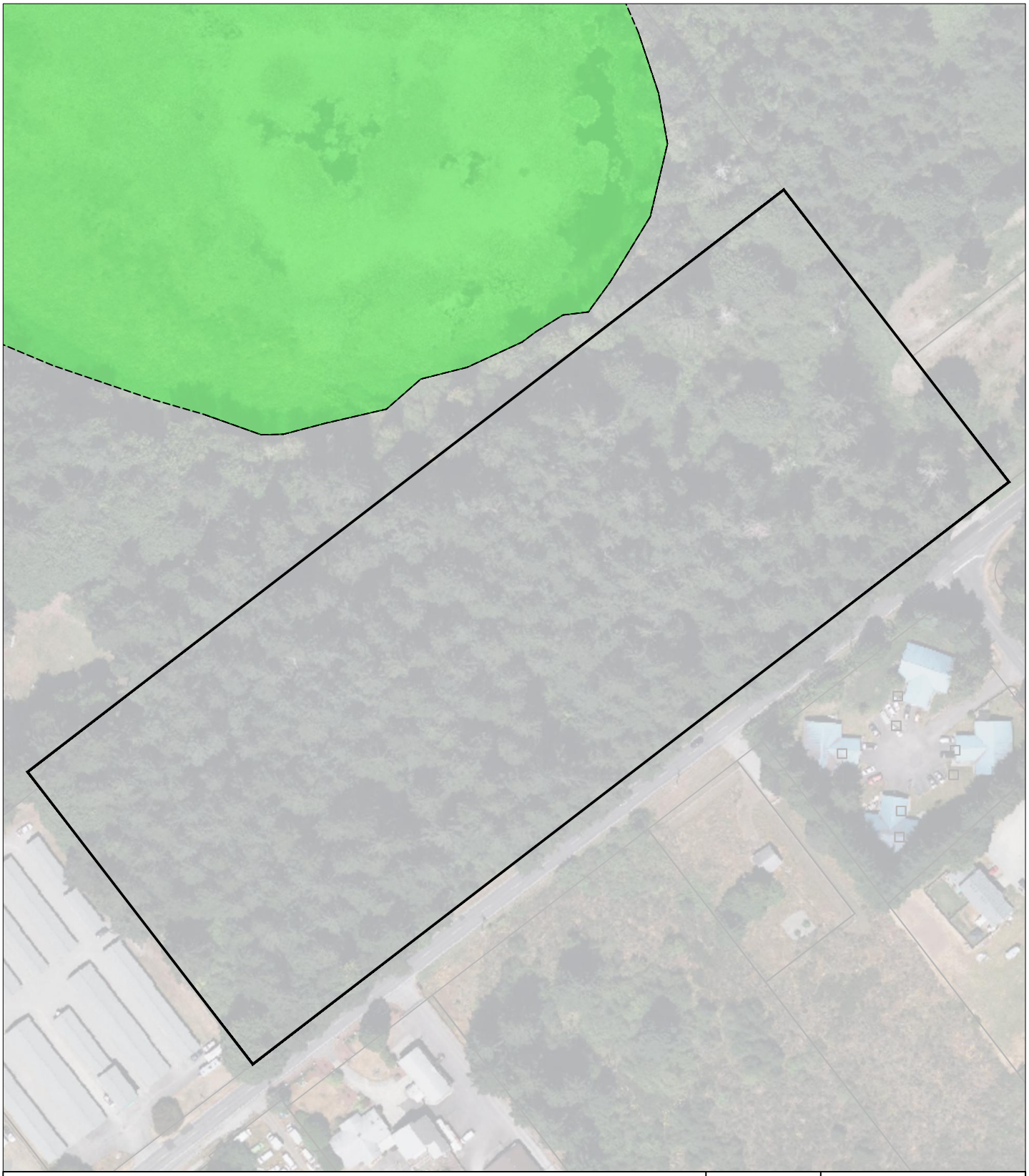
Henderson

Vicinity Map

Scale: 1" = 4000'

0 4000'

26 June 2023



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Wetland (Confirmed)

Wetland (Agency Mapped & LiDAR)

Streams

Figure 2

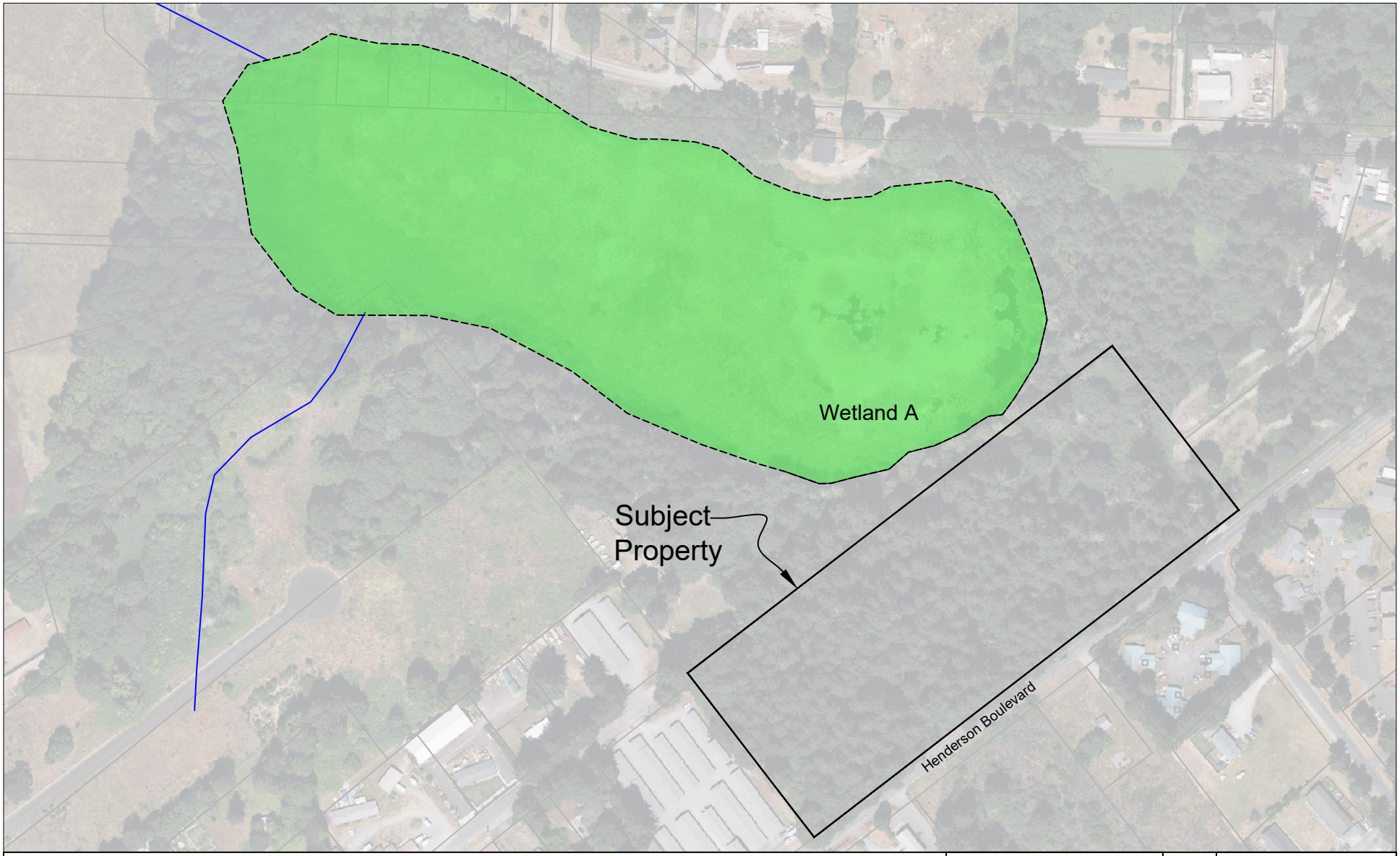
Henderson

Existing Conditions

Scale: 1"= 150'

0 150'

26 June 2023



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Wetland (Confirmed)

Wetland (Agency Mapped & LiDAR)

Figure 3

Henderson

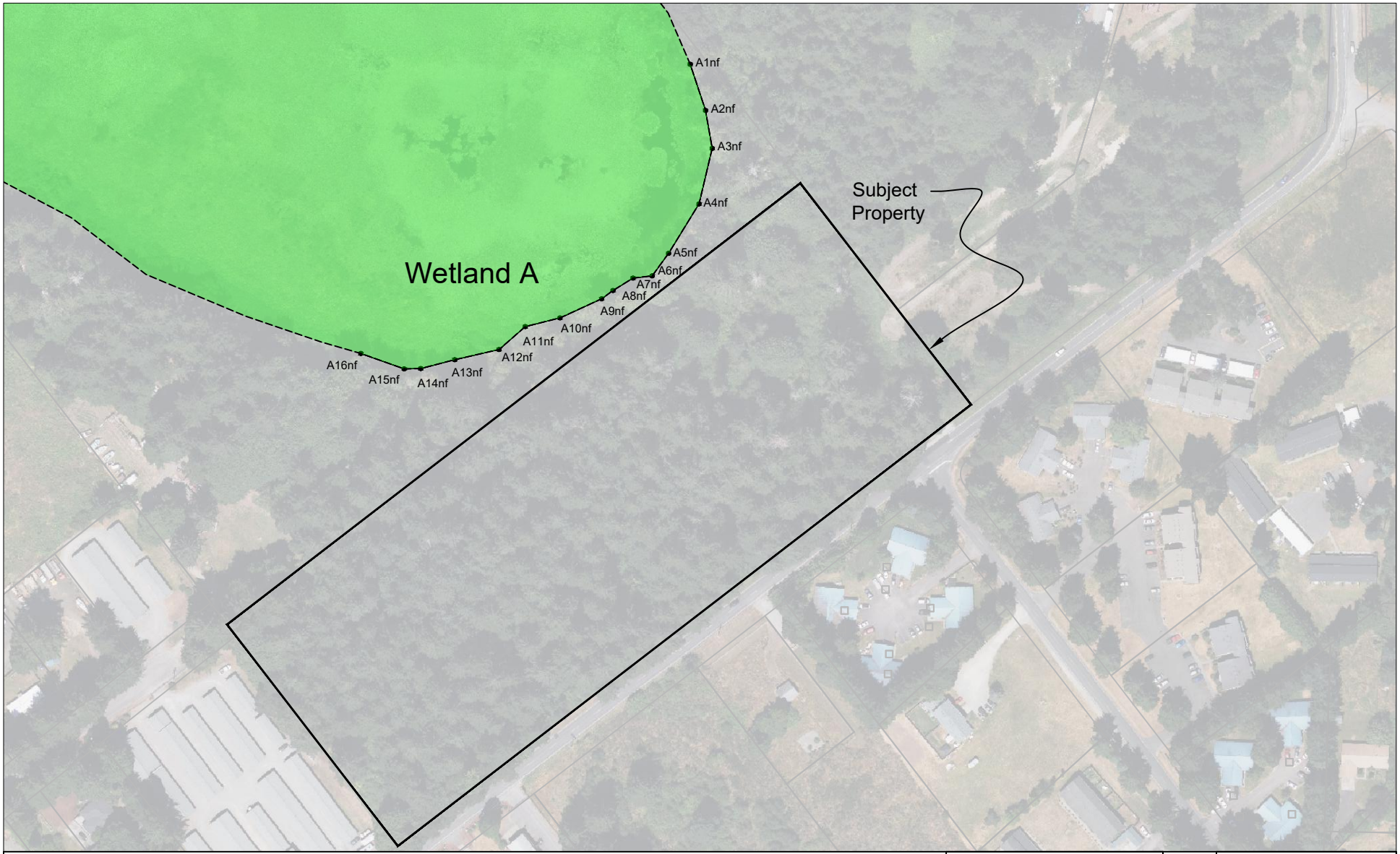
Existing Conditions
Wetland A

N

Scale: 1" = 270'

0 270'

26 June 2023



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Wetland (Confirmed)

Wetland (Agency Mapped & LiDAR)

A-1 — A-2 Wetland Delineation

▲TP A-2 Test Plot

nf: no flag at this location

Figure 4

Henderson

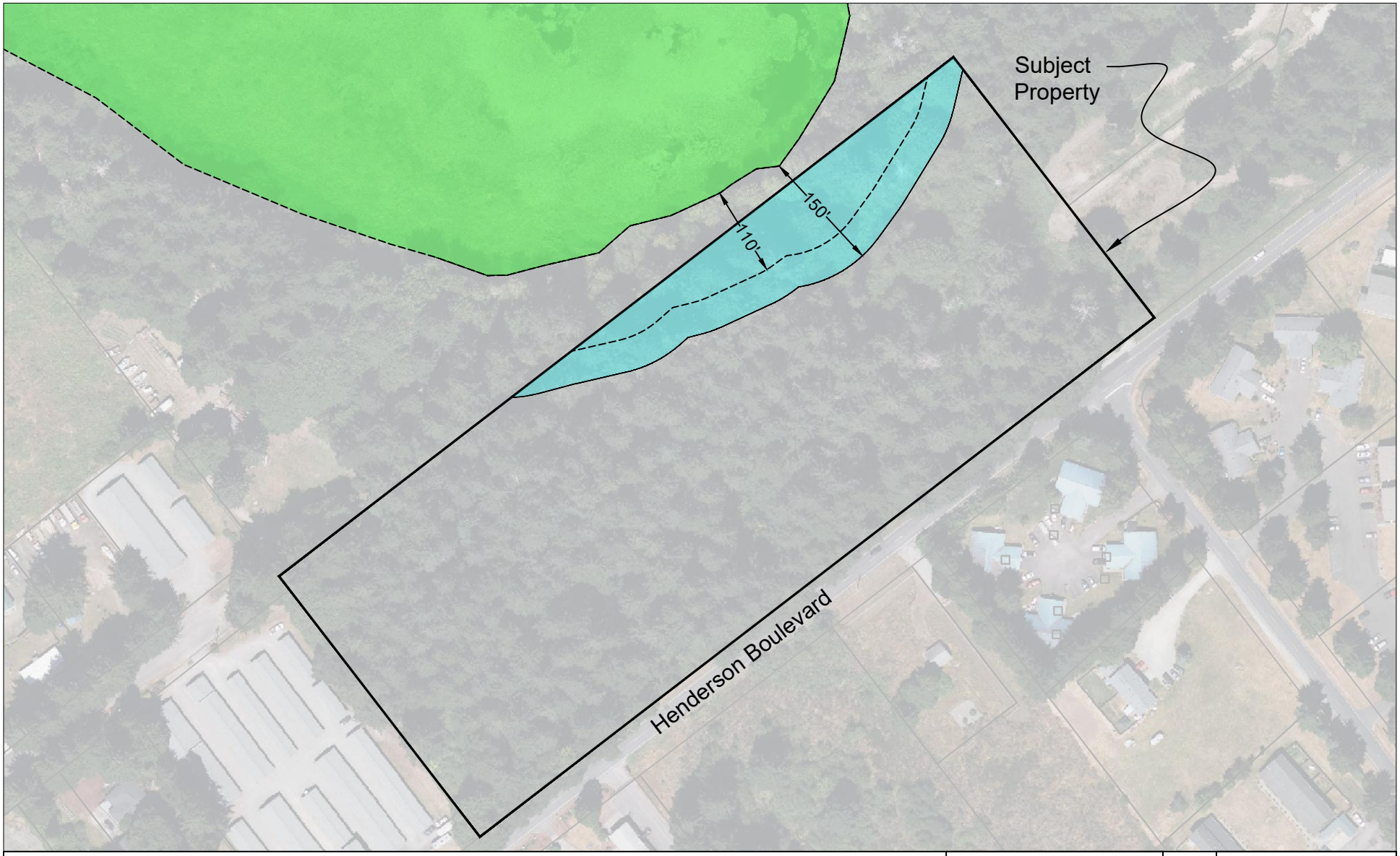
Wetland Delineation

N

Scale: 1" = 200'

0 200'

26 June 2023



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Wetland (Confirmed)

Wetland (Estimated from Agency Databases)

Standard Wetland Buffer (150 feet)

Reduced Buffer with Mitigation (110 feet)

Figure 5

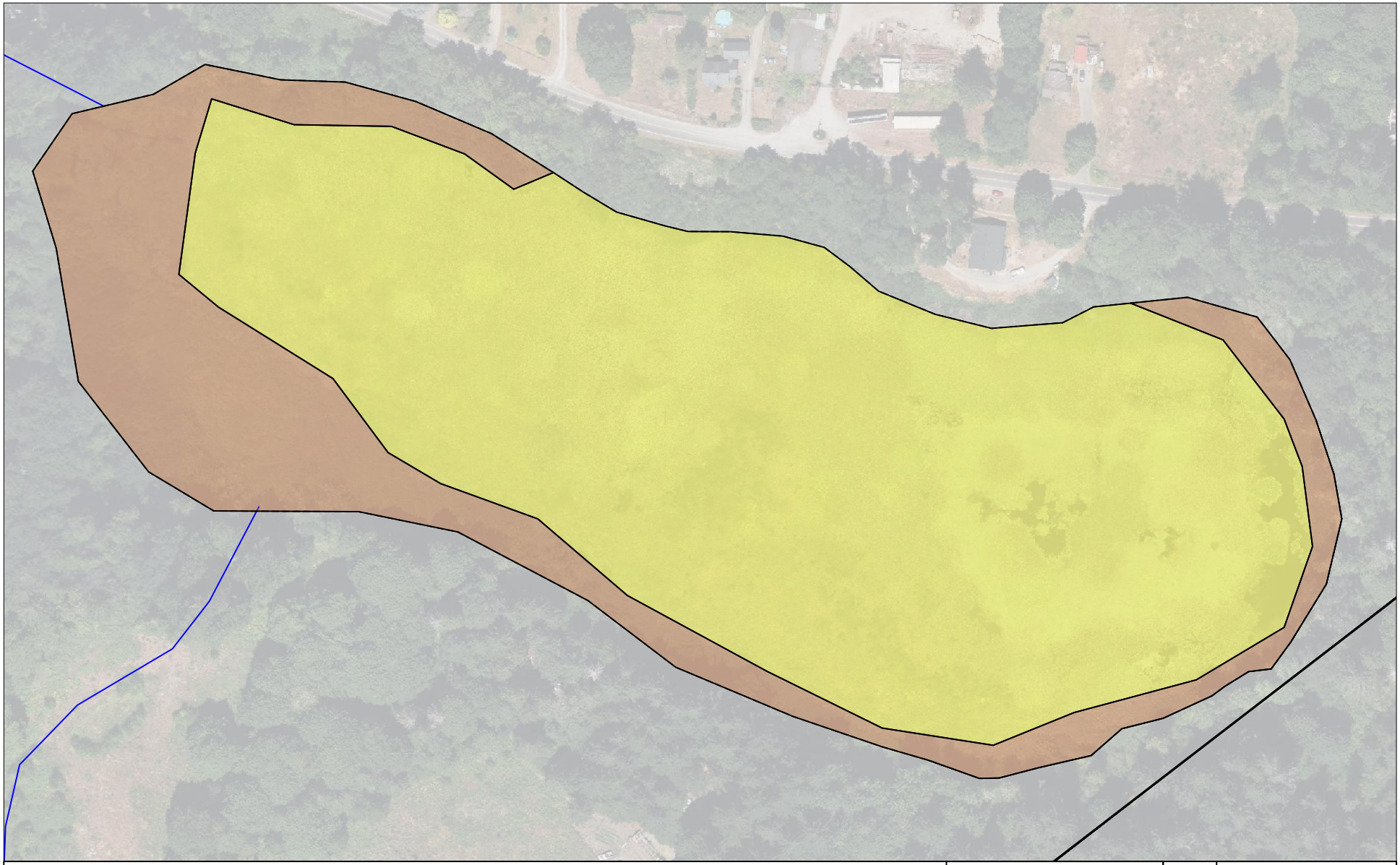
Henderson

Wetland Buffers

Scale: 1" = 170'

0 170'

26 June 2023



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Aquatic bed Permenantly-flooded

Scrub-shrub Seasonally-flooded

Figure 6

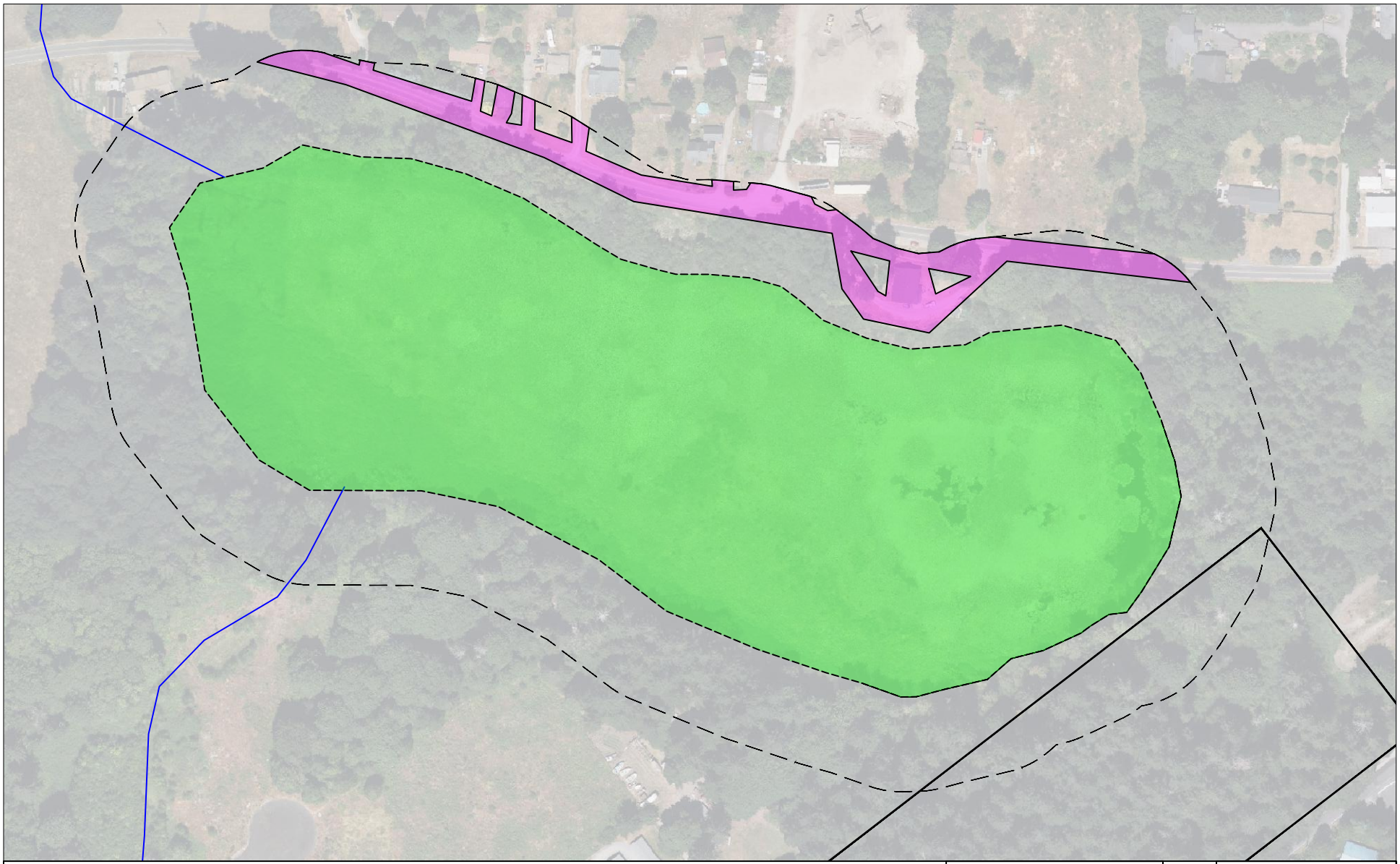
Henderson

Vegetation Classes & Hydroperiods

Scale: 1" = 100'

0 100'

26 June 2023



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Potential Pollutants 12%
Stream
150-foot polygon

Figure 7

Henderson

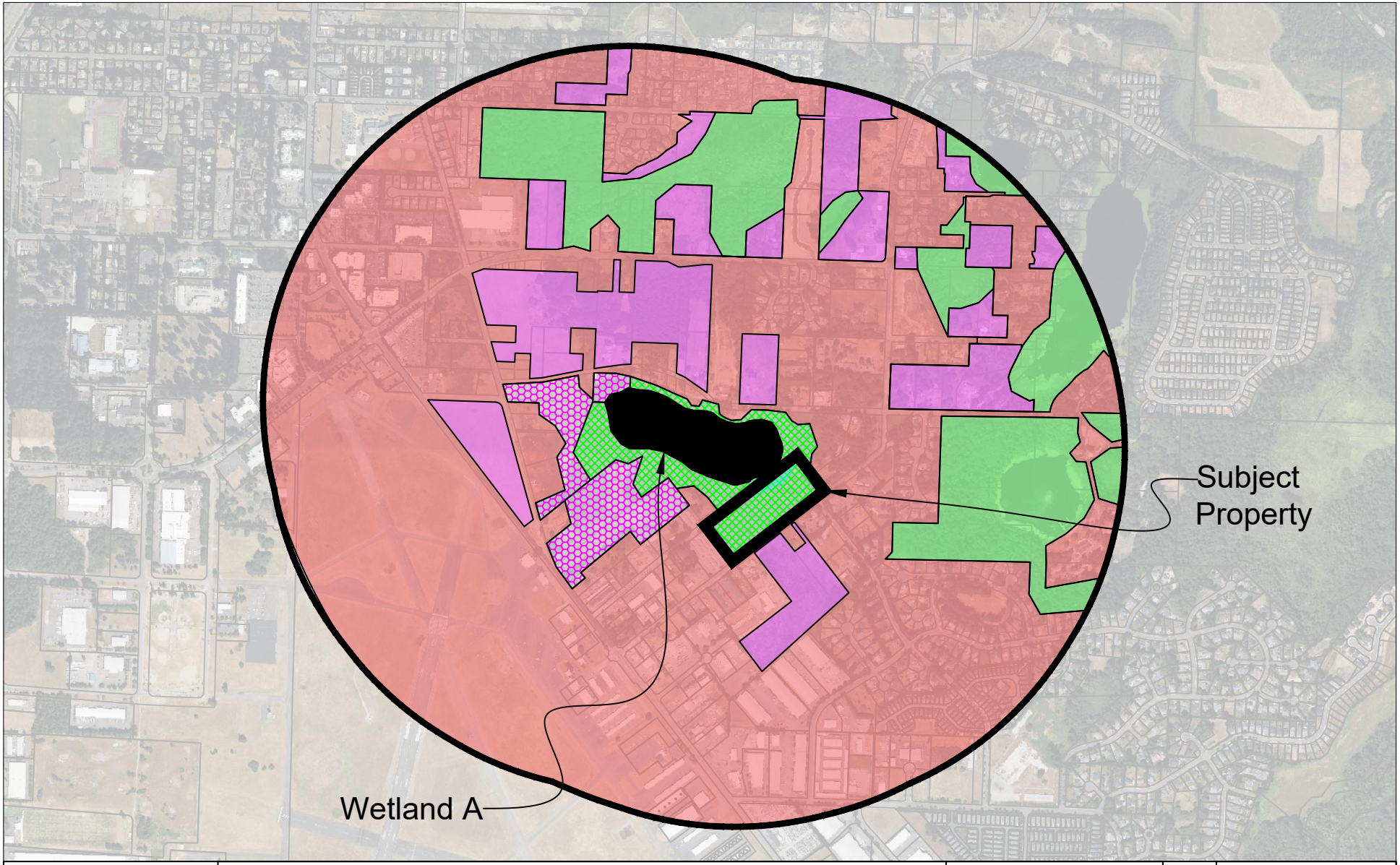
Potential Pollutants

N

Scale: 1" = 100'

0 100'

26 June 2023



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Accessible Habitat (1,078,815 sf, 24.8 acres, 2.5%)

Accessible Moderate to Low Intensity Land Use (1,043,172 sf, 24 acres, 2%)

Total Undisturbed Habitat + Accessible Habitat (6,560,541 sf, 150.6 acres, 15%)

Low to Moderate Intensity Land Use (6,424,199 sf, 147.5 acres, 15%)

High Intensity Land Use (27,992,387 sf, 665.6 acres, 66.2%)

1km Polygon 43,794,349 sf (1,005 acres)

H2.1: 2.5% + 2%/2 = 3.5% (0 points) H2.2: 15% + 15%/2 = 22.5% (1 point) H2.3: High Intensity = 66.2% (-2 points)

Figure 8

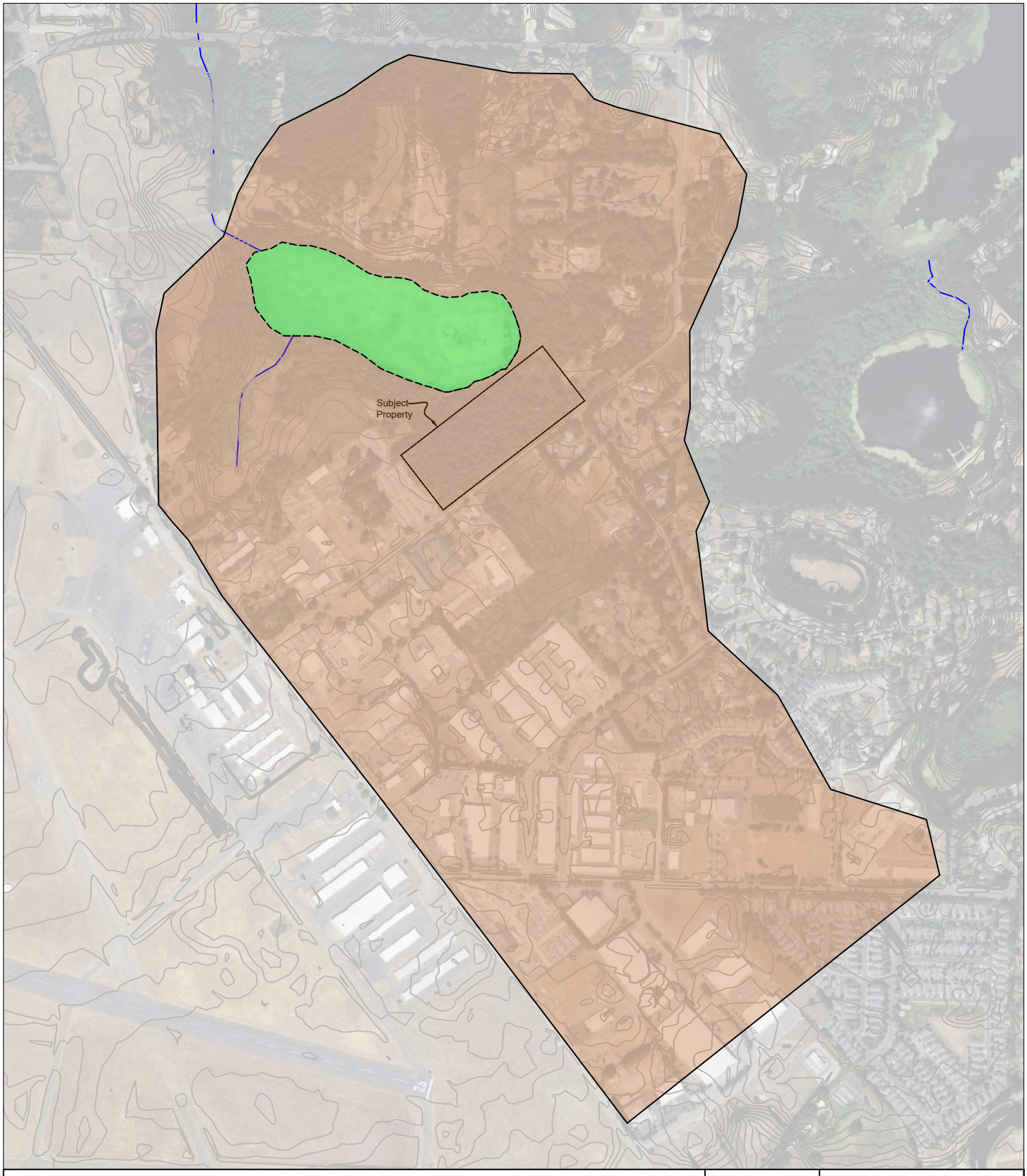
Henderson

1 km Polygon
Wetland E

Scale: 1" = 1250'

0 1250'

26 June 2023



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Wetland A (Confirmed)

Wetland (Mapped from LiDAR)

Wetland A (18x)

Figure 9

Henderson

Contributing Basin

Scale: 1" = 800'

0 800'

26 June 2023

APPENDIX A

PHOTOGRAPHS


Photo 1. Vegetated wetland buffer area onsite


Photo 2. Vegetated wetland buffer area onsite


Photo 3. Property line or corner


Photo 4. Property line or corner


Photo 5. Wetland A, Aquatic bed interior, scrub shrub periphery


Photo 6. Scrub shrub periphery of wetland


Photo 7. Scrub shrub periphery of wetland


Photo 8. Scrub shrub periphery of wetland

Photo 9. Wetland A, Aquatic bed interior, scrub shrub periphery

Photo 10. Wetland A, Aquatic bed interior, scrub shrub periphery

Photo 11. TP-A1 in Wetland A

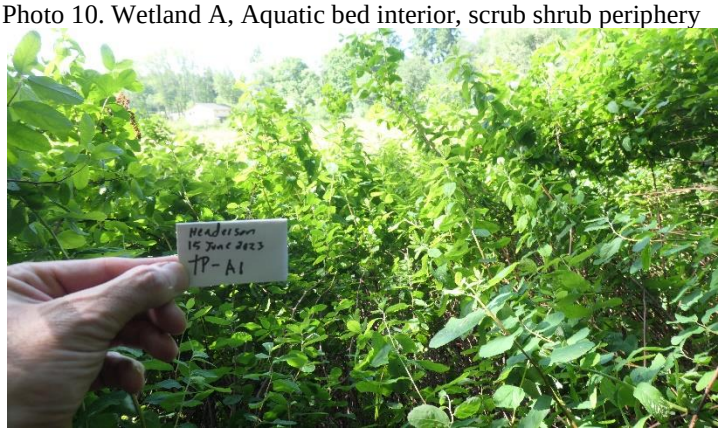


Photo 12. Vegetation at TP-A1

Photo 13. TP-A2 in wetland buffer

Photo 14. TP-A2 in wetland buffer

Photo 15. Vegetation at TP-A2

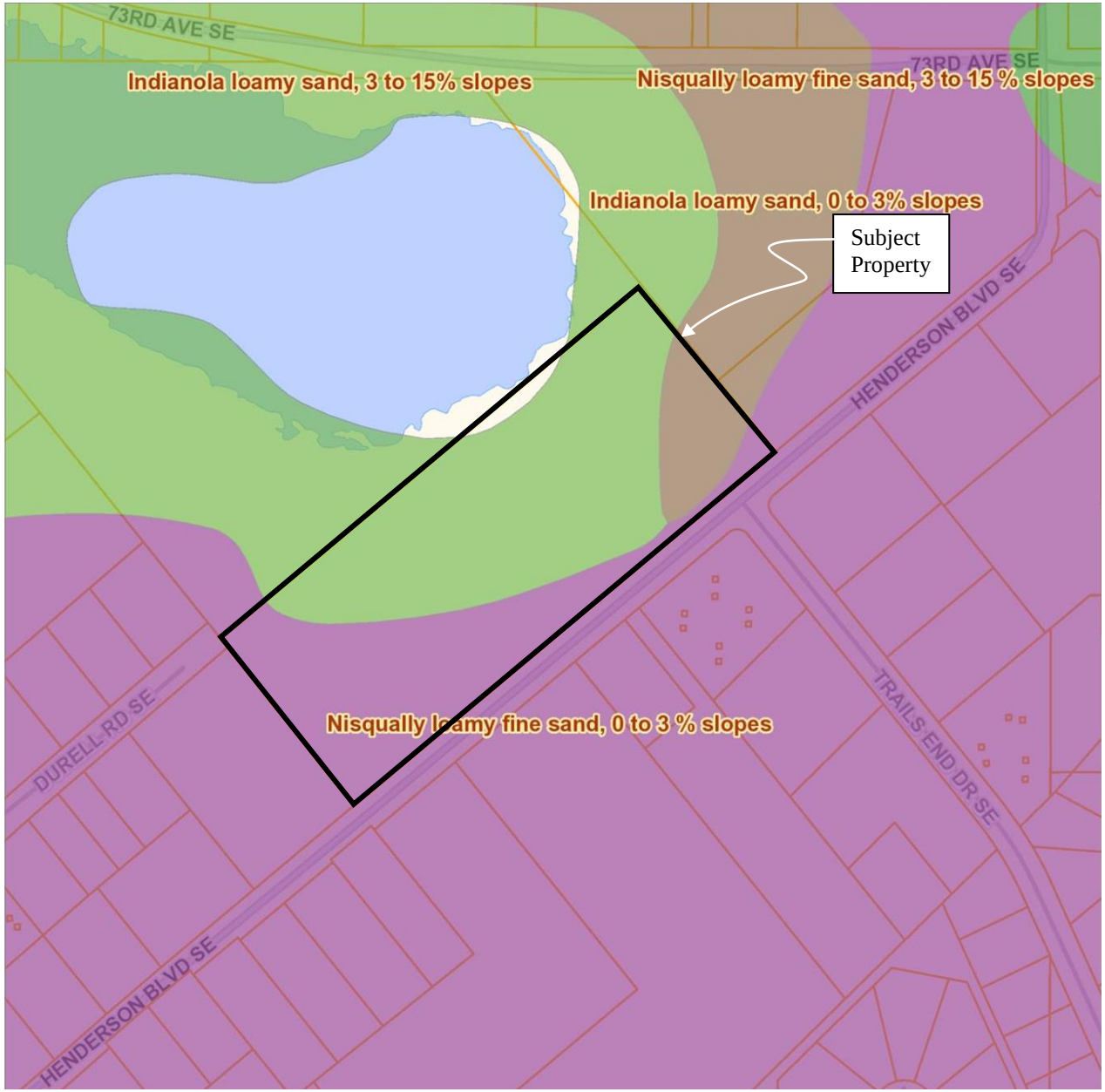
Photo 16. Vegetation at TP-A2

Appendix B

Thurston County

Geodata Center

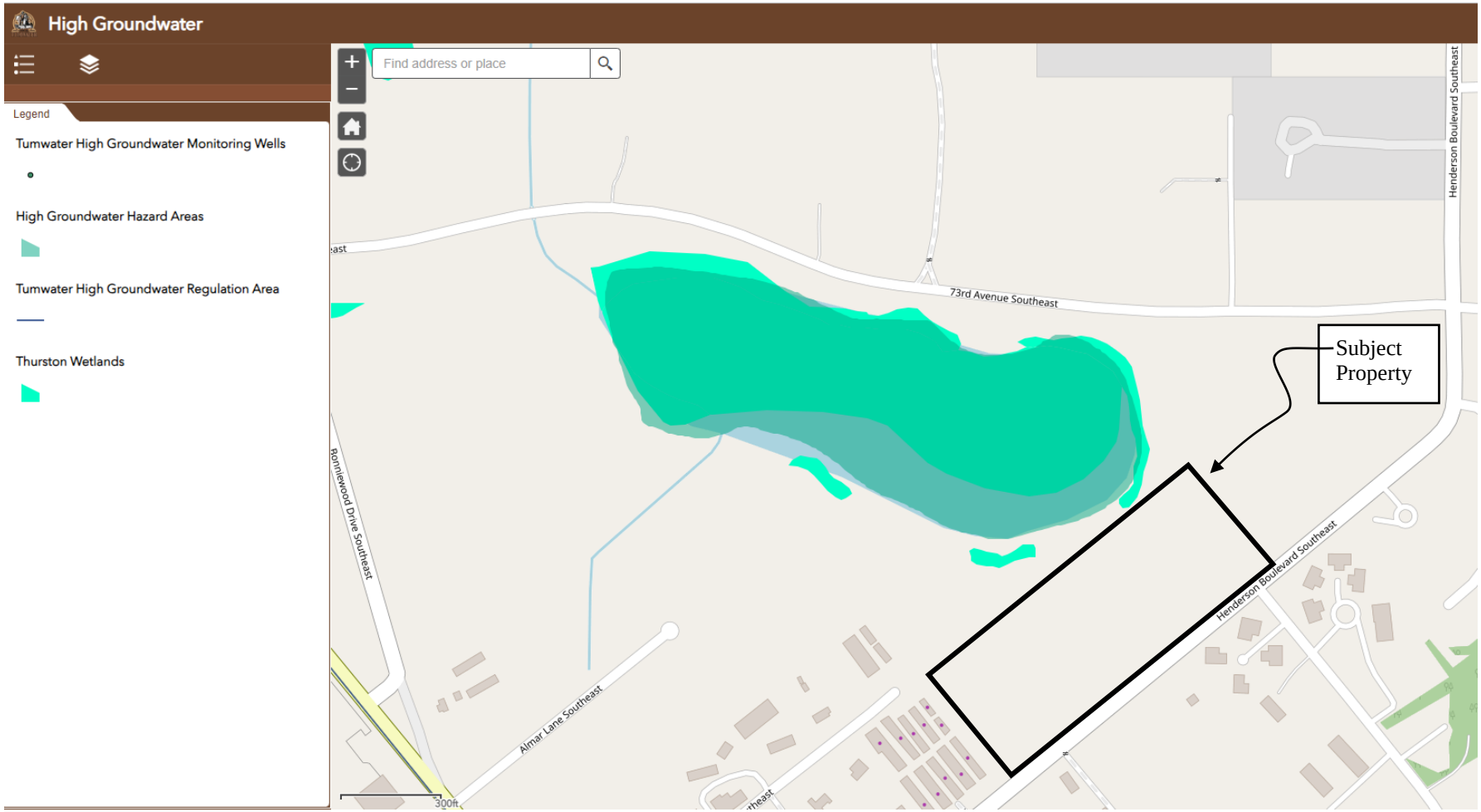
Soils Survey


73RD AVE SE
Indianola loamy sand, 3 to 15% slopes
73RD AVE SE
Nisqually loamy fine sand, 3 to 15 % slopes
Indianola loamy sand, 0 to 3% slopes
Subject Property
HENDERSON BLVD SE
DURELL RD SE
Nisqually loamy fine sand, 0 to 3 % slopes
TRAILS END DR SE
HENDERSON BLVD SE

Appendix C

City of Tumwater

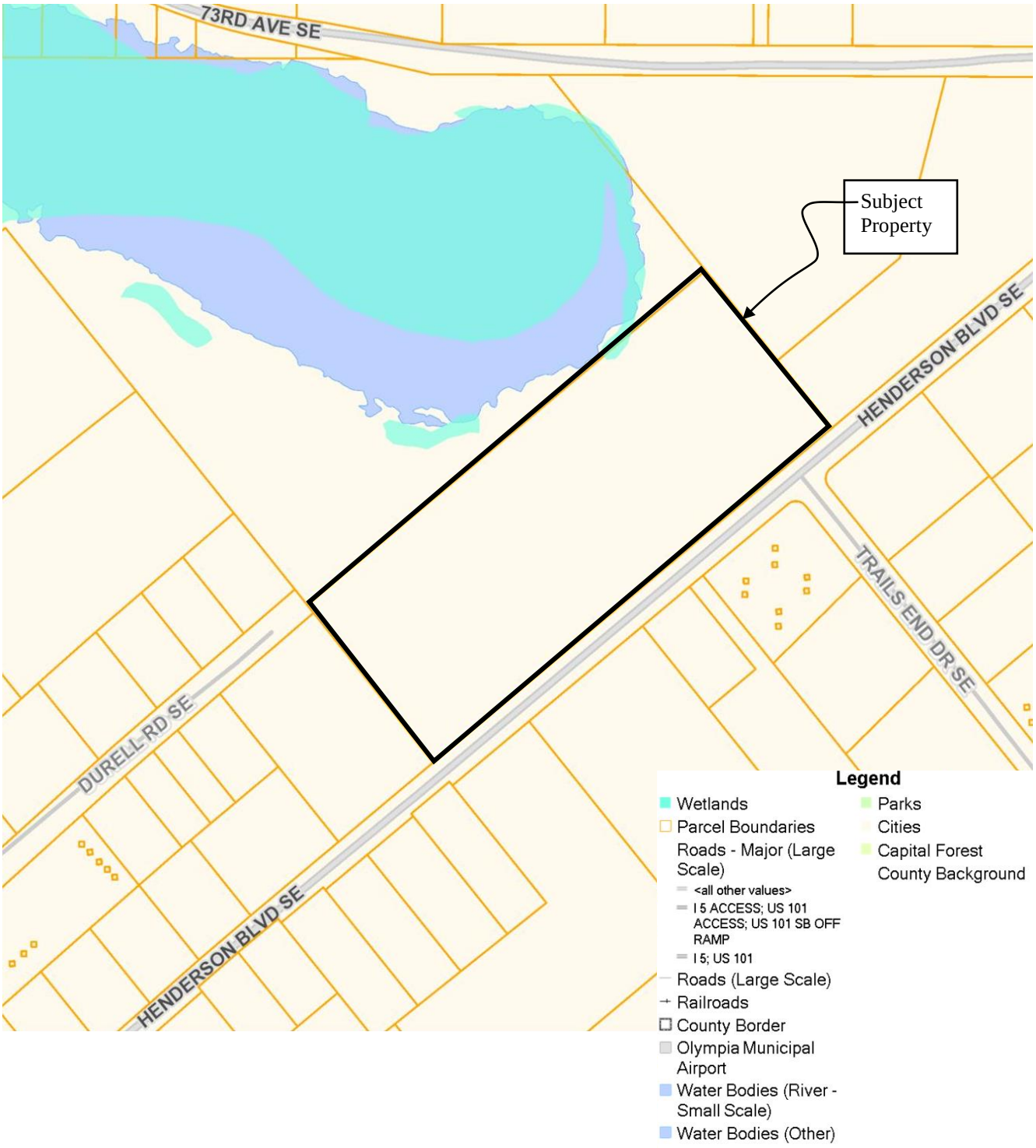
Wetlands and Streams


High Groundwater
Legend
Tumwater High Groundwater Monitoring Wells
High Groundwater Hazard Areas
Tumwater High Groundwater Regulation Area
Thurston Wetlands
Find address or place
73rd Avenue Southeast
Henderson Boulevard Southeast
Bonniewood Drive Southeast
Almar Lane Southeast
Subject Property
300ft

Appendix D

Thurston County

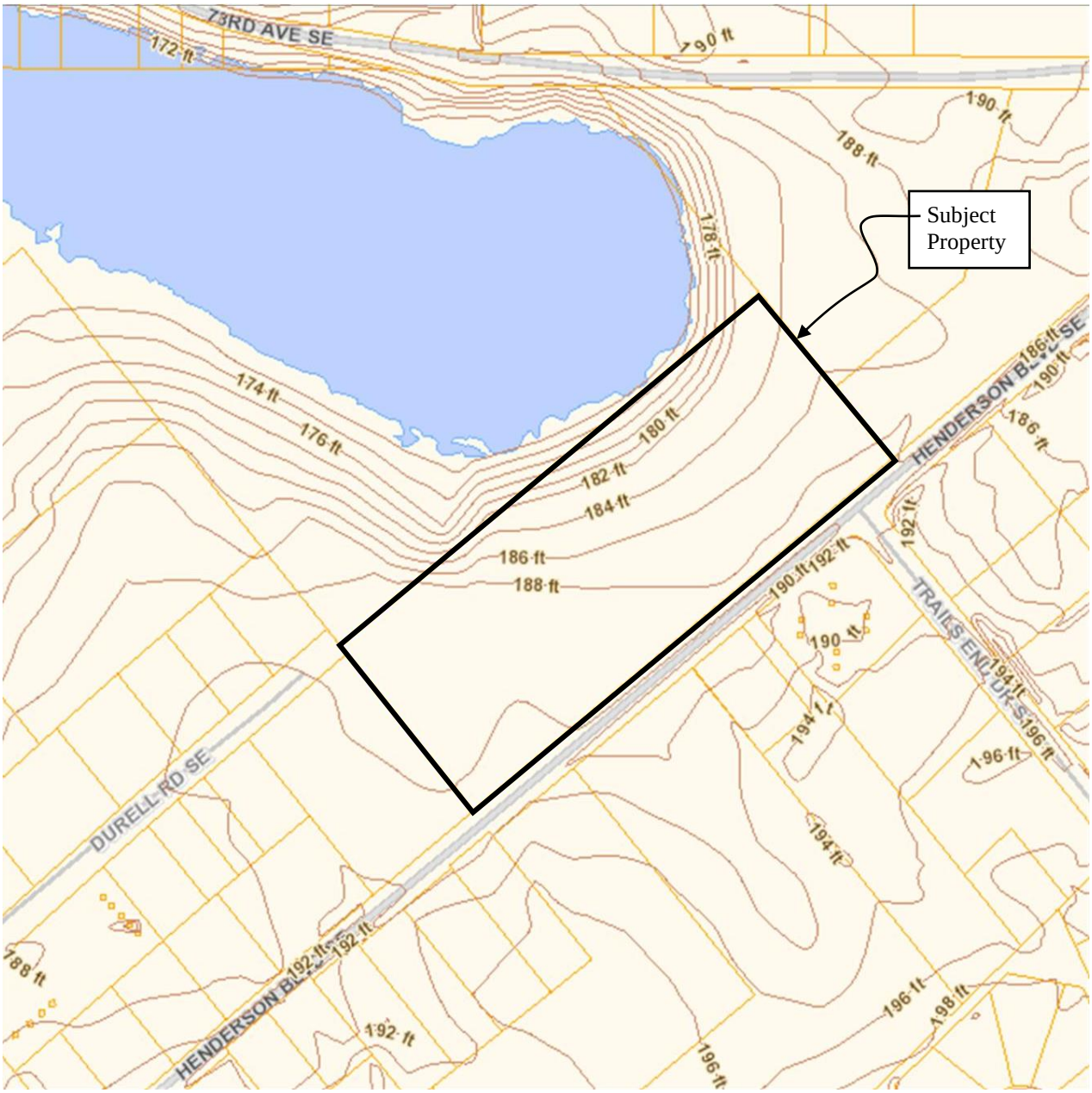
Geodata Center Database


73RD AVE SE
Subject Property
HENDERSON BLVD SE
TRAILS END DR SE
DURELL RD SE
HENDERSON BLVD SE
Legend
Wetlands
Parcel Boundaries
Roads - Major (Large Scale)
<all other values>
I 5 ACCESS; US 101 ACCESS; US 101 SB OFF RAMP
I 5; US 101
Roads (Large Scale)
Railroads
County Border
Olympia Municipal Airport
Water Bodies (River - Small Scale)
Water Bodies (Other)
Parks
Cities
Capital Forest
County Background

Appendix E

Thurston County

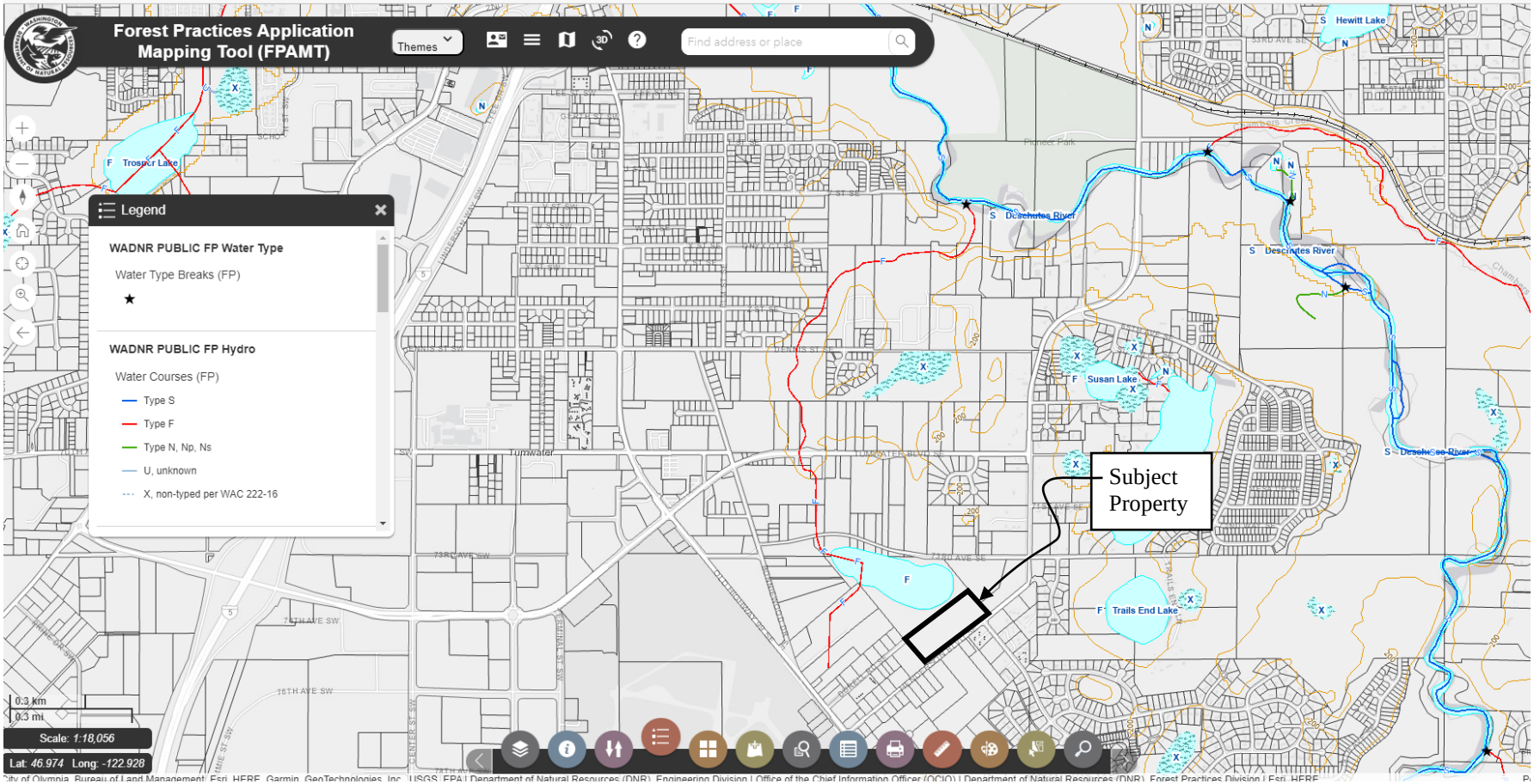
Contours


73RD AVE SE
172 ft
190 ft
188 ft
178 ft
Subject Property
174 ft
176 ft
180 ft
182 ft
184 ft
186 ft
188 ft
HENDERSON BLVD SE
186 ft
190 ft
186 ft
192 ft
190 ft
192 ft
TRAILS END LOOP S
190 ft
194 ft
194 ft
196 ft
194 ft
DURELL RD SE
188 ft
192 ft
192 ft
192 ft
196 ft
198 ft
196 ft

Appendix F

State Department of Natural Resources (DNR)

Water Typing Database

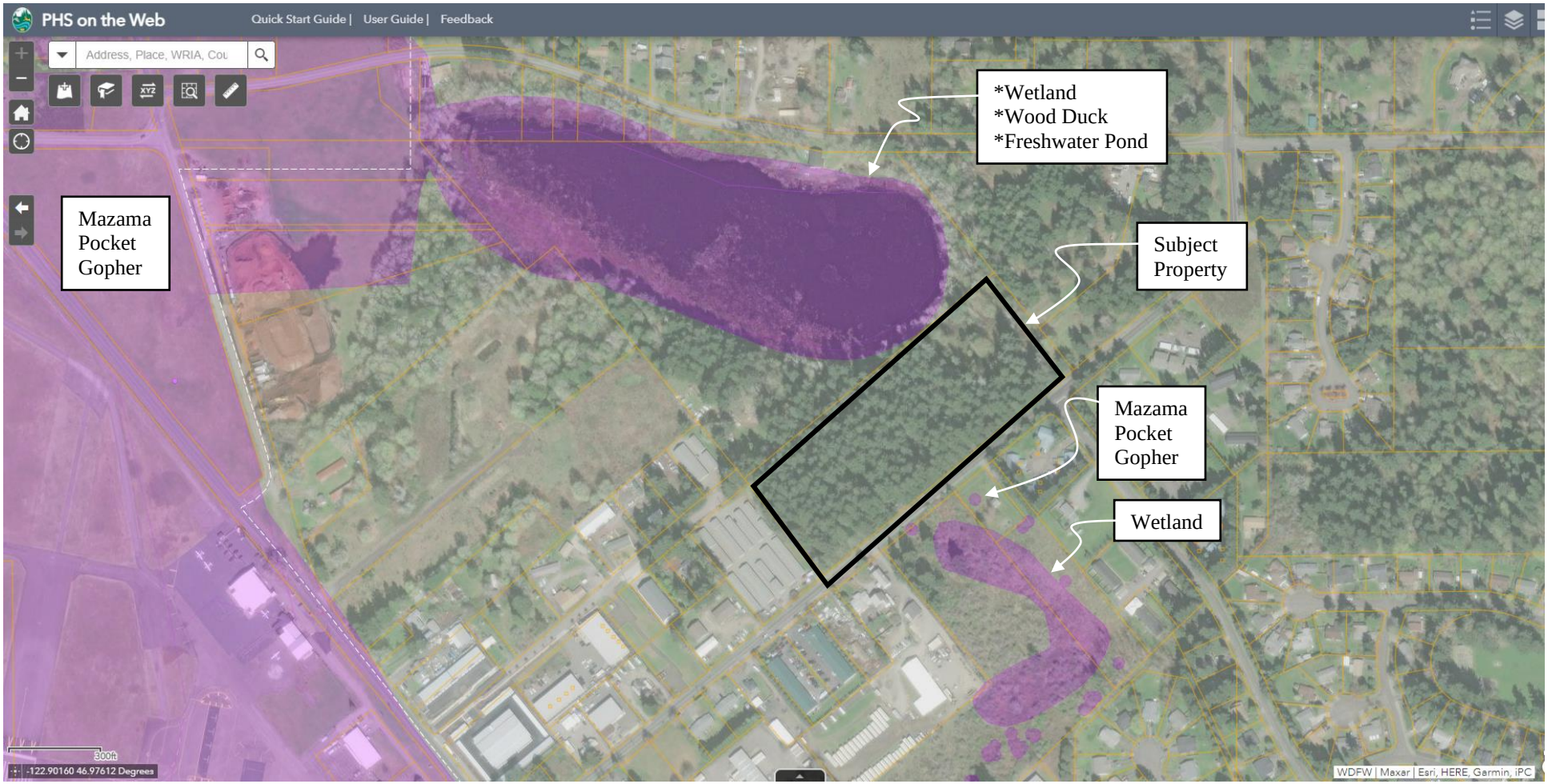

Forest Practices Application Mapping Tool (FPAMT)
Themes
Find address or place
Legend
WADNR PUBLIC FP Water Type
Water Type Breaks (FP)
WADNR PUBLIC FP Hydro
Water Courses (FP)
Type S
Type F
Type N, Np, Ns
U, unknown
X, non-typed per WAC 222-16
Subject Property
Hewitt Lake
Deschutes River
Susan Lake
Trails End Lake
Tumwater
0.3 km
0.3 mi
Scale: 1:18,056
Lat: 46.974 Long: -122.928

Appendix G

Washington Department of Fish and Wildlife (WDFW)

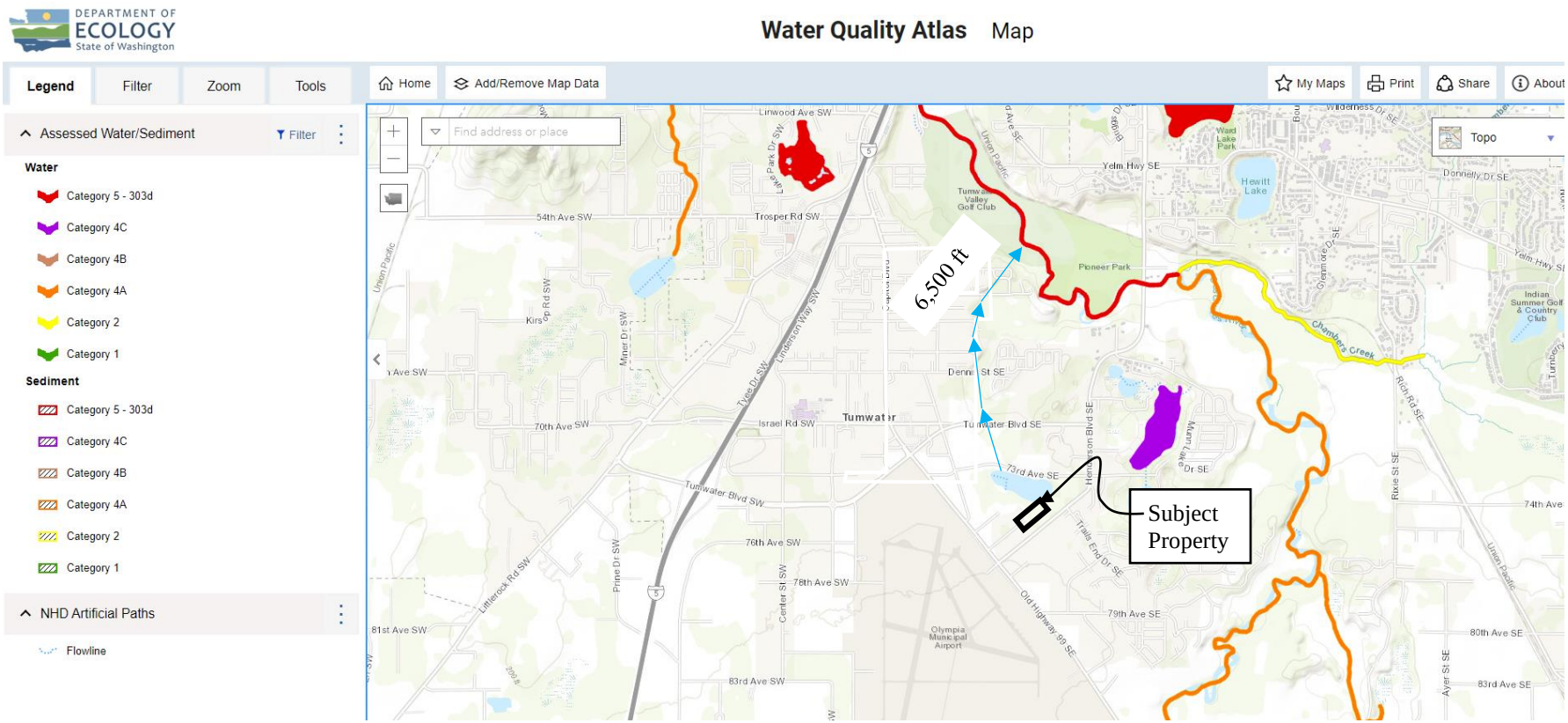
Priority Habitats and Species (PHS)

Database


PHS on the Web
Quick Start Guide | User Guide | Feedback
Address, Place, WRIA, Cou
*Wetland
*Wood Duck
*Freshwater Pond
Mazama Pocket Gopher
Subject Property
Mazama Pocket Gopher
Wetland
300ft
-122.90160 46.97612 Degrees
WDFW | Maxar | Esri, HERE, Garmin, iPC

Appendix H

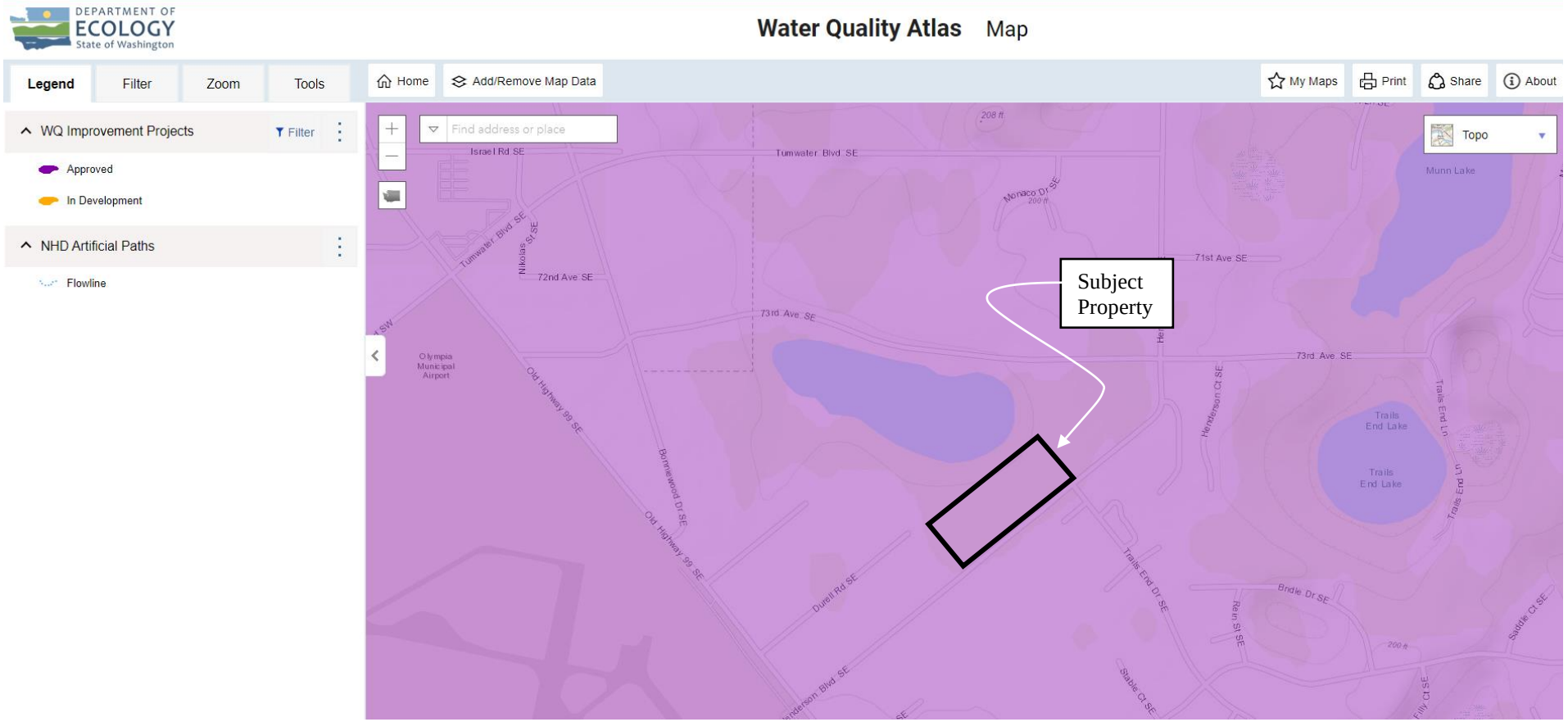
303(d)


DEPARTMENT OF ECOLOGY
State of Washington
Water Quality Atlas Map
Legend
Filter
Zoom
Tools
Home
Add/Remove Map Data
My Maps
Print
Share
About
Assessed Water/Sediment
Filter
Water
Category 5 - 303d
Category 4C
Category 4B
Category 4A
Category 2
Category 1
Sediment
Category 5 - 303d
Category 4C
Category 4B
Category 4A
Category 2
Category 1
NHD Artificial Paths
Flowline
Find address or place
Topo
6,500 ft
Subject Property
Tumwater
Linwood Ave SW
Trosper Rd SW
54th Ave SW
Israel Rd SW
70th Ave SW
Tumwater Blvd SW
76th Ave SW
78th Ave SW
79th Ave SE
81st Ave SW
83rd Ave SW
Yelm Hwy SE
Pioneer Park
Chambers Creek
Tumwater Blvd SE
73rd Ave SE
Old Highway 99 SE
Olympia Municipal Airport

Appendix I

Department of Ecology Water Quality Atlas Database

TMDL

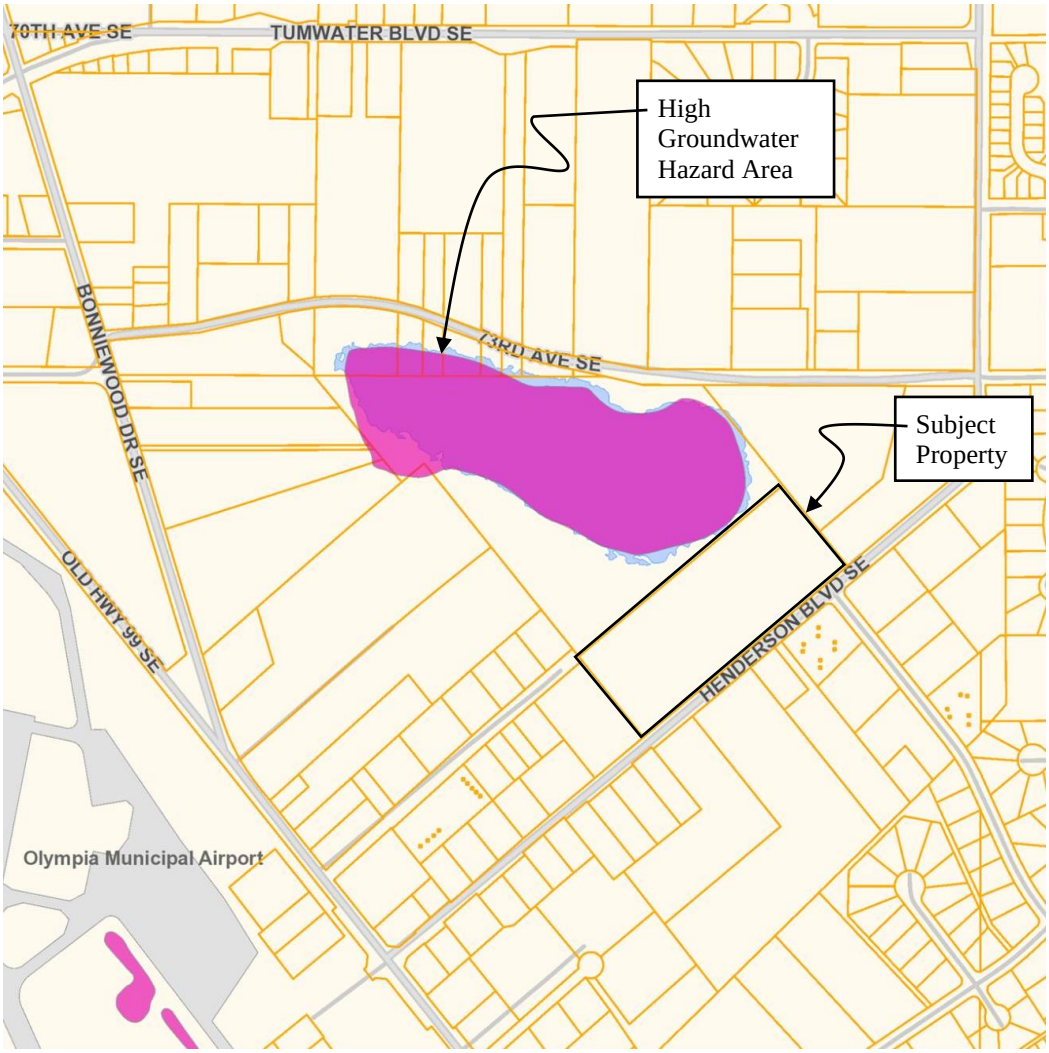

DEPARTMENT OF ECOLOGY State of Washington
Water Quality Atlas Map
Legend
Filter
Zoom
Tools
Home
Add/Remove Map Data
My Maps
Print
Share
About
WQ Improvement Projects
Filter
Approved
In Development
NHD Artificial Paths
Flowline
Find address or place
Topo
Subject Property
Israel Rd SE
Tumwater Blvd SE
Monaco Dr SE
Munn Lake
Tumwater Blvd SE
Nikolas St SE
72nd Ave SE
71st Ave SE
73rd Ave SE
Olympia Municipal Airport
Old Highway 99 SE
Bonniewood Dr SE
Henderson Ct SE
Trails End Lake
Trails End Ln
Durell Rd SE
Trails End Dr SE
Bridle Dr SE
Rein St SE
Saddle Ct SE
Stable Ct SE

Appendix J

Thurston County

Geodata Center

High Water Hazard Area


70TH AVE SE
TUMWATER BLVD SE
High Groundwater Hazard Area
BONNIEWOOD DR SE
73RD AVE SE
Subject Property
OLD HWY 99 SE
HENDERSON BLVD SE
Olympia Municipal Airport

Appendix K

Rating Forms

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland A Date of site visit: 15-Jun-23

Rated by Curtis Wambach Trained by Ecology? ☑ Yes ☐ No Date of training Continual

HGM Class used for rating Depressional & Flats 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 GoogleEarth, AutoDesk, Thurston Geodata

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

1. Category of wetland based on FUNCTIONS

_____ **Category I** - Total score = 23 - 27
_____ **Category II** - Total score = 20 - 22
X **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	M	
Landscape Potential	M	M	L	
Value	H	M	H	**Total**
Score Based on Ratings	7	6	6	**19**

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	6
Hydroperiods	D 1.4, H 1.2	6
Location of outlet (*can be added to map of hydroperiods*)	D 1.1, D 4.1	6
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	D 2.2, D 5.2	7
Map of the contributing basin	D 4.3, D 5.3	9
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	8
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	Appendix I
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	Appendix H

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream (*can be added to another figure*)	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
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)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

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	H 2.1, H 2.2, H 2.3	

polygons for accessible habitat and undisturbed habitat		
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	

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*

☐ 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:

DEPRESSIONAL AND FLATS WETLANDS

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

D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 ☑ Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 ☐ Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	1
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic (*use NRCS definitions*). Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants > 95% of area points = 5 Wetland has persistent, ungrazed, plants > ½ of area points = 3 Wetland has persistent, ungrazed plants > $^1/_{10}$ of area points = 1 Wetland has persistent, ungrazed plants < $^1/_{10}$ of area points = 0	3
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is > ½ total area of wetland points = 4 Area seasonally ponded is > ¼ total area of wetland points = 2 Area seasonally ponded is < ¼ total area of wetland points = 0	4
Total for D 1 Add the points in the boxes above	**8**

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

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	0
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	1
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1 - D 2.3? Source Yes = 1 No = 0	0
Total for D 2 Add the points in the boxes above	**2**

Rating of Landscape Potential If score is: ☐ **3 or 4 = H** ☑ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	1
D 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 basin in which the unit is found*)? Yes = 2 No = 0	2
Total for D 3 Add the points in the boxes above	**3**

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

DEPRESSIONAL AND FLATS WETLANDS

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

D 4.0. Does the site have the potential to reduce flooding and erosion?		
D 4.1. Characteristics of surface water outflows from the wetland:		
Wetland is a depression or flat depression with no surface water leaving it (no outlet)	points = 4	0
Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet	points = 2	
Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch	points = 1	
Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing	points = 0	
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.*		3
Marks of ponding are 3 ft or more above the surface or bottom of outlet	points = 7	
Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet	points = 5	
☑ Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet	points = 3	
☐ The wetland is a "headwater" wetland	points = 3	
Wetland is flat but has small depressions on the surface that trap water	points = 1	
Marks of ponding less than 0.5 ft (6 in)	points = 0	
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.*		3
☐ The area of the basin is less than 10 times the area of the unit	points = 5	
The area of the basin is 10 to 100 times the area of the unit	points = 3	
The area of the basin is more than 100 times the area of the unit	points = 0	
☐ Entire wetland is in the Flats class	points = 5	
Total for D 4	Add the points in the boxes above	**6**

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

D 5.0. Does the landscape have the potential to support hydrologic function of the site?		
D 5.1. Does the wetland unit receive stormwater discharges?	Yes = 1 No = 0	0
D 5.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate excess runoff?	Yes = 1 No = 0	0
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)?	Yes = 1 No = 0	1
Total for D 5	Add the points in the boxes above	**1**

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

D 6.0. Are the hydrologic functions provided by the site valuable to society?		
D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.*		1
The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon		
● Flooding occurs in a sub-basin that is immediately down-gradient of unit.	points = 2	
☐ ● Surface flooding problems are in a sub-basin farther down-gradient.	points = 1	
☑ Flooding from groundwater is an issue in the sub-basin.	points = 1	
☐ The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. Explain why	points = 0	

☐ There are no problems with flooding downstream of the wetland.	points = 0	
D 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 D 6	Add the points in the boxes above	**1**

Rating of Value If score is: ☑ **2 - 4 = H** ☑ **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	1
☐ 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

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	1
☑ 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**	

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***

2

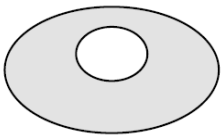
If you counted:	> 19 species	points = 2
	5 - 19 species	points = 1
	< 5 species	points = 0

H 1.4. Interspersion of habitats

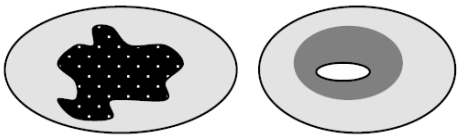
Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always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

1

None = 0 points

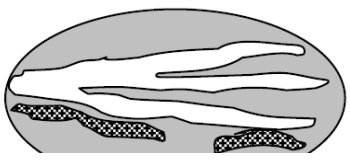


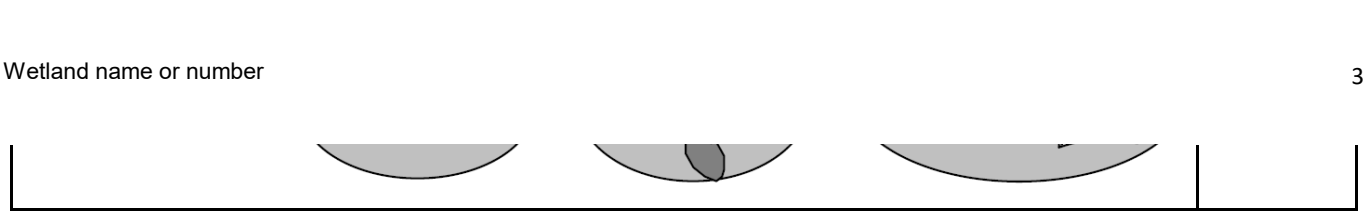
Low = 1 point



Moderate = 2 points

All three diagrams in this row are **HIGH** = 3 points





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* ☐ 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	**9**

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:* 2.5 % undisturbed habitat + (2 % moderate & low intensity land uses / 2) = 3.5% 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	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* 15 % undisturbed habitat + (15 % moderate & low intensity land uses / 2) = 22.5% 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	1
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	-2
Total for H 2 Add the points in the boxes above	**-1**

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	2

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	

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.

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

Appendix L

Datasheets

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

Project/Site: Henderson Property City/County: Thurston County Sampling Date: 15 June 2023

Applicant/Owner: Henderson Property State: WA Sampling Point: TP-A1

Investigator(s): Curtis Wambach Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation no, Soil no, or Hydrology no significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation no, Soil no, or Hydrology no 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 ☒ No ☐ Hydric Soil Present? Yes ☒ No ☐ Wetland Hydrology Present? Yes ☒ No ☐	**Is the Sampled Area within a Wetland?** Yes ☒ No ☐

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	15	= Total Cover	
Sapling/Shrub Stratum (Plot size: 12)			
1. Douglas spirea (Spiraea douglasii)	100	Y	FACW
2. Pacific crabapple (Malus fusca)	20	Y	FACW
3.			
4.			
5.			
	120	= Total Cover	
Herb Stratum (Plot size: 6)			
1. Reed canarygrass (Phalaris arundinacea)	20	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	20	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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: 185 (A)	370 (B)

Prevalence Index = B/A = 2

Hydrophytic Vegetation Indicators:

- ☒ Rapid Test for Hydrophytic Vegetation
- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 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 ☒ No ☐**

Remarks:

SOIL

Sampling Point: TP-A1

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

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

[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** ☐

Remarks:

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 ☐ Depth (inches): Surface

Water Table Present? Yes ☒ No ☐ Depth (inches): Surface

Saturation Present? (includes capillary fringe) Yes ☒ No ☐ Depth (inches): surface

Wetland Hydrology Present? **Yes** ☒ **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: Henderson City/County: Thurston County Sampling Date: 15 June 2023

Applicant/Owner: Henderson State: WA Sampling Point: TP-A2

Investigator(s): Curtis Wambach Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation no, Soil no, or Hydrology no significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation no, Soil no, or Hydrology no 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 ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Douglas fir (Pseudotsuga menziesii)	30	Y	FACU
2. Oregon ash (Fraximus latafolia)	20	Y	FACW
3. Big leaf maple (Acer macrophyllum)	20	Y	FACU
4.			
	70	= Total Cover	
Sapling/Shrub Stratum (Plot size: 12)			
1. Snowberry (Physocarpus albus)	60	Y	FACU
2. Osoberry (Oemleria cerasiformis)	30	Y	FACU
3. Serviceberry (Amelanchier alnifolia)	30	Y	FACU
4. Vine maple (Acer circinatum)	10	N	FAC
5. Himalayan blackberry (Rubus armeniacus)	5	N	FAC
	135	= Total Cover	
Herb Stratum (Plot size: 6)			
1. Swordfern (Polystichum munitum)	60	Y	FACU
2. Trailing blackberry (Rubus ursinus)	30	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 12.5% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 20	x 2 = 40
FAC species 15	x 3 = 45
FACU species 260	x 4 = 1040
UPL species _____	x 5 = _____
Column Totals: 295 (A)	1125 (B)

Prevalence Index = B/A = 3.81

Hydrophytic Vegetation Indicators:

- ☐ Rapid Test for Hydrophytic Vegetation
- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 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 ☐ No ☒

Remarks:

SOIL

Sampling Point: TP-A2

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

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

[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 ☒

Remarks:

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)
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- ☐ 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 ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

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

Remarks: