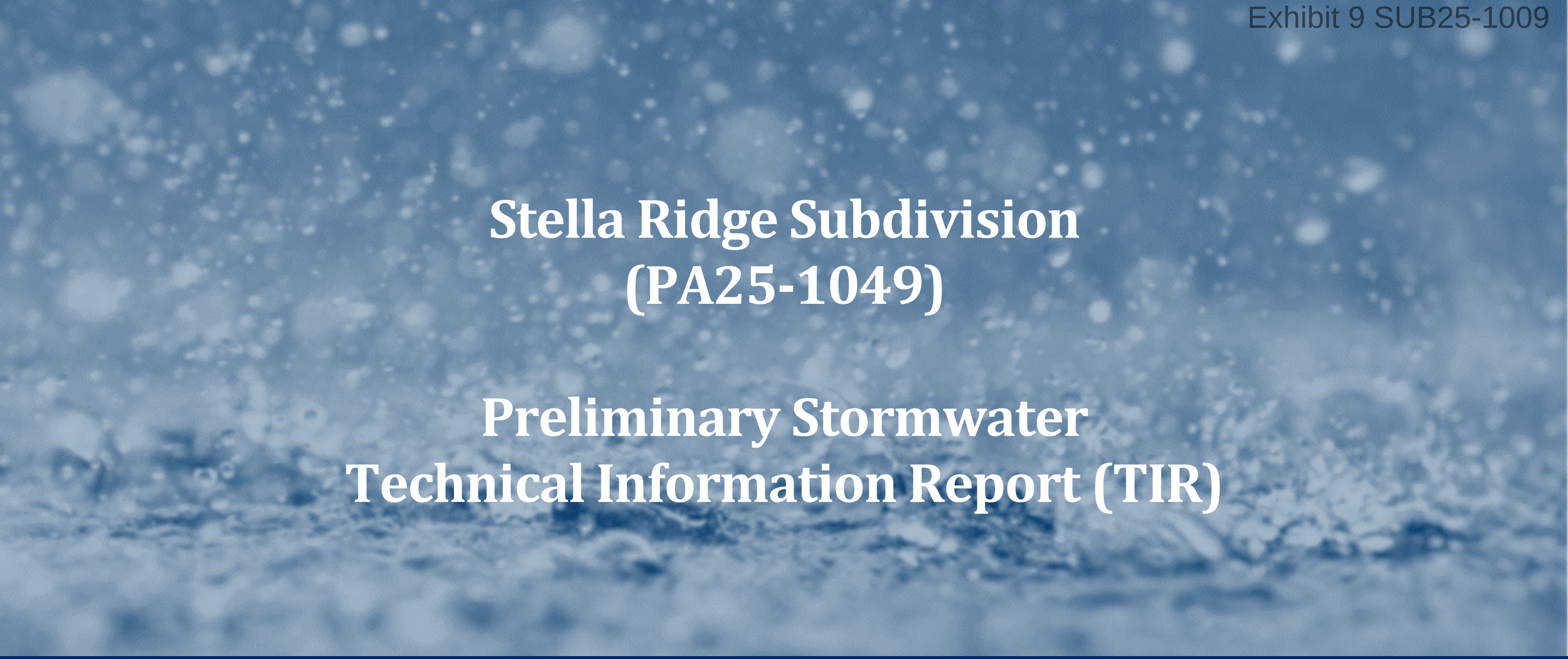
5. Preliminary Stormwater Technical Information Report (TIR)

Exhibit 9 SUB25-1009



Stella Ridge Subdivision
(PA25-1049)

Preliminary Stormwater
Technical Information Report (TIR)

Date:	September 2025
Submitted To:	City of Camas Community Development Department 616 NE 4th Avenue Camas, WA 98607
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AKS Job Number:	12107

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Certificate of the Engineer

Camas Meadows Subdivision
Camas, Washington
Preliminary Technical Information Report

This Technical Information Report (TIR) and the data contained herein were prepared by the undersigned, whose seal, as a Professional Engineer licensed to practice as such, is affixed below. All information required by Camas Municipal Code (CMC) Chapter 14.02 is included in the proposed stormwater plan, and the proposed facilities are feasible.

JOHN M. MEIER
42614

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References

2024 Stormwater Management Manual for Western Washington, (Ecology Publication No. 24-10-013, July 2024) – “SWMMWW”

Preliminary Stormwater Technical Information Report (TIR)

STELLA RIDGE SUBDIVISION
CAMAS, WASHINGTON

Section A – Project Overview

This report analyzes the effects the proposed development will have on the existing stormwater conveyance system; documents the criteria, methodology, and informational sources used to design the proposed stormwater system; and presents the results from the preliminary hydraulic analysis. Any changes to the proposed site and its effects on the hydraulic analysis, associated models and facility designs will be outlined and provided in the final technical information report.

Section A.1 – Site Location

The Stella Ridge Subdivision project site is addressed at 4511 NW 18th Avenue, Camas, WA 98607 and is a total of 24.41 acres in size. The site is composed of Clark County Parcel Numbers 125193000, 986055381, and 125185000 within the southwest quarter of Section 04, Township 1 North, Range 3 East, Willamette Meridian. The parcels are zoned Multifamily Residential (MF-18) and are currently vacant with no existing structures on-site. The site will be accessed from the South via NW 18th Avenue, to the northeast from NW Brady Road and to the southeast through a proposed extension of NW 20th Avenue.

Section A.2 – Site Topography and Critical Areas

The site slopes generally to the northeast, with slopes ranging from 5 – 10 percent. The site is mostly covered in field grass and brush, with a dense stand of trees located centrally on parcel 986055381. Wetlands were delineated on site by AKS Engineering & Forestry during a site visit in May 2025. Three wetlands were identified, and are subsequently referred to as Wetland A, B, and C respectively. Wetlands A and B were rated as Category IV wetlands with a habitat score of 3, and Wetland C was rated as a Category IV wetland with a habitat score of 4. The site is not within a City of Camas-mapped Critical Aquifer Recharge Area (CARA) and does not contain any critical species or habitat area, steep slopes or landslide areas, streams, shoreline area, or any other environmental constraints.

Section A.3 – Existing On-Site Stormwater System

With existing conditions, stormwater disperses or sheet flows, collecting in on-site wetlands and ultimately flowing off-site into an inlet owned by the City of Camas. This area drain was constructed as part of the Brady Road Improvements Project (Camas Project Number S-587) and conveys stormwater across NW Brady Road, further to the northeast and ultimately discharging back into an existing ditch following the natural drainage pattern of the Lacamas Creek Watershed. An existing stormwater outfall from an adjacent property exists on site. However, no significant offsite drainage is expected to influence stormwater design, and site design will not impact the existing outfall.

Section A.4 – Site Parameters That Influence Stormwater Design

As previously discussed, the existing site conditions generally drain toward the northeast of the site. The selected placement of the stormwater facilities and their respective outlets are designed to maintain the existing natural drainage path. These facilities and these locations are discussed in further detail subsequently in this report and can be found in proposed development plans, attached in Appendix C. Per the project geotechnical report completed by Columbia West Engineering, Inc (Columbia West) dated May 28, 2025, the native soil meets the classification criteria of WWHM Soil Group 4, and is not suitable for the design of infiltration facilities. Per Columbia West's recommendation, infiltration is not feasible on site

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and was the primary factor in determining water quality and quantity BMPs to be used on site. Further information on the native soil conditions is discussed subsequently in this report and within the project geotechnical report, attached in Appendix H.

Section A.5 –Adjacent Property Drainage

Adjacent properties do not or minimally drain to the project site, and any off-site runoff has been determined as nominal for purposes of the preliminary stormwater model. Parcel 125651-000 to the east is developed and has on-site stormwater infrastructure. Parcel 986055382 to the south is heavily forested as it slopes towards the project site and is not expected to contribute off-site drainage. NW 18th Avenue includes stormwater infrastructure; therefore, stormwater does not drain on-site from the street frontage.

An existing section, NW 20th Avenue, fronts along the southwest boundary of the site. When this section of road was constructed, catch basins were installed on the north and south sides of the road to capture runoff from within the right-of-way. The stormwater runoff collected within this extent of NW 20th Avenue is subsequently treated and detained by structures owned and maintained by the adjacent Parker Village Subdivision HOA, located directly to the south. The mitigated flow is then conveyed back north across NW 20th Avenue and discharged onto the project site. As this stormwater is already mitigated before entering the site, it is not expected to influence stormwater design on the proposed project. See basins plans attached in Appendix D, and proposed development plans in Appendix C for more information.

Section A.6 – Adjacent Site Areas

The proposed development is bounded to the west by an existing business park development. Adjacent properties to the north and northwest are undeveloped, zoned Business Park (BP) and Light Industrial/Business Park (LI/BP). To the east, the site fronts NW Brady Road. To the South, the site fronts NW 20th Avenue, NW 18th Avenue, and abuts existing City of Camas property.

Section A.7 – General Project Stormwater Description

Proposed improvements for the development include 158 single-family lots, public and private streets, 3 parking tracts, utilities, and associated site improvements. As previously discussed, the current drainage on site is encompassed within one existing basin, ultimately discharging at the northeast corner of the site. This pattern will be maintained with the proposed site improvements, and the site is modeled as two threshold discharge areas (TDA), flowing to one point of compliance (POC).

This TDA is divided into 2 basins, referred to as Basins 1S and 2S respectively. These subbasins are depicted in the Post Developed Basin plans, attached in Appendix D. Both subbasins contain proposed stormwater quality and quantity facilities to manage their respective runoff, and while these two subbasins discharge in two different locations, their mitigated flows ultimately combine upstream of their final discharge offsite at the designated POC.

All runoff from pollution generating surfaces (PGS) and runoff from non-pollution generating surfaces (NPGS) that has a chance to mix with runoff from PGS will be conveyed to water quality treatment vaults prior to discharge into detention facilities. All water quality and quantity facilities were sized using Western Washington Hydrology Model (WWHM) and reports from these respective models are included Appendix F. The stormwater system is designed per the Stormwater Management Manual for Western Washington (SWMMWW). See the development plans (Appendix C), Stormwater Basin Plans (Appendix D), and WWHM Analysis (Appendix F) for location, size, and analysis.

Section B – Minimum Requirements

Section B.1 – Determination of Applicable Minimum Requirements

Proposed land disturbances shall include grading and excavation of unsuitable soils for the construction of lots, streets, sidewalks, parking, and associated utilities. Due to the amount of proposed hard surfaces (greater than 5,000 square feet), the project is required to meet Minimum Requirements 1 through 9 per Figure I-3.1 of the 2024 SWMMWW, attached for reference in Appendix B.

The following tables summarize each stormwater basin within the project area. See the Stormwater Basin Plans for basin locations (Appendix D).

Table B-1: Proposed Hard Surface and Landscaping

Basin	Existing Hard Surfaces (acres)	New Hard Surfaces (acres)	Replaced Hard Surfaces (acres)	Native Vegetation Replaced w/ Landscape (acres)	Total Land Disturbed (acres)
1S	0.000	11.097	0.000	3.162	14.067
2S	0.000	3.402	0.000	1.063	4.465

Note: Areas listed are in acres. Assumes 400-square-foot driveways and the maximum 65% lot coverage per lot.

Tables B-2 and B-3 show the mitigated site basins, differentiating between pollution- and non-pollution-generating surfaces. It is important to note that any non-pollution-generating areas directly mixing or having the opportunity to mix with stormwater runoff from pollution-generating surface areas are classified as pollution-generating.

Table B-2: Pollution-Generating Surfaces

Basin	Hard Surfaces (acres)	Pervious Surfaces (acres)	Total Surface Area (acres)
1S	7.314	0.876	8.190
2S	1.893	0.159	2.052

Note: Areas listed are in acres. Assumes 400-square-foot driveways and the maximum 65% lot coverage per lot.

Table B-3: Non-Pollution-Generating Surfaces

Basin	Hard Surfaces (acres)	Pervious Surfaces (acres)	Total Surface Area (acres)
1S	3.782	2.286	6.069
2S	1.510	0.904	2.414

Note: Areas listed are in acres. Assumes 400-square-foot driveways and the maximum 65% lot coverage per lot.

Each developed basin's effective hard surfaces and their applicability for meeting Minimum Requirements 6 through 8 are summarized in Table B-4 below.

Table B-4: Effective Hard Surfaces

Basin	Hard Surface Area (acres)	MR #6 Required (Y/N)	MR #7 Required (Y/N)	MR #8 Required (Y/N)
1S	10.905	Y	Y	Y
2S	3.402	Y	Y	Y

Note: Areas listed are in acres. Assumes 400-square-foot driveways and the maximum 65% lot coverage per lot.

Section C – Soils Evaluation

A geotechnical investigation was completed on the project site by Columbia West Engineering, Inc. The project geotechnical report, dated May 2025, summarizes findings and results of the field work and subsequent testing performed with the site investigation. On-site, 12 test pits (TPs) were excavated between 5.5 and 15 feet below ground surface (BGS). Additionally, per The City of Camas requirements, infiltration testing was performed in 3 test pits. Results from these tests and their application to the stormwater system design are explained subsequently in this report and in the project geotechnical report, attached in Appendix H.

Section C.1 –Soil Suitability for Low Impact Development BMPs

Per the recommendations of the geotechnical engineer, the Stella Ridge Subdivision project is not suitable for stormwater infiltration. Therefore, infiltration BMPs were not viable for flow control, runoff treatment, or low impact development (LID) considerations. More information on results of infiltration testing performed on site are included in *Section C.4* below.

Additionally, all disturbed areas will meet post-construction soil quality and quantity requirements per best management practice (BMP) T5.13.

Section C.2 – Water Table Information

Per the project geotechnical report, groundwater seepage was encountered in several test pits between 5.5 and 8 feet BGS during the site exploration. It is anticipated that no stormwater facilities will be affected by groundwater presence. However, perched groundwater may be present on-site during the wetter months and periods of heavy rain, and dewatering during excavation may be required.

Section C.3 – Soil Parameters

Per Natural Resources Conservation Service (NRCS) Soil Survey of Clark County, Washington, on-site soils consist of the following:

- OdB (Odne silt loam, 0 to 5 percent slopes), 4.3 percent of the site (Type D soil / WWHM Soil Group 4).
- PoB (Powell silt loam, 0 to 8 percent slopes), 95.7 percent of the site (Type D soil / WWHM Soil Group 4).

In general, Powell and Odne silt loam exhibit low permeability, and the NCRS soils map is consistent with the near surface soils that were observed on site and documented in the geotechnical report. The NCRS soils map is included in Appendix A.

Section C.4 –Infiltration Rate Testing

The project geotechnical report dated May 2025, attached in Appendix H, details the infiltration testing operations conducted on site. Infiltration tests were completed in 3 of the 12 TPs excavated across the site, TP-5, TP-8, and TP-11. In all TPs, tests were conducted at 2 feet BGS, and the infiltration rates were determined to be negligible. Because of this, the site has been classified as WWHM soil group 4, and design on infiltration facilities on site was determined to be infeasible.

Section C.5 – Complex Soil Conditions

A geotechnical report has been prepared and is included with this report (see Appendix H). Existing soil conditions are summarized, and recommendations are presented in relation to site design considerations. All stormwater facility design is predicated upon the findings and subsequent recommendations presented in this report.

Gravel, cobbles, and boulders were encountered in several test pits on the western extent of the site at depths between 5.5 and 7 feet BGS. The project geotechnical report interpreted this as a transition between the clay later and underlying basalt bedrock.

Section D –Source Control

Volume IV of the 2024 SWMMWW contains the following applicable source control BMPs for residential development. The source control BMPs and applicable notes to control stormwater runoff impacted by these activities will be included in the Erosion Control Plans and Details and in the Stormwater Pollution Prevention Plan (SWPPP). The project SWPPP will be submitted prior to commencement of any construction activities on the project site.

Section E –On-Site Stormwater Management BMPs

The project is required to adhere to meet Minimum Requirement #5. Figure I-3.3 of the SWMMWW is used to determine the applicable requirements and is attached in Appendix B. Due to the in-situ considerations discussed previously, the project will not achieve the LID Performance Standard. As such, the project is then required to utilize List #2, located in SWMMWW Table I-3.2, to evaluate the feasibility of listed BMPs. All LID BMPs per List #2 are infeasible for the hard surface areas of the project due to soil and site constraints. Full Dispersion (BMP T5.30), Downspout Dispersion Systems (BMP T5.10B), and Sheet Flow Dispersion (BMP T5.12) are not feasible, as site layout constraints do not allow for an appropriate flow path. Along with this, Full Infiltration (BMP T5.10A), Bioretention (BMP T7.30), Perforated Stub-outs (BMP T5.10C), and Permeable Pavements (BMP T5.15) are infeasible, as infiltration rates on-site have been determined as negligible. However, all disturbed areas to remain as pervious surface will meet post-construction soil quality and quantity requirements per BMP T5.13. See BMP Flow Chart, attached in Appendix E.

Section F –Runoff Treatment Analysis and Design

Surface water from pollution-generating surfaces will be treated utilizing Washington Department of Ecology (ECY)-approved manufactured treatment devices. As required per MR #6, at least 91% of the post-developed pollution generating runoff volume, as predicted by a continuous runoff model, will be treated. The project site is located within the Lacamas Lake watershed. Lacamas Lake is listed as a category 5-303d waterbody for total phosphorus. The project basin ultimately drains to and discharges into Lacamas lake, above Round Lake Dam, and therefore will require phosphorus treatment. All preliminary water quality flow rate sizing was done utilizing ECY approved media approved for phosphorus treatment.

All stormwater treatment structures will be located upstream of proposed detention facilities as shown in the proposed development plans, attached in Appendix C. Any non-pollution-generating runoff that has an opportunity to mix with pollution-generating runoff will be considered pollution-generating and conveyed through the treatment devices. Per City of Camas requirements, stormwater treatment structures will not be located within the right-of-way, but within the privately owned and maintained stormwater tracts and easements proposed on site.

As discussed previously, the project site contains two post-developed basins. Both the proposed basins will contain a central water quality vault structure, directly upstream of respective detention facilities. These two vaults will be used to treat the majority of all runoff pollution-generating runoff, with the exception of runoff generated by a section of private driveways fronting along NW 20th Avenue.

Both Basins 1S and 2S contain non-pollution generating areas that will bypass the proposed treatment vaults. These are on-lot landscape and roof areas that will be captured and conveyed through rear yard storm lines, avoiding any potential mixture with pollutant-laden runoff, and discharge directly into detention facilities. A water quality basin plan delineating these areas has been prepared and attached in Appendix D. All stormwater quality facilities for the site have been designed in compliance with the 2024 SWMMWW. The approximate location and size of the proposed runoff treatment facilities are shown on the development plans located in Appendix D.

Table F-1 below summarizes the offline water quality treatment provided with each preliminary structure. All offline water quality treatment flow rates were calculated using the 2012 Western Washington Hydrology Model (WWHM), the approved continuous runoff model. A complete WWHM analysis, including water quality flow rates, is attached in Appendix F.

Table F-1: Water Quality Flow Rate

Proposed Structure	Basin (Tract)	New Pollutant-Generating Impervious Surface (acres) (WWHM)	New Pollutant-Generating Pervious Surface (acres) (WWHM)	Required Water Quality Flow Rate (cubic feet per second)	Provided Water Quality Flow Rate (cubic feet per second)	Contech StormFilter Cartridges
8-foot-by-20-foot Peak Diversion StormFilter	1S (TR F)	8.190	0	1.164	1.701	(34)-27”
6-foot-by-12-foot Peak Diversion StormFilter	2S (TR B)	2.052	0	0.4262	0.4350	(13)-18”

Section G –Flow Control Analysis and Design

The development is required to adhere to MR #7, and all stormwater discharges from the project site are required to meet the flow control performance standard. As such, all mitigated stormwater discharges are designed to meet or exceed this standard, by matching pre-developed discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak flow.

As previously stated, the project site consists of two main basins with a single TDA and POC. Both developed basins contain a proposed stormwater detention pond facility (BMP D.1), designed to capture and mitigate discharge of runoff generated with the post-developed conditions of the site as proposed in the project plans. These facilities were designed using the approved continuous runoff model, WWHM, per the requirement of the 2024 SWMMWW. A complete WWHM analysis detailing the proposed facility design and their performance in successfully meeting MR #7 is attached in Appendix F.

The stormwater detention pond facilities are proposed to be located within stormwater tracts and are to be privately owned and maintained. For proposed locations of these Tracts and the associated facilities, see development plans attached in Appendix C.

Section H –Wetland Protection

The development is required to meet MR #8. As aforementioned, wetlands are present on-site, and Basin 1S will discharge mitigated flows via a flow spreader directly downstream of the proposed detention facility. However, per Figure I-3.5 of the 2024 SWMWW and associated wetland ratings and habitat scores, the TDA is only required to meet the basic protection requirements:

1. General Wetland Protection (I-C.2)
2. Wetland Protection from Pollutants (I-C.3)

All elements of the site and stormwater design adhere to these requirements, as the wetland areas proposed to be protected on-site are located within a designated open space tract, and impacts to the wetland and its buffers were reduced to the maximum extent practical with the given site constraints. In addition to this, all discharge upstream of the on-site wetlands will be treated mitigated as required by MR's #6-8. All stormwater facilities and site design were completed in accordance with the 2024 SWMMWW and mitigate impacts to existing on-site wetlands as a result of runoff generated with the proposed improvements. Figure I-3.5 has been attached in Appendix B for reference.

Section I –Other Permits

A Construction Stormwater General Permit from the Washington State Department of Ecology (ECY) will be obtained prior to construction of this project. The General Permit will encompass all phases of construction.

No additional permits relating to the design of the stormwater system are anticipated.

Section J – Conveyance System Analysis and Design

The proposed system design will include public conveyance pipe and structures located within the right-of-way and private conveyance pipe and structures located within a lot of private stormwater easements. The contributing area of the site is less than 40 acres in size and the final proposed conveyance systems will be designed for the 10-year, 24-hour peak storm event as required by the 2024 SWMMWW. A complete analysis of the conveyance system will be completed with the final technical information report.

Section K – Off-Site Analysis

Prior to discharge off-site, the proposed project will mitigate all stormwater and potential downstream impacts as required by MRs #1-9 of the 2024 SWMMWW. During construction, all applicable BMPs will be installed as feasible to prevent excessive sedimentation and stream bank erosion and prevent discharge of sediment-laden runoff to City facilities, adjacent properties, or water of the State. All site stormwater design is centric to the principle of reducing impacts to downstream properties and groundwater sources.

The ultimate discharge location for the project is in the northeast corner of the site and includes an energy dissipating flow.

If site stormwater systems are constructed and maintained properly by the final technical information report and SWPPP, no downstream water quality impacts are anticipated as a result of this development.

Section L –Conditions of Approval

Any applicable conditions of approval as associated with the project's stormwater design will be addressed with the final technical information report.

Section M – Special Reports and Studies

A geotechnical report by Columbia West Engineer, Inc, dated May 28, 2025, is included in Appendix H.

Section N – Maintenance and Operations

A maintenance and operations manual will be completed per the 2024 SWMMWW and will be included with the final technical information report.

Appendix A: Map Submittals

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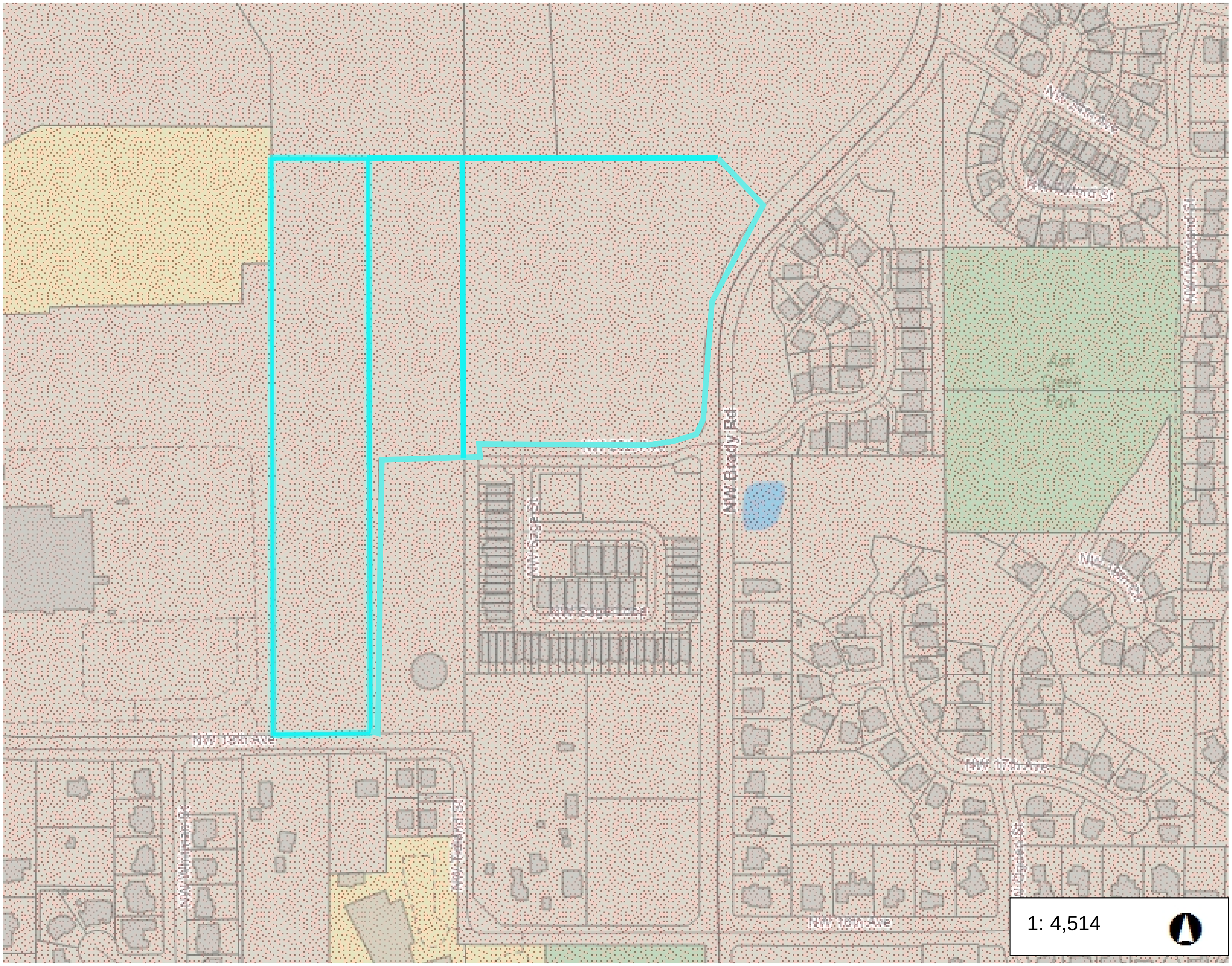
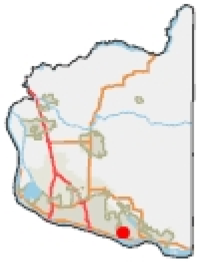
CARA MAP





Legend

▨ Building Footprints

☐ Taxlots

Critical Aquifer Recharge Area

- 🟥 Category 1 Recharge Areas
- ▨ Category 2 Recharge Areas
- ▨ Critical Aquifer Recharge Area (Var
- ▨ Within 1900 foot buffer (Vancouver)

Notes:

PARCEL NUMBERS:
125193000
986055381
125185000

752.3 0 376.17 752.3 Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

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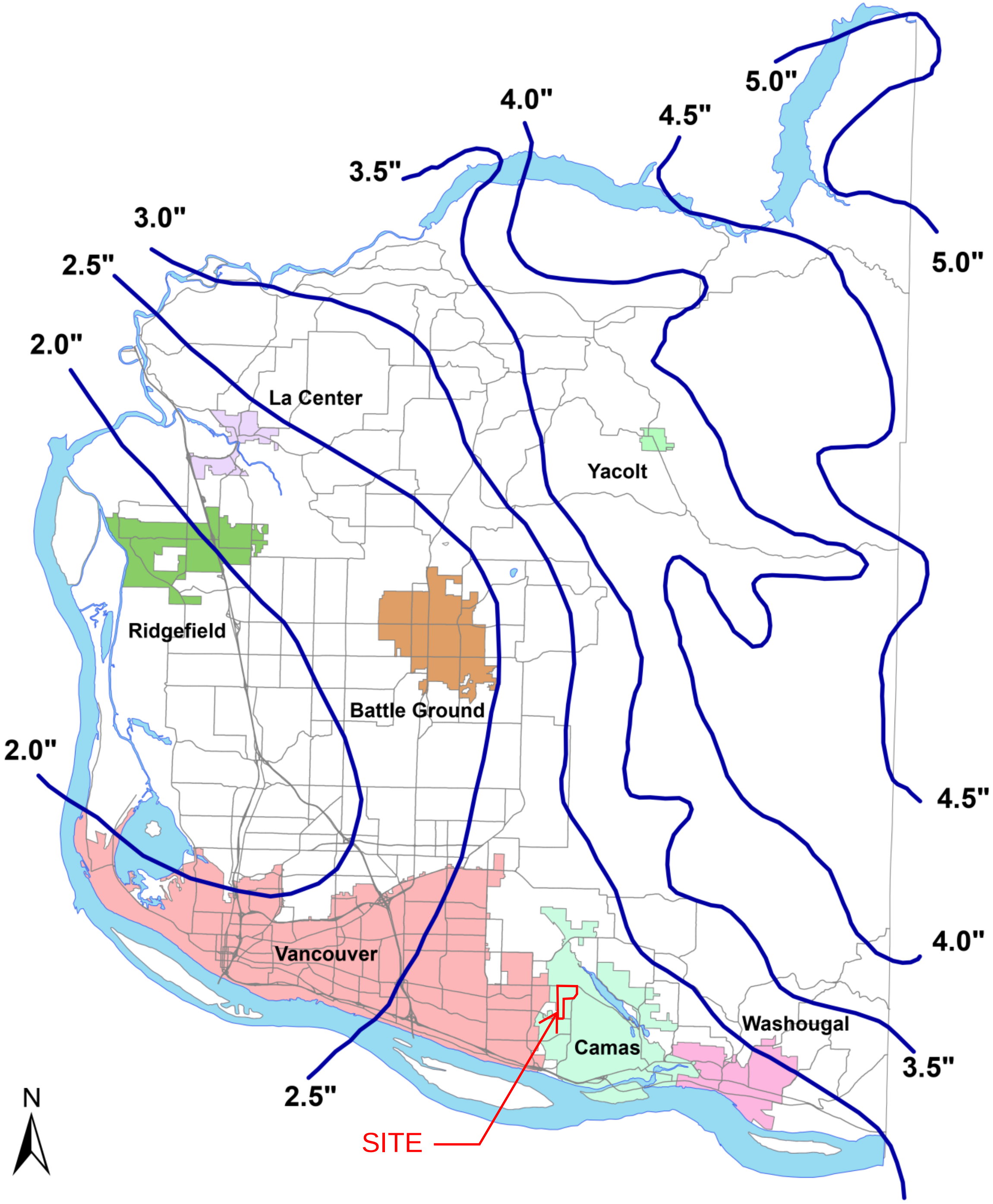
Isopluvial Map for Clark County

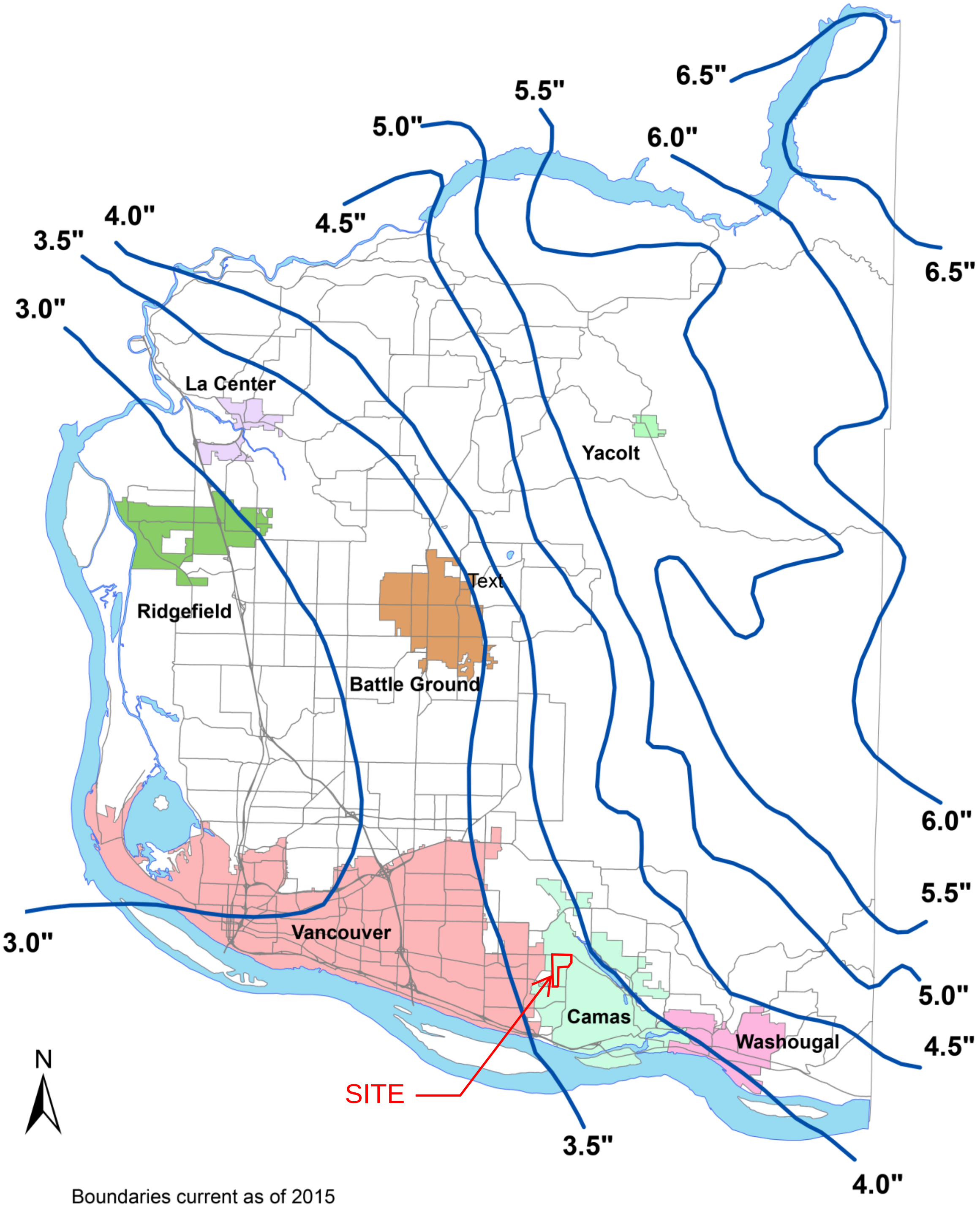
2-Year, 24-Hour Design Storm



Boundaries current as of 2015

Isopluvial Map for Clark County

10-Year, 24-Hour Design Storm



Boundaries current as of 2015

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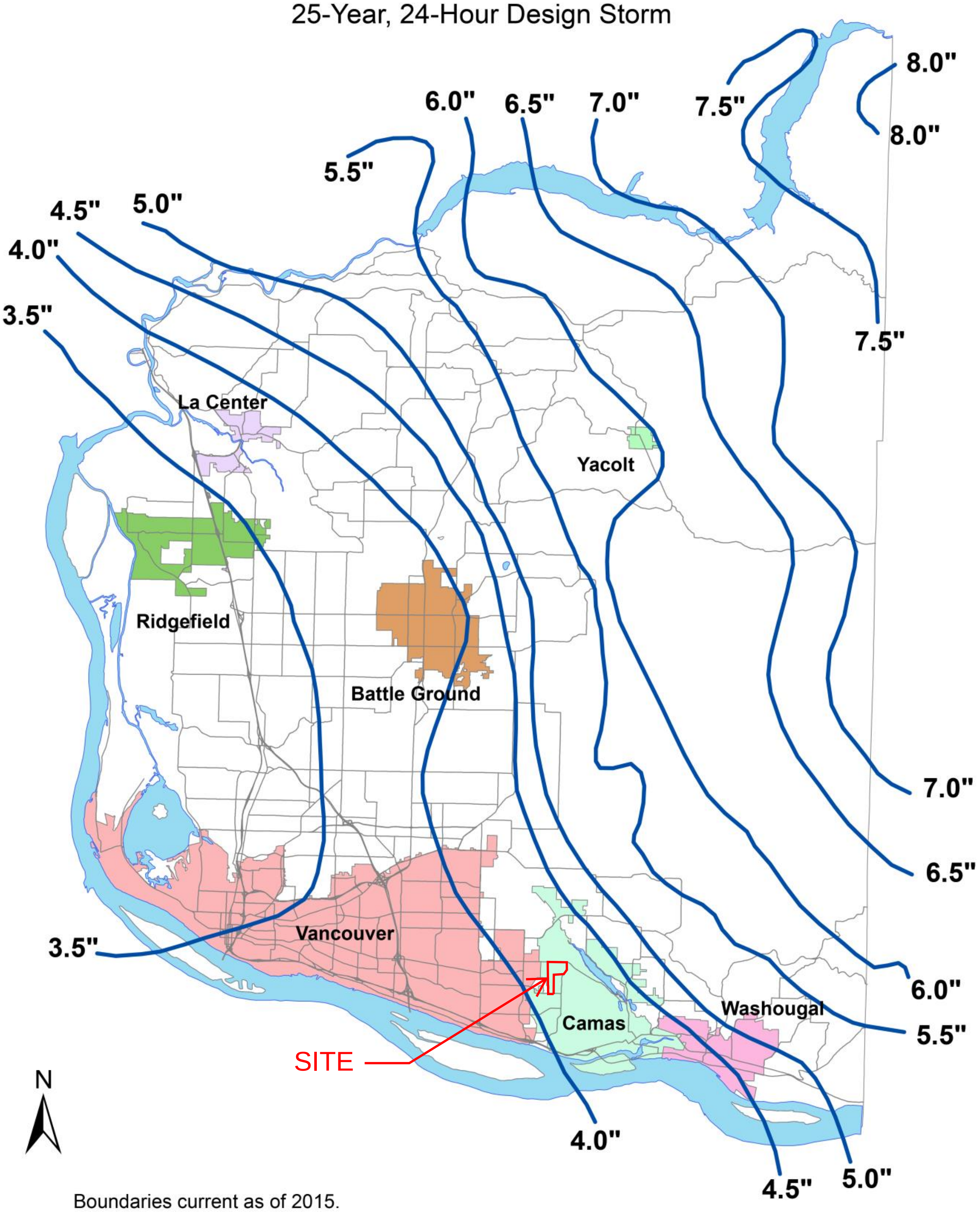
Isopluvial Map for Clark County

25-Year, 24-Hour Design Storm



Boundaries current as of 2015.

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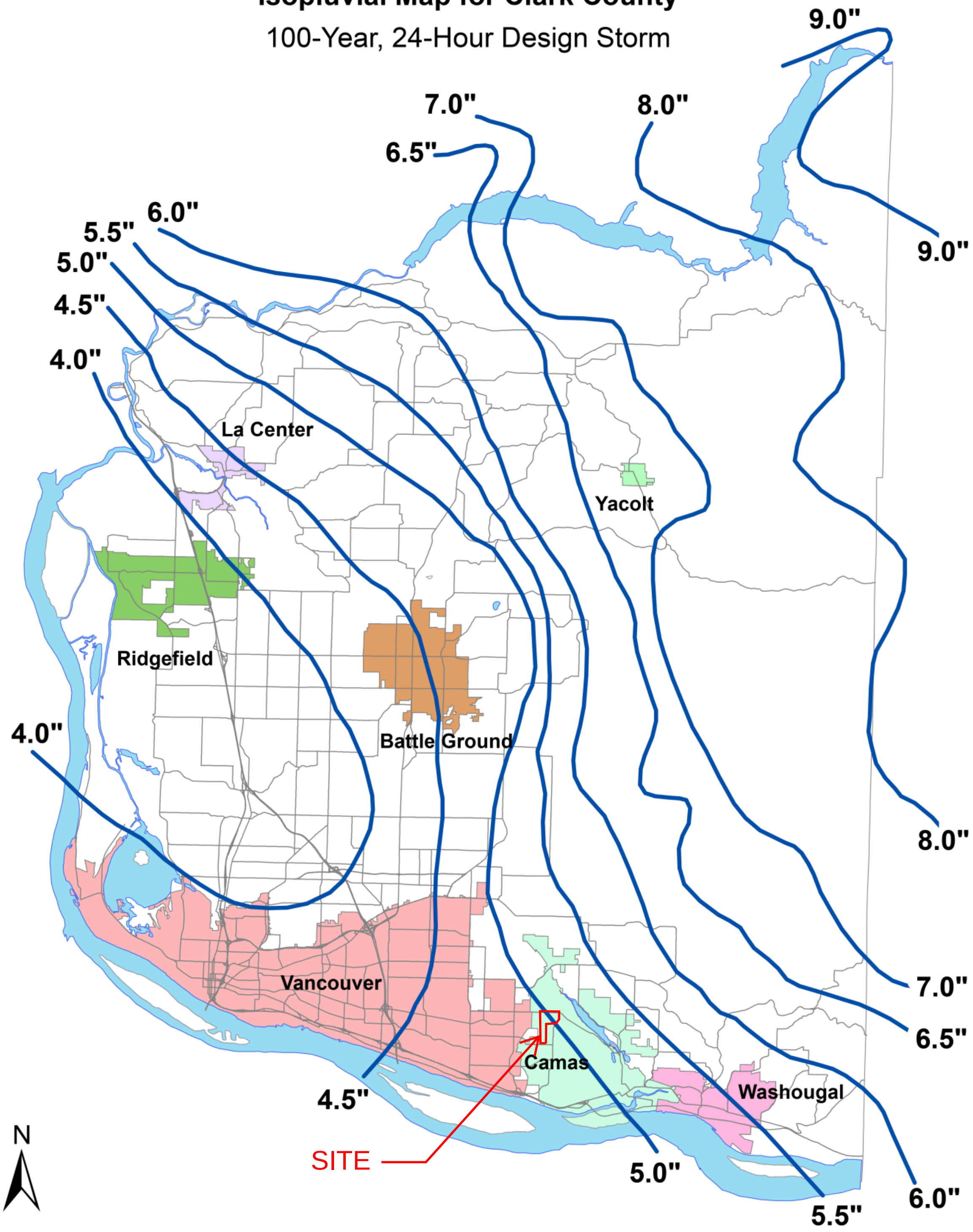
Isopluvial Map for Clark County

100-Year, 24-Hour Design Storm



Boundaries current as of 2015.

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United States
Department of
Agriculture

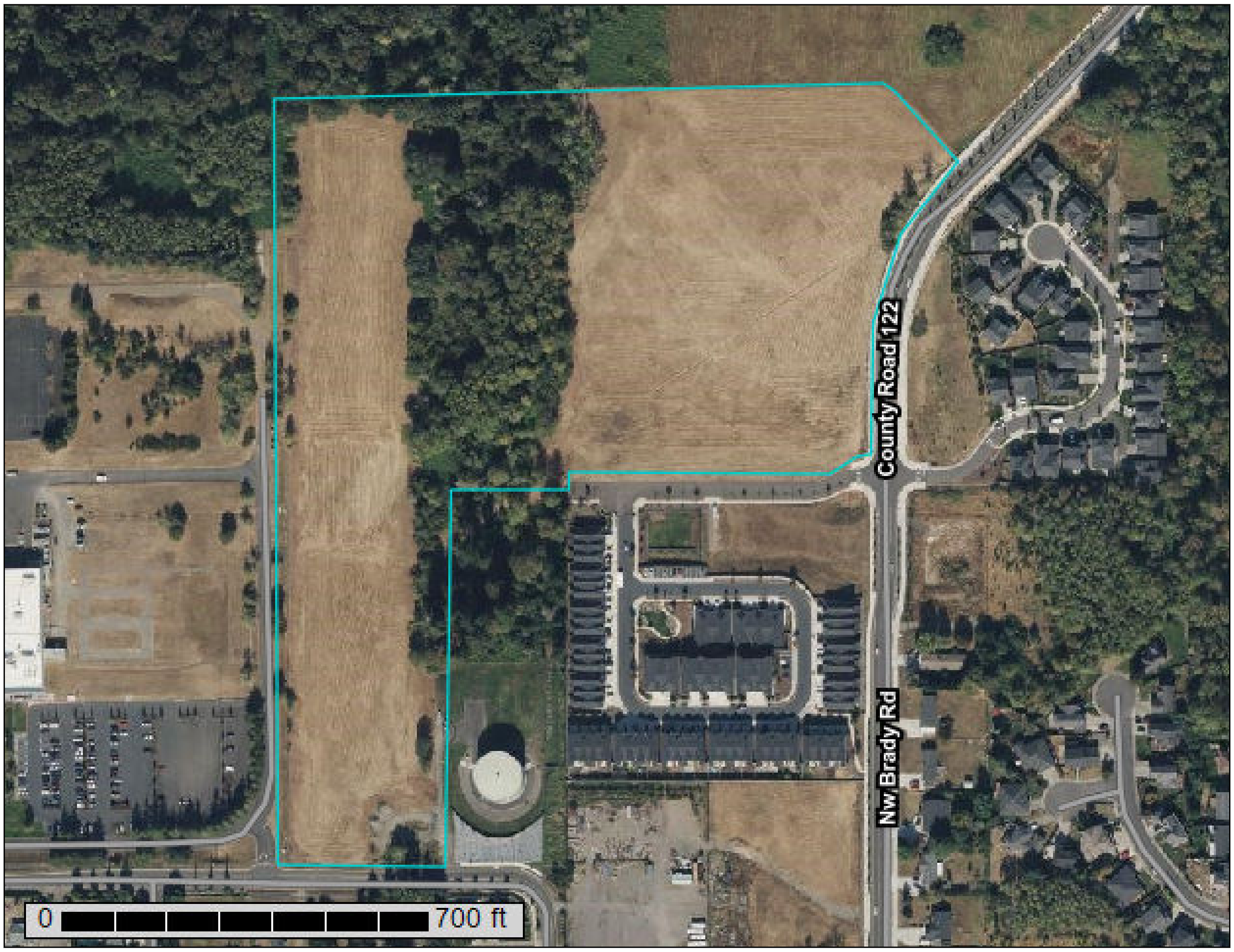
Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Clark County, Washington

Stella Ridge (12107)



August 6, 2025

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Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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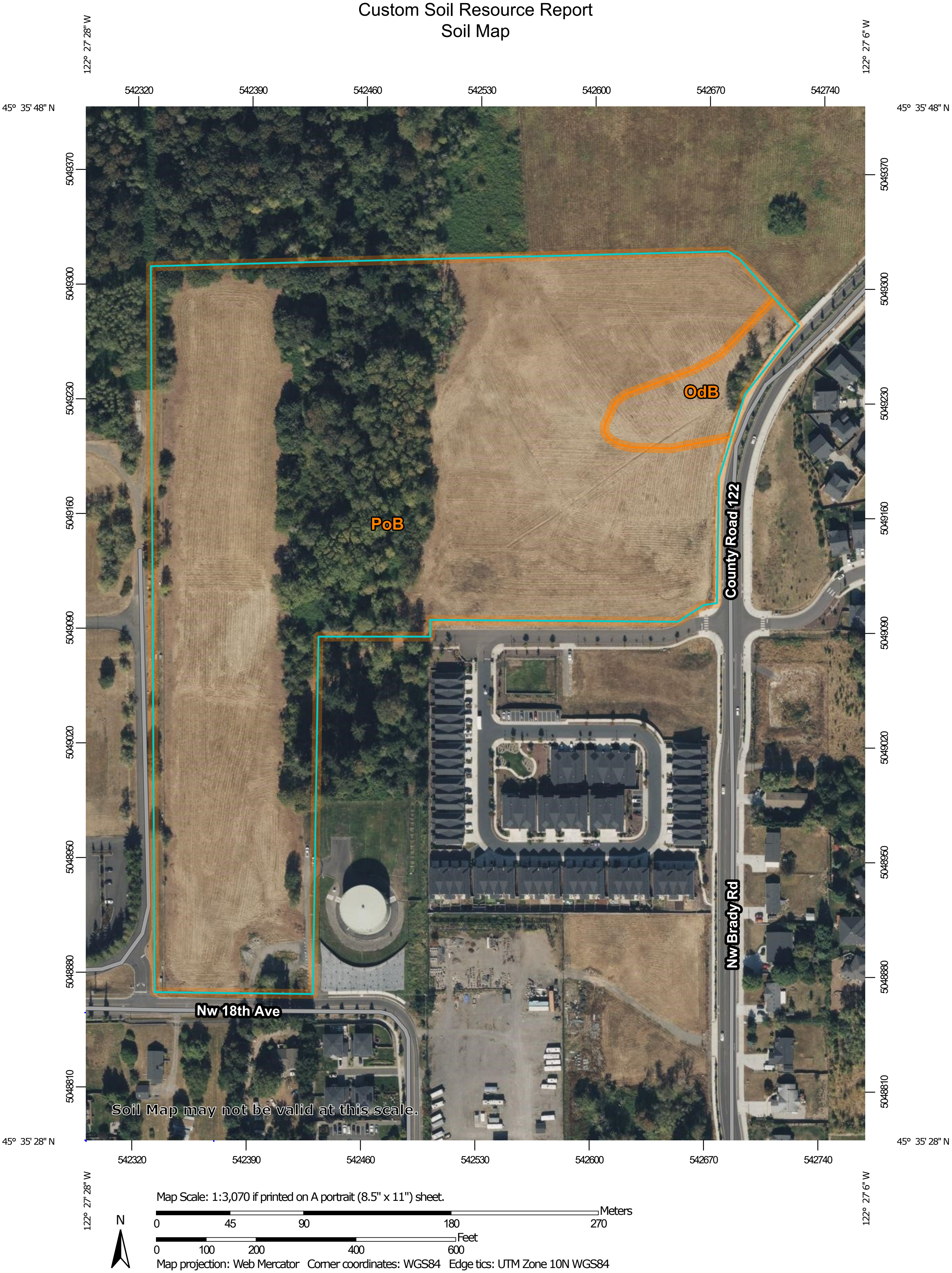
    Clark County, Washington...10
      OdB—Odne silt loam, 0 to 5 percent slopes...10
      PoB—Powell silt loam, 0 to 8 percent slopes...10
References...12

Exhibit 9 SUB25-1009

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,070 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Exhibit 9 SUB25-1009

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clark County, Washington
Survey Area Data: Version 22, Aug 26, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 26, 2022—Oct 11, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Exhibit 9 SUB25-1009

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
OdB	Odne silt loam, 0 to 5 percent slopes	1.1	4.3%
PoB	Powell silt loam, 0 to 8 percent slopes	24.4	95.7%
Totals for Area of Interest		**25.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

Exhibit 9 SUB25-1009

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Clark County, Washington

OdB—Odne silt loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2dyr
Elevation: 100 to 500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Odne and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Odne

Setting

Landform: Drainageways, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 5 inches: ashy silt loam
H2 - 5 to 33 inches: silt loam
H3 - 33 to 60 inches: loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: F002XB007WA - Portland Basin Wet Forest
Forage suitability group: Wet Soils (G002XV102WA)
Other vegetative classification: Wet Soils (G002XV102WA)
Hydric soil rating: Yes

PoB—Powell silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2dz9

Elevation: 300 to 600 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Powell and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 17 inches: silt loam
H3 - 17 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 17 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F002XB004WA - Portland Basin Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: No

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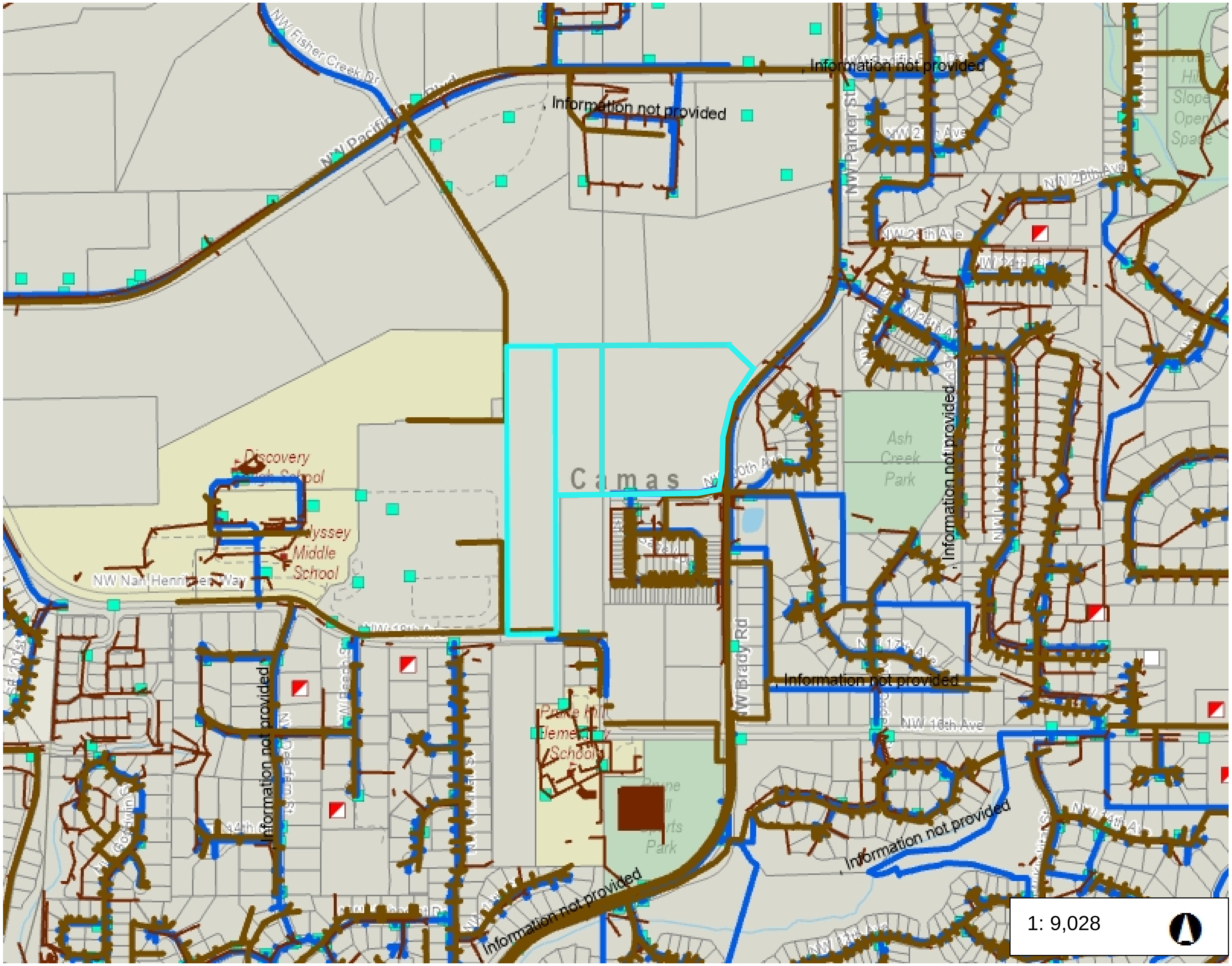
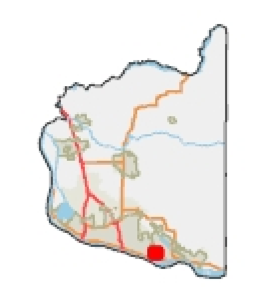
Exhibit 9 SUB25-1009

12107 Water, Sewer, Storm Lines





Legend

▬ Sanitary Sewer

— Storm Sewer - includes cities (

▬ Water Line

■ Water Valves and Hydrants

Septic System

☐ No Associated Documents

■ Apps. and As-Builts

◩ online RME Documents

◩ Both Available

☐ Taxlots

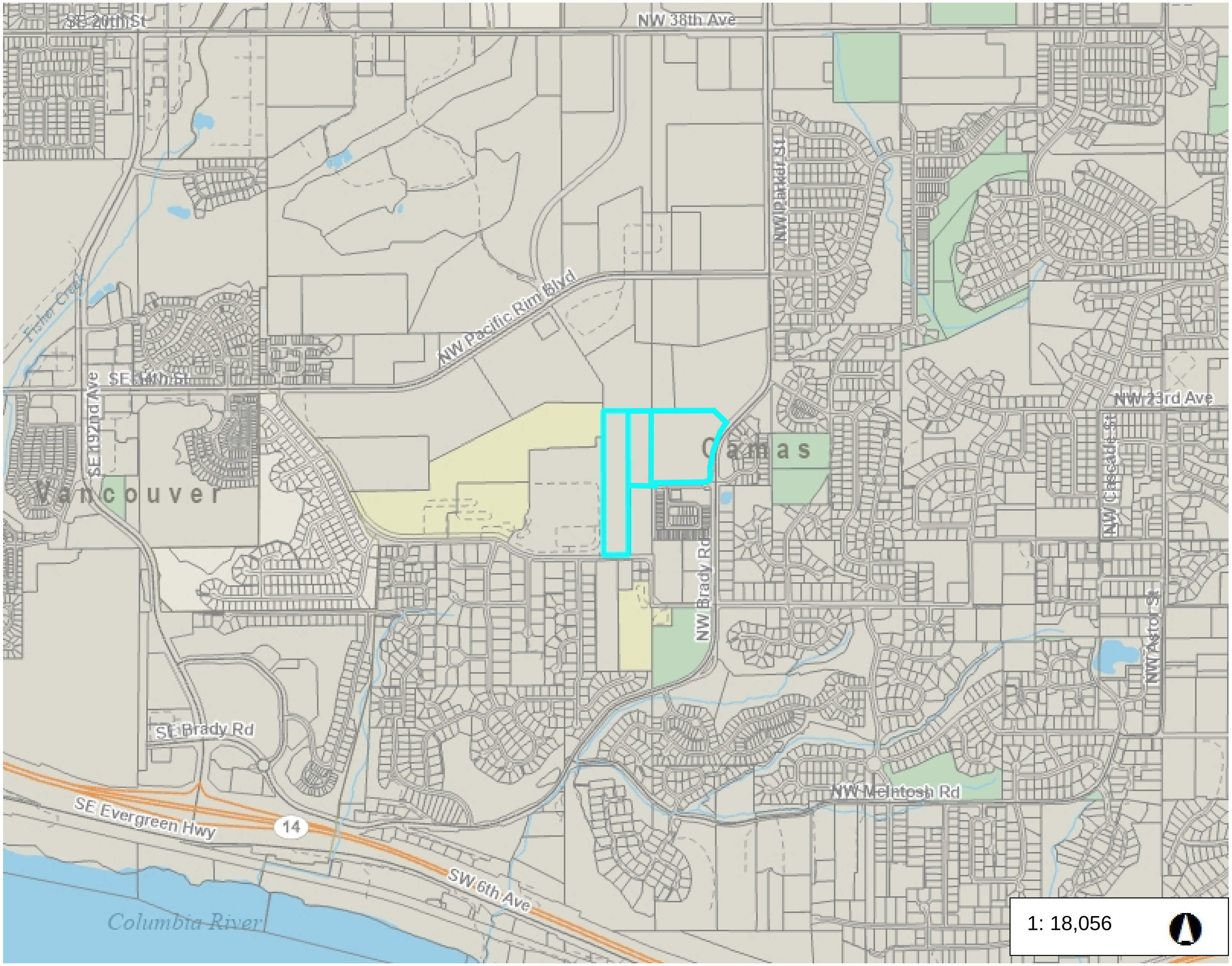
1,504.7 0 752.33 1,504.7 Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

This map was generated by Clark County's "MapsOnline" website. Clark County does not warrant the accuracy, reliability or timeliness of any information on this map, and shall not be held liable for losses caused by using this information. Taxlot (i.e., parcel) boundaries cannot be used to determine the location of property lines on the ground.

Notes:

12107 Vicinity Map



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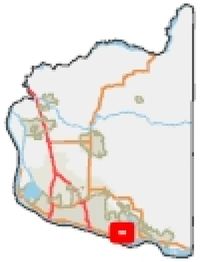


Legend

☐ Taxlots

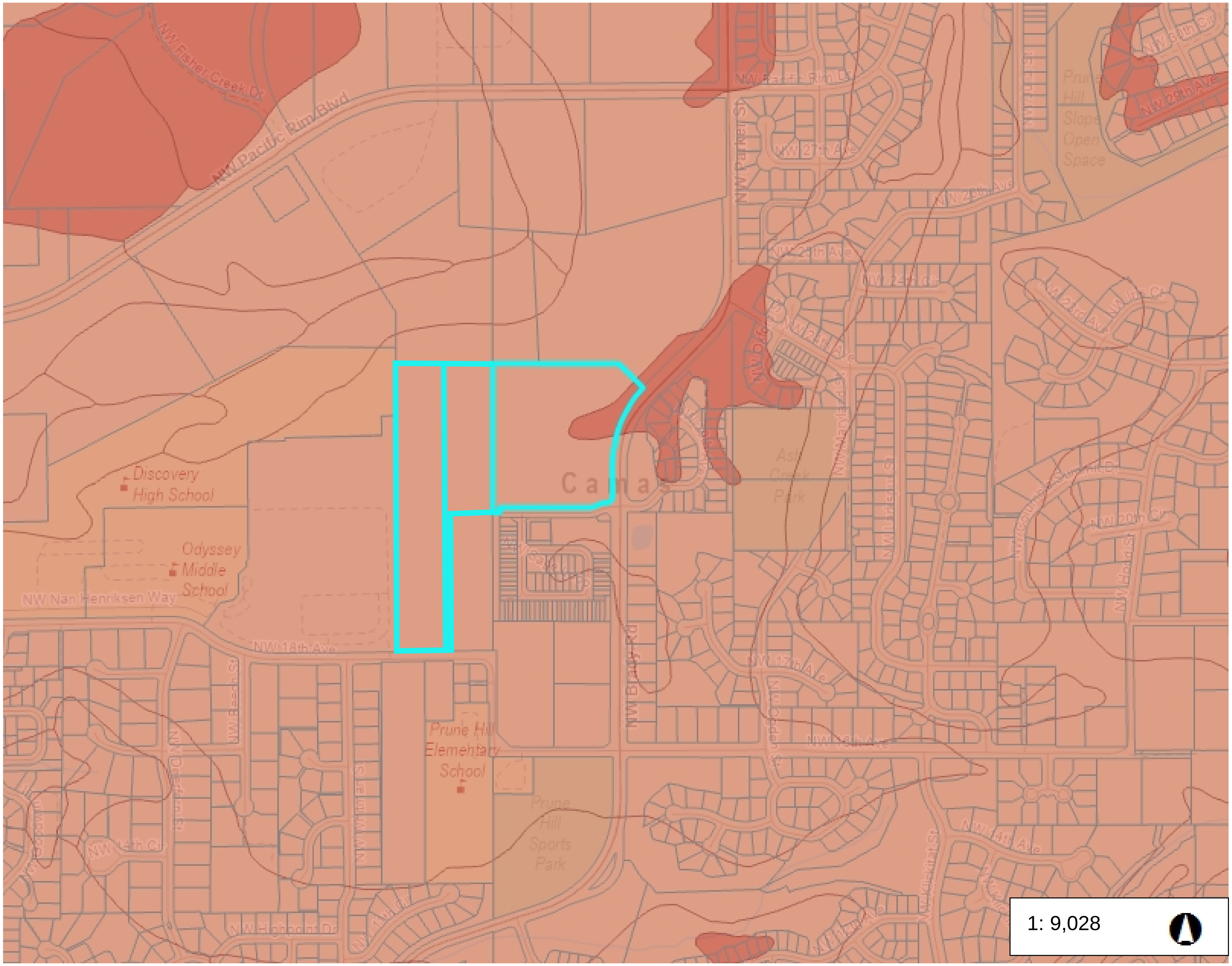
Notes:

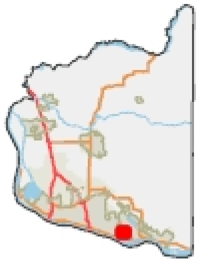
3,009.3 | 0 | 1,504.67 | 3,009.3 | Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Exhibit 9 SUB25-1009

12107 WWHM Soil Group





Legend

☐ Taxlots

WWHM Soil Group

▨ 1 - Excessively drained soils

▨ 2 - Well drained soils

▨ 3 - Moderately drained soils

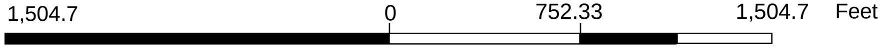
▨ 4 - Poorly drained soils

▨ 5 - Wetland soils

▨ Unknown

Notes:

1: 9,028



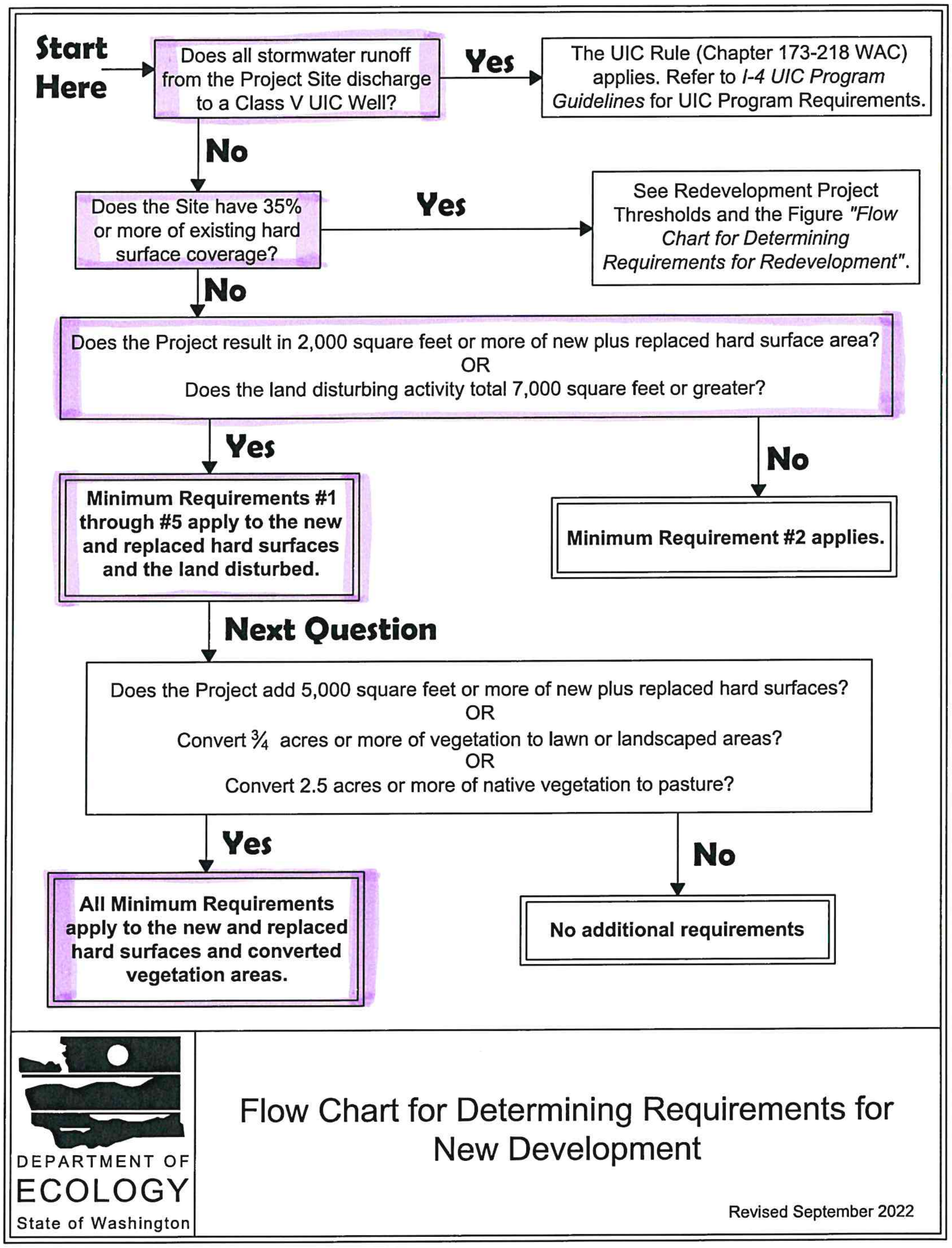
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Exhibit 9 SUB25-1009

Appendix B: New Development Flow Chart

Exhibit 9 SUB25-1009

Figure I-3.1: Flow Chart for Determining Requirements for New Development



Does all stormwater runoff from the Project Site discharge to a Class V UIC Well?

The UIC Rule (Chapter 173-218 WAC) applies. Refer to *I-4 UIC Program Guidelines* for UIC Program Requirements.

Does the Site have 35% or more of existing hard surface coverage?

See Redevelopment Project Thresholds and the Figure *"Flow Chart for Determining Requirements for Redevelopment"*.

Does the Project result in 2,000 square feet or more of new plus replaced hard surface area?
OR
Does the land disturbing activity total 7,000 square feet or greater?

Minimum Requirements #1 through #5 apply to the new and replaced hard surfaces and the land disturbed.

Minimum Requirement #2 applies.

Does the Project add 5,000 square feet or more of new plus replaced hard surfaces?
OR
Convert ¾ acres or more of vegetation to lawn or landscaped areas?
OR
Convert 2.5 acres or more of native vegetation to pasture?

All Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

No additional requirements

Flow Chart for Determining Requirements for New Development

Revised September 2022

Exhibit 9 SUB25-1009

Note that if a MR1-9 project spans multiple parcels (and/or rights-of-way), and one (or more) of those parcels is 5 acres or larger and outside the UGA, then the only compliance option available for the project is the LID Performance Standard and BMP T5.13: Post-Construction Soil Quality and Depth, since that is the only option for MR1-9 projects on a parcel 5 acres or larger and outside the UGA.

Projects that Trigger Only Minimum Requirements #1 - #5

Projects that are not Flow Control exempt that trigger only Minimum Requirements #1 through #5 (per the Project Thresholds in I-3.3 Applicability of the Minimum Requirements) shall either:

- Use the LID BMPs from List #1 for all surfaces within each type of surface in List #1;

  or

- Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth (if feasible).

Projects that Trigger Minimum Requirements #1 - #9

Projects that are not Flow Control exempt that trigger Minimum Requirements #1 through #9 (per the Project Thresholds in I-3.3 Applicability of the Minimum Requirements) have the compliance options shown in Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9.

Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9

Project Location and Parcel Size	Minimum Requirement #5 Compliance Options
Projects inside the UGA, on any size parcel	• Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2; or • Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth (if feasible).
Projects outside the UGA, on a parcel smaller than 5 acres	
Projects outside the UGA, on a parcel 5 acres or larger	Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth (if feasible).
Note: This text refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the project is located in a county that is not subject to planning under the GMA, the city limits shall be used instead.	

Exhibit 9 SUB25-1009

Flow Control Exempt Projects

Projects qualifying as Flow Control exempt in accordance with the TDA Exemption in I-3.4.7 MR7: Flow Control shall either:

- Use the LID BMPs from List #3 for all surfaces within each type of surface in List #3;

or

- Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth (if feasible).

If the project has multiple TDAs, all TDAs must be Flow Control exempt per the TDA Exemption in I-3.4.7 MR7: Flow Control for the project to use the options listed here.

The text in this box originates from one or more of the following Permits:
Appendix 1 of the Phase I / Phase II Municipal Stormwater Permits
Construction Stormwater General Permit

Exhibit 9 SUB25-1009

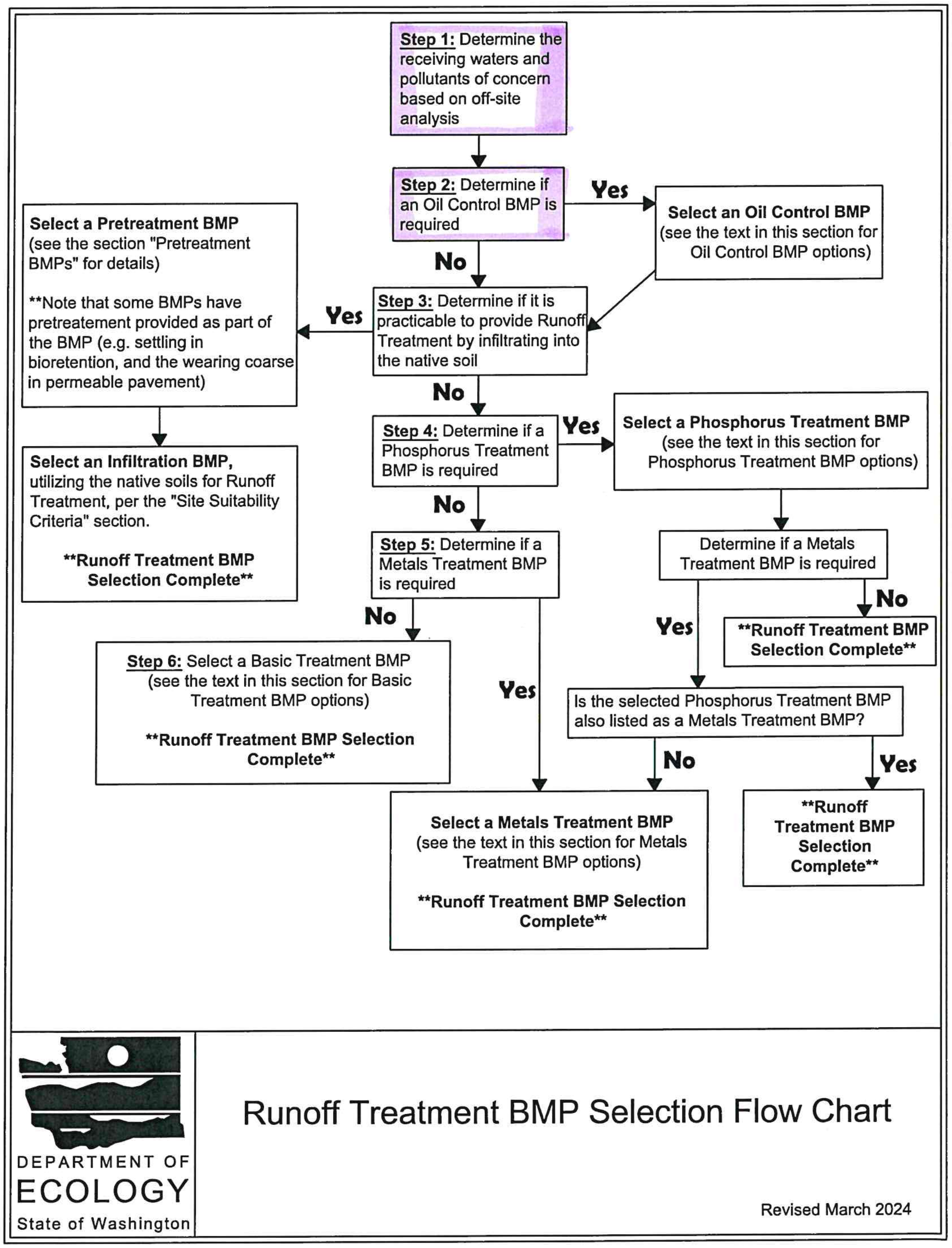


Figure III-1.1: Runoff Treatment BMP Selection Flow Chart

Exhibit 9 SUB25-1009

Table III-1.3: Screening Runoff Treatment BMP Types Based on Soil Type

Soil Type	Infiltration/Bioretention	Wet Pond*	Biofiltration* (Swale or Filter Strip)
Coarse Sand or Cobbles	X	X	X
Sand	✓	X	X
Loamy Sand	✓	X	✓
Sandy Loam	✓	X	✓
Loam	X	X	✓
Silt Loam	X	X	✓
Sandy Clay Loam	X	✓	✓
Silty Clay Loam	X	✓	✓
Sandy Clay	X	✓	✓
Silty Clay	X	✓	X
Clay	X	✓	X

Notes:

✓ Indicates that the BMP type is generally appropriate for this soil type.

X Indicates that the BMP type is generally not appropriate for this soil type.

* Coarser soils may be used for these BMPs if a liner is installed to prevent infiltration, or if the soils are amended to reduce the infiltration rate.

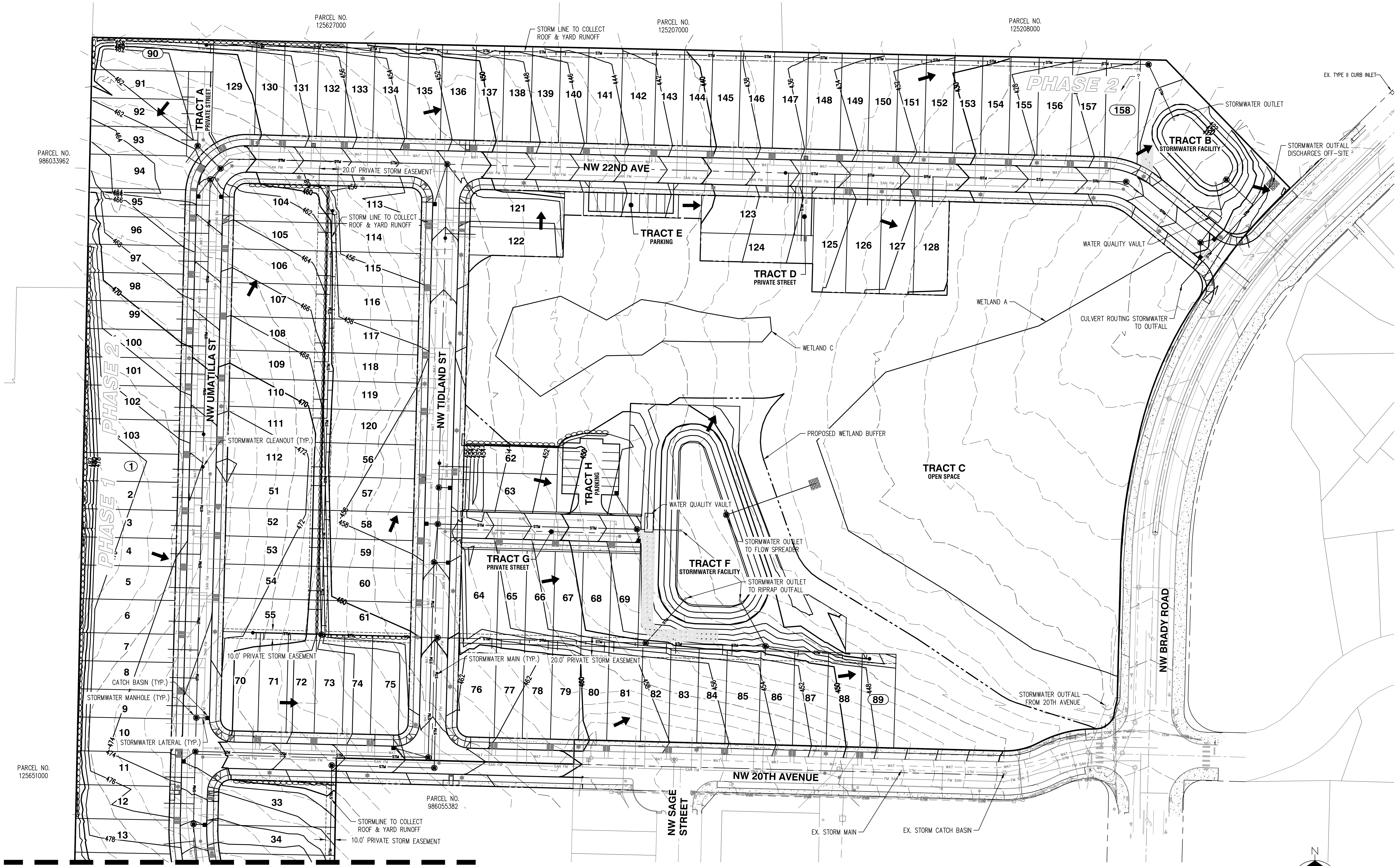
Note: Sand filtration is not listed because its feasibility is not dependent on soil type.

III-1.3 Choosing Your Flow Control BMPs

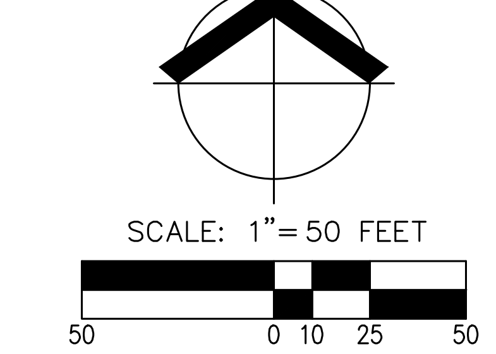
Use this section to determine the type of Flow Control BMPs most appropriate for the project.

Flow Control BMPs might apply to the project (or a TDA within the project) if directed by I-3.3 Applicability of the Minimum Requirements, I-3.4.5 MR5: On-Site Stormwater Management, I-3.4.7 MR7: Flow Control, and/or I-3.4.8 MR8: Wetlands Protection. Note that some Flow Control

Appendix C: Development Plans



SEE SHEET P7.1



LEGEND

EXISTING GROUND CONTOUR (2 FT)	- - - - -
EXISTING GROUND CONTOUR (10 FT)	— — 350 — —
FINISHED GRADE CONTOUR (2 FT)	————
FINISHED GRADE CONTOUR (10 FT)	——350——

GENERAL NOTES

1. STORMWATER TREATMENT AND RETENTION FACILITIES FOR THIS DEVELOPMENT ARE TO BE OWNED AND MAINTAINED BY THE HOA.
2. THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.
3. THERE ARE EXISTING ON-SITE STORMWATER FACILITIES.
4. STORMWATER INFRASTRUCTURE EXISTS IN NW 20TH AVENUE & NW BRADY ROAD. STORMWATER FROM THESE STREETS DOES NOT CONTRIBUTE TO ON-SITE FLOWS.
5. NO WELLS, AGRICULTURAL DRAIN TILES, POTENTIAL SLOPE INSTABILITY, STRUCTURES, UTILITIES, SEPTIC TANKS, OR DRAIN FIELDS EXIST ONSITE.
6. NO FLOODPLAIN, FLOODWAYS, OR SHORELINE EXIST ONSITE.
7. WETLANDS EXIST ON THE SITE.
8. EXISTING DRAINAGE FLOW ROUTES ARE GENERALLY NORTHEAST FOR THE THRESHOLD DISCHARGE AREA (TDA). EXISTING STORMWATER FROM THE SITE DISCHARGES THROUGH NW BRADY ROAD TO THE NORTHEAST.
9. PROPOSED DRAINAGE FLOW ROUTES TO FOLLOW EXISTING FLOW ROUTES TO THE NORTHEAST AFTER BEING DISCHARGED FROM STORMWATER FACILITIES.
10. RUNOFF FROM ROOF AREAS FOR LOTS 47-75, 92-135, 139-156 DRAIN TO A STORMWATER LATERAL.

AKS DRAWING FILE: 12107 P7.0 PRELIMINARY STORMWATER PLAN.DWG | LAYOUT: P7.0

AKS ENGINEERING & FORESTRY, LLC
9600 NE 126TH AVE, STE 2520
VANCOUVER, WA 98682
360.882.0419
WWW.AKS-ENG.COM

ENGINEERING · SURVEYING · NATURAL RESOURCES
FORESTRY · PLANNING · LANDSCAPE ARCHITECTURE

PRELIMINARY STORMWATER PLAN
STELLA RIDGE SUBIDVSION
ALLIED DEVELOPMENT, LLC
CAMAS, WASHINGTON

JOHN M. MEIER
42614
PRELIMINARY NOT FOR CONSTRUCTION

JOB NUMBER:	12107
DATE:	9/12/2025
DESIGNED BY:	NTL
DRAWN BY:	JCS
CHECKED BY:	NTL

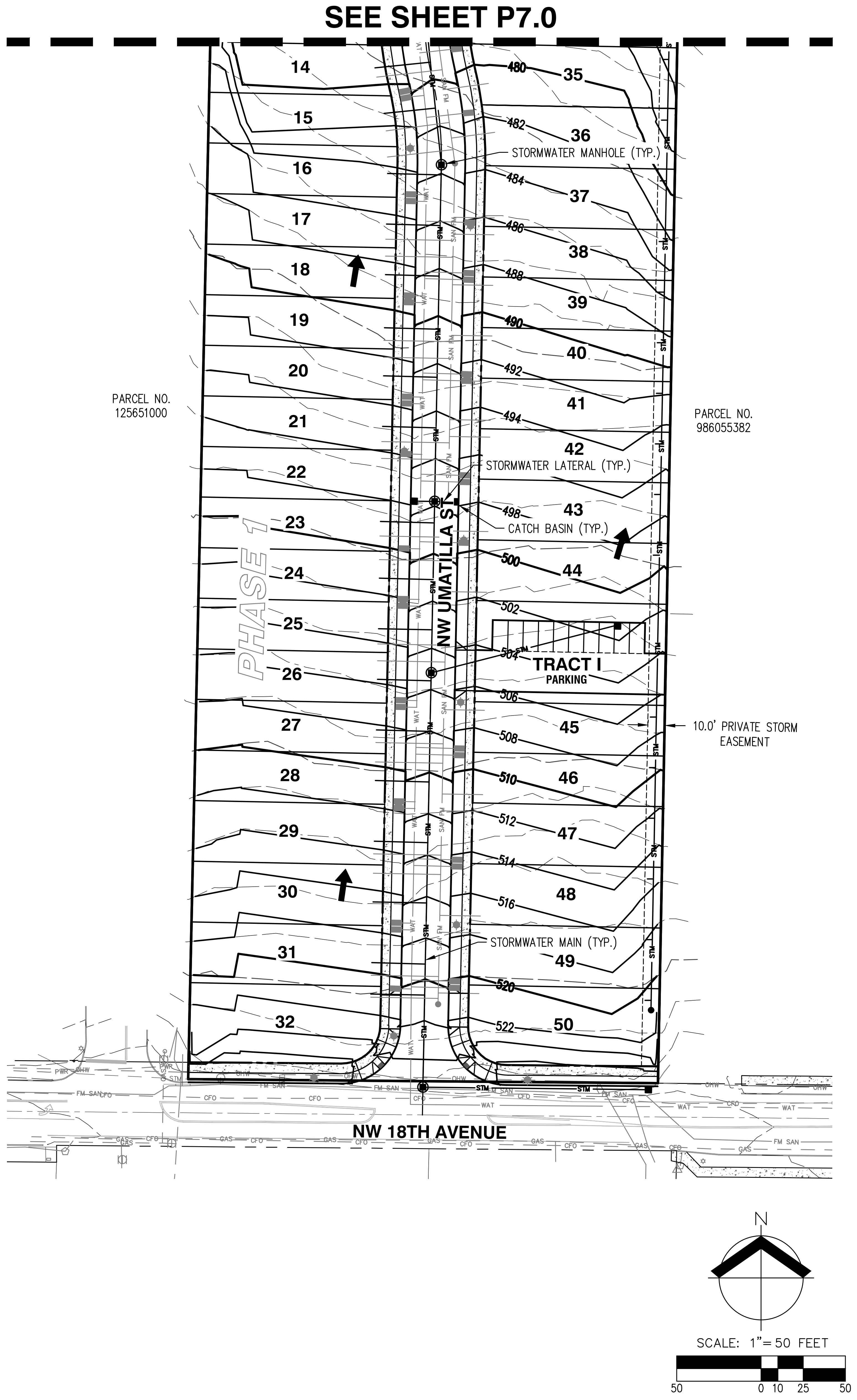
Exhibit 9 SUB25-1009

LEGEND

EXISTING GROUND CONTOUR (2 FT)	– – – – –
EXISTING GROUND CONTOUR (10 FT)	– – –350– – –
FINISHED GRADE CONTOUR (2 FT)	———
FINISHED GRADE CONTOUR (10 FT)	——350——

GENERAL NOTES

1. STORMWATER TREATMENT AND RETENTION FACILITIES FOR THIS DEVELOPMENT ARE TO BE OWNED AND MAINTAINED BY THE HOA.
2. THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.
3. THERE ARE EXISTING ON-SITE STORMWATER FACILITIES.
4. STORMWATER INFRASTRUCTURE EXISTS IN NW 20TH AVENUE & NW BRADY ROAD. STORMWATER FROM THESE STREETS DOES NOT CONTRIBUTE TO ON-SITE FLOWS.
5. NO WELLS, AGRICULTURAL DRAIN TILES, POTENTIAL SLOPE INSTABILITY, STRUCTURES, UTILITIES, SEPTIC TANKS, OR DRAIN FIELDS EXIST ONSITE.
6. NO FLOODPLAIN, FLOODWAYS, OR SHORELINE EXIST ONSITE.
7. WETLANDS EXIST ON THE SITE.
8. EXISTING DRAINAGE FLOW ROUTES ARE GENERALLY NORTHEAST FOR THE THRESHOLD DISCHARGE AREA (TDA). EXISTING STORMWATER FROM THE SITE DISCHARGES THROUGH NW BRADY ROAD TO THE NORTHEAST.
9. PROPOSED DRAINAGE FLOW ROUTES TO FOLLOW EXISTING FLOW ROUTES TO THE NORTHEAST AFTER BEING DISCHARGED FROM STORMWATER FACILITIES.
10. RUNOFF FROM ROOF AREAS FOR LOTS 47-75, 92-135, 139-156 DRAIN TO A STORMWATER LATERAL.



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PRELIMINARY STORMWATER PLAN
STELLA RIDGE SUBIDIVSION
ALLIED DEVELOPMENT, LLC
CAMAS, WASHINGTON

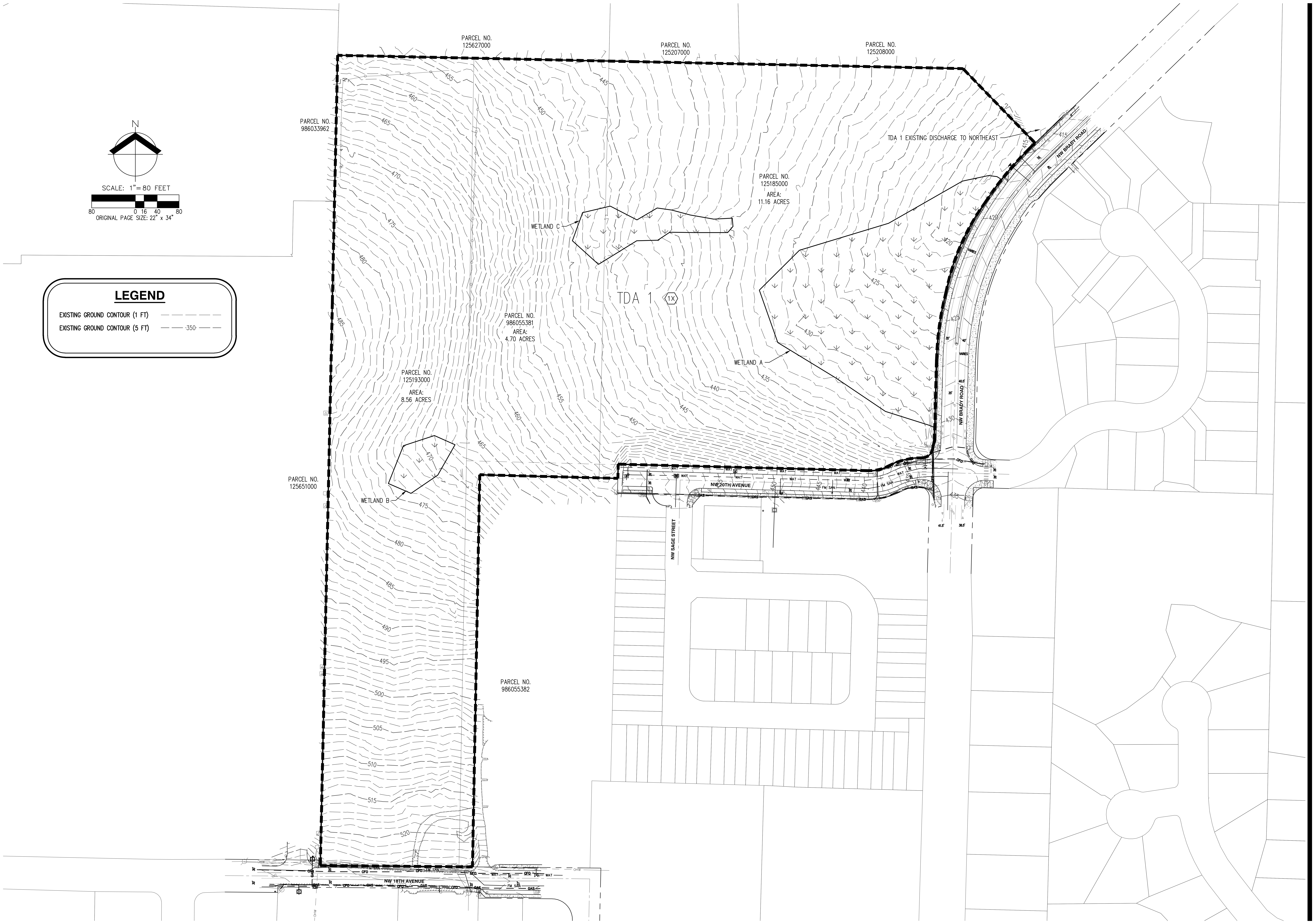
PRELIMINARY NOT FOR CONSTRUCTION
42614

JOB NUMBER:	12107
DATE:	9/12/2025
DESIGNED BY:	NTL
DRAWN BY:	JCS
CHECKED BY:	NTL

P7.1

AKS DRAWING FILE: 12107 P7.0 PRELIMINARY STORMWATER PLAN.DWG | LAYOUT: P7.1

Appendix D: Stormwater Basin Plans



AKS DRAWING FILE: 12107 PREDEV BASIN.DWG | LAYOUT: PREDEV

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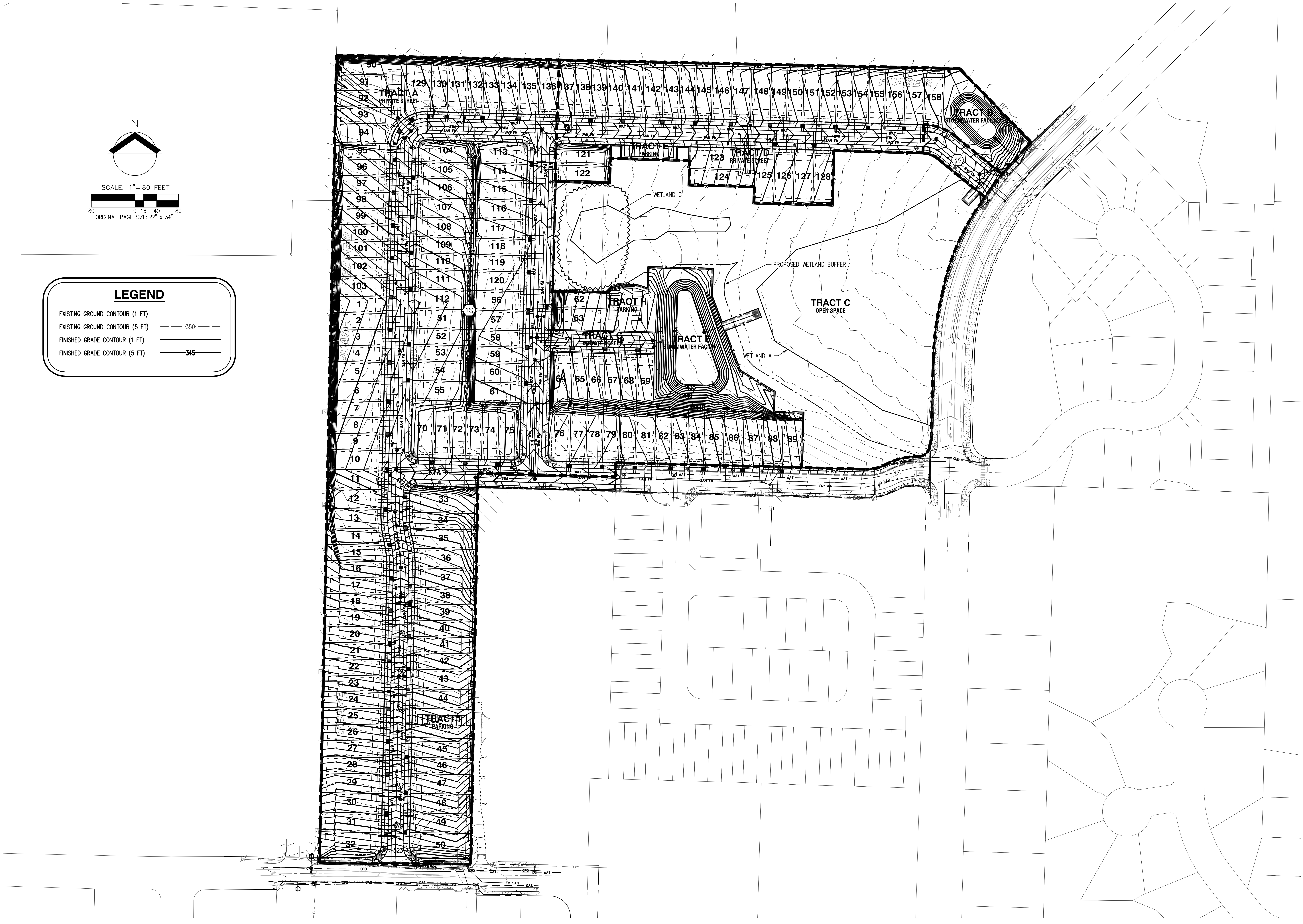
PRE DEVELOPED BASIN MAP
STELLA RIDGE SUBDIVISION

CAMAS, WASHINGTON

JOB NUMBER:	12107
DATE:	9/12/2025
DESIGNED BY:	NTL
DRAWN BY:	NTL
CHECKED BY:	JMM

EX A



AKS DRAWING FILE: 12107 POSTDEV BASIN.DWG | LAYOUT: POSTDEV

POST DEVELOPED BASIN MAP
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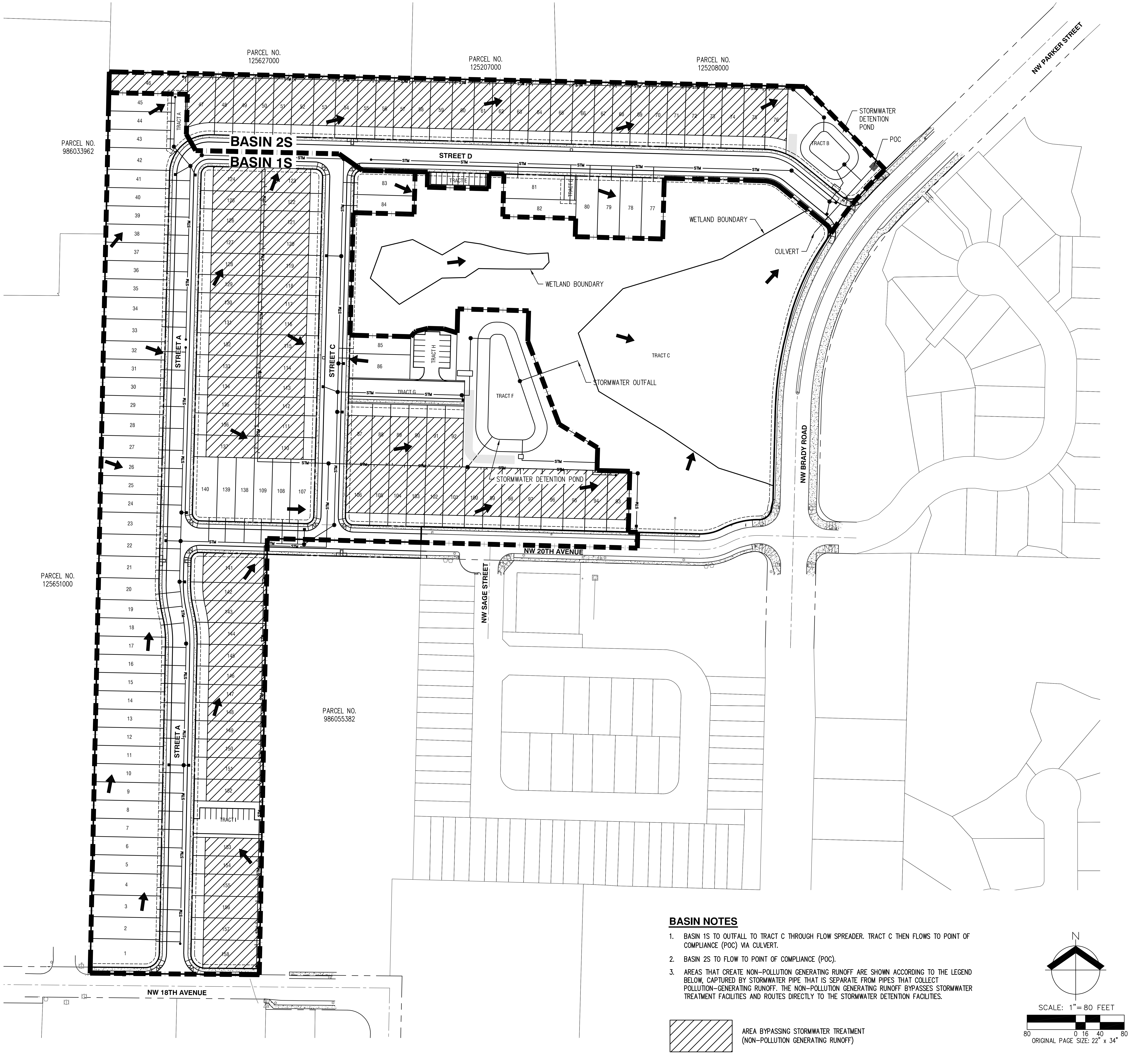
EX B



BASIN NOTES

1. BASIN 1S TO OUTFALL TO TRACT C THROUGH FLOW SPREADER. TRACT C THEN FLOWS TO POINT OF COMPLIANCE (POC) VIA CULVERT.
2. BASIN 2S TO FLOW TO POINT OF COMPLIANCE (POC).
3. AREAS THAT CREATE NON-POLLUTION GENERATING RUNOFF ARE SHOWN ACCORDING TO THE LEGEND BELOW, CAPTURED BY STORMWATER PIPE THAT IS SEPARATE FROM PIPES THAT COLLECT POLLUTION-GENERATING RUNOFF. THE NON-POLLUTION GENERATING RUNOFF BYPASSES STORMWATER TREATMENT FACILITIES AND ROUTES DIRECTLY TO THE STORMWATER DETENTION FACILITIES.

▨ AREA BYPASSING STORMWATER TREATMENT (NON-POLLUTION GENERATING RUNOFF)

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WATER QUALITY BASIN PLAN
STELLA RIDGE SUBIDIVSION
ALLIED DEVELOPMENT, LLC
CAMAS, WASHINGTON

PRELIMINARY
NOT FOR
CONSTRUCTION

JOB NUMBER:	12107
DATE:	8/27/2025
DESIGNED BY:	NTL
DRAWN BY:	JCS
CHECKED BY:	NTL

EX C

AKS DRAWING FILE: 12107 WATER QUALITY BASIN MAP.DWG | LAYOUT: ST-3

Appendix E: BMP Flow Chart

Exhibit 9 SUB25-1009

Stella Ridges

Table I-3.2: The List Approach for MR5 Compliance

List #1 **(For MR #1 - #5 Projects That Are Not Flow Control Exempt)**	**List #2** **(For MR #1 - #9 Projects That Are Not Flow Control Exempt)**	**List #3** **(For Flow Control Exempt Projects)**
Surface Type: Lawn and Landscaped Areas		
BMP T5.13: Post-Construction Soil Quality and Depth	BMP T5.13: Post-Construction Soil Quality and Depth	BMP T5.13: Post-Construction Soil Quality and Depth
Surface Type: Roofs		
1. BMP T5.30: Full Dispersion or BMP T5.10A: Downspout Full Infiltration	1. BMP T5.30: Full Dispersion or BMP T5.10A: Downspout Full Infiltration	1. BMP T5.10A: Downspout Full Infiltration
2. BMP T5.14: Rain Gardens or BMP T7.30: Bioretention	2. BMP T7.30: Bioretention	2. BMP T5.10B: Downspout Dispersion Systems
3. BMP T5.10B: Downspout Dispersion Systems	3. BMP T5.10B: Downspout Dispersion Systems	3. BMP T5.10C: Perforated Stub-out Connections
4. BMP T5.10C: Perforated Stub-out Connections	4. BMP T5.10C: Perforated Stub-out Connections	
Surface Type: Other Hard Surfaces		
1. BMP T5.30: Full Dispersion	1. BMP T5.30: Full Dispersion	BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion
2. BMP T5.15: Permeable Pavement or BMP T5.14: Rain Gardens or BMP T7.30: Bioretention	2. BMP T5.15: Permeable Pavement	
3. BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion	3. BMP T7.30: Bioretention	
	4. BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion	

Exhibit 9 SUB25-1009

Appendix F: WWHM Analysis

Exhibit 9 SUB25-1009

WWHM4

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 20250822 WQ Check

Site Name:	12107 Stella Ridge
Site Address:	4511 NW 18th Ave
City:	Camas
Report Date:	9/5/2025
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2025/05/13

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

Basin (MINUS TRACT D)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SG4, Forest, Flat	18.533
Pervious Total	18.533
Impervious Land Use	acre
Impervious Total	0
Basin Total	18.533

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

Basin 1S (TRACT G)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	3.468
ROOF TOPS FLAT	3.322
DRIVEWAYS FLAT	1.102
PARKING FLAT	0.298
Impervious Total	8.19
Basin Total	8.19

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin 2S (TRACT C)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.054
ROOF TOPS FLAT	0.591
DRIVEWAYS FLAT	0.349
PARKING FLAT	0.058
Impervious Total	2.052
Basin Total	2.052

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Routing Elements

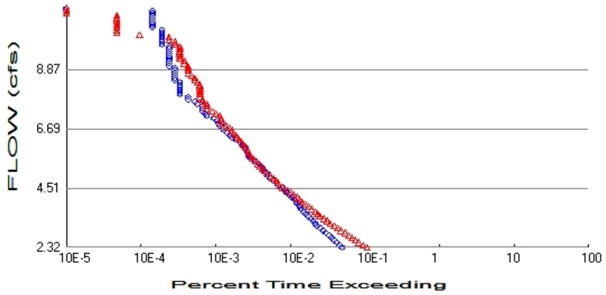
Predeveloped Routing

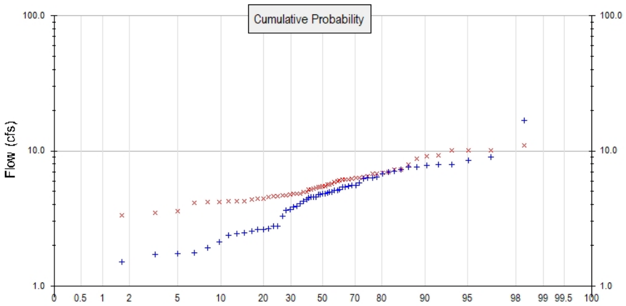
Mitigated Routing

Exhibit 9 SUB25-1009

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 18.533
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 10.242

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	4.649714
5 year	7.279152
10 year	8.713901
25 year	10.17764
50 year	11.049077
100 year	11.76638

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	5.515508
5 year	7.070974
10 year	8.117924
25 year	9.465552
50 year	10.48976
100 year	11.532867

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	3.631	8.748
1950	4.761	4.600
1951	6.289	4.833
1952	3.686	5.135
1953	4.973	4.726
1954	6.931	6.724
1955	3.859	4.981
1956	7.567	5.905
1957	5.755	5.504
1958	4.269	6.513

Exhibit 9 SUB25-1009

1959	2.482	4.589
1960	2.451	4.540
1961	6.815	4.972
1962	4.573	4.414
1963	5.081	5.438
1964	4.849	4.374
1965	4.348	4.198
1966	5.556	4.834
1967	4.841	5.238
1968	6.330	10.141
1969	5.158	9.065
1970	16.860	10.902
1971	2.667	5.364
1972	4.534	7.289
1973	4.516	6.108
1974	7.111	4.849
1975	3.875	4.096
1976	5.570	4.231
1977	0.152	3.311
1978	7.939	6.044
1979	5.374	7.255
1980	3.286	4.211
1981	7.547	5.737
1982	5.080	6.146
1983	8.450	6.420
1984	2.757	3.469
1985	2.125	4.442
1986	2.625	6.839
1987	4.581	4.189
1988	1.769	5.349
1989	1.922	6.969
1990	1.744	6.214
1991	4.945	5.600
1992	5.440	5.152
1993	6.395	6.291
1994	4.889	5.423
1995	4.056	5.602
1996	7.758	7.871
1997	8.984	9.278
1998	7.263	10.118
1999	5.428	4.244
2000	2.628	3.563
2001	1.515	3.119
2002	7.927	6.288
2003	6.232	4.663
2004	1.710	5.968
2005	2.557	6.791
2006	4.783	6.112
2007	2.368	4.705
2008	2.779	10.144

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	16.8600	10.9021
2	8.9842	10.1439
3	8.4503	10.1412
4	7.9393	10.1178

5	7.9274	9.2781
6	7.7579	9.0647
7	7.5671	8.7479
8	7.5475	7.8709
9	7.2632	7.2888
10	7.1108	7.2549
11	6.9308	6.9690
12	6.8145	6.8391
13	6.3945	6.7909
14	6.3301	6.7242
15	6.2886	6.5134
16	6.2322	6.4201
17	5.7551	6.2908
18	5.5697	6.2880
19	5.5562	6.2135
20	5.4401	6.1460
21	5.4280	6.1117
22	5.3736	6.1082
23	5.1580	6.0437
24	5.0810	5.9684
25	5.0796	5.9048
26	4.9733	5.7371
27	4.9450	5.6018
28	4.8889	5.6004
29	4.8492	5.5044
30	4.8414	5.4378
31	4.7828	5.4227
32	4.7606	5.3639
33	4.5811	5.3494
34	4.5726	5.2378
35	4.5340	5.1517
36	4.5155	5.1352
37	4.3476	4.9810
38	4.2692	4.9721
39	4.0565	4.8493
40	3.8749	4.8335
41	3.8588	4.8327
42	3.6864	4.7260
43	3.6308	4.7046
44	3.2862	4.6627
45	2.7786	4.5996
46	2.7570	4.5889
47	2.6665	4.5397
48	2.6284	4.4420
49	2.6252	4.4143
50	2.5567	4.3741
51	2.4819	4.2442
52	2.4514	4.2309
53	2.3678	4.2113
54	2.1252	4.1981
55	1.9220	4.1892
56	1.7689	4.0960
57	1.7435	3.5627
58	1.7104	3.4692
59	1.5147	3.3105
60	0.1517	3.1187

Exhibit 9 SUB25-1009

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.3249	1043	2243	215	Fail
2.4130	960	1975	205	Fail
2.5011	894	1738	194	Fail
2.5892	811	1568	193	Fail
2.6774	746	1412	189	Fail
2.7655	693	1276	184	Fail
2.8536	631	1148	181	Fail
2.9417	582	1008	173	Fail
3.0298	536	908	169	Fail
3.1180	484	816	168	Fail
3.2061	456	721	158	Fail
3.2942	425	654	153	Fail
3.3823	402	590	146	Fail
3.4705	367	525	143	Fail
3.5586	336	486	144	Fail
3.6467	314	454	144	Fail
3.7348	298	407	136	Fail
3.8230	280	368	131	Fail
3.9111	265	334	126	Fail
3.9992	253	303	119	Fail
4.0873	238	281	118	Fail
4.1754	221	258	116	Fail
4.2636	201	233	115	Fail
4.3517	186	214	115	Fail
4.4398	175	194	110	Fail
4.5279	167	168	100	Pass
4.6161	145	152	104	Fail
4.7042	139	144	103	Pass
4.7923	126	134	106	Pass
4.8804	113	125	110	Pass
4.9686	104	115	110	Pass
5.0567	101	103	101	Pass
5.1448	95	94	98	Pass
5.2329	90	90	100	Pass
5.3211	85	84	98	Pass
5.4092	80	77	96	Pass
5.4973	71	71	100	Pass
5.5854	62	67	108	Pass
5.6735	59	63	106	Pass
5.7617	57	59	103	Pass
5.8498	56	58	103	Pass
5.9379	53	56	105	Pass
6.0260	52	53	101	Pass
6.1142	48	50	104	Pass
6.2023	45	47	104	Pass
6.2904	39	43	110	Pass
6.3785	35	41	117	Fail
6.4667	33	39	118	Fail
6.5548	30	36	120	Fail
6.6429	27	35	129	Fail
6.7310	27	32	118	Fail
6.8192	24	29	120	Fail
6.9073	23	26	113	Fail
6.9954	22	25	113	Fail

7.0835	20	25	125	Fail
7.1716	16	24	150	Fail
7.2598	15	21	140	Fail
7.3479	14	19	135	Fail
7.4360	14	16	114	Fail
7.5241	14	16	114	Fail
7.6123	12	16	133	Fail
7.7004	11	14	127	Fail
7.7885	9	14	155	Fail
7.8766	9	13	144	Fail
7.9648	7	13	185	Fail
8.0529	7	13	185	Fail
8.1410	7	13	185	Fail
8.2291	7	13	185	Fail
8.3173	7	13	185	Fail
8.4054	7	12	171	Fail
8.4935	6	11	183	Fail
8.5816	6	11	183	Fail
8.6697	6	10	166	Fail
8.7579	6	9	150	Fail
8.8460	6	9	150	Fail
8.9341	6	9	150	Fail
9.0222	5	9	180	Fail
9.1104	5	8	160	Fail
9.1985	5	8	160	Fail
9.2866	5	7	140	Fail
9.3747	5	7	140	Fail
9.4629	5	7	140	Fail
9.5510	5	7	140	Fail
9.6391	5	7	140	Fail
9.7272	5	7	140	Fail
9.8153	4	6	150	Fail
9.9035	4	6	150	Fail
9.9916	4	5	125	Fail
10.0797	4	5	125	Fail
10.1678	4	2	50	Pass
10.2560	4	1	25	Pass
10.3441	4	1	25	Pass
10.4322	3	1	33	Pass
10.5203	3	1	33	Pass
10.6085	3	1	33	Pass
10.6966	3	1	33	Pass
10.7847	3	1	33	Pass
10.8728	3	1	33	Pass
10.9610	3	0	0	Pass
11.0491	3	0	0	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	1.164 acre-feet
On-line facility target flow:	1.7013 cfs.
Adjusted for 15 min:	1.7013 cfs.
Off-line facility target flow:	0.9599 cfs.
Adjusted for 15 min:	0.9599 cfs.

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 3

POC #3 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 4

POC #4 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Exhibit 9 SUB25-1009

POC 5

POC #5 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

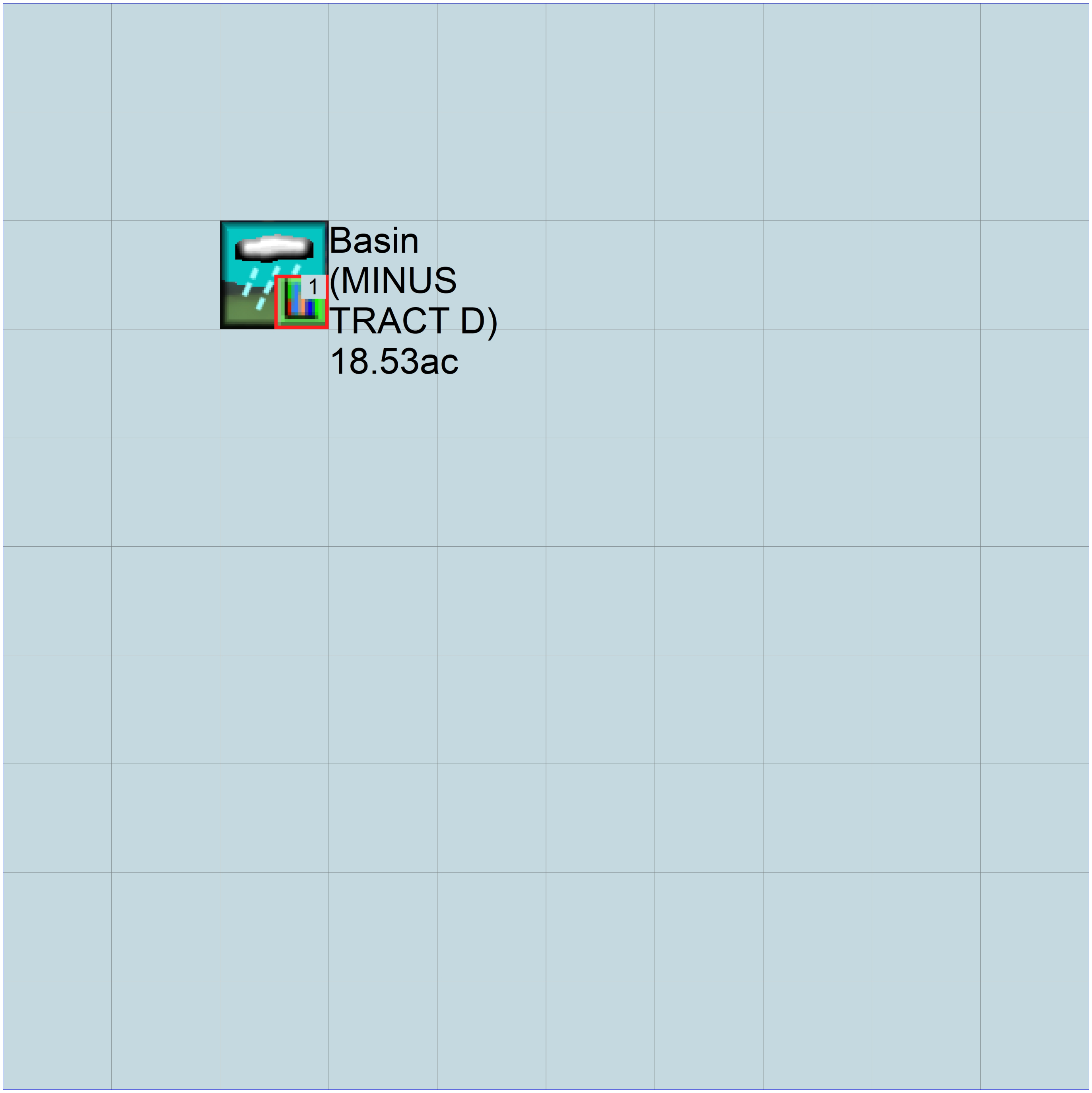
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 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   20250822 WQ Check.wdm
MESSU      25   Pre20250822 WQ Check.MES
           27   Pre20250822 WQ Check.L61
           28   Pre20250822 WQ Check.L62
           30   POC20250822 WQ Check1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      28
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin (MINUS TRACT D)       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           ***
   28     SG4, 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 ***
   28         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  *********
   28         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

Exhibit 9 SUB25-1009

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   28         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
   28              0         6      0.04       400      0.05         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   28              0         0         3         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   28            0.2       0.4      0.35         2       0.4       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
   28              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin (MINUS TRACT D)***
PERLND  28                      18.533     COPY   501     12
PERLND  28                      18.533     COPY   501     13

******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    1.3            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.3            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 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   20250822 WQ Check.wdm
MESSU      25   Mit20250822 WQ Check.MES
           27   Mit20250822 WQ Check.L61
           28   Mit20250822 WQ Check.L62
           30   POC20250822 WQ Check1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      IMPLND       4
      IMPLND       5
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1S (TRACT G)         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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  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
    4      ROOF TOPS/FLAT        1    1    1   27    0
    5      DRIVEWAYS/FLAT        1    1    1   27    0
   11      PARKING/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
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
   11         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
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
   11         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     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
   11         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
```

```
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1S (TRACT G)***
IMPLND   1                       3.468     COPY   501     15
IMPLND   4                       3.322     COPY   501     15
IMPLND   5                       1.102     COPY   501     15
IMPLND  11                       0.298     COPY   501     15
Basin  2S (TRACT C)***
IMPLND   1                       1.054     COPY   501     15
IMPLND   4                       0.591     COPY   501     15
IMPLND   5                       0.349     COPY   501     15
IMPLND  11                       0.058     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
```

Exhibit 9 SUB25-1009

```
  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    1.3            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.3            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            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     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
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Exhibit 9 SUB25-1009

Predeveloped HSPF Message File

Exhibit 9 SUB25-1009

Mitigated HSPF Message File

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Local (360)943-0304

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Exhibit 9 SUB25-1009

Appendix G: Geotechnical Reports

Exhibit 9 SUB25-1009

Report of Geotechnical Engineering Services

NW 18th Avenue Subdivision

Camas, Washington

May 28, 2025

Geotechnical ■ Environmental ■ Special Inspections

Columbia West

Engineering, Inc

www.columbia-west.com

Exhibit 9 SUB25-1009

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West
Engineering, Inc

Vancouver, Washington • Phone: 360-823-2900
Portland, Oregon • Phone: 971-384-1666
www.columbia-west.com

May 28, 2025

Allied Development
16430 North Scottsdale Road, Suite 210
Scottsdale, AZ 85254

Attention: Joe Deaser

Re: Report of Geotechnical Engineering Services
NW 18th Avenue Subdivision
4511 NW 18th Avenue
Camas, Washington
CWE Project: AlliedDev-1-01-1

Columbia West Engineering, Inc. (Columbia West) is pleased to present this report of geotechnical engineering services for the NW 18th Avenue Subdivision project located in Camas, Washington. Our services were conducted in accordance with our proposal dated March 27, 2025.

We appreciate the opportunity to work on the project. Please contact us if you have any questions regarding this report.

Sincerely,

Greg L. Williamson, PE
Senior Geotechnical Engineer

Daniel E. Lehto, PE, GE
Principal Engineer

DANIEL E. LEHTO
44702

Signed 05/28/2025

Expires 06/05/2025

GLW:DEL:kat
Attachments
Document ID: AlliedDev-1-01-1-052825-geor.docx

EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed NW 18th Avenue Subdivision project located in Camas, Washington. Our conclusions and recommendations are based on the subsurface information presented in the report and proposed development information provided by the design and construction team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Proposed residential structures may be supported by conventional spread footings bearing on firm, native soil or engineered structural fill.

- The near-surface native soil is sensitive to disturbance when at a moisture content that is above optimum. As discussed in the report, the subgrade should be protected from disturbance and damage by construction traffic.

- Moisture conditioning will be required to use the on-site soil as structural fill. Accordingly, extended dry weather will be required to adequately condition and place the soil as structural fill. Adequately compacting the on-site soil during the rainy season or during prolonged periods of rainfall will be difficult, if not impossible.

- Gravel, cobbles, and boulders were encountered in portions of the site that caused excavator refusal in four locations (test pits TP-8 through TP-10 and TP-12) at depths between 5.5 and 7 feet BGS. The site is underlain by the Basaltic Andesite of Prune Hill geologic formation and the soil encountered resembled residual soil that formed over this material. If deep excavations or utilities are planned, additional exploration may be warranted in specific locations to determine if conventional excavation equipment will be adequate to complete site construction.

- Groundwater seepage was encountered in a few of our test pits at depths between 5.5 and 8 feet BGS. Dewatering may be required for deeper utilities, particularly in areas of cut and during the wet season. Drainage mat construction may be required where fill material needs to be placed over wet soil or areas of shallow groundwater seepage.

- Based on the results of our subsurface explorations and infiltration testing results, infiltration is not a feasible option for stormwater management.

- Based on the results of infiltration testing, the near-surface native soil meets the classification criteria for WWHM Soil Group 4.

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ABBREVIATIONS AND ACRONYMS

AC	asphalt concrete
AOS	apparent opening size
ASCE	American Society of Civil Engineers
ASTM	ASTM International
BGS	below ground surface
g	gravitational acceleration (32.2 feet/second^2)
H:V	horizontal to vertical
in/hr	inch(es) per hour
km	kilometer(s)
MCE	maximum considered earthquake
NAVD 88	North American Vertical Datum of 1988
OSHA	Occupational Safety and Health Administration
pcf	pounds per cubic foot
pci	pounds per cubic inch
psf	pounds per square foot
PVC	polyvinyl chloride
ReMi	refraction microtremor
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WSS	Washington Standard Specifications for Road, Bridge, and Municipal Construction (2024)
WWHM	Western Washington Hydrology Model

REPORT OF GEOTECHNICAL ENGINEERING SERVICES
NW 18TH AVENUE SUBDIVISION
CAMAS, WASHINGTON

1.0 INTRODUCTION

Columbia West is pleased to submit this report of geotechnical engineering services for the NW 18th Avenue Subdivision project located in Camas, Washington. The 24.41-acre site is located northwest of the intersection of NW Brady Road and NW 20th Avenue. The site is shown relative to surrounding physical features on Figure 1. The existing conditions and exploration locations are shown on Figure 2. Abbreviations and acronyms used herein are defined immediately following the Table of Contents.

2.0 PROJECT UNDERSTANDING

Based on our correspondence and review of a preliminary site plan, we understand the proposed development includes construction of a residential subdivision with 155 single-family residential lots, AC-paved public roadways and private streets, underground utilities, and stormwater management facilities. Adjacent to NW Brady Road, approximately 6.5 acres of the site are proposed as open space. We assume that future residential structures will be of wood-framed construction with relatively light foundation loads. Based on site topography, cuts and fills are expected to be up to several feet each. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

3.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for use in design and construction of the proposed residential structures. Specifically, we completed the following tasks:

- Reviewed information available in Columbia West's files from previous geological and geotechnical studies conducted at and in the vicinity of the site.
- Coordinated and managed the field exploration program, which included coordinating site access and scheduling subcontractors and Columbia West field staff.
- Excavated 12 test pits to depths between 5.5 and 15 feet BGS.
- Conducted infiltration testing in three of the test pits in accordance with City of Camas requirements.
- Maintained continuous logs of the explorations and collected soil samples at representative intervals for laboratory testing.
- Completed a laboratory testing program using select soil samples collected from the explorations, which included the following:
  - Twelve moisture content determinations in general accordance with ASTM D2216
  - Six particle-size analyses in general accordance with ASTM D1140
  - Three Atterberg limits tests in general accordance with ASTM D4318
- Prepared this geotechnical report that includes the following:
  - Summary of soil and groundwater conditions at the site
  - Assessment of seismic hazards
  - Exploration logs and laboratory testing results

- Recommendations for shallow spread footings, including foundation settlement potential
- Recommendations for floor slab subgrade preparation
- Recommendations for retaining walls, including lateral earth pressures, backfill, compaction, and drainage
- Recommendations for site preparation, including grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork
- Recommendations for managing groundwater conditions that may affect the performance of structures and site improvements
- Infiltration testing results and WWHM soil group classifications
- Recommendations for AC pavement construction
- Code-based seismic design parameters in accordance with ASCE 7-16

4.0 SITE CONDITIONS

4.1 GEOLOGY

The site lies within the Willamette Valley/Puget Sound Lowland, a wide physiographic depression flanked by the mountainous Coast Range on the west and the Cascade Range on the east. Inclined or uplifted structural zones within the Willamette Valley/Puget Sound Lowland constitute highland areas, and depressed structural zones form sediment-filled basins. The site is located in the east portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

The near-surface geology is expected to consist of Pleistocene-aged Basaltic Andesite of Prune Hill (Qbph; Evarts and O’Connor 2008). The unit is part of the Boring Volcanic Field, a series of volcanic vents that form several buttes or cone-shaped hills in the basin. The formation is exposed south of the site in the recently reclaimed Fisher Pit Quarry.

The Web Soil Survey identifies the surface soil primarily as Powell silt loam with a small swath mapped as Odne silt loam in the proposed open space area (USDA 2025). Powell and Odne series soils are generally fine-grained clays and silts with low permeability, moderate to high water capacity, and low shear strength. They are generally moisture sensitive, somewhat compressible, and described as having low to moderate shrink-swell potential. The erosion hazard is slight primarily based on slope grade. Odne soils are typically found in wetland areas and are mapped as “hydric” according to Clark County Maps Online (Clark County 2025).

4.2 SURFACE CONDITIONS

The 24.41-acre site is generally bounded by industrial development to the west, undeveloped acreage to the north, NW Brady Road to the east, and NW 18th Avenue to the south. The site consists of vacant, undeveloped land that is forested through the central area and vegetated with grass to the east and west. Along the southern site boundary, remnant asphalt, debris, and small piles of gravel are present adjacent to NW 18th Avenue. Review of historical aerial photographs indicates that the remnant materials may be associated with residential and agricultural structures that were present on the site between the 1970s and 1990s. The site slopes gently down from west to east with elevations ranging from approximately 520 to 420 feet (NAVD 88).

Exhibit 9 SUB25-1009

4.3 SUBSURFACE CONDITIONS

Subsurface conditions were explored by excavating 12 test pits (TP-1 through TP-12) to depths between 5.5 and 15 feet BGS. The exploration locations are shown on Figure 2. A description of the field exploration program and the exploration logs are presented in Appendix A. A description of the laboratory testing program and the testing results are presented in Appendix B. A summary of the subsurface conditions is presented below.

4.3.1 Tilled Zone/Topsoil and Root Zone

All of the test pits were explored through grass vegetation with 14 to 18 inches of tilled zone/topsoil and a 3- to 4-inch-thick root zone. The tilled zone/topsoil generally consists of sandy clay with trace organics.

4.3.2 Clay

Underlying the tilled zone/topsoil layer in all test pits, clay extends to depths between 5.5 and 15 feet BGS. The clay contains varying proportions of sand and is medium stiff in consistency. In test pits TP-6, TP-8 through TP-10, and TP-12, the clay contains gravel, cobbles, and boulders at depths below 4 to 10 feet BGS. We interpret the gravel to indicate the transition between the near-surface residual clay and underlying basaltic andesite bedrock. In test pits TP-8 through TP-10 and TP-12, refusal of the excavator was observed on boulders or basalt. The moisture content of the clay ranged from 20 to 31 percent at the time of exploration. Atterberg limits testing indicates that the clay exhibits low to high plasticity.

4.3.3 Basalt

Underlying the clay in test pits TP-8 through TP-10 and TP-12, refusal of the excavator was observed on boulders or basalt at depths between 5.5 and 7 feet BGS. The boulders and basalt appear to represent the Pleistocene-aged Basaltic Andesite of Prune Hill (Evarts and O’Connor 2008). Where encountered, boulders were up to 36 inches in diameter.

4.3.4 Groundwater

Groundwater seepage was observed in test pits TP-1, TP-3, and TP-8 at depths between 5.5 and 8 feet BGS. Based on our knowledge of the surrounding area, groundwater levels are subject to seasonal variation and may rise during extended periods of increased precipitation or flooding. Perched groundwater may also be present in localized areas at shallow depths, as indicated.

4.4 INFILTRATION TESTING

Infiltration testing was completed in three of the test pits to assist in the evaluation of stormwater infiltration facilities for the project. The infiltration testing was conducted using the single-ring, failing head test method in general accordance with the *Clark County Stormwater Manual* (Clark County 2021). Table 1 summarizes our infiltration testing results and fines content determinations. The exploration logs and laboratory testing results are presented in Appendices A and B, respectively. Based on the infiltration testing results and presence of shallow groundwater seepage and near-surface rock, infiltration is not considered to be a feasible option for stormwater management.

Table 1. Infiltration Testing Results

Location	Depth (feet BGS)	Soil Description	Fines Content[1] (percent)	Unfactored Saturated Hydraulic Conductivity (in/hr)
TP-5	2	CLAY (CL)	86	Negligible
TP-8	2	CLAY (CL)	86	Negligible
TP-11	2	CLAY (CL)	87	Negligible

1. Percent passing U.S. Standard No. 200 sieve

4.4.1 WWHM Soil Group Classification

As shown in Table 1, infiltration rates were negligible in the tested locations. Based on review of Table 7-2 of the USDA hydrologic soil group criteria (USDA 2009), Appendix 2-A of the 2021 *Clark County Stormwater Manual,* and the Clark County Western Washington Hydrology Model (WWHM) Soil Groupings Memorandum (Otak 2010), the near-surface native soil meets the classification criteria for WWHM Soil Group 4.

4.5 SEISMIC HAZARDS

4.5.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction and undergoes a loss of strength until the excess pore pressures dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking. As previously summarized, native subsurface conditions generally consist of clay underlain by basaltic andesite bedrock. Accordingly, liquefaction is not a geotechnical design consideration.

4.5.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. Since liquefaction is not considered a hazard at the site, lateral spreading is also not a geotechnical design consideration.

4.5.3 Fault Rupture

Based on USGS interactive fault mapping, the nearest mapped fault to the site is the Lacamas Lake fault, which is located approximately 3.3 km northeast of the site (USGS 2025). As such, fault rupture is not considered a hazard at the site.

5.0 DESIGN

5.1 FOUNDATION SUPPORT

5.1.1 General

Based on the results of our explorations and analysis, the proposed residential structures can be supported by spread footings bearing on firm, native soil or engineered structural fill.

Foundations should not be supported by unsuitable fill, soft soil, deleterious material, or disturbed soil. Although not observed in our test pits, undocumented fill may be present near NW 18th Avenue where previous residential and agricultural structures are shown on historical aerial photographs. If encountered during foundation excavation, these materials should be removed and replaced with structural fill. If footing subgrade soil is above its optimum moisture content at the time of subgrade preparation, we recommend placing a sufficient amount of crushed rock (typically 2 to 4 inches) to protect it from foot traffic. The crushed rock should consist of imported granular material as described in Section 6.4 (Materials).

5.1.2 Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum widths of 18 and 24 inches, respectively. The bases of exterior footings should be at least 18 inches below the lowest adjacent exterior grade. The bases of interior footings should bear at least 12 inches below the base of the floor.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 1,500 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

5.1.3 Settlement

Foundations designed in accordance with this report are expected to experience post-construction settlement of less than 1 inch. Differential post-construction settlement between comparably loaded footing elements is not expected to exceed 0.5 inch over a distance of 50 feet.

5.1.4 Resistance to Sliding

Lateral loads on building and retaining wall footings can be resisted by passive earth pressure on the sides of structures and by friction on the bases of footings. Our analysis indicates that the available passive earth pressure for footings confined by the on-site soil or planned structural fill is 250 pcf, modeled as an equivalent fluid pressure. Adjacent floor slabs, pavement, or the upper 12-inch depth of unpaved areas should not be considered when calculating passive resistance. An allowable coefficient of friction equal to 0.35 can be used for footings supported on native soil. If a minimum of 6 inches of gravel are placed at the base of a footing, the coefficient of friction can be increased to 0.4.

5.1.5 Subgrade Observation and Preparation

All footing subgrade should be evaluated by a representative of Columbia West to confirm suitable bearing conditions. Observations should also confirm that loose or soft material, organic material, unsuitable fill, prior topsoil zones, and softened subgrade (if present) have been removed. Localized deepening of footing excavations may be required to penetrate any deleterious or soft material, particularly during wet weather conditions. Footing excavations should be backfilled with compacted crushed aggregate.

Exhibit 9 SUB25-1009

5.2 FLOOR SLABS

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Floor slabs with maximum floor loads of 150 psf may be designed assuming a modulus of subgrade reaction, k, of 125 pci.

To provide a capillary break, slabs should be underlain by at least 6 inches of compacted crushed aggregate that contains less than 5 percent fines by dry weight. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab aggregate base and subgrade geotextile are discussed in Section 6.4 (Materials).

All slab subgrade should be evaluated by a member of our geotechnical staff to confirm suitable bearing conditions. Observations should also confirm that loose or soft material, organic material, unsuitable fill, prior topsoil zones, and softened subgrade have been removed and replaced with structural fill. In addition, contaminated base rock for the slabs should be removed and replaced prior to pouring the slab.

5.3 SEISMIC DESIGN CRITERIA

Seismic design for the proposed residential structures is prescribed by ASCE 7-16. Based on the results of subsurface exploration and our experience running ReMi arrays on nearby sites, an appropriate site class for the site is Site Class D. Seismic design parameters for Site Class D are presented in Table 2.

Table 2. Seismic Design Parameters in Accordance with ASCE 7-16[1]

Parameter	Short Period (T_s)	1-Second Period (T_1)
MCE spectral response acceleration, S	S_s = 0.836 g	S_1 = 0.359 g
Site class	D	
Site coefficient, F	F_a = 1.17	F_v = 1.94
Adjusted spectral response acceleration, S_M	S_{MS} = 0.97 g	S_{M1} = 0.70 g
Design spectral response acceleration, S_D	S_{DS} = 0.65 g	S_{D1} = 0.46 g

[1] The structural engineer should evaluate ASCE 7-16 code requirements and exceptions to determine if these parameters are valid for design.

Columbia West recommends the project structural engineer evaluate the requirements and exceptions presented in ASCE 7-16 to determine if the parameters for Site Class D provided in Table 2 can be used for design or if a site-specific seismic hazard evaluation is required (not anticipated for typical residential structures).

5.4 RETAINING STRUCTURES

Lateral earth pressures should be considered in design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Retaining wall foundation construction and bearing capacity should adhere to the specifications in Section 5.1 (Foundation Support).

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressure from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 3.

Seismic forces may be calculated by superimposing a uniform lateral force of $9H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a uniformly distributed load with the resultant located at 0.6H from the base of the wall.

5.4.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the bases of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications in Section 7.6 (Materials). Perforated collector pipes should discharge at an appropriate location away from the base of the wall. Discharge pipes should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill placed behind walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 6.4.1 (Structural Fill).

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

5.5 PAVEMENT

We understand that public roadways for the subdivision will be constructed in accordance with jurisdictional standards. For dry weather construction, pavement surface sections should bear on competent subgrade consisting of firm, native soil or engineered structural fill. Wet weather construction may require an increased thickness of aggregate base as discussed in Section 6.2 (Construction Traffic and Staging).

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress. Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix, as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Washington, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thicknesses greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thicknesses between 2 and 2.5 inches. If AC paving must take place during cold weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

5.6 DRAINAGE

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. In general, drainage design should conform to City of Camas regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains and subdrains are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements in Section 6.4 (Materials*)*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seepage becomes evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

5.6.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains should be considered for shallow foundations constructed below existing site grades but are not necessary for the functionality of the buildings.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains should consist of 4-inch-diameter, perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of 0.5 percent. The invert elevation of the drainpipe should be at least 18 inches below the elevation of the floor slab.

5.6.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater or seepage should be conveyed via a drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and subsurface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits.

5.6.3 Drainage Mat

Site construction in some areas may occur at or near the groundwater table or in areas of existing preferential pathways for surface and subsurface water flow, particularly if work is conducted during wet weather conditions. A drainage mat is typically required in areas that require structural fill placed on top of a natural drainage swale or known seep or spring area. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 4. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed. Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

5.7 PERMANENT SLOPES

Fill slopes should consist of structural fill material as discussed in Section 6.4.1 (Structural Fill). Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than 6 feet in height should be vertically keyed into existing subsurface soil. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. The extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 10 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from the top of the cut or fill slope face or overall slope height divided by three (H/3), whichever is greater.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least 2 feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

6.0 CONSTRUCTION

6.1 SITE PREPARATION

Vegetation, organic material, remnant pavement, unsuitable fill, and deleterious material should be cleared from areas identified for structures and grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed or used only as landscape fill in non-structural areas with slopes less than 25 percent. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed 1 foot. Actual stripping depths should be determined based on visual observations made during construction when soil conditions are exposed.

6.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill, exposed subgrade soil should be evaluated by proof rolling with a fully loaded dump truck or similar heavy, rubber-tired construction equipment. When the subgrade is too wet for proof rolling or inaccessible to a loaded dump truck, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over excavated and backfilled with compacted imported granular fill.

6.1.2 Test Pit Locations

Test pits excavated during our explorations were backfilled loosely with on-site soil. These excavations should be located and properly backfilled with structural fill during site improvement construction. Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

6.2 CONSTRUCTION TRAFFIC AND STAGING

Near-surface, clay soil will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas, resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet weather conditions.

If construction occurs during wet weather conditions or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular access pads and staging areas will also be necessary to provide a firm support base and sustain construction equipment.

Based on our experience, between 12 and 18 inches of imported granular material are generally required in staging areas and between 18 and 24 inches in areas supporting construction traffic. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize fines migration into the aggregate base layer.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

6.3 EXCAVATION

Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations to the depths of our test pit explorations. Gravel, cobbles, and boulders representing weathered basaltic andesite were encountered in the west portion of the site at depths as shallow as 4 feet BGS. In these locations, refusal of the excavator was observed as shallow as 5.5 feet BGS. Difficult excavation conditions should be anticipated in areas underlain by shallow bedrock. If utility or grading design requires excavations beyond the depths explored during our test pit explorations, a location-specific exploration is recommended to determine if specialized equipment or blasting of intact bedrock may be required.

Temporary excavation sidewalls should maintain a vertical cut to a depth of approximately 4 feet BGS in near-surface clay, provided groundwater seepage is not present in the sidewalls. In sandy soil, excavations will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1.5H:1V and groundwater seepage does not occur. Excavation side slopes should be reduced to a stable inclination if excessive sloughing or raveling occurs.

Groundwater seepage was observed in our test pits at depths between 5.5 and 8 feet BGS. Recommendations as described in Section 6.3.1 (Construction Dewatering) should be considered where subsurface construction activities intersect the shallow groundwater table.

Shoring may be required if open-cut excavations are not feasible. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems. If box shoring is used, the contractor should understand it is a safety feature used to protect workers and does not prevent caving. If excavations are left open, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting the excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

6.3.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater, if encountered. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of the exposed site soil. During rough and finished grading of building pad areas, the contractor should keep all footing excavations and slab subgrade soil free of standing water.

The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least 2 feet below the bases of proposed trench excavations. Without adequate trench dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches.

If groundwater is present at the bases of utility excavations, we recommend placing 18 to 24 inches of stabilization material at the bases of the excavation. Subgrade geotextile placed directly over trench subgrade soil may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. Trench stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements in Section 6.4 (Materials).

We note that these recommendations are for guidance only. Dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

6.4 MATERIALS

6.4.1 Structural Fill

6.4.1.1 General

Areas proposed for fill placement should be appropriately prepared as described in Section 6.1 (Site Preparation). Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet the specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory testing and approval by Columbia West prior to placement.

6.4.1.2 On-Site Soil

The on-site clay will be suitable for use as structural fill if adequately dried and moisture conditioned to achieve recommended compaction specifications. Native clay soil with a plasticity index greater than 25 should be evaluated at the time of construction and approved by Columbia West prior to use as structural fill. We note that clay meeting this criteria was observed in test pit TP-1 at a depth of 5 feet BGS. The high plasticity clay will likely require blending with non-plastic or low plasticity soil prior to use as structural fill.

Laboratory testing indicates that the moisture content of the native soil was above optimum at the time of exploration. Moisture conditioning will likely be necessary to dry the soil prior to applying compaction effort. In addition, near-surface clay soil will be moisture sensitive and difficult, if not impossible, to compact during wet weather conditions. Therefore, structural fill placement using on-site soil should be performed during dry summer months if possible.

If excavated or blasted bedrock is proposed for use as engineered fill, individual fragment size should not exceed 6 inches. Larger fragments should either be removed or crushed into acceptable sizes. Rock fragments should be well dispersed within the fill to prevent nesting. Crushing and mixing processes should be observed by Columbia West.

On-site soil used as structural fill should be placed in loose lifts not exceeding 8 inches in thickness and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density, as determined by ASTM D698. Compacted on-site fill soil should be covered shortly after placement.

The on-site soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this study. We can provide site-specific factors upon request.

6.4.1.3 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The imported granular material should also be durable, angular, and fairly well graded between coarse and fine material; should have less than 5 percent fines by dry weight; and should have at least two mechanically fractured faces. Imported granular material should be placed in loose lifts not exceeding 12 inches in thickness and compacted to at least 95 percent of maximum dry density as determined by ASTM D1557. During wet weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

6.4.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting WSS 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding. Pipe zone backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of WSS 9-03.19 – Bank Run Gravel for Trench Backfill or WSS 9 03.14(2) – Select Borrow with a maximum particle size of 2½ inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

6.4.1.5 Stabilization Material

Stabilization material used to create haul roads for construction traffic or at the base of unstable trench subgrade should consist of pit- or quarry-run rock or crushed rock. The material should have a maximum particle size of 6 inches and less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, should have at least two mechanically fractured faces, and should be free of organic material and other deleterious material. Material meeting the specifications in WSS 9-27.3(6) – Stone is generally acceptable for use. Stabilization material should be placed in lifts between 12 and 18 inches thick and compacted to a firm condition with a smooth-drum roller without using vibratory action.

6.4.1.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and less than 2 percent fines by dry weight. Drain rock should be free of roots, organic material, and other unsuitable material and should have at least two mechanically fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

6.4.1.7 Retaining Wall Backfill

Backfill placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of imported granular material as described above and should have less than 7 percent fines by dry weight. We recommend the wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

The wall backfill should be compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of maximum dry density as determined by ASTM D1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavement) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of maximum dry density as determined by ASTM D1557.

6.4.1.8 Retaining Wall Leveling Pad

Imported granular material placed at the bases of retaining wall footings should consist of select granular material. The granular material should be ¾- to 1-inch-minus aggregate size and should have at least two mechanically fractured faces. The leveling pad material should be placed in a 6- to 12-inch-thick lift and compacted to not less than 95 percent of maximum dry density as determined by ASTM D1557.

6.4.1.9 Floor Slab Aggregate Base

Aggregate base for building floor slabs should consist of 1¼-inch-minus crushed aggregate meeting WSS 9-03.9(3) – Crushed Surfacing. Slab aggregate base should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

6.4.2 Geotextile Fabric

6.4.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications in WSS 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

6.4.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications in WSS 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties. The AOS should be between U.S. Standard No. 70 and No. 100 sieves. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.5 EROSION CONTROL

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed before construction begins. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

7.0 OBSERVATION OF CONSTRUCTION

Satisfactory pavement, earthwork, and foundation performance depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Columbia West should be retained to observe subgrade preparation, fill placement, foundation excavations, drainage system installation, and pavement placement and to review laboratory compaction and field moisture-density information.

Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

8.0 LIMITATIONS

We have prepared this report for use by the addressee and members of the design and construction team for the proposed project. This report is subject to the limitations expressed in Appendix C.

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We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

Greg L. Williamson, PE
Senior Geotechnical Engineer

Daniel E. Lehto, PE, GE
Principal Engineer

REFERENCES

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Exhibit 9 SUB25-1009

FIGURES

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Exhibit 9 SUB25-1009

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

PROJECT NO.:
ALLIEDDEV-1-01-1

MAY 2025

VICINITY MAP
NW 18TH AVENUE SUBDIVISION
CAMAS, WASHINGTON

FIGURE
1

Exhibit 9 SUB25-1009

LEGEND

⬚ SITE BOUNDARY

▣ TEST PIT

▨ PROPOSED OPEN SPACE

N

0 100 200 300 400

NOTES:
1. AERIAL PHOTO SOURCED FROM GOOGLE EARTH.
2. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
3. REFER TO REPORT TEXT FOR EXPLORATION DESCRIPTIONS.

Columbia West Engineering, Inc
Geotechnical ▪ Environmental ▪ Special Inspections

NW 18TH AVENUE SUBDIVISION
CAMAS, WASHINGTON
4511 NW 18TH AVENUE

SITE PLAN

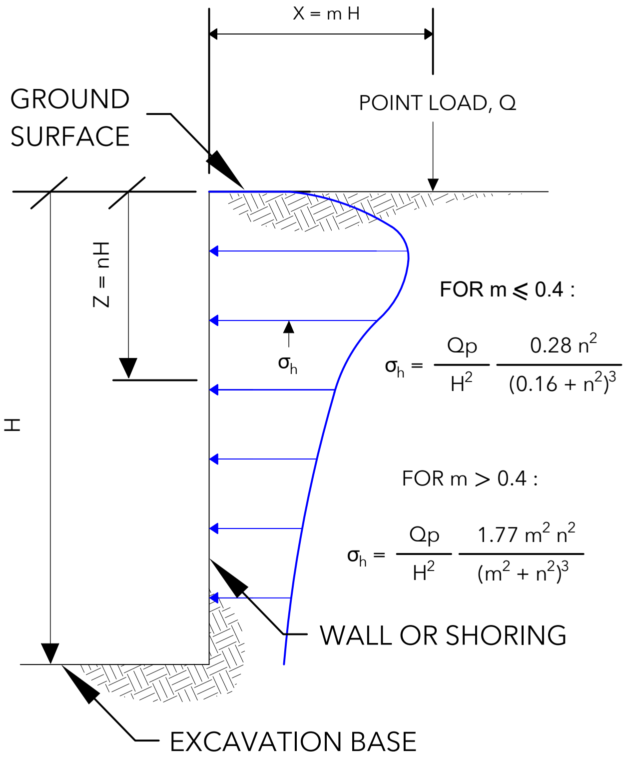
PROJECT NO:
ALLIEDDEV-1-01-1

MAY 2025

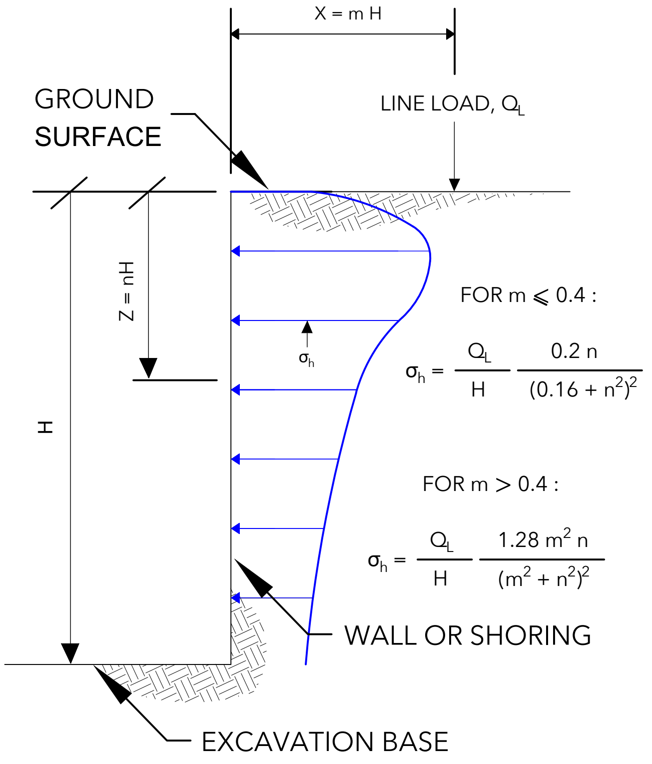
FIGURE
2

Exhibit 9 SUB25-1009

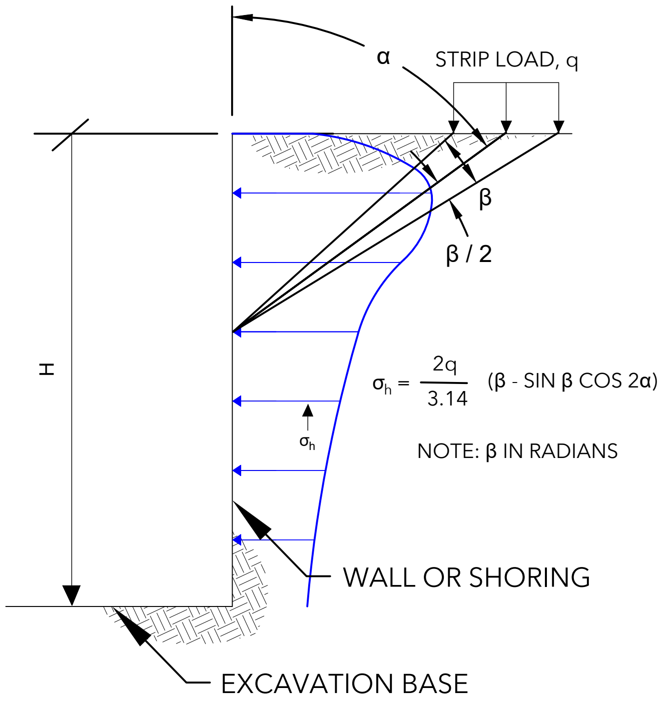
VERTICAL POINT LOAD



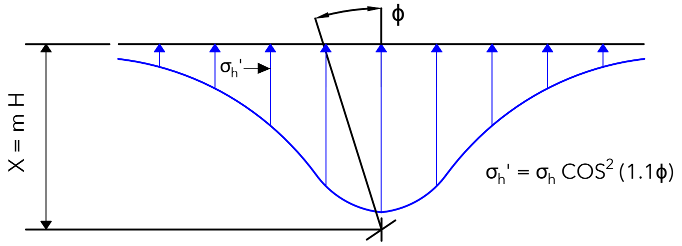
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL



VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

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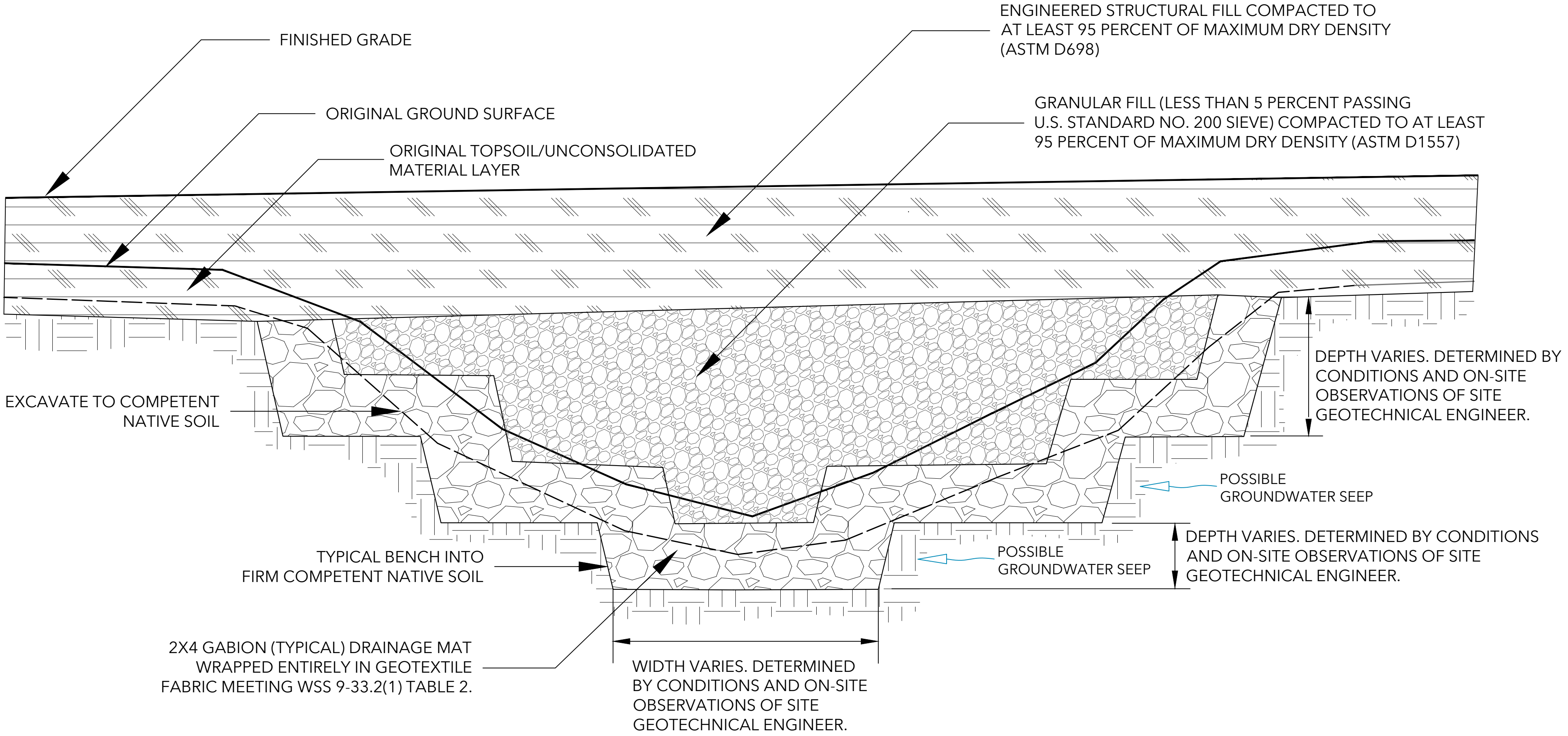
SURCHARGE-INDUCED LATERAL EARTH PRESSURES

FIGURE
3

Exhibit 9 SUB25-1009



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TYPICAL DRAINAGE MAT CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL DRAINAGE MAT SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE 4

Exhibit 9 SUB25-1009

APPENDIX A

APPENDIX A
FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by excavating 12 test pits (TP-1 through TP-12) to depths between 5.5 and 15 feet BGS. Excavation services were provided by L&S Contractors of Yacolt, Washington, on April 29, 2025, using a track-mounted excavator. The explorations were logged on a full-time basis by Columbia West personnel. The exploration logs are presented in this appendix.

The exploration locations are shown on Figure 2. The exploration locations were determined in the field by pacing or measuring from existing site features. This information should be considered accurate only to the degree implied by the methods used.

SOIL SAMPLING

Representative disturbed samples of soil observed in the test pit explorations were collected from the test pit walls and base using the excavator bucket. Sampling methods and intervals are shown on the exploration logs.

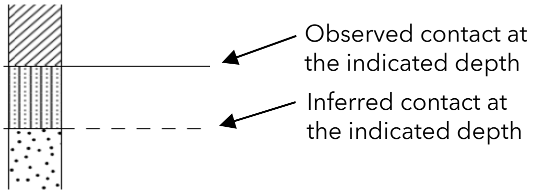
SOIL CLASSIFICATION

The soil samples were classified in the field in accordance with the "Exploration Legend" and "Soil Classification System," which are presented in this appendix. The exploration logs indicate the depths at which the soil characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

Exhibit 9 SUB25-1009

EXPLORATION LEGEND

SAMPLER TYPE	**DESCRIPTION**
SPT	Sample collected from the indicated depth in general accordance with ASTM D1586, *Standard Test Method Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils,* using an SPT sampler and 140-pound hammer
SH	Sample collected from the indicated depth in general accordance with ASTM D1587, *Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes,* using a thin-walled Shelby tube, or in general accordance with ASTM D6519, *Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler,* using a thin-walled tube
D&M	Sample collected from the indicated depth in general accordance with ASTM D3550, *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils,* using a Dames & Moore sampler and 140-pound hammer or pushed
CSS	Sample collected from the indicated depth in general accordance with ASTM D3550, *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils,* using a 3-inch-outside diameter California split-spoon sampler and 140-pound hammer
DP	Sample collected from the indicated depth in general accordance with ASTM D6282, *Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations,* using a direct-push soil sampler
GRAB	Grab sample collected from the indicated depth
CORE	Pavement or rock core interval at the indicated depth



GEOTECHNICAL ABBREVIATIONS

ATT	Atterberg limits	PP	Pocket penetrometer
CBR	California bearing ratio	P200	Percent passing No. 200 sieve
CON	Consolidation test	RES	Resilient modulus
DD	Dry density	SIEV	Sieve analysis
DS	Direct shear	TS	Torvane shear
HYD	Hydrometer	tsf	Tons per square foot
MC	Moisture content	UC	Unconfined compressive strength
MD	Moisture-density relationship	UU	Unconsolidated undrained triaxial test
NP	Non-plastic	VS	Vane shear
OC	Organic content	WD	Wet density

ENVIRONMENTAL ABBREVIATIONS

CA	Sample submitted for chemical analysis	ND	Not detected
		NS	No sheen
PID	Photoionization detector headspace analysis	SS	Slight sheen
		MS	Moderate sheen
ppm	Parts per million	HS	Heavy sheen

Exhibit 9 SUB25-1009

SOIL CLASSIFICATION SYSTEM

PARTICLE-SIZE CLASSIFICATION

COMPONENT	ASTM / USCS		AASHTO	
	Size Range	**Sieve Size Range**	**Size Range**	**Sieve Size Range**
Boulders	Greater than 300 mm	Greater than 12 inches	--	--
Cobbles	75 mm to 300 mm	3 inches to 12 inches	Greater than 75 mm	Greater than 3 inches
Gravel	75 mm to 4.75 mm	3 inches to No. 4 sieve	75 mm to 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm to 19.0 mm	3 inches to 3/4-inch sieve	--	--
Fine	19.0 mm to 4.75 mm	3/4-inch to No. 4 sieve	--	--
Sand	4.75 mm to 0.075 mm	No. 4 to No. 200 sieve	2.00 mm to 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm to 2.00 mm	No. 4 to No. 10 sieve	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve	--	--
Fine	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	Less than 0.075 mm	Passing No. 200 sieve	Less than 0.075 mm	Passing No. 200 sieve

CONSISTENCY FOR COHESIVE SOIL

CONSISTENCY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)	POCKET PENETROMETER (unconfined compressive strength [tsf])
Very soft	0 to 2	0 to 3	Less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.5
Medium stiff	4 to 8	6 to 12	0.5 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	Greater than 30	Greater than 30	Greater than 4.0

RELATIVE DENSITY FOR GRANULAR SOIL

RELATIVE DENSITY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)
Very loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very dense	Greater than 50	Greater than 120

MOISTURE DESIGNATIONS

TERM	FIELD IDENTIFICATION
Dry	Very low moisture, dry to touch
Moist	Damp, color appears darkened, without visible moisture, cohesive soil will clump, sand will bulk
Wet	Visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Percent	SILT AND CLAY IN		Percent	SAND AND GRAVEL IN		Percent	SECONDARY MATERIAL
	Fine-Grained Soil	**Coarse-Grained Soil**		**Fine-Grained Soil**	**Coarse-Grained Soil**		**Organics and Man-Made Debris**
< 5	trace	trace	< 5	trace	trace	< 4	trace
5 – 12	minor	with	5 – 15	minor	minor	4 – 12	some
> 12	some	silty/clayey	15 – 30	with	with		
			> 30	sandy/gravelly	with		

Exhibit 9 SUB25-1009

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TEST PIT NUMBER: TP-1

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 8:15 AM
LOGGED BY S. Chandra
TIME COMPLETED 8:43 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-PI)	FINES (%)	REMARKS
				▒	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (14-inch-thick tilled zone, 3-inch-thick root zone). 1.2					
			CH	▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, high plasticity, sand is fine.					
5	Grab	TP1.1					31	62-25-37	89	
					Brown with orange-gray mottles, wet at 8 feet.					
10										
	Grab	TP1.2					29			
					14.0					
15					Exploration completed at 14 feet.					

GROUNDWATER: Slow seepage at 8 feet

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

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TEST PIT NUMBER: TP-2

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 8:50 AM
LOGGED BY S. Chandra
TIME COMPLETED 9:27 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
	Grab	TP2.1			Medium stiff, dark brown sandy CLAY, trace organics and gravel, moist, medium plasticity (18-inch-thick tilled zone, 3-inch-thick root zone). 1.5			
	Grab	TP2.2	CL		Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.		27	
5								
10					14.0			
15					Exploration completed at 14 feet.			

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

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TEST PIT NUMBER: TP-3

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 9:30 AM
LOGGED BY S. Chandra
TIME COMPLETED 9:55 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
				▩	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5				
				▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.				
	Grab	TP3.1					29		
5									
	Grab	TP3.2			Wet at 7 feet.		29	90	
			CL						
10									
					14.0				
					Exploration completed at 14 feet.				
15									

GROUNDWATER: Moderate seepage at 7 feet

CAVING: Not observed

Exhibit 9 SUB25-1009

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TEST PIT NUMBER: TP-4

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 9:58 AM
LOGGED BY S. Chandra
TIME COMPLETED 10:18 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
					Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone).			
	Grab	TP4.1			1.5			
					Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.			
5	Grab	TP4.2						
			CL					
10								
					14.0			
					Exploration completed at 14 feet.			
15								

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

TEST PIT NUMBER: TP-5

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision

CLIENT Allied Development

PROJECT NO. AlliedDev-1-01-1

PROJECT CITY, STATE Camas, Washington

CONTRACTOR L&S Contractors

DATE COMPLETED 04/29/2025

EQUIPMENT CAT 307E2

TIME STARTED 10:21 AM

LOGGED BY S. Chandra

TIME COMPLETED 11:30 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
				▩	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5				
	SH	TP5.1	CL	▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, low to medium plasticity, sand is fine.	2.5	24	86	Infiltration test at 2 feet.
5				▨					
	Grab	TP5.2		▨					
10				▨					
				▨	14.0				
					Exploration completed at 14 feet.				
15									

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

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Columbia West
Engineering, Inc

TEST PIT NUMBER: TP-6

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 10:52 AM
LOGGED BY S. Chandra
TIME COMPLETED 11:15 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
				≋	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5	1.0		
			CL	▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.			
	Grab	TP6.1		▨			27	
5				▨				
	Grab	TP6.2		▨				
10				▨	With cobbles, cobbles are subrounded and up to 12 inches in diameter at 10 feet.			Very stiff, difficult excavation at 10 feet.
15				▨	15.0			

Exploration completed at 15 feet.

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West
Engineering, Inc

TEST PIT NUMBER: TP-7

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 11:40 AM
LOGGED BY S. Chandra
TIME COMPLETED 12:05 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
				▩	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5			
	Grab	TP7.1	CL	▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.		28	
	Grab	TP7.2						
5								
10								
	Grab	TP7.3						
					14.0			
					Exploration completed at 14 feet.			
15								

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

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Columbia West Engineering, Inc

TEST PIT NUMBER: TP-8

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 12:07 PM
LOGGED BY S. Chandra
TIME COMPLETED 12:24 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-PI)	FINES (%)	REMARKS
				▩	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5					
	SH	TP8.1	CL	▨	Medium stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity. With cobbles and boulders, cobbles are subrounded and up to 12 inches in diameter, boulders are subrounded and up to 36 inches in diameter at 4 feet. Wet at 5.5 feet. 5.5		20	32-20-12	86	Infiltration test at 2 feet.
5	Grab	TP8.2								
					Exploration terminated at 5.5 feet due to refusal on boulders.					
10										
15										

GROUNDWATER: Perched at 5.5 feet

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

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Columbia West
Engineering, Inc

TEST PIT NUMBER: TP-9

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 12:26 PM
LOGGED BY S. Chandra
TIME COMPLETED 12:40 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
				≋	Medium stiff, brown sandy CLAY, trace organics, moist, low plasticity (14 inches of topsoil, 4-inch-thick root zone). 1.2				
			CL	▨	Medium stiff to stiff, brown with orange mottled CLAY with sand, moist, medium plasticity, sand is fine.				
	Grab	TP9.1				3	24	82	
5	Grab	TP9.1			With cobbles and boulders, cobbles are subrounded and up to 12 inches in diameter, boulders are subrounded and up to 24 inches in diameter at 4 feet. 5.5				
					Exploration terminated at 5.5 feet due to refusal on basalt.				
10									
15									

GROUNDWATER: Not observed

CAVING: Not observed

Exhibit 9 SUB25-1009

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TEST PIT NUMBER: TP-10

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision

CLIENT Allied Development

PROJECT NO. AlliedDev-1-01-1

PROJECT CITY, STATE Camas, Washington

CONTRACTOR L&S Contractors

DATE COMPLETED 04/29/2025

EQUIPMENT CAT 307E2

TIME STARTED 12:46 PM

LOGGED BY S. Chandra

TIME COMPLETED 1:05 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
	Grab	TP10.1			Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5			
	Grab	TP10.2	CL	▨	Medium stiff to stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity.		29	
5								
					With gravel, cobbles, and boulders, gravel is rounded, cobbles are rounded and up to 12 inches in diameter, boulders are rounded and up to 24 inches in diameter at 6 feet. 7.0			
					Exploration terminated at 7 feet due to refusal on basalt.			
10								
15								

GROUNDWATER: Not observed

CAVING: Not observed

BoreDM Template: Test Pit Template - New

Exhibit 9 SUB25-1009

TEST PIT NUMBER: TP-11

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision
CLIENT Allied Development
PROJECT NO. AlliedDev-1-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 04/29/2025
EQUIPMENT CAT 307E2
TIME STARTED 1:10 PM
LOGGED BY S. Chandra
TIME COMPLETED 1:58 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-PI)	FINES (%)	REMARKS
	Grab	TP11.1		▩	Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5					
	SH	TP11.2	CL	▨	Medium stiff to stiff, brown with orange mottled CLAY, minor sand, moist, low plasticity.		26	31-23-8	87	Infiltration test at 2 feet.
	Grab	TP11.3		▨						
5				▨						
	Grab	TP11.4		▨						
10				▨	Very stiff at 10 feet.					
				▨	12.0					
15					Exploration completed at 12 feet.					

GROUNDWATER: Not observed

CAVING: Not observed

Exhibit 9 SUB25-1009

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West
Engineering, Inc

TEST PIT NUMBER: TP-12

Page 1 of 1

PROJECT NAME NW 18th Avenue Subdivision

CLIENT Allied Development

PROJECT NO. AlliedDev-1-01-1

PROJECT CITY, STATE Camas, Washington

CONTRACTOR L&S Contractors

DATE COMPLETED 04/29/2025

EQUIPMENT CAT 307E2

TIME STARTED 2:00 PM

LOGGED BY S. Chandra

TIME COMPLETED 2:15 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
					Medium stiff, dark brown sandy CLAY, trace organics, moist, medium plasticity (18-inch-thick tilled zone, 4-inch-thick root zone). 1.5			
			CL		Medium stiff to stiff, brown with orange mottled CLAY, minor sand, moist, medium plasticity, sand is fine.			
5	Grab	TP12.1			With cobbles and boulders, cobbles are rounded and up to 12 inches in diameter, boulders are rounded and up to 24 inches in diameter at 5.5 feet. 5.5			
10								
15								

Exploration terminated at 5.5 feet due to refusal.

GROUNDWATER: Not observed

CAVING: Not observed

Exhibit 9 SUB25-1009

APPENDIX B

APPENDIX B
LABORATORY TESTING

GENERAL

Laboratory testing was conducted on select soil samples to confirm field classifications and determine the index engineering properties. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications. The locations of the tested samples are shown on the exploration logs. Descriptions of the tests are presented below, and results of the testing are presented in this appendix.

MOISTURE CONTENT

The natural moisture content of select soil samples was determined in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to dry soil in a test sample and is expressed as a percentage.

PARTICLE-SIZE ANALYSIS

Particle-size analysis was completed on select soil samples in general accordance with ASTM D1140 (P200). This test is a quantitative determination of the percent passing the U.S. Standard No. 200 sieve by dry weight.

ATTERBERG LIMITS TESTING

Atterberg limits (plastic and liquid limits) testing was performed on select soil samples in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits.

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MOISTURE CONTENT, PERCENT PASSING NO. 200 SIEVE BY WASHING

PROJECT
NW 18th Avenue Subdivision
4511 NW 18th Avenue
Camas, Washington

CLIENT
Allied Development
16430 N Scottsdale Road, Suite 210
Scottsdale, AZ 85254

PROJECT NO.: AlliedDev-1-01-1

ISSUE DATE: 05/21/25

PAGE: 1 of 1

DATE SAMPLED: 04/29/25

SAMPLED BY: S. Chandra

LABORATORY TEST DATA

TEST PROCEDURE
ASTM D2216 - Method A, ASTM D1140

LAB ID	CONTAINER MASS (g)	MOIST MASS + CONTAINER (g)	DRY MASS + CONTAINER (g)	AFTER WASH DRY MASS + CONTAINER (g)	FIELD ID	SAMPLE DEPTH (ft)	PERCENT MOISTURE CONTENT	PERCENT PASSING NO. 200 SIEVE
S25-1005	579.10	842.98	781.03	600.63	TP1.1	5	31%	89%
S25-1006	86.86	273.12	230.87	-	TP1.2	12	29%	-
S25-1007	86.63	265.27	227.54	-	TP2.2	3	27%	-
S25-1008	86.51	283.20	239.17	-	TP3.1	4	29%	-
S25-1009	541.75	852.67	782.05	565.74	TP3.2	7	29%	90%
S25-1010	561.52	863.57	805.51	595.62	TP5.1	2	24%	86%
S25-1011	87.29	313.81	265.73	-	TP6.1	3	27%	-
S25-1012	87.75	297.67	251.72	-	TP7.1	2	28%	-
S25-1013	574.83	854.33	807.67	608.39	TP8.1	2	20%	86%
S25-1014	547.98	822.00	769.65	588.87	TP9.1	3	24%	82%
S25-1015	87.15	377.78	311.97	-	TP10.2	4	29%	-
S25-1016	550.38	884.13	816.10	585.65	TP11.2	2	26%	87%

NOTES:

DATE TESTED: 05/15/25

TESTED BY: M. Scherette

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	
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		ISSUE DATE 05/21/25	PAGE 1 of 1
		LAB ID S25-1005	FIELD ID TP1.1
		DATE SAMPLED 04/29/25	SAMPLED BY S. Chandra

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
CLAY	Test Pit TP-1 depth = 5 feet	no data provided

LABORATORY TEST DATA

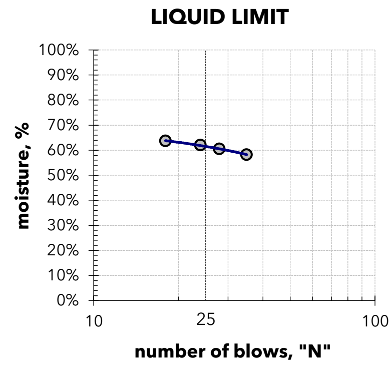
LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318 - Method A

ATTERBERG LIMITS

liquid limit = 62
plastic limit = 25
plasticity index = 37

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	32.15	32.13	31.74	33.38
dry soil + pan weight, g =	27.84	27.76	27.50	28.48
pan weight, g =	20.43	20.54	20.67	20.78
N (blows) =	35	28	24	18
moisture, % =	58.2 %	60.5 %	62.1 %	63.6 %

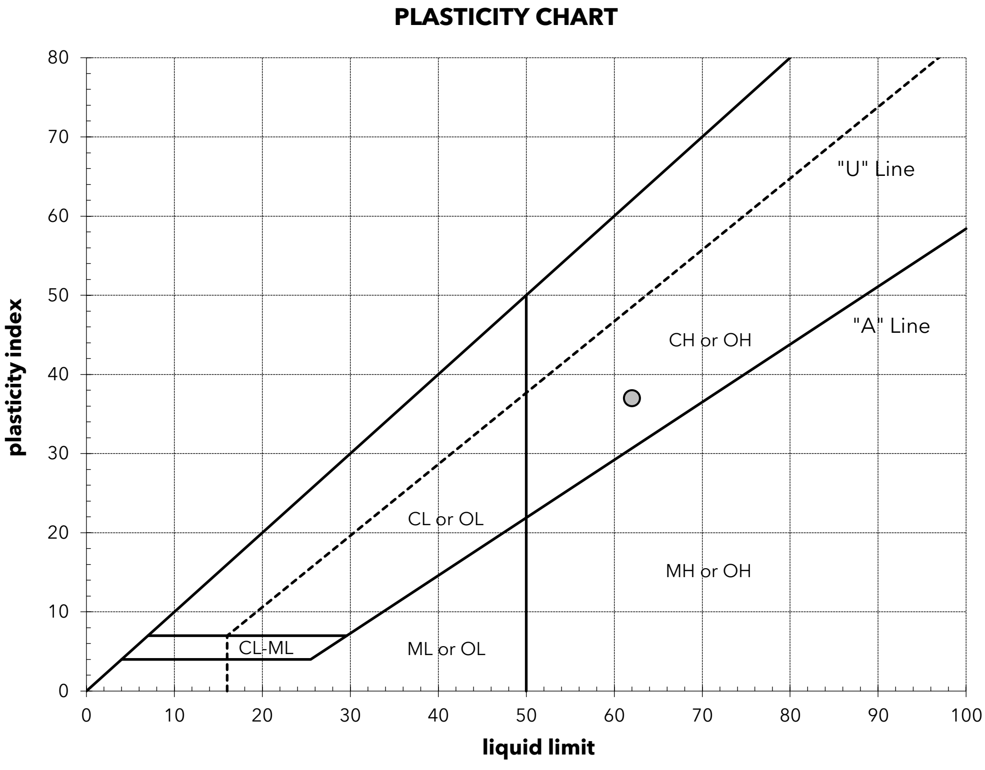


SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.63	27.61		
dry soil + pan weight, g =	26.28	26.16		
pan weight, g =	20.93	20.42		
moisture, % =	25.2 %	25.3 %		



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = 31%

DATE TESTED	TESTED BY
05/19/25	M. Scherette

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	
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		ISSUE DATE 05/21/25	PAGE 1 of 1
		LAB ID S25-1013	FIELD ID TP8.1
		DATE SAMPLED 04/29/25	SAMPLED BY S. Chandra

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
CLAY	Test Pit TP-8 depth = 2 feet	no data provided

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318 - Method A

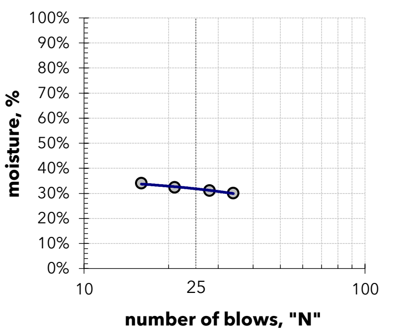
ATTERBERG LIMITS

liquid limit = 32
plastic limit = 20
plasticity index = 12

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	31.49	31.41	33.51	30.55
dry soil + pan weight, g =	29.02	28.81	30.44	28.13
pan weight, g =	20.82	20.43	20.96	21.01
N (blows) =	34	28	21	16
moisture, % =	30.1 %	31.0 %	32.4 %	34.0 %

LIQUID LIMIT



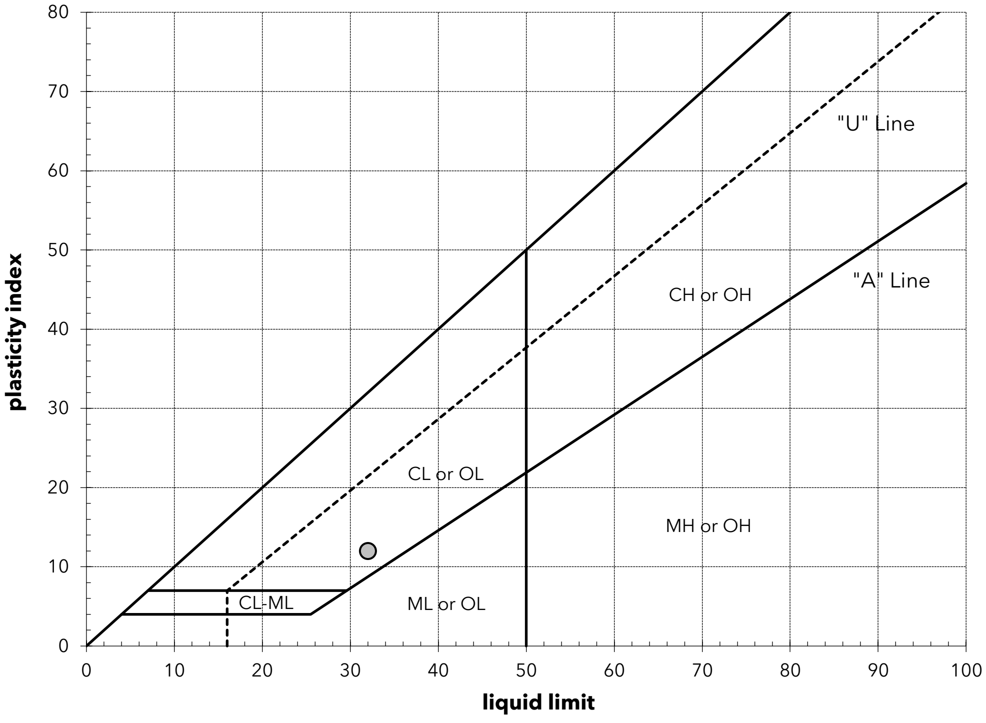
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.24	27.78		
dry soil + pan weight, g =	26.17	26.65		
pan weight, g =	20.87	21.02		
moisture, % =	20.2 %	20.1 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = 20%

DATE TESTED	TESTED BY
05/16/25	G. Hausmann

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	
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		ISSUE DATE 05/21/25	PAGE 1 of 1
		LAB ID S25-1016	FIELD ID TP11.2
		DATE SAMPLED 04/29/25	SAMPLED BY S. Chandra

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
CLAY	Test Pit TP-11 depth = 2 feet	no data provided

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318 - Method A

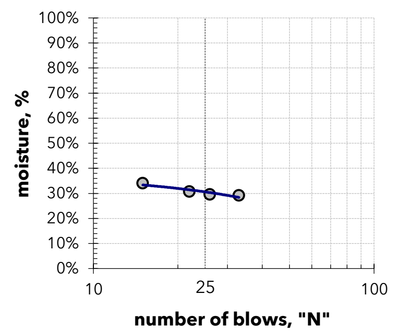
ATTERBERG LIMITS

liquid limit = 31
plastic limit = 23
plasticity index = 8

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	30.63	35.01	31.06	32.49
dry soil + pan weight, g =	28.33	31.77	28.70	29.56
pan weight, g =	20.43	20.81	21.02	20.96
N (blows) =	33	26	22	15
moisture, % =	29.1 %	29.6 %	30.7 %	34.1 %

LIQUID LIMIT



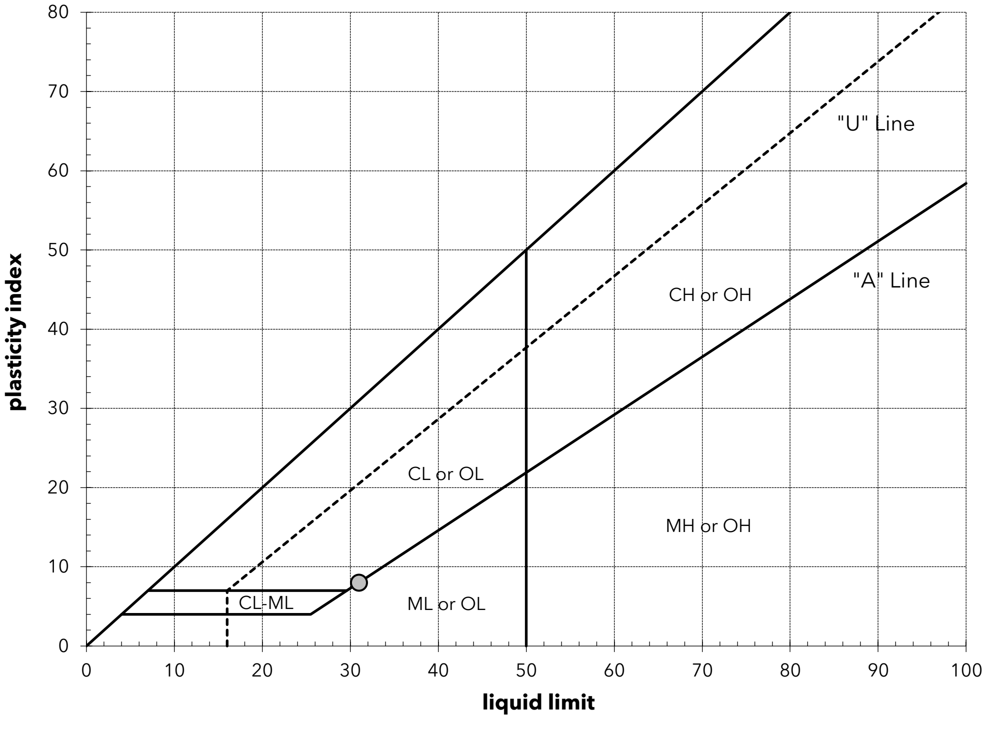
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.99	29.48		
dry soil + pan weight, g =	27.46	27.90		
pan weight, g =	20.87	21.02		
moisture, % =	23.2 %	23.0 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = 26%

DATE TESTED	TESTED BY
05/19/25	G. Hausmann

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APPENDIX C

APPENDIX C
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction Observation

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled Report Ownership. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

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Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.