Land Surveying Civil Engineering Land Use Planning Landscape Architecture

Exhibit 14 CUP22-02

CITY OF CAMAS

PRELIMINARY DRAINAGE ANALYSIS

CAMAS CROSSING

MAJ DEVELOPMENT

JOB # 10320.01.01

REVIEWED BY: PETER TUCK, P.E.

DESIGNED BY: SEAN HENGCHUA, P.E.

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CITY OF CAMAS

Preliminary Drainage Analysis

Camas Crossing

MAJ Development

Job #A10320.01.01

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31817
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February 8, 2022

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REVISION	BY	DATE	COMMENTS

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Section A – Project Overview

1. **Describe the site location.**

   The proposed Camas Crossing Project site is approximately 2.33 acres in size and fronts two streets: NW Brady Road runs in a North-South orientation to the East of the property; and NW 16th Street runs in an East-West orientation along the South of the Property. The development occupies parcel 127357-000.

2. **Describe the topography, natural drainage patterns, vegetative ground cover, and presence of critical areas (CMC Title 16). Critical areas that receive runoff from the site shall be described to a minimum of ¼ mile away from the site boundary.**

   The internal site slopes from the southwest to the northeast with grades ranging from 0.5% to 10%. The site is a vacant, forested lot. An existing riprap drainage ditch exists at the northeast corner of the property. Site runoff adjacent to the ROW flows to the East, then North along NW 16th Avenue & NW Brady Street. A developed commercial landscaping lot is located to the west of the property, with a rock retaining wall and chain link fence lining the property line. A vacant lot is located North of the property. Storm runoff from the site mostly drains to NW Brady Road. No critical areas are located within the site. Critical areas exist within ¼ mile offsite to the North and South, however they do not receive runoff from the site. Since the runoff from the site will be reduced to match a forested historical state, there should be no impact from the project.

3. **Identify and discuss existing onsite stormwater systems and their functions**

   The existing site is a vacant vegetated lot. There are no existing stormwater systems onsite.

4. **Identify and discuss site parameters that influence stormwater system design.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Onsite Geotechnical testing by Hart Crowser shows the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for WWHM calculations due to the lack of any infiltration potential. See geotechnical report in Appendix G.

5. **Describe drainage to and from adjacent properties.**

   The site slopes to the East and North. There are existing roads to the East and South of the site. Runoff from these areas is routed to existing storm systems that bypass the site. These existing streets have existing underground stormwater infrastructure. Runoff from the site discharges to the storm ditch adjacent to Brady Road. Runoff routes in developed condition will be the same as predeveloped routes.

6. **Describe adjacent areas, including streams, lakes, wetland areas, residential areas, and roads that might be affected by the construction project.**

   Existing roads border the East and South property lines of the parcel. A commercial landscape lot borders the West property line. A vacant vegetated lot borders the North Property line. An elementary school is located southwest of the site. There are no streams or wetlands adjacent to the site.

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7. Generally describe proposed site construction, size of improvements, and proposed methods of mitigating stormwater runoff quantity and quality impacts.

The proposed development is approximately 2.33 acres in size and includes the construction of three commercial buildings, a fuel island, underground fuel tanks, an underground stormwater facility, retaining walls, onsite parking, sidewalk and landscaping. Offsite construction includes frontage improvements for NW 16th Avenue along the south property line. A driveway, and minor sidewalk improvements are proposed along NW Brady Road. Improvements include 0.333 acres of roof, 0.152 acres of sidewalk, 1.38 acres of pavement, 0.029 acres of driveways and 0.436 acres of landscaping.

Runoff from all pavement will be collected and routed to underground treatment systems meeting the phosphorous and enhanced treatment standards prior to an underground detention system. All runoff from the development except for the NE driveway area will be routed to an underground detention system. The runoff from the NE driveway will be released without detention but will mitigated by over detention in the onsite system, Overall discharge rates for the project will meet the required forested pre-developed standard. After detention, runoff will be released to the public drainage system on NW Brady Road in the northeast corner of the site.

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Section B – Minimum Requirements

1. Describe the land-disturbing activity and document the applicable minimum requirements for the project site. Include the following information in table form: a) amount of existing impervious surface, b) new impervious surface, c) replaced impervious surface, d) native vegetation converted to lawn or landscaping, e) native vegetation converted to pasture, and f) total amount of land-disturbing activity in table format.

There is only one TDA for the project. The site is divided into two Catchment Areas: Catchment Area 1 consists of:

- NW 16th Avenue Frontage Improvements
- All site Area except NE Driveway Area

Catchment Area 2 consists of the NE driveway area and adjacent landscape area

The site is vacant and consists primarily of approximately 2.33 acres of steep forested surface cover with trees and shrub vegetation along the perimeters of the property. The proposed development includes the construction of 0.33 acres of new roof, 1.26 acres of new asphalt pavement, 0.13 acres of new concrete surfaces, 0.15 acres of new concrete sidewalks, and 0.03 acres of new concrete driveway that are all classified as “New Impervious Surface.” The proposed development also includes 0.44 acres of landscaped areas.

Based on Fig. 1.1 and 1.2 from the City of Camas Stormwater Manual (See Appendix B), the project must meet Minimum Requirements 1 to 9.

The following table summarizes the proposed site changes:

Catchment Area	
Existing Impervious Surface (Acres)	0.00
New Impervious Surface (Acres)	1.89
Replaced Impervious Surface (Acres)	0.00
Existing Impervious Surface to Remain (Acres)	0.00
Native vegetation converted to lawn or landscaping (Acres)	0.44
Native vegetation converted to pasture (Acres)	0.00
Total land-disturbing activity (Acres)	2.33

Table B1: Site Improvement Summary

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2. Provide a statement that confirms the minimum requirements that will apply to the development activity. For land-disturbing activities where minimum requirements 1 through 10 must be met include the following: a) Provide the amount of effective impervious area in each TDA, and document through an approved continuous runoff simulation model the increase in the 100-year flood frequency from pre-developed to developed conditions for each TDA, b) list the TDAs that must meet the runoff control requirements listed in Minimum Requirement 6, c) list the TDAs that must meet the flow control requirements listed in Minimum Requirement 7, and d) list the TDAs that must meet the wetlands protection requirements listed in Minimum Requirement 8.

The 1.41 acres of new asphalt & concrete pavement and 0.15 acres of new driveway are classified as “Effective Pollution Generating Impervious Surface” (PGIS). The 0.44 acres of landscaping is classified as “Effective Pollution Generating Pervious Surface” (PGPS). The following table summarizes the additional characteristics that determine compliance with Minimum Requirements 6, 7, and 8:

Catchment Area	TDA 1
Effective Pollution Generating Impervious Surface (PGIS) (Acres)	1.41
Effective Pollution Generating Pervious Surface (PGPS) (Acres)	0.44
Does the Large Water Body Exemption apply to this project?	No
Does the 100-year runoff increase by more than 0.1 cfs?	Yes
Does the project discharge directly or indirectly (through a conveyance system) into a wetland?	No

Table B2: Additional Compliance Characteristics

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Section C – Soils Evaluation

1. **Describe the site's suitability for stormwater infiltration for flow control, runoff treatment, and low impact development (LID) measures.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Onsite Geotechnical testing by Hart Crowser shows the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for WWHM calculations due to the lack of any infiltration potential. See geotechnical report in Appendix G.

   Based on the low to non-existent infiltration onsite, the site is not suitable to use infiltration for flow control or using Low Impact Development (LID) measures.

2. **Identify water table elevations, flow directions (where available), and data on seasonal water table fluctuations with minimum and maximum water table elevations where these may affect stormwater facilities.**

   Since infiltration is not being used on the site, depth to groundwater is not applicable

3. **Identify and describe soil parameters and design methods for use in hydrologic and hydraulic design of proposed facilities.**
   The Soil Survey of Clark County by the Soil Conservation Service shows the soil onsite is Powell Silt Loam (PoB). (See Vicinity Maps Section and Appendix A of this report for the Soils Map). The soil properties are as follows:

   Powell Silt Loam (PoB)
   Classification: Hydrologic Group D / SG4
   Permeability: 0-24 in. depth, < 0.06 in/hr

Curve Numbers:	Meadow/Pasture	CN=89
	Grass/Landscape:	CN=90
	Pavement/Sidewalk:	CN=98
	Roof:	CN=98

4. **Report findings of testing and analysis used to determine the infiltration rate.**
   Due to the poor permeability of the existing soil, infiltration is not being proposed for this development.

5. **Where unstable or complex soil conditions exist that may significantly affect the design of stormwater facilities, the responsible official may require a preliminary soils report that addresses stormwater design considerations arising from soil conditions. The preliminary soils report shall be prepared by a registered professional engineer proficient in geotechnical investigation and engineering or a registered soil scientist. The preliminary soils report shall include a soils map developed using the criteria set in the *NRCS National Soil Survey Handbook* (NRCS 2007) and the *SCS Soil Survey Manual* (SCS 1993), at a minimum scale of 1:5,000 (12.7 inch/mile).**

   Geotechnical site investigations were completed by Hart Crowser. Their finding and associated report are in Appendix G.

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Section D – Source Control

1. **If the development activity includes any of the activities listed in Section 2.2 of Volume IV of the *Stormwater Management Manual for Western Washington* (SMMWW), identify the source control BMPs to be used with the land-disturbing activity.**

   The following Source Control BMPs apply to this project:

- BMPs for Landscaping and Lawn/Vegetation Management
  - Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
  - Do not dispose of collected vegetation into waterways or storm drainage systems.

- BMPs for Maintenance of Stormwater Drainage and Treatment Systems
  - Promptly repair any deterioration threatening the structural integrity of the facilities. These include replacement of clean-out gates and catch basin lids.
  - Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.
  - Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to sanitary sewer if approved by the sewer authority, or truck to a local or state government approved disposal site.
  - Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to invert of lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe.
  - Clean woody debris in catch basins as frequently as needed to ensure proper operation of the catch basin.
  - Post warning signs; “Dump No Waste – Drains to Ground Water,” “Streams,” “Lakes,” or emboss on or adjacent to all storm drain inlets where practical.
  - Disposal of sediments and liquids must comply with “Recommendations for Management of Street Wastes” described in Appendix IV-G of Volume IV of the Stormwater Manual.

- BMPs for Fueling at Dedicated Stations & Car washes
  - Prepare an emergency spill response and cleanup plan (Per BMPs for Spills of Oil and Hazardous Substances) and have designated trained person(s) available either on site or on call at all times to promptly and properly implement that plan and immediately cleanup all spills. Keep suitable cleanup materials, such as dry adsorbent materials, on site to allow prompt cleanup of a spill.
  - Train employees on the proper use of fuel dispensers. Post signs in accordance with the Uniform Fire Code (UFC). Post “No Topping Off” signs (topping off gas tanks causes spillage and vents gas fumes to the air). Make sure that the automatic shutoff on the fuel nozzle is functioning properly.
  - The person conducting the fuel transfer must be present at the fueling pump during fuel transfer, particularly at unattended or self-serve stations.
  - Keep drained oil filters in a suitable container or drum.

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- BMPs for Washing and Steam Cleaning Vehicles/Equipment/Building Structures
  - Vehicle/ washing conducted in a building constructed specifically for washing vehicles shall drain to a sanitary sewer.
  - Collect the washwater from building structures and convey it to appropriate treatment such as a sanitary system if it contains oils, soaps, or detergents, where feasible. If the washwater does not contain oils, soaps, or detergents then it could drain to soils that have sufficient natural attenuation capacity for dust and sediment.

- BMPs for Spills of Oil and Hazardous Substances
  - Prepare an Emergency Spill Control Plan(SCP), which includes:
    - A description of the facility including the owner's name and address;
    - The nature of the activity at the facility;
    - A site plan showing the location of storage areas for chemicals, the locations of storm drains, the areas draining to them, and the location and description of any devices to stop spills from leaving the site such as positive control valves;
    - Cleanup procedures;
    - Notification procedures to be used in the event of a spill, such as notifying key personnel. Agencies such as Ecology, local fire department, Washington State Patrol, and the local Sewer Authority, shall be notified;
    - The name of the designated person with overall spill cleanup and notification responsibility;
  - Train key personnel in the implementation of the Emergency SCP. Prepare a summary of the plan and post it at appropriate points in the building, identifying the spill cleanup coordinators, location of cleanup kits, and phone numbers of regulatory agencies to be contacted in the event of a spill;
  - Update the SCP regularly;
  - Immediately notify Ecology and the local Sewer Authority if a spill may reach sanitary or storm sewers, ground water, or surface water in accordance with federal and Ecology spill reporting requirements;
  - Immediately clean up spills. Do not use emulsifiers unless an appropriate disposal method for the resulting oily wastewater is implemented. Absorbent material shall not be washed down a floor drain or storm sewer;
  - Locate emergency spill containment and cleanup kit(s) in high potential spill areas. The contents of the kit shall be appropriate for the type and quantities of chemical liquids stored at the factory.

- BMPs for Roof/Building Drains at Commercial Buildings
  - If leachates and/or emissions from buildings are suspected sources of stormwater pollutants, then sample and analyze the stormwater drainage from the building.
  - If a roof/building stormwater pollutant source is identified, implement appropriate source control measures such as air pollution control equipment, selection of materials, operational changes, material recycling, process changes, etc.

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Section E – Onsite Stormwater Management BMPs

1. **On the preliminary development plan or other maps, show the site areas where on-site stormwater management BMPs will be effectively implemented. The plan must show the areas of retained native vegetation and required flow lengths and vegetated flow paths, as required for proper implementation of each onsite stormwater BMP. Arrows must show the stormwater flow path to each BMP.**

   The runoff from the paved areas of the site will be treated using one of two Biopod Treatment Units. All runoff from the site will be mitigated for quantity control through the use of an underground detention system. The location of all BMP's is shown on the Preliminary Plan in Appendix F.

2. **Identify and describe geotechnical studies or other information used to complete the analysis and design of each on-site stormwater BMP.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Onsite Geotechnical testing by Hart Crowser shows the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for WWHM calculations due to the lack of any infiltration potential. See geotechnical report in Appendix G.

3. **Identify the criteria (and their source) used to complete analyses for each on-site stormwater BMP.**

   The Biopod Treatment Units have been designed to treatment the water quality storm as determined by the WWHM continuous hydrological model. The detention facility was also sized using the WWHM model with the site in a forested state for the pre-developed condition. These standards are in accordance with City of Camas Stormwater Design Manual.

4. **Describe how design criteria will be met for each proposed on-site stormwater management BMP.**

   Biopod Treatment Units are being used to provide the required treatment levels for this project. Detention will be by underground vault located within the site.

5. **Describe any on-site application of LID measures planned for the project. Provide a plan that shows the proposed location and approximate size of each LID facility.**

   Due to very low to non-existent infiltration rates and saturated soil conditions, infiltration LID measures are not applicable to this project.

6. **Identify and describe any assumptions used to complete the analysis.**

   The detention volume in each storage pipe was assumed to be dry at the beginning of the modeled storm event.

7. **Describe site suitability, including hydrologic soil groups, slopes, areas of native vegetation, and adequate location of each BMP.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Onsite Geotechnical testing by Hart Crowser shows the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for WWHM calculations due to the lack of any infiltration potential. See geotechnical report in Appendix G.

The proposed stormwater facilities have been located within a central area of the site for the most efficient drainage collection, treatment & conveyance for the development.

Section F – Runoff Treatment Analysis and Design

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1. **Document the level of treatment required (basic, enhanced, phosphorus, oil/water separation) based on procedures in Vol. V, Chapter 2 of the SMMWW.**

   The development is located within the Dwyer Creek sub-watershed and Lacamas Creek Watershed area of the City of Camas therefore requires phosphorous treatment. In addition, the project also requires an enhanced level of treatment. The proposed improvements include a car wash and fueling island. These proposed uses shall require the installation of oil/water separators. An oil/water separator will be provided as part of the carwash system. For the fueling canopy, a dead-end sump will be installed.

2. **Provide background and description to support the selection of the treatment BMP being proposed. Include an analysis of initial implementation costs and long-term maintenance costs.**

   Due to the very low infiltration rates and saturated soil conditions, it was determined that Combined Underground Detention and Biopod treatment vaults would be the most viable treatment option for the site. A cost analysis has not been prepared but could be provided if deemed to be necessary.

3. **Identify geotechnical or soils studies or other information used to complete the analysis and design.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Geotechnical testing on similar soils near the project show the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for wwhm calculations due to the lack of any infiltration potential.

   Based on the low to non-existent infiltration onsite, the site is not suitable to use infiltration for flow control or using Low Impact Development (LID) measures.

4. **Identify the BMPs used in the design, and their sources.**

   Biopod Treatment Vaults for each catchment area is proposed to meet treatment requirements.

5. **Summarize the results of the runoff treatment design and describe how the proposed design meets the requirements of CMC Chapter 14.02 and the Stormwater Manual.**

   Table F1 below provides treatment sizes for the Biopod vaults for each of the catchment areas.

Treatment System	Required WQ Flowrate	Biopod Sizing	Allowable WQ Flowrate
Catchment 1	0.175 cfs	4ft x 16ft vault	0.217 cfs
Catchment 2	0.011 cfs	4ft x 4ft Vault	0.057 cfs

Table F1: Water Quality Flow Rate and Cartridge Filter Selection

Refer to Appendix C for screen shots of the WWHM model.

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6. **Provide a table that lists the amount of Pollution-Generating Pervious Surfaces (PGPS) and Pollution-Generating Impervious Surfaces (PGIS) for each Threshold Discharge Area (TDA).**

   The following table lists the areas of Pollution-Generating Pervious Surfaces (PGPS) and Pollution-Generating Impervious Surfaces (PGIS) for each Threshold Discharge Area (TDA):

Catchment Area	TDA 1
Effective Pollution Generating Impervious Surface (PGIS) (Acres)	1.56
Effective Pollution Generating Pervious Surface (PGPS) (Acres)	0.44

Table F2: Effective Pollution Generating Surface Summary

Section G – Flow Control Analysis and Design

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1. **Identify the site's suitability for stormwater infiltration for flow control, including tested infiltration rates, logs of soil borings, and other information.**

   The onsite soils are mapped as Powell Silt Loam (PoB). Onsite Geotechnical testing by Hart Crowser shows the soil as a lean clay to sandy lean clay with infiltrations rates less than 0.01"/hr. Based on these characteristics, the soil is considered as an SG4 for WWHM calculations due to the lack of any infiltration potential. See geotechnical report in Appendix G.

   Based on the low to non-existent infiltration onsite, the site is not suitable to use infiltration for flow control or using Low Impact Development (LID) measures.

2. **Identify and describe geotechnical or other studies used to complete the analysis and design.**

   Hart Crowser completed a onsite geotechnical analysis. The findings of the exploration and recommendations can be found in the Geotechnical report in Appendix G.

3. **If infiltration cannot be utilized for flow control, provide the following additional information:**

   a. **Identify areas where flow control credits can be obtained for dispersion, LID, or other measures, per the requirements in the Stormwater Manual.**

      Due to the saturated soil conditions and non-existent infiltration rates, LID measures are not feasible for this project.

   b. **Provide the approximate sizing and location of flow control facilities for each TDA, per Volume III of the Stormwater Manual.**

      There is one detention facility on the site located in the central portion of the site within the parking area.

      The stormwater facility consists of 468ft of 4ft diameter pipe to provide the detention volume followed by a control manhole used to release required flow rates. Since the driveway area in the NE corner of the site cannot be routed to the detention system, the system was oversized to mitigate the directly released runoff. Overall, for the site, the discharge rates meet the forested pre-existing condition.

   c. **Identify the criteria (and their sources) used to complete the analysis, including pre-developed and post-developed land use characteristics.**

      The facility has been designed to provide detention to match the forested predeveloped condition using the wwhm model in accordance with the requirements of the City of Camas Stormwater Design Manual.

      The pre-developed condition was assumed to be forested. The post developed condition included the area of new road, sidewalk, roof, driveway, and lawn. Summary of the pre-developed and developed catchment data are shown in the tables below:

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Pre-developed catchment areas:

Catchment Area	Storm Facility	Description	Area (acres)
Existing	Tract 'A'	SG4, Forest, Moderate	2.33

Table G1: Hydrologic parameters used in pre-developed catchment analysis

Developed catchment areas:

Catchment	Storm Facility	Description	Area (acres)
Area 1	Tract 'A'	Roof Flat Pavement Flat Sidewalks Flat SG4, Lawn, Flat	0.333 1.334 0.152 0.425
Area 2	Tract 'A'	Driveways Steep SG4, Lawn, Steep	0.079 0.011

Table G2: Hydrologic parameters used in developed catchment analysis

4. **For sites considered to be historical prairie, submit a project site report prepared by a wetland scientist or horticulturist experienced in identifying soils, plans, and other evidence associated with historic prairies to demonstrate the existence of historic prairie on the project site. Areas within Camas that were historically prairie include Fern and Lacamas prairies. Contact City staff for a map showing potential prairie locations.**

   This section does not apply.

5. **Complete a hydrologic analysis for existing and developed site conditions, in accordance with the requirements of Chapter 4 of this manual and Chapter 2, Volume III of the Stormwater Manual, using an approved continuous runoff simulation model. Compute existing and developed flow duration for all subbasins. Provide an output table from the continuous flow model.**

   A summary of the pre-developed and developed flows for the Detention Facility are shown in the table below:

Return Period	Pre-developed Flow (cfs)	Developed Flow (cfs)
2-Year	0.701	0.434
10-Year	1.267	0.885
100-Year	1.681	1.842

Table G3: Pre-developed and developed flows for Tract 'A' Facility.

A summary of the developed flows and stormwater facility storage volumes and stage elevations for the Tract 'A' Facility from the WWHM2012 calculations is shown in the table below:

Return Period	Developed Flow (cfs)	Detention Volume (ac-ft)	Detention Stage Elevation (ft)
2-Year	0.434	0.123	3.36
10-Year	0.885	0.135	3.69
100-Year	1.842	0.149	4.06

Table G4: Developed flows and storage volumes / stage elevations for Detention Facility

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From the tables above, it can be seen that the proposed design meets the flow-control requirements, as specified in the City of Camas Stormwater Design Manual. See WWHM report in Appendix C.

6. **Include and reference all hydrologic computations, equations, graphs, and any other aids necessary to clearly show the methodology and results.**

   Refer to Appendix C for a detailed WWHM2012 hydraulic analysis of the pre-developed and developed site during the 2, 10, and 100-yr. continuous storm events.

7. **Include all maps, exhibits, graphics, and references used to determine existing and developed site hydrology.**

   Refer to the Catchment Plans in Appendix F for catchment area locations and the specific locations of the stormwater facilities.

   Refer to the Maps section of this report.

Section H – Wetlands Protection

No wetlands are present on the property.

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Map Symbol	**Soil Name**	**Hydrologic Group**	**Clark County WWHM Soils Group**
NbA	NEWBERG	B	2
NbB	NEWBERG	B	2
OdB	ODNE	D	4
OeD	OLEQUA	B	3
OeE	OLEQUA	B	3
OeF	OLEQUA	B	3
OhD	OLEQUA VARIANT	C	4
OhF	OLEQUA VARIANT	C	4
OIB	OLYMPIC	B	3
OID	OLYMPIC	B	3
OIE	OLYMPIC	B	3
OIF	OLYMPIC	B	3
OmE	OLYMPIC	B	3
OmF	OLYMPIC	B	3
OpC	OLYMPIC VARIANT	C	3
OpE	OLYMPIC VARIANT	C	3
OpG	OLYMPIC VARIANT	C	3
OrC	OLYMPIC VARIANT	C	3
PhB	PILCHUCK	C	2
PoB	POWELL	C	3
PoD	POWELL	C	3
PoE	POWELL	C	3
PuA	PUYALLUP	B	2
Ra	RIVERWASH	D	N/A
Rc	RIVERWASH	D	N/A
Rk	ROCK LAND	D	N/A
Ro	ROUGH BROKEN LAND	A	1
SaC	SALKUM	B	2
SIB	SARA	D	4
SID	SARA	D	4
SIF	SARA	D	4
SmA	SAUVIE	B	3
SmB	SAUVIE	B	3
SnA	SAUVIE	D	3
SpB	SAUVIE	B	3

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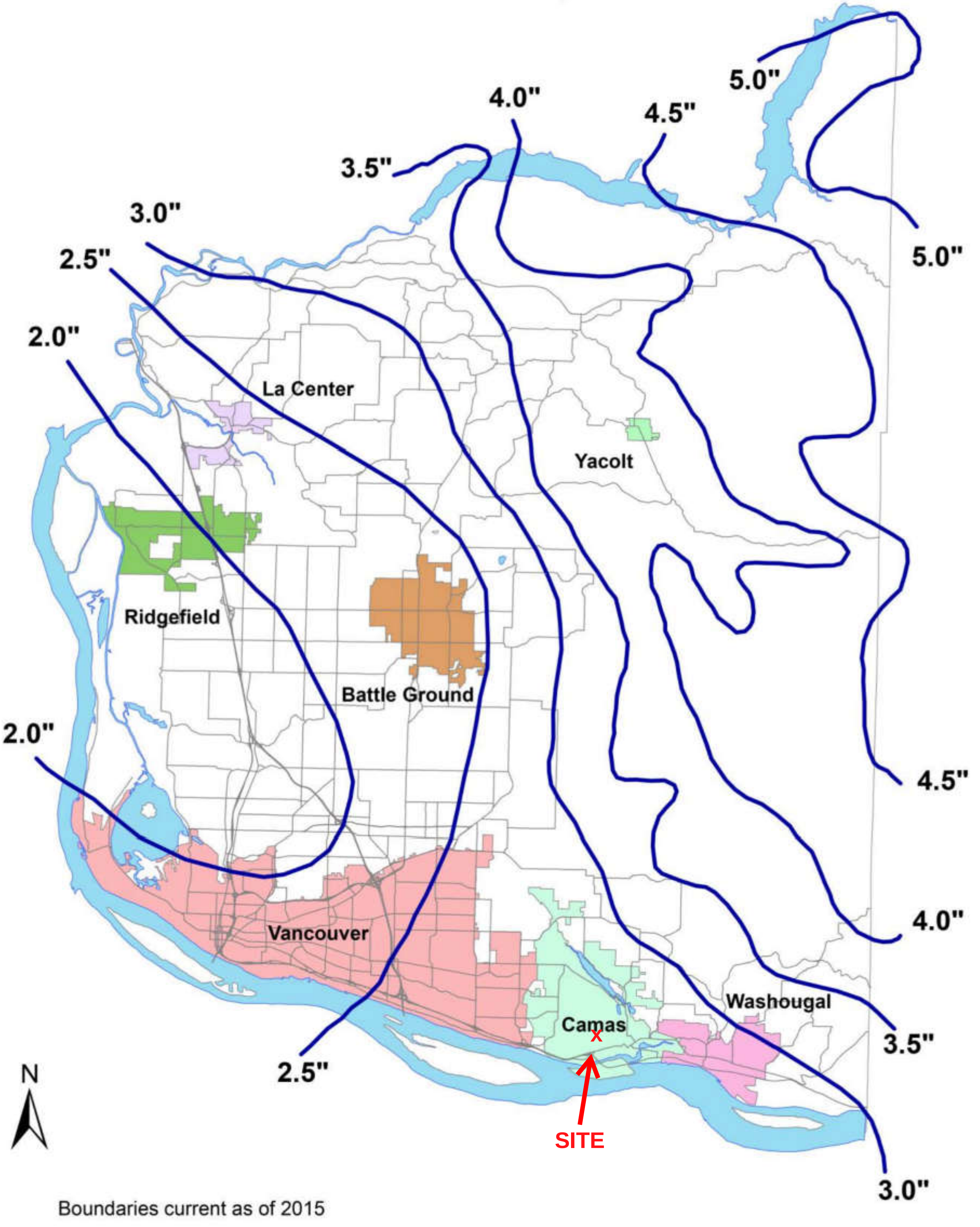
Isopluvial Map for Clark County

2-Year, 24-Hour Design Storm



Isopluvial Map for Clark County

10-Year, 24-Hour Design Storm

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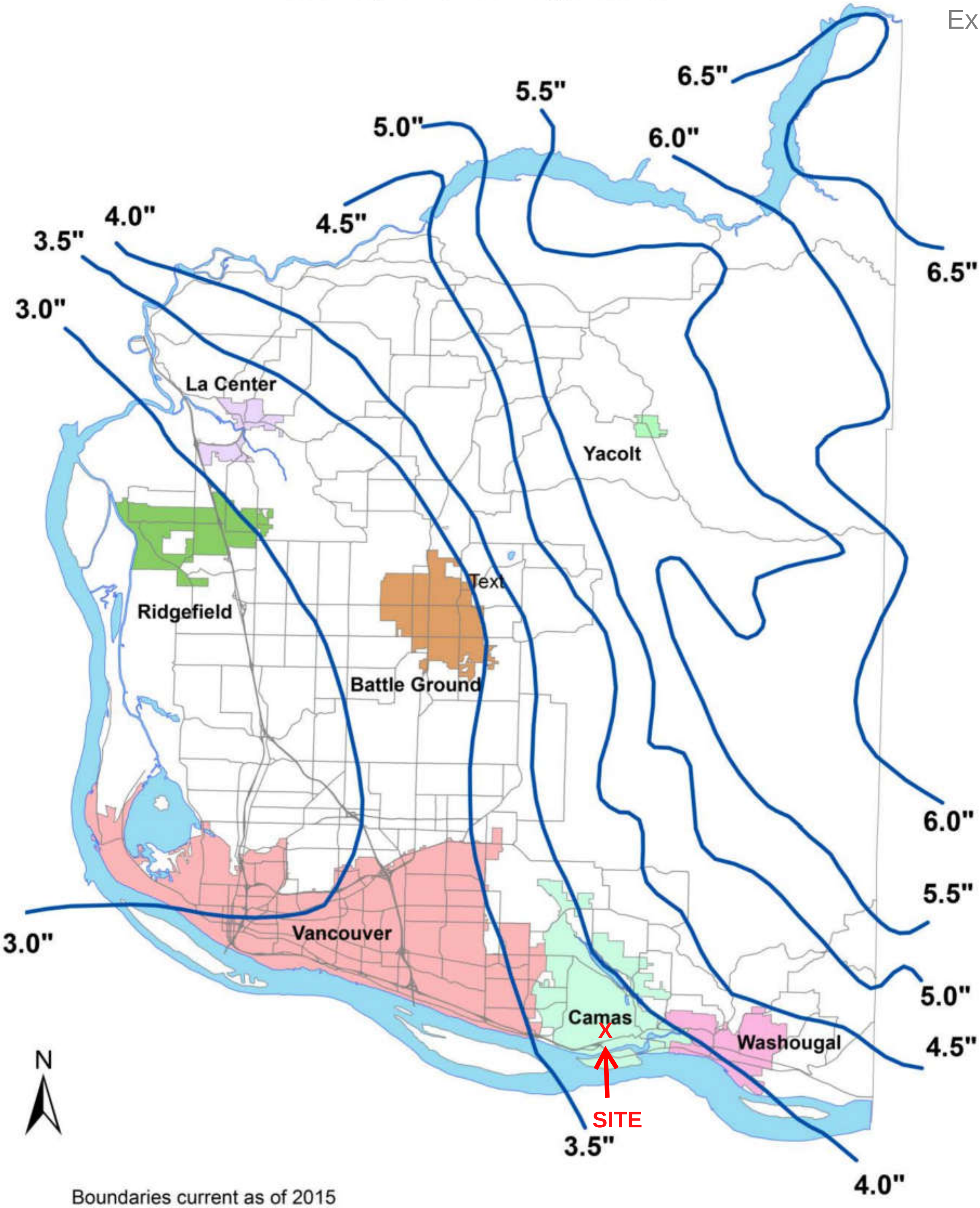

Boundaries current as of 2015

Isopluvial Map for Clark County

25-Year, 24-Hour Design Storm

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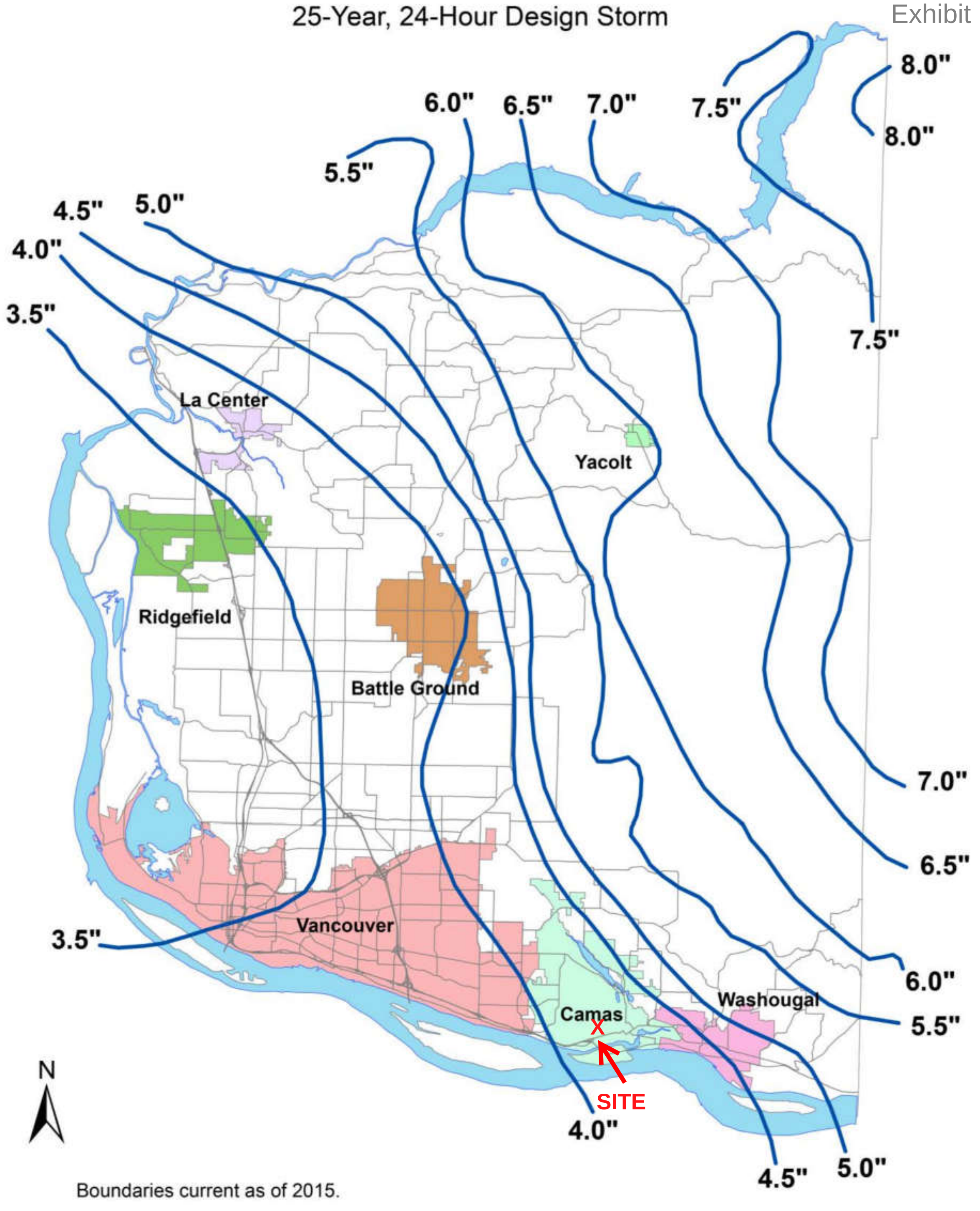

Boundaries current as of 2015.

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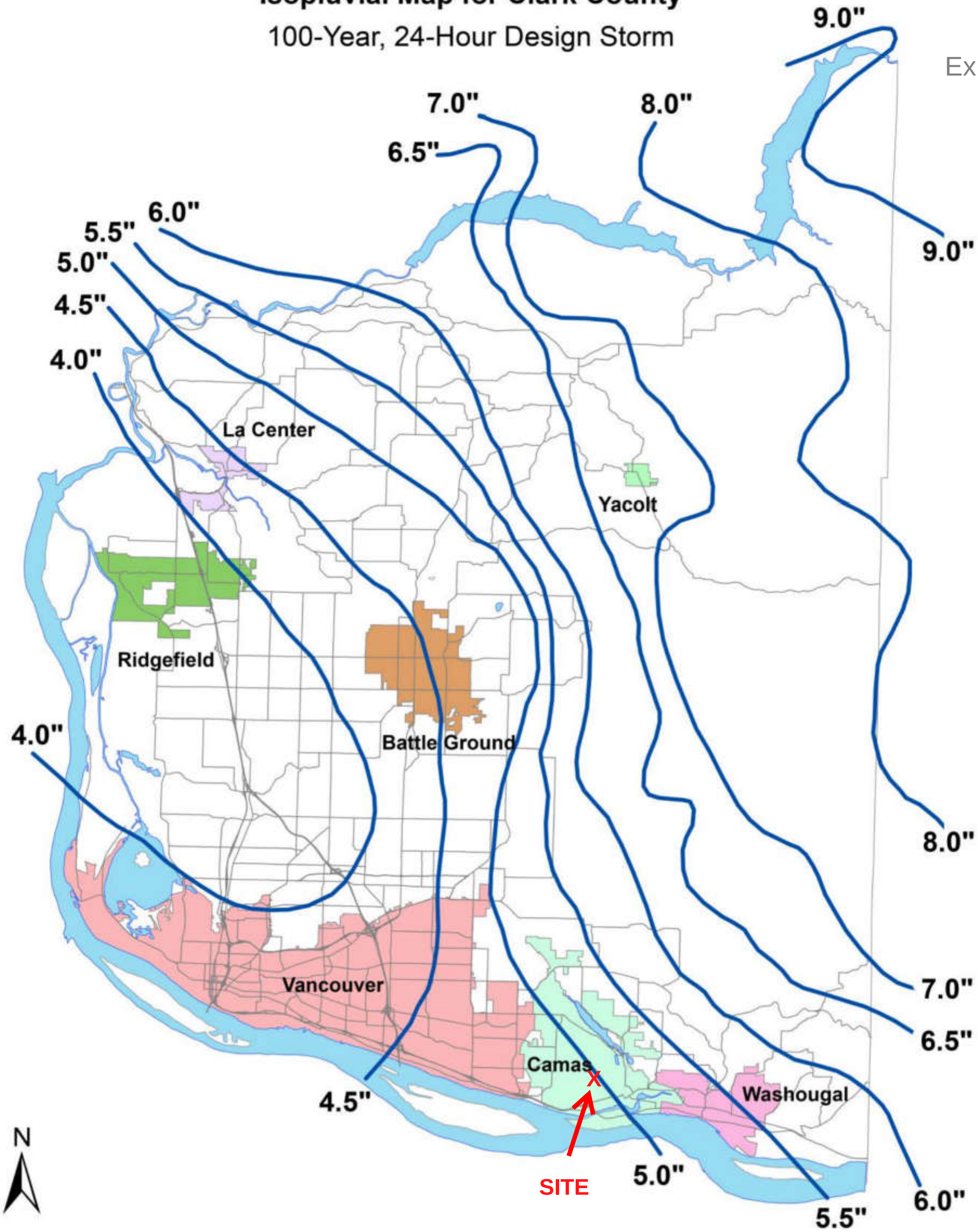
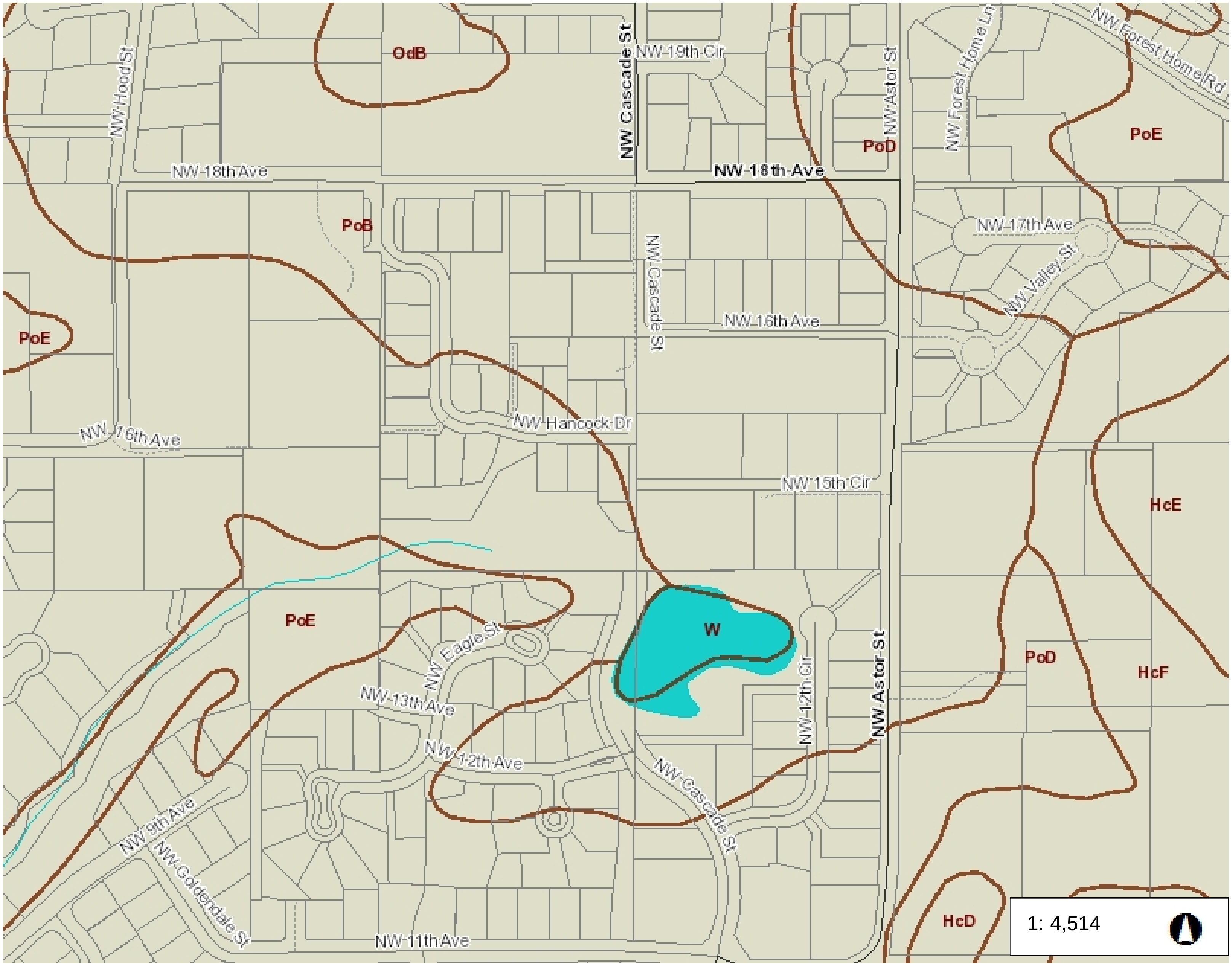
Isopluvial Map for Clark County

100-Year, 24-Hour Design Storm



Boundaries current as of 2015.

soil types



Legend

☐ Taxlots

☐ Soil Type

All Roads

- — Interstate
- — State Route
- — Arterial
- — Forest Arterial
- — Minor Collector
- — Forest Collector
- --- Private or Other

▨ Cities Boundaries

▨ Urban Growth Boundaries

Notes:

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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TABLE 7.—*Estimated physical and chemical properties of the soils*—Continued

Soil series and map symbols	Depth from surface	Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction
		Dominant USDA texture	Unified	AASHO	No. 4 (4.76 mm.) [1]	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
	Inches							*Inches per hour*	*Inches per inch of soil*	*pH*
Minniece: MnA, MnD.	0–48	Silty clay and clay	CH	A–7	90–95	85–95	65–75	<0. 06	0. 06–0. 08	6. 1–7.
	48	Basalt bedrock.								
MoA.	0–12	Silt loam	ML	A–4	100	95–100	65–75	0. 63–2. 0	0. 19–0. 21	6. 1–6.
	12–22	Silty clay	CH	A–7	95–100	95–100	80–90	0. 06–0. 2	0. 12–0. 14	6. 1–6.
	22–60	Very gravelly clay loam (weakly cemented).	GC	A–2	35–50	30–50	20–35	<0. 06	0. 03–0. 05	5. 6–6.
Mossyrock: MsB.	0–23	Silt loam	OL or OH	A–5	95–100	95–100	50–60	0. 63–2. 0	0. 19–0. 21	6. 1–6.
	23–60	Silt loam	ML	A–5	100	95–100	55–65	0. 63–2. 0	0. 19–0. 21	6. 6–7.
	60–74	Loam	ML	A–4	100	95–100	70–80	0. 63–2. 0	0. 16–0. 18	6. 1–7.
Newberg: NbA, NbB.	0–7	Silt loam	ML	A–4	--------	100	70–80	0. 63–2. 0	0. 19–0. 21	5. 6–6.
	7–52	Fine sandy loam and sandy loam.	SM or ML	A–4	--------	100	40–55	2. 0–6. 3	0. 13–0. 15	6. 1–7.
	52–72	Sand	SM	A–1	--------	100	5–15	0. 63–20. 0	0. 05–0. 07	6. 6–7.
Odne: OdB.	0–50	Silt loam, silty clay loam, clay loam, and loam.	CL	A–4 or A–6	--------	100	75–85	<0. 06	0. 10–0. 12	5. 0–6.
Olequa: OeD, OeE, OeF.	0–17	Silt loam	ML	A–7	--------	100	75–85	0. 63–2. 0	0. 19–0. 21	6. 1–6.
	17–90	Heavy silt loam and silty clay loam.	CL	A–7	--------	100	80–90	0. 2–0. 63	0. 19–0. 21	4. 5–6.
OhD, OhF.	0–32	Silty clay loam	CL	A–7	95–100	90–95	85–95	0. 2–0. 63	0. 19–0. 21	–6.
	32–82	Silty clay and clay	CH	A–7	95–100	90–95	85–95	<0. 06	0. 06–0. 08	[illegible]. 1–6.
Olympic: OlB, OlD, OlE, OlF, OmE, OmF.	0–44	Clay loam and silty clay loam.	ML or CL	A–7	90–100	90–100	75–85	0. 2–0. 63	0. 19–0. 21	5. 1–6.
	44–59	Gravelly clay loam.	GC	A–4	75–90	70–85	35–50	0. 2–0. 63	0. 10–0. 12	4. 5–5.
	59	Fractured basalt.								
OpC, OpE, OpG, OrC.	0–30	Heavy clay loam and heavy silty clay loam.	ML or CL	A–7	90–95	90–95	75–85	0. 2–0. 63	0. 19–0. 21	5. 1–6.
	30	Fractured basalt.								
Pilchuck: PhB.	0–60	Fine sand	SM	A–3	95–100	90–100	5–10	6. 3–20. 0	0. 05–0. 07	6. 1–7.
Powell: PoB, PoD, PoE.	0–23	Silt loam	ML	A–4	--------	100	80–90	0. 63–0. 20	0. 18–0. 20	5. 1–6.
	23–63	Slit loam (fragipan).	ML	A–4	--------	100	80–90	0. 06–0. 20	0. 06–0. 08	5. 1–6.
Puyallup: PuA.	0–27	Stratified fine sandy loam, loam, and loamy sand.	SM	A–4	100	95–100	35–50	2. 0–6. 3	0. 10–0. 12	5. 6–6.
	27–60	Gravelly sand	SP or SW	A–1	70–90	65–85	0–5	6. 3–20. 0	0. 04–0. 06	6. 6–7.
Riverwash, sandy: Ra.	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Riverwash, cobbly: Rc.	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Rock land: Rk.	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Rough broken land: Ro.	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

See footnotes at end of table.

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Table III-1.3 SCS Western Washington Runoff Curve Numbers (Published by SCS in 1982) Runoff curve numbers for selected agricultural, suburban and urban land use for Type 1A rainfall distribution, 24-hour storm duration.

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP			
		A	B	C	D
Cultivated land(1):	winter condition	86	91	94	95
Mountain open areas:	low growing brush & grasslands	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	undisturbed	42	64	76	81
Wood or forest land:	young second growth or brush	55	72	81	86
Orchard:	with cover crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping.					
Good condition:	grass cover on ≥75% of the area	68	80	86	90
Fair condition:	grass cover on 50-75% of the area	77	85	90	92
Gravel roads & parking lots:		76	85	89	91
Dirt roads & parking lots:		72	82	87	89
Impervious surfaces, pavement, roofs etc.		98	98	98	98
Open water bodies:	lakes, wetlands, ponds etc.	100	100	100	100
Single family residential(2):					
Dwelling Unit/Gross Acre	%Impervious(3)	Separate curve number shall be selected for pervious & impervious portions of the site or basin			
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
PUD's, condos, apartments, commercial businesses & industrial areas	%impervious must be computed				

(1) For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.

(2) Assumes roof and driveway runoff is directed into street/storm system.

(3) The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

Exhibit 14 CUP22-02

Figure 1.1: Flow Chart for Determining Stormwater Requirements

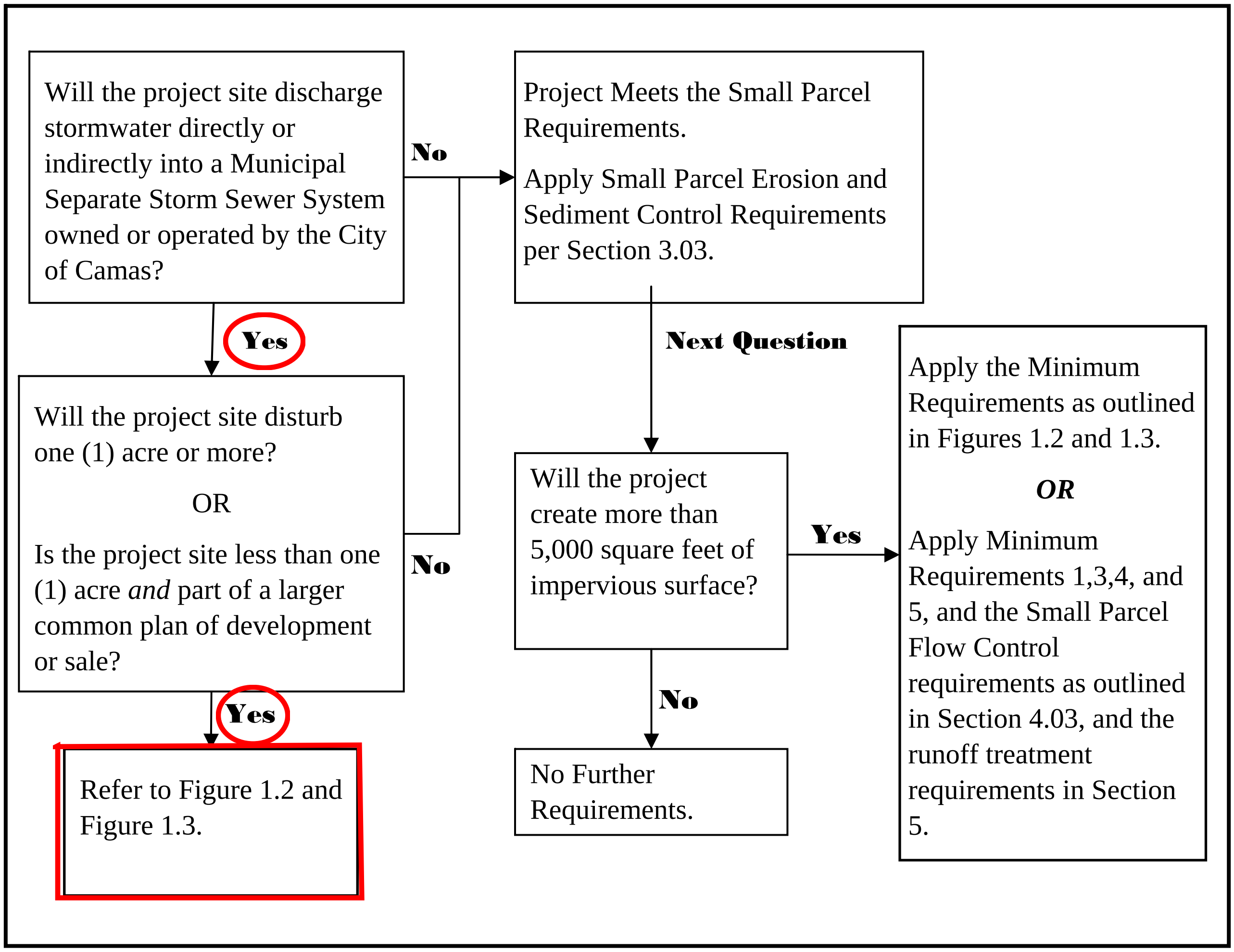


Exhibit 14 CUP22-02

Figure 1.2: New Development Minimum Requirements Flow Chart

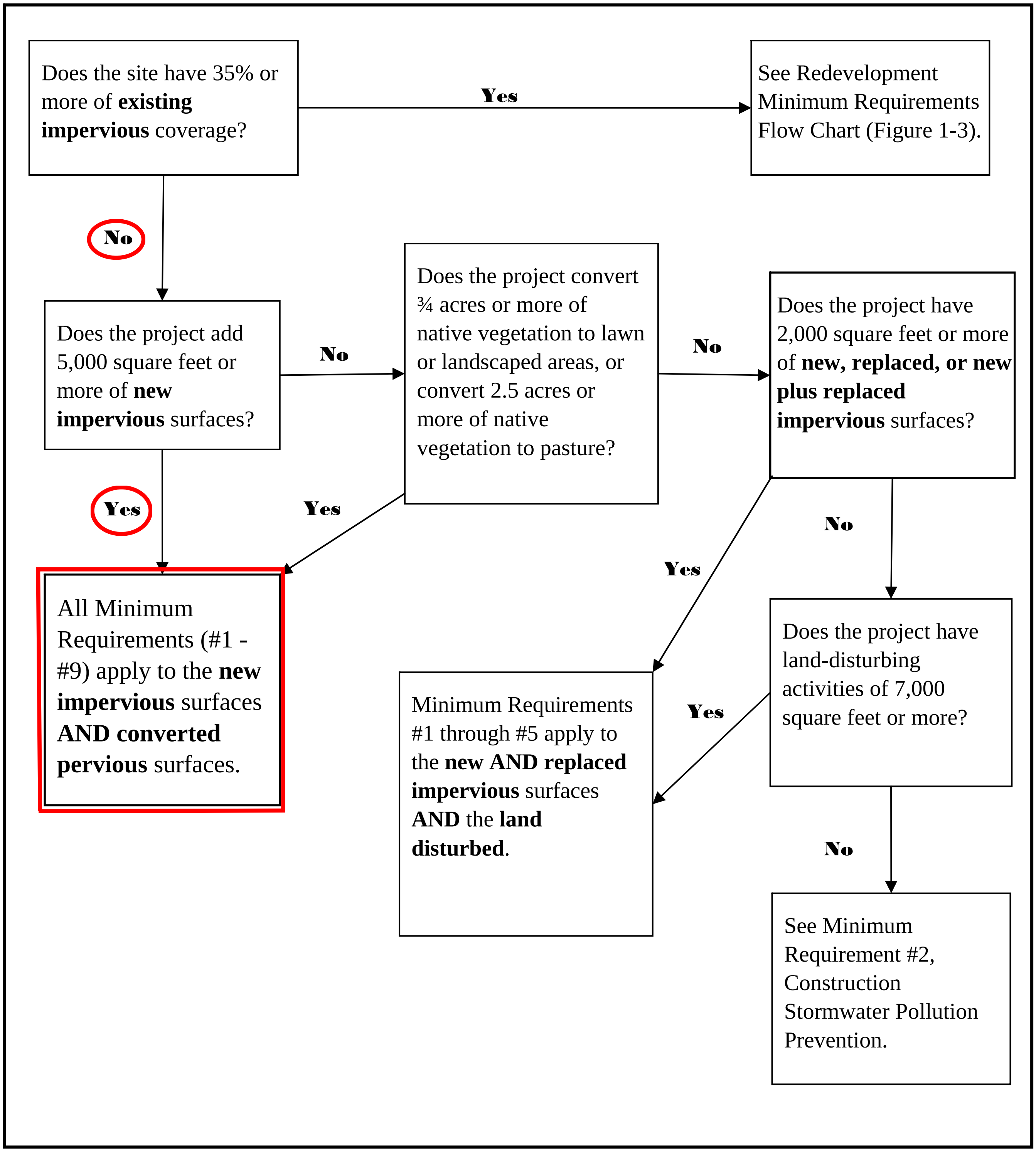
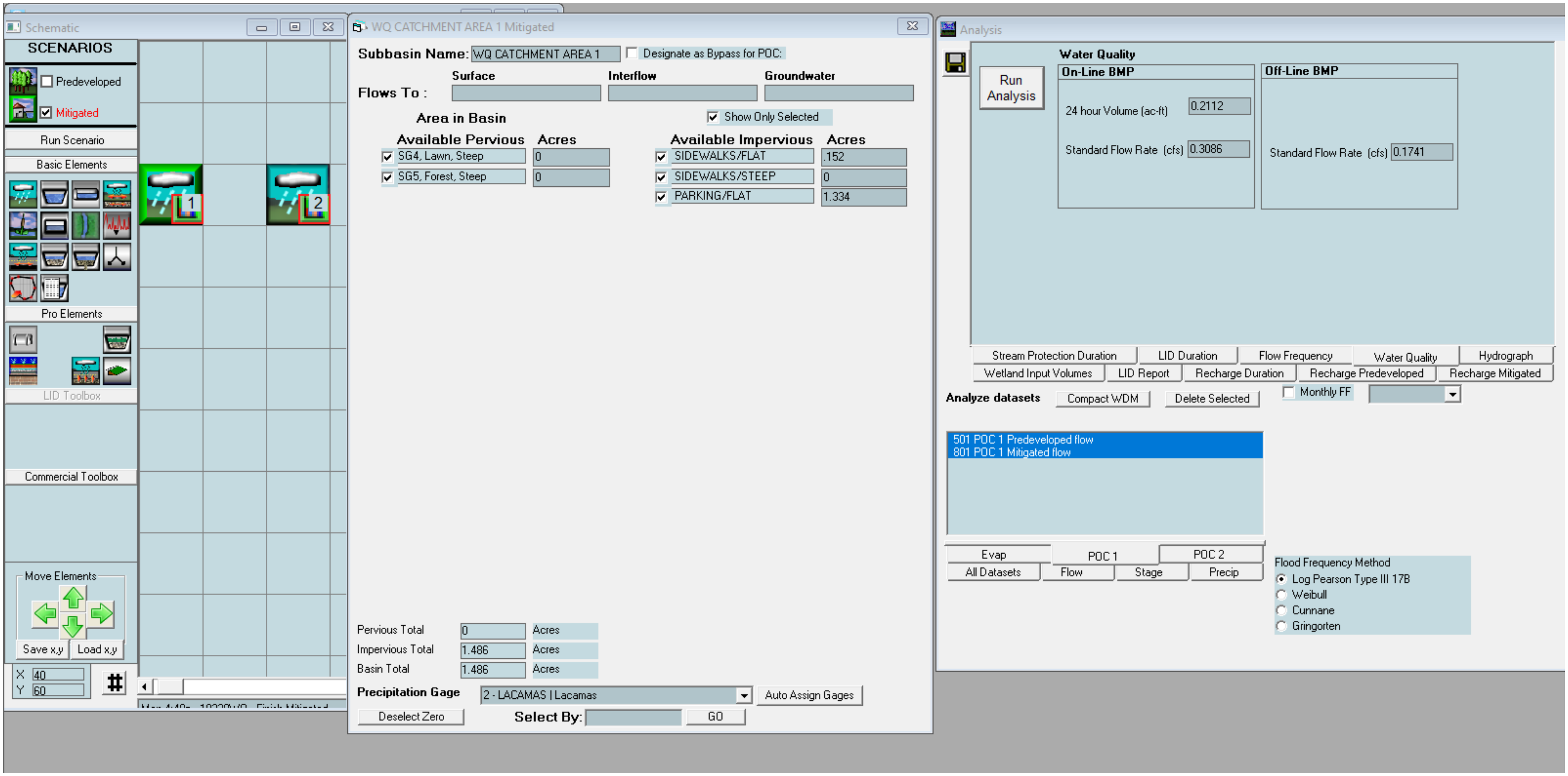


Exhibit 14 CUP22-02



☐ Predeveloped
☑ Mitigated

X 40
Y 60

WQ CATCHMENT AREA 1 Mitigated

Subbasin Name: WQ CATCHMENT AREA 1 ☐ Designate as Bypass for POC:

Flows To : Surface Interflow Groundwater

Area in Basin ☑ Show Only Selected

Available Pervious	Acres
☑ SG4, Lawn, Steep	0
☑ SG5, Forest, Steep	0

Available Impervious	Acres
☑ SIDEWALKS/FLAT	.152
☑ SIDEWALKS/STEEP	0
☑ PARKING/FLAT	1.334

Pervious Total	0	Acres
Impervious Total	1.486	Acres
Basin Total	1.486	Acres

Precipitation Gage 2 - LACAMAS | Lacamas

Select By:

Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.2112

Standard Flow Rate (cfs) 0.3086

Off-Line BMP

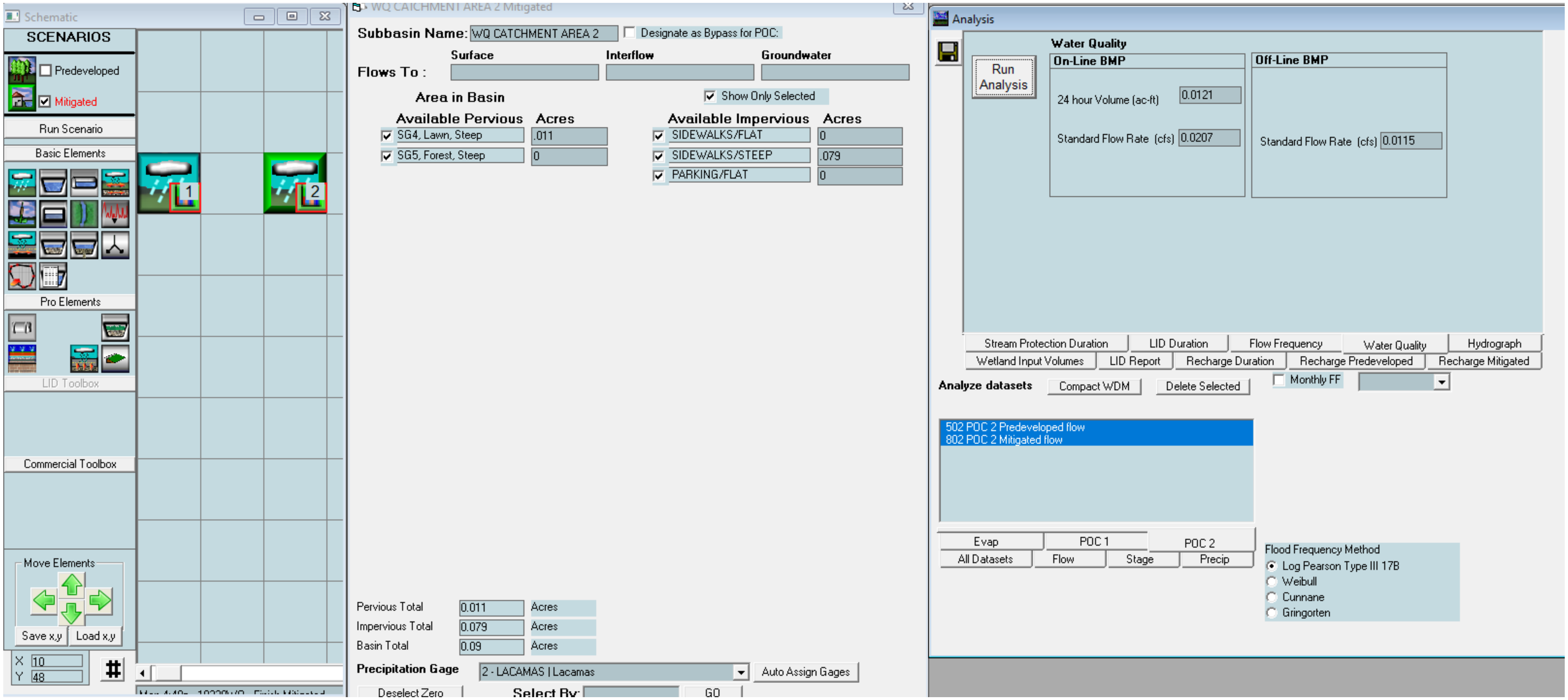
Standard Flow Rate (cfs) 0.1741

Analyze datasets ☐ Monthly FF

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

Exhibit 14 CUP22-02



X 10
Y 48

WQ CATCHMENT AREA 2 Mitigated

Subbasin Name: WQ CATCHMENT AREA 2 ☐ Designate as Bypass for POC:

Flows To : Surface Interflow Groundwater

Area in Basin ☑ Show Only Selected

Available Pervious	Acres
☑ SG4, Lawn, Steep	.011
☑ SG5, Forest, Steep	0

Available Impervious	Acres
☑ SIDEWALKS/FLAT	0
☑ SIDEWALKS/STEEP	.079
☑ PARKING/FLAT	0

Pervious Total	0.011	Acres
Impervious Total	0.079	Acres
Basin Total	0.09	Acres

Precipitation Gage 2 - LACAMAS I Lacamas

Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.0121

Standard Flow Rate (cfs) 0.0207

Off-Line BMP

Standard Flow Rate (cfs) 0.0115

Analyze datasets ☐ Monthly FF

502 POC 2 Predeveloped flow
802 POC 2 Mitigated flow

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

Exhibit 14 CUP22-02

WWHM2012

PROJECT REPORT

General Model Information

Exhibit 14 CUP22-02

Project Name:	10320
Site Name:	
Site Address:	
City:	
Report Date:	2/3/2022
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2019/09/13
Version:	4.2.17

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

Exhibit 14 CUP22-02

PREDEVELOPED AREA

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SG4, Forest, Steep	2.34
Pervious Total	2.34
Impervious Land Use	acre
Impervious Total	0
Basin Total	2.34

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

CATCHMENT AREA 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SG4, Lawn, Flat	0.425
Pervious Total	0.425
Impervious Land Use	acre
ROOF TOPS FLAT	0.333
SIDEWALKS FLAT	0.152
PARKING FLAT	1.334
Impervious Total	1.819
Basin Total	2.244

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Exhibit 14 CUP22-02

CATCHMENTAREA 2

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
SG4, Lawn, Steep	0.011
Pervious Total	0.011
Impervious Land Use	acre
DRIVEWAYS STEEP	0.079
Impervious Total	0.079
Basin Total	0.09

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements

Predeveloped Routing

Exhibit 14 CUP22-02

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	40.00 ft.
Bottom Width:	40.00 ft.
Depth:	5 ft.
Volume at riser head:	0.1490 acre-feet.
Side slope 1:	0 To 1
Side slope 2:	0 To 1
Side slope 3:	0 To 1
Side slope 4:	0 To 1
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	0.515 ft.
Notch Height:	0.756 ft.
Orifice 1 Diameter:	2.677 in. Elevation:0 ft.

Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.036	0.000	0.000	0.000
0.0556	0.036	0.002	0.045	0.000
0.1111	0.036	0.004	0.064	0.000
0.1667	0.036	0.006	0.079	0.000
0.2222	0.036	0.008	0.091	0.000
0.2778	0.036	0.010	0.102	0.000
0.3333	0.036	0.012	0.112	0.000
0.3889	0.036	0.014	0.121	0.000
0.4444	0.036	0.016	0.129	0.000
0.5000	0.036	0.018	0.137	0.000
0.5556	0.036	0.020	0.145	0.000
0.6111	0.036	0.022	0.152	0.000
0.6667	0.036	0.024	0.158	0.000
0.7222	0.036	0.026	0.165	0.000
0.7778	0.036	0.028	0.171	0.000
0.8333	0.036	0.030	0.177	0.000
0.8889	0.036	0.032	0.183	0.000
0.9444	0.036	0.034	0.189	0.000
1.0000	0.036	0.036	0.194	0.000
1.0556	0.036	0.038	0.199	0.000
1.1111	0.036	0.040	0.205	0.000
1.1667	0.036	0.042	0.210	0.000
1.2222	0.036	0.044	0.215	0.000
1.2778	0.036	0.046	0.219	0.000
1.3333	0.036	0.049	0.224	0.000
1.3889	0.036	0.051	0.229	0.000
1.4444	0.036	0.053	0.233	0.000
1.5000	0.036	0.055	0.238	0.000
1.5556	0.036	0.057	0.242	0.000
1.6111	0.036	0.059	0.246	0.000
1.6667	0.036	0.061	0.251	0.000
1.7222	0.036	0.063	0.255	0.000

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1.7778	0.036	0.065	0.259	0.000	
1.8333	0.036	0.067	0.263	0.000	
1.8889	0.036	0.069	0.267	0.000	
1.9444	0.036	0.071	0.271	0.000	
2.0000	0.036	0.073	0.275	0.000	
2.0556	0.036	0.075	0.278	0.000	
2.1111	0.036	0.077	0.282	0.000	
2.1667	0.036	0.079	0.286	0.000	
2.2222	0.036	0.081	0.289	0.000	
2.2778	0.036	0.083	0.293	0.000	
2.3333	0.036	0.085	0.297	0.000	
2.3889	0.036	0.087	0.300	0.000	
2.4444	0.036	0.089	0.304	0.000	
2.5000	0.036	0.091	0.307	0.000	
2.5556	0.036	0.093	0.310	0.000	
2.6111	0.036	0.095	0.314	0.000	
2.6667	0.036	0.098	0.317	0.000	
2.7222	0.036	0.100	0.320	0.000	
2.7778	0.036	0.102	0.324	0.000	
2.8333	0.036	0.104	0.327	0.000	
2.8889	0.036	0.106	0.330	0.000	
2.9444	0.036	0.108	0.333	0.000	
3.0000	0.036	0.110	0.336	0.000	
3.0556	0.036	0.112	0.339	0.000	
3.1111	0.036	0.114	0.343	0.000	
3.1667	0.036	0.116	0.346	0.000	
3.2222	0.036	0.118	0.349	0.000	
3.2778	0.036	0.120	0.362	0.000	
3.3333	0.036	0.122	0.400	0.000	
3.3889	0.036	0.124	0.452	0.000	2YR * 0.434CFS
3.4444	0.036	0.126	0.514	0.000	DEPTH - 3.36FT; VOL - 0.123ACFT
3.5000	0.036	0.128	0.585	0.000	
3.5556	0.036	0.130	0.664	0.000	
3.6111	0.036	0.132	0.750	0.000	
3.6667	0.036	0.134	0.842	0.000	10YR * 0.885 CFS
3.7222	0.036	0.136	0.941	0.000	DEPTH - 3.69FT; VOL - 0.135ACFT
3.7778	0.036	0.138	1.045	0.000	
3.8333	0.036	0.140	1.155	0.000	
3.8889	0.036	0.142	1.270	0.000	
3.9444	0.036	0.144	1.390	0.000	
4.0000	0.036	0.147	1.514	0.000	
4.0556	0.036	0.149	1.725	0.000	100YR * 1.842
4.1111	0.036	0.151	2.107	0.000	DEPTH - 4.06FT; VOL - 0.149ACFT
4.1667	0.036	0.153	2.596	0.000	
4.2222	0.036	0.155	3.162	0.000	
4.2778	0.036	0.157	3.776	0.000	
4.3333	0.036	0.159	4.413	0.000	
4.3889	0.036	0.161	5.043	0.000	
4.4444	0.036	0.163	5.639	0.000	
4.5000	0.036	0.165	6.177	0.000	
4.5556	0.036	0.167	6.638	0.000	
4.6111	0.036	0.169	7.011	0.000	
4.6667	0.036	0.171	7.300	0.000	
4.7222	0.036	0.173	7.523	0.000	
4.7778	0.036	0.175	7.800	0.000	
4.8333	0.036	0.177	8.022	0.000	
4.8889	0.036	0.179	8.237	0.000	
4.9444	0.036	0.181	8.445	0.000	

5.0000	0.036	0.183	8.647	0.000
5.0556	0.036	0.185	8.843	0.000

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Analysis Results

POC 1

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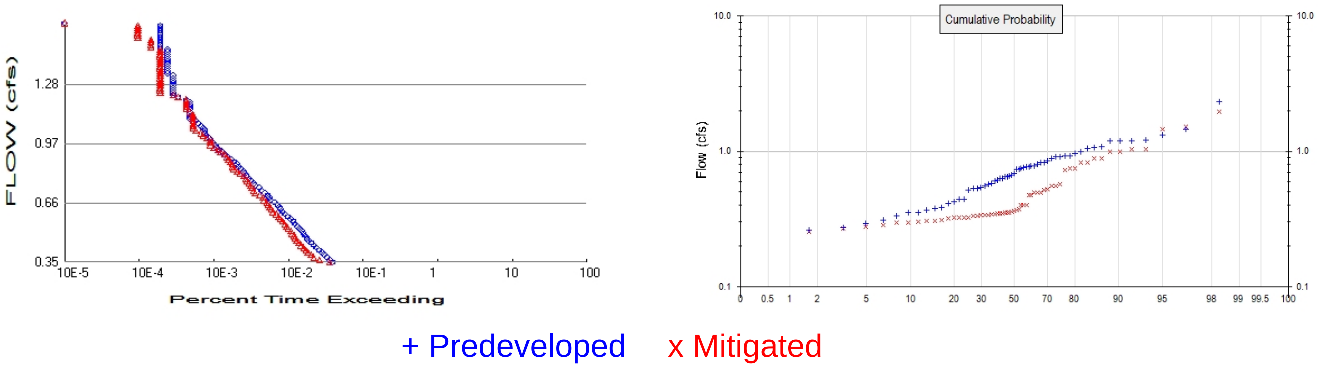

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.34
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.436
Total Impervious Area: 1.898

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.700934
5 year	1.06916
10 year	1.266611
25 year	1.46611
50 year	1.584077
100 year	1.680772

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.433828
5 year	0.677371
10 year	0.884734
25 year	1.208325
50 year	1.500389
100 year	1.841898

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.529	0.399
1950	0.653	0.353
1951	0.921	0.340
1952	0.576	0.551
1953	0.739	0.323
1954	1.201	0.346
1955	0.571	0.312
1956	1.049	0.999
1957	0.967	0.359
1958	0.756	1.039

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1959	0.441	0.276
1960	0.411	0.374
1961	0.930	0.478
1962	0.662	0.344
1963	0.739	0.345
1964	0.682	0.332
1965	0.611	0.523
1966	0.829	0.362
1967	0.768	0.345
1968	0.881	0.495
1969	0.910	1.514
1970	2.329	1.955
1971	0.377	0.285
1972	0.601	0.325
1973	0.632	0.477
1974	0.917	1.033
1975	0.531	0.324
1976	0.829	0.401
1977	0.027	0.269
1978	1.219	0.730
1979	0.774	0.744
1980	0.445	0.303
1981	1.074	0.821
1982	0.751	0.887
1983	1.326	0.552
1984	0.423	0.299
1985	0.294	0.368
1986	0.367	0.354
1987	0.653	0.354
1988	0.352	0.305
1989	0.382	0.321
1990	0.309	0.298
1991	0.777	0.332
1992	0.784	0.308
1993	0.993	0.886
1994	0.667	0.521
1995	0.540	0.824
1996	1.188	1.462
1997	1.468	0.999
1998	1.203	0.398
1999	0.798	0.574
2000	0.520	0.248
2001	0.275	0.256
2002	1.086	0.348
2003	0.850	0.493
2004	0.263	0.339
2005	0.335	0.323
2006	0.628	0.339
2007	0.353	0.743
2008	0.552	0.499

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	2.3289	1.9549
2	1.4678	1.5138
3	1.3260	1.4623
4	1.2194	1.0394

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5	1.2026	1.0329
6	1.2010	0.9994
7	1.1881	0.9990
8	1.0857	0.8868
9	1.0742	0.8859
10	1.0489	0.8236
11	0.9929	0.8208
12	0.9673	0.7445
13	0.9301	0.7426
14	0.9209	0.7300
15	0.9170	0.5742
16	0.9104	0.5521
17	0.8813	0.5514
18	0.8500	0.5227
19	0.8291	0.5207
20	0.8291	0.4986
21	0.7982	0.4952
22	0.7837	0.4928
23	0.7775	0.4780
24	0.7739	0.4772
25	0.7679	0.4011
26	0.7561	0.3993
27	0.7508	0.3979
28	0.7394	0.3740
29	0.7393	0.3680
30	0.6822	0.3619
31	0.6668	0.3588
32	0.6618	0.3542
33	0.6534	0.3536
34	0.6529	0.3530
35	0.6319	0.3478
36	0.6281	0.3457
37	0.6108	0.3453
38	0.6007	0.3449
39	0.5761	0.3438
40	0.5712	0.3396
41	0.5521	0.3388
42	0.5398	0.3387
43	0.5308	0.3323
44	0.5292	0.3322
45	0.5202	0.3253
46	0.4451	0.3243
47	0.4405	0.3232
48	0.4227	0.3231
49	0.4112	0.3209
50	0.3823	0.3124
51	0.3769	0.3078
52	0.3665	0.3055
53	0.3526	0.3031
54	0.3518	0.2994
55	0.3347	0.2977
56	0.3086	0.2851
57	0.2941	0.2760
58	0.2748	0.2689
59	0.2634	0.2562
60	0.0271	0.2483

Exhibit 14 CUP22-02

Duration Flows

The Facility PASSED

Exhibit 14 CUP22-02

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3505	815	746	91	Pass
0.3629	752	549	73	Pass
0.3754	692	462	66	Pass
0.3878	633	420	66	Pass
0.4003	583	382	65	Pass
0.4128	541	362	66	Pass
0.4252	499	339	67	Pass
0.4377	466	310	66	Pass
0.4502	424	291	68	Pass
0.4626	392	267	68	Pass
0.4751	371	256	69	Pass
0.4875	353	252	71	Pass
0.5000	332	237	71	Pass
0.5125	313	225	71	Pass
0.5249	293	209	71	Pass
0.5374	276	199	72	Pass
0.5498	259	187	72	Pass
0.5623	243	175	72	Pass
0.5748	223	164	73	Pass
0.5872	205	155	75	Pass
0.5997	190	144	75	Pass
0.6121	175	129	73	Pass
0.6246	165	124	75	Pass
0.6371	158	118	74	Pass
0.6495	150	112	74	Pass
0.6620	136	108	79	Pass
0.6744	121	99	81	Pass
0.6869	116	95	81	Pass
0.6994	110	87	79	Pass
0.7118	101	75	74	Pass
0.7243	92	72	78	Pass
0.7367	85	68	80	Pass
0.7492	75	65	86	Pass
0.7617	71	62	87	Pass
0.7741	66	59	89	Pass
0.7866	62	56	90	Pass
0.7991	57	53	92	Pass
0.8115	55	47	85	Pass
0.8240	52	43	82	Pass
0.8364	48	39	81	Pass
0.8489	45	37	82	Pass
0.8614	43	37	86	Pass
0.8738	39	35	89	Pass
0.8863	36	33	91	Pass
0.8987	32	31	96	Pass
0.9112	29	29	100	Pass
0.9237	27	26	96	Pass
0.9361	25	24	96	Pass
0.9486	23	21	91	Pass
0.9610	22	19	86	Pass
0.9735	20	19	95	Pass
0.9860	19	19	100	Pass
0.9984	18	17	94	Pass

Exhibit 14 CUP22-02

1.0109	17	15	88	Pass
1.0233	16	14	87	Pass
1.0358	16	12	75	Pass
1.0483	15	11	73	Pass
1.0607	14	11	78	Pass
1.0732	13	11	84	Pass
1.0856	12	11	91	Pass
1.0981	10	11	110	Pass
1.1106	10	11	110	Pass
1.1230	10	11	110	Pass
1.1355	10	10	100	Pass
1.1480	10	9	90	Pass
1.1604	10	9	90	Pass
1.1729	10	9	90	Pass
1.1853	10	9	90	Pass
1.1978	9	9	100	Pass
1.2103	7	7	100	Pass
1.2227	6	6	100	Pass
1.2352	6	4	66	Pass
1.2476	6	4	66	Pass
1.2601	6	4	66	Pass
1.2726	6	4	66	Pass
1.2850	6	4	66	Pass
1.2975	6	4	66	Pass
1.3099	6	4	66	Pass
1.3224	6	4	66	Pass
1.3349	5	4	80	Pass
1.3473	5	4	80	Pass
1.3598	5	4	80	Pass
1.3722	5	4	80	Pass
1.3847	5	4	80	Pass
1.3972	5	4	80	Pass
1.4096	5	4	80	Pass
1.4221	5	4	80	Pass
1.4345	5	4	80	Pass
1.4470	5	4	80	Pass
1.4595	5	4	80	Pass
1.4719	4	3	75	Pass
1.4844	4	3	75	Pass
1.4969	4	3	75	Pass
1.5093	4	3	75	Pass
1.5218	4	2	50	Pass
1.5342	4	2	50	Pass
1.5467	4	2	50	Pass
1.5592	4	2	50	Pass
1.5716	4	2	50	Pass
1.5841	4	2	50	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

Exhibit 14 CUP22-02

LID Report

Exhibit 14 CUP22-02

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Trapezoidal Pond 1 POC	☐	371.00			☐	0.00			
Total Volume Infiltrated		371.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

Exhibit 14 CUP22-02

PERLND Changes

No PERLND changes have been made.

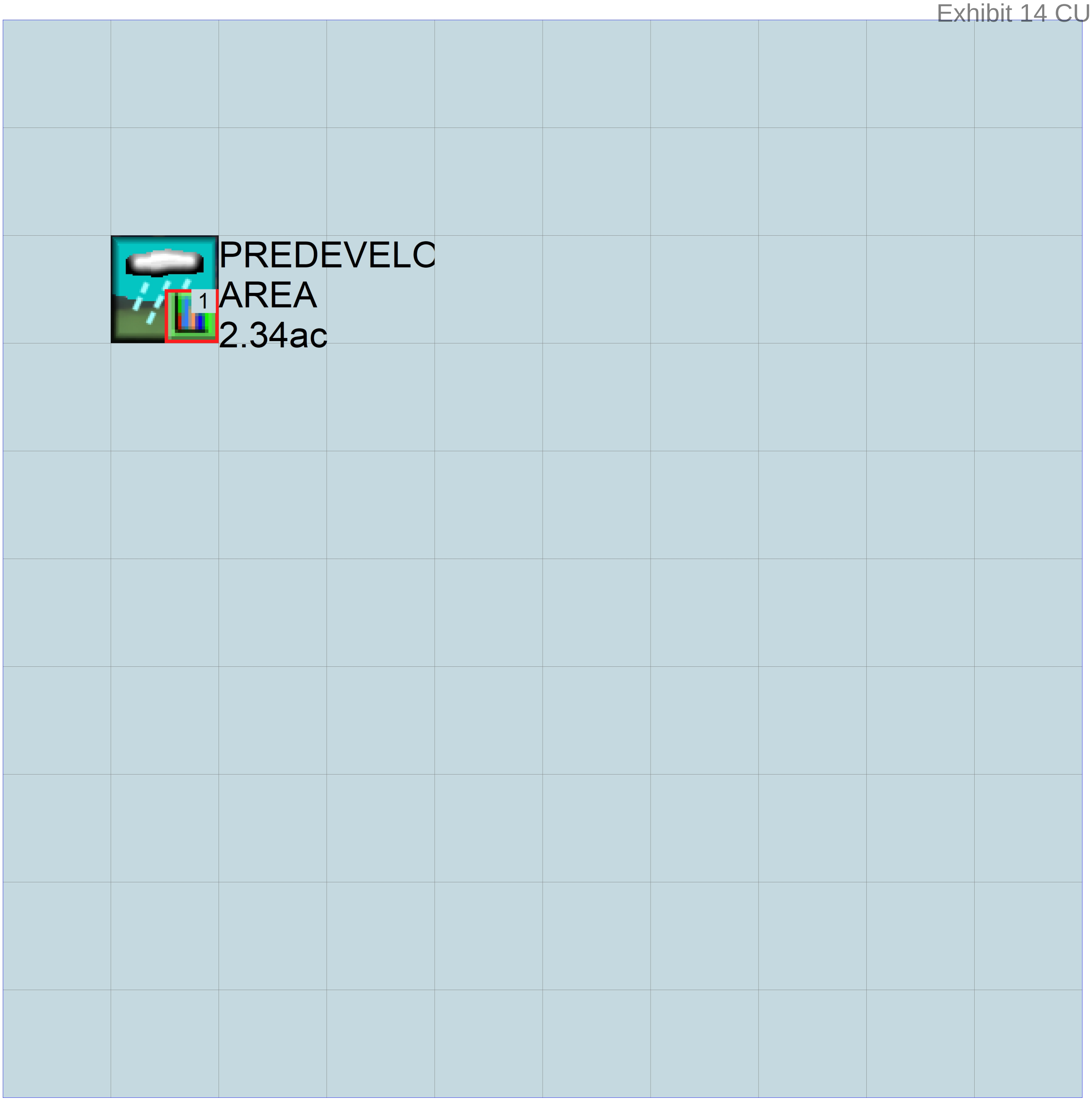
IMPLND Changes

No IMPLND changes have been made.

Appendix

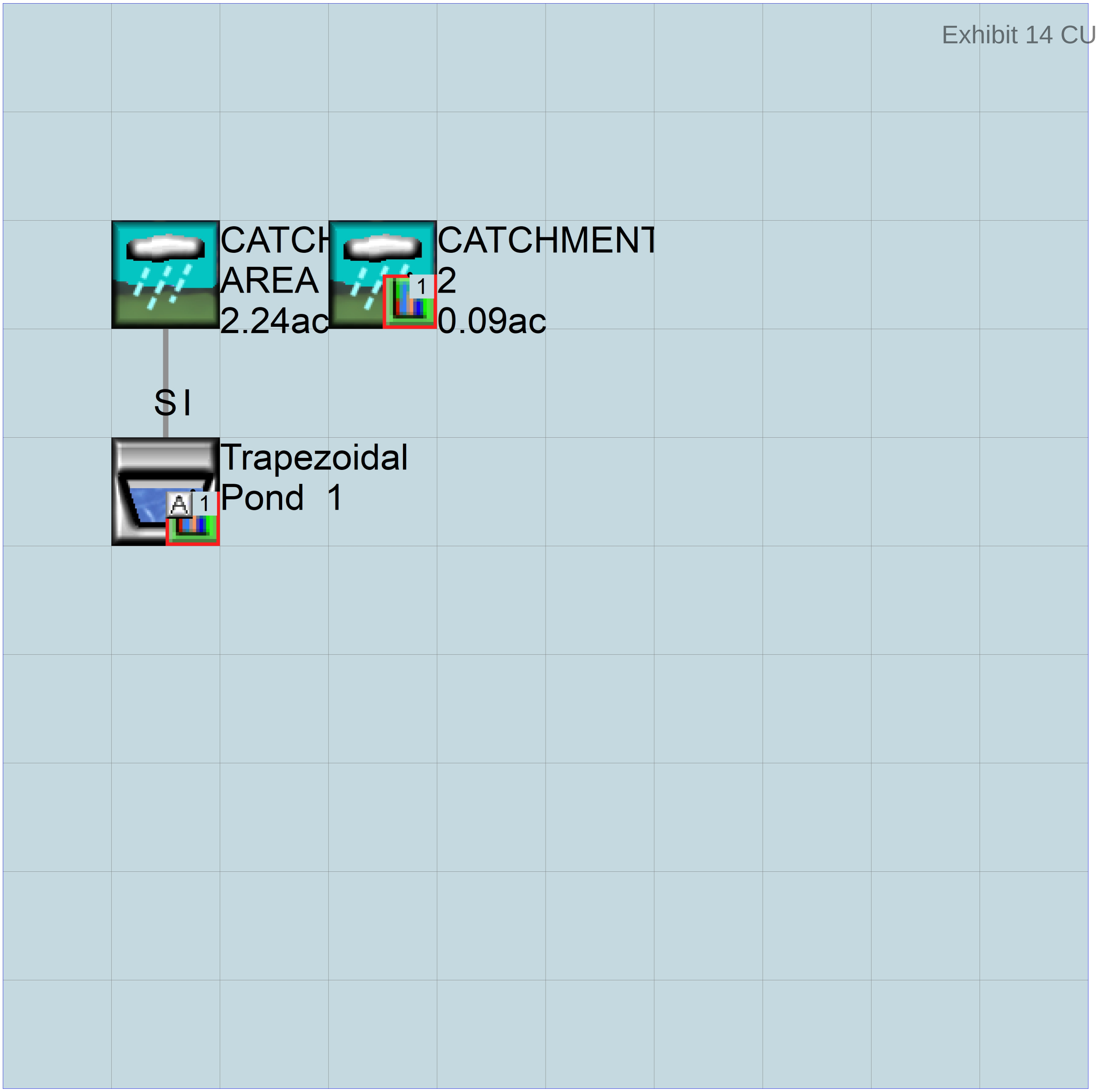
Predeveloped Schematic

Exhibit 14 CUP22-02



Mitigated Schematic

Exhibit 14 CUP22-02



Predeveloped UCI File

Exhibit 14 CUP22-02

```
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   10320.wdm
MESSU      25   Pre10320.MES
           27   Pre10320.L61
           28   Pre10320.L62
           30   POC103201.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      30
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        PREDEVELOPED AREA           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           ***
   30      SG4, Forest, Steep      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 ***
   30         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  *********
   30         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

Exhibit 14 CUP22-02

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   30         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
   30              0         6      0.04       400      0.15         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   30              0         0         3         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   30            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
   30              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
```

Exhibit 14 CUP22-02

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
PREDEVELOPED AREA***
PERLND  30                        2.34     COPY   501     12
PERLND  30                        2.34     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
```

Exhibit 14 CUP22-02

```
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

Exhibit 14 CUP22-02

```
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   10320.wdm
MESSU      25   Mit10320.MES
           27   Mit10320.L61
           28   Mit10320.L62
           30   POC103201.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      34
      IMPLND       4
      IMPLND       8
      IMPLND      11
      PERLND      36
      IMPLND       7
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  601        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           ***
   34     SG4, Lawn, Flat         1    1    1    1   27    0
   36     SG4, Lawn, Steep        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

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

Exhibit 14 CUP22-02

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   34         0    0    1    0    0    0    0    0    0    0    0    0
   36         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  *********
   34         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   36         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   34         0    0    0    0    0    0    0    0    0    0    0
   36         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
   34              0         6      0.02       400      0.05         0      0.96
   36              0         6      0.02       400      0.15         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   34              0         0         3         2         0         0         0
   36              0         0         3         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   34            0.1       0.2      0.25         2       0.4      0.25
   36            0.1       0.2      0.25         2       0.4      0.25
  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
   34              0         0         0         0       2.5         1         0
   36              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        ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
    7      DRIVEWAYS/STEEP        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
    7         0    0    1    0    0    0
  END ACTIVITY
```

Exhibit 14 CUP22-02

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
    7         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
    7         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4           400       0.01       0.1       0.1
    8           400       0.01       0.1       0.1
   11           400       0.01       0.1       0.1
    7           400        0.1       0.1      0.05
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    8              0         0
   11              0         0
    7              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    8              0         0
   11              0         0
    7              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
CATCHMENT AREA 1***
PERLND  34                       0.425     RCHRES   1      2
PERLND  34                       0.425     RCHRES   1      3
IMPLND   4                       0.333     RCHRES   1      5
IMPLND   8                       0.152     RCHRES   1      5
IMPLND  11                       1.334     RCHRES   1      5
CATCHMENTAREA 2***
PERLND  36                       0.011     COPY   501     12
PERLND  36                       0.011     COPY   601     12
PERLND  36                       0.011     COPY   501     13
PERLND  36                       0.011     COPY   601     13
IMPLND   7                       0.079     COPY   501     15
IMPLND   7                       0.079     COPY   601     15

******Routing******
PERLND  34                       0.425     COPY     1     12
IMPLND   4                       0.333     COPY     1     15
IMPLND   8                       0.152     COPY     1     15
IMPLND  11                       1.334     COPY     1     15
PERLND  34                       0.425     COPY     1     13
```

Exhibit 14 CUP22-02

```
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                  ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                            ***
    1     Trapezoidal Pond-006    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.036739  0.000000  0.000000
  0.055556  0.036739  0.002041  0.045837
  0.111111  0.036739  0.004082  0.064824
  0.166667  0.036739  0.006123  0.079393
  0.222222  0.036739  0.008164  0.091675
  0.277778  0.036739  0.010205  0.102495
```

Exhibit 14 CUP22-02

```
 0.333333  0.036739  0.012246  0.112278
 0.388889  0.036739  0.014287  0.121274
 0.444444  0.036739  0.016328  0.129648
 0.500000  0.036739  0.018369  0.137512
 0.555556  0.036739  0.020410  0.144950
 0.611111  0.036739  0.022451  0.152025
 0.666667  0.036739  0.024492  0.158785
 0.722222  0.036739  0.026533  0.165269
 0.777778  0.036739  0.028575  0.171508
 0.833333  0.036739  0.030616  0.177527
 0.888889  0.036739  0.032657  0.183349
 0.944444  0.036739  0.034698  0.188992
 1.000000  0.036739  0.036739  0.194471
 1.055556  0.036739  0.038780  0.199800
 1.111111  0.036739  0.040821  0.204991
 1.166667  0.036739  0.042862  0.210053
 1.222222  0.036739  0.044903  0.214996
 1.277778  0.036739  0.046944  0.219828
 1.333333  0.036739  0.048985  0.224556
 1.388889  0.036739  0.051026  0.229187
 1.444444  0.036739  0.053067  0.233725
 1.500000  0.036739  0.055108  0.238178
 1.555556  0.036739  0.057149  0.242548
 1.611111  0.036739  0.059190  0.246842
 1.666667  0.036739  0.061231  0.251061
 1.722222  0.036739  0.063272  0.255211
 1.777778  0.036739  0.065313  0.259295
 1.833333  0.036739  0.067354  0.263315
 1.888889  0.036739  0.069395  0.267275
 1.944444  0.036739  0.071436  0.271177
 2.000000  0.036739  0.073477  0.275024
 2.055556  0.036739  0.075518  0.278818
 2.111111  0.036739  0.077559  0.282560
 2.166667  0.036739  0.079600  0.286254
 2.222222  0.036739  0.081641  0.289901
 2.277778  0.036739  0.083682  0.293502
 2.333333  0.036739  0.085724  0.297060
 2.388889  0.036739  0.087765  0.300575
 2.444444  0.036739  0.089806  0.304050
 2.500000  0.036739  0.091847  0.307486
 2.555556  0.036739  0.093888  0.310884
 2.611111  0.036739  0.095929  0.314245
 2.666667  0.036739  0.097970  0.317570
 2.722222  0.036739  0.100011  0.320861
 2.777778  0.036739  0.102052  0.324119
 2.833333  0.036739  0.104093  0.327344
 2.888889  0.036739  0.106134  0.330538
 2.944444  0.036739  0.108175  0.333701
 3.000000  0.036739  0.110216  0.336834
 3.055556  0.036739  0.112257  0.339939
 3.111111  0.036739  0.114298  0.343015
 3.166667  0.036739  0.116339  0.346064
 3.222222  0.036739  0.118380  0.349087
 3.277778  0.036739  0.120421  0.362567
 3.333333  0.036739  0.122462  0.400558
 3.388889  0.036739  0.124503  0.452188
 3.444444  0.036739  0.126544  0.514328
 3.500000  0.036739  0.128585  0.585355
 3.555556  0.036739  0.130626  0.664227
 3.611111  0.036739  0.132667  0.750201
 3.666667  0.036739  0.134708  0.842713
 3.722222  0.036739  0.136749  0.941314
 3.777778  0.036739  0.138790  1.045636
 3.833333  0.036739  0.140831  1.155373
 3.888889  0.036739  0.142873  1.270261
 3.944444  0.036739  0.144914  1.390073
 4.000000  0.036739  0.146955  1.514608
 4.055556  0.036739  0.148996  1.725571
 4.111111  0.036739  0.151037  2.107778
 4.166667  0.036739  0.153078  2.596898
```

Exhibit 14 CUP22-02

```
  4.222222  0.036739  0.155119  3.162211
  4.277778  0.036739  0.157160  3.776723
  4.333333  0.036739  0.159201  4.413009
  4.388889  0.036739  0.161242  5.042997
  4.444444  0.036739  0.163283  5.639279
  4.500000  0.036739  0.165324  6.177293
  4.555556  0.036739  0.167365  6.638093
  4.611111  0.036739  0.169406  7.011605
  4.666667  0.036739  0.171447  7.300266
  4.722222  0.036739  0.173488  7.523025
  4.777778  0.036739  0.175529  7.800596
  4.833333  0.036739  0.177570  8.022420
  4.888889  0.036739  0.179611  8.237032
  4.944444  0.036739  0.181652  8.445097
  5.000000  0.036739  0.183693  8.647184
  END FTABLE  1
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
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
END EXT TARGETS

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

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

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

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

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

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

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16
```

```
END MASS-LINK

END RUN
```

Exhibit 14 CUP22-02

Predeveloped HSPF Message File

Mitigated HSPF Message File

Exhibit 14 CUP22-02

Disclaimer

Legal Notice

Exhibit 14 CUP22-02

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Exhibit 14 CUP22-02

Catch Basins and Curb Inlets

Catch basins and curb inlets trap sediment and some oils that are washed off the road surface during a storm event. This sediment and the oils if not removed from the basins and inlets have the potential to pollute water bodies. They need to be inspected and cleaned at a minimum annually, more often if necessary; to remove accumulated sediment, fluids, and trash.

Maintenance Results

R1	Avoid or minimize sediment and pollutant discharges from the work area.
R2	Prevent parking areas, roads, drainage systems, facilities, and property from becoming pollutant sources.
R7	Maintain or restore the intended infrastructure function
R8	Prevent or reduce flooding.
R9	Protect infrastructure.

Procedures

Inspection

Inspect catch basins and curb inlets at least once per year, more often if necessary.

Periodically inspect the catch basin or curb inlets and surrounding areas for pollutants, such as leaks from dumpsters, minor spills, and oil dumping. Act to have the pollutant source removed. Ensure that grass clippings and leave debris is not being blown into the streets.

Cleaning

Clean catch basins and curb inlets when they become one third full in order to maintain sediment-trapping capacity. Catch basin, curb inlet, and manhole cleaning should be performed in a manner that keeps removed sediment and contaminated water from being discharged back into the storm sewer.

Clean putrid materials from the catch basins and curb inlets when discovered or reported.

Keep the inlet grates cleared of debris and litter.

Safety

Work inside underground structures (e.g. manholes) requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor for this work.

Materials Handling

Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations, including the Minimum Functional Standards for Solid Waste handling Chapter 173-304 WAC; guidelines for disposal of waste materials; and where appropriate, Dangerous Waste Regulations, Chapter 173-303 WAC.

Exhibit 14 CUP22-02

Removed sediment must be disposed of in the garbage as solid waste. Contaminated water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed according to the manufacture's instructions.

Repairs
Repair any damages that prevent the catch basin or curb inlet from functioning as designed. An example is a broken or missing outlet elbow.

Follow the Procedures described under the Activity: Installation, Repair and Replacement of Enclosed Drainage Systems.

Manholes

Exhibit 14 CUP22-02

Manholes are large cylindrical vaults usually set at storm sewer pipe connections. Unless you have OSHA approved training and equipment, never enter a manhole. There is a considerable risk of poisonous gas and injury.

Maintenance Results

R1	Avoid or minimize sediment and pollutant discharges from the work area.
R2	Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
R7	Maintain or restore the intended infrastructure function.
R8	Prevent or reduce flooding.
R9	Protect infrastructure.

Procedures

Inspection

Inspect the manhole once per year. Check frame and lid for cracks and wear, such as rocking lids or lids move by traffic.

Periodically inspect the manhole and surrounding areas for pollutants such as leaks from dumpsters, minor spills, and oil dumping. Take action to have the pollutant source removed.

Cleaning

Clean manholes when there is a blockage of the stormwater channel. Cleaning should be performed in a way that ensures removed sediment and water is not discharged back into the storm sewer.

Safety

Never enter a confined space without proper training and safety gear. Work inside underground structures requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor.

Materials Handling

Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations, including the Minimum Functional Standards for Solid Waste handling Chapter 173-304 WAC; guidelines for disposal of waste materials; and where appropriate, Dangerous Waste Regulations, Chapter 173-303 WAC.

Removed sediment must be disposed of in the garbage as solid waste. Contaminated water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed according to the manufacture's instructions.

Repairs

Repair all security and access features so they are fully functional. This includes locking lids, cover, and ladder rungs.

Exhibit 14 CUP22-02

Replace broken parts or lids that rock or are moved by traffic.

Follow the practice described under the Activity: Installation, Repair and Replacement of Enclosed Drainage Systems.

Flow Control Structures/Flow Restrictors

Exhibit 14 CUP22-02

Flow control structures and flow restrictors direct or restrict flow in or out of a facility. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or be releasing water at too high of a rate. This would likely damage streams habitat and property. Site plans should have detailed drawings showing how the flow control structures should appear. Consult a licensed professional engineer or the City of Camas Public Works Department for assistance.

Maintenance Results

R2 Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
R7 Maintain or restore the intended infrastructure function.
R9 Protect infrastructure.

Procedures

Inspection

Inspect at least once per year for all features listed under Cleaning and Repairs, or when a facility does not drain properly or other problems occur.

Cleaning

Remove sediment within 18-inches of the bottom of an orifice plate.

Remove trash and debris that may block the orifice plate.

Remove any trash or debris that may bloc an overflow pipe.

Safety

Work inside underground structures requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor.

Materials Handling

Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations, including the Minimum Functional Standards for Solid Waste handling Chapter 173-304 WAC; guidelines for disposal of waste materials; and where appropriate, Dangerous Waste Regulations, Chapter 173-303 WAC.

Removed sediment must be disposed of in the garbage as solid waste. Contaminated water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed according to the manufacture's instructions.

Exhibit 14 CUP22-02

Repairs

Repair or replace to original design specification any outlet orifice that is enlarged, bypassed, or damaged.

Make certain that overflow outlets are not blocked.

Structures should be securely in place and within 10 percent of vertical.

Repair outlet pipe structures that have leaking connections or holes not specified by the design.

Repair or replace a non-functional or damaged cleanout gate.

Repair or replace damaged orifice plates to original design specification.

No outflow controls can be modified with approval of the City of Camas Public Works Department engineer.

Follow the practice described under the Activity: Installation, Repair and Replacement of Enclosed Drainage Systems.

Exhibit 14 CUP22-02

Storm Sewer/Drain Pipe

Storm sewer pipes convey stormwater. Storm pipes are constructed of many different types of materials and are sometimes perforated to allow groundwater to be collected by the storm system. Storm pipes are cleaned to remove sediment or blockages when problems are identified. Storm pipes must be clear of obstructions and breaks to prevent localized flooding.

Maintenance Results

O1	Avoid or minimize sediment and pollutant discharges from the work area.
O2	Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
O7	Maintain or restore the intended infrastructure function.
O8	Prevent or reduce flooding.
O9	Protect infrastructure.

Procedures

Inspection

Pipes are difficult to inspect requiring special equipment and training. Usually, if a problem occurs the owner needs to call a sewer of plumbing contractor to inspect, repair, or clean pipelines.

Cleaning

Clean pipes when sediment depth is greater than 20 percent of pipe diameter. When cleaning a pipe, minimize sediment and debris discharges from pipes to the storm sewer. Install downstream debris traps (where applicable) before cleaning and then remove material.

Generally, use mechanical methods to remove root obstructions from inside storm sewer pipes. Do not put root-dissolving chemicals in storm sewer pipes. If there is a problem, remove the vegetation over the line.

Safety

Work inside underground structures requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor.

Materials Handling

Sediment and debris from pipes should be disposed in the garbage as solid waste. Pick out any rocks first.

Repairs

Repair or replace pipes when a dent or break closes more than 20 percent of the pipe diameter.

Repair or replace pipes damaged by rust or deterioration.

Follow the practice described under the Activity: Installation, Repair, and Replacement of Enclosed Drainage Systems.

Exhibit 14 CUP22-02

Underground Detention Systems

Some detention systems consist of underground tanks or vaults that are usually placed under paved areas. They hold and slowly release stormwater runoff from roofs and pavement.

Tanks and vaults are confined spaces where work requires special OSHA-required training and equipment.

Maintenance Results

R1	Avoid or minimize sediment and pollutant discharges from the work area.
R2	Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
R7	Maintain or restore the intended infrastructure function.
R9	Protect infrastructure.

Procedures

Inspection

Inspect annually for the features listed under Cleaning and Repairs.

Periodically inspect the manhole and surrounding areas for pollutants such as leaks from dumpsters, minor spills, and oil dumping. Take action to have the pollutant source removed.

Cleaning

Remove trash and litter from the vault, inlet, and piping.

Clean air vents that have one-half of their area plugged.

Remove sediment when it accumulates to 1/10th the depth of a rectangular vault or 1/10th the diameter of a round tank or pipe.

Safety

Work inside underground structures requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor.

Materials Handling

Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations, including the Minimum Functional Standards for Solid Waste handling Chapter 173-304 WAC; guidelines for disposal of waste materials; and where appropriate, Dangerous Waste Regulations, Chapter 173-303 WAC.

Removed sediment must be disposed of in the garbage as solid waste. Contaminated water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed according to the manufacture’s instructions.

Exhibit 14 CUP22-02

Repairs
Repair any cracked or defective plates or baffles. Cracks are repaired so that no cracks greater than ¼-inch are present.

Any part of a tank or pipe that is bent out of shape more than 10 percent of its design shape must be replaced or repaired.

Repair any joints that are cracked and allow soil into the facility.

Repair all security and access features so they are fully functional. This includes locking lids, covers, and ladder rungs.

Follow the practice described under the Activity: Installation, Repair and Replacement of Enclosed Drainage Systems.

Exhibit 14 CUP22-02

Access Roads and Easements

Most stormwater facilities have access roads to bring in heavy equipment for facility maintenance. These roads should be maintained for inspection access and ease of equipment access.

Maintenance Results

R1 Avoid or minimize sediment and pollutant discharges from the work area.
R2 Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
R7 Maintain or restore the intended infrastructure function.
R10 Meet public expectations for aesthetics.

Procedures

Inspection
Inspect once a year or when facilities are maintained.

Cleaning
Remove litter when mowing or when there is any accumulation.

Remove any debris that blocks roads or may damage tires.

Vegetation Management
Manage vegetation as for the rest of the facility. Trees and shrubs may be removed from access roads and easements if they block access for necessary maintenance or will prevent or harm intended stormwater facility function. Use of pesticides is prohibited unless prior approval is received from the City.

Repairs
Correct any bare or eroded soils by seeding or a cover BMP.

Repair road surfaces when they may lead to erosion or limit equipment access.

Pavement Sweeping

Exhibit 14 CUP22-02

Pavement sweeping is performed as a means of removing sand, dirt, and litter from streets and curb gutters. Sweeping also reduces dust during dry weather. Pavement sweeping is also part of storm sewer maintenance procedure because it limits the amount of sediment washed into the storm sewer facilities. The water quality procedure for street sweeping focuses on sediment removal and disposal. Reducing the amount of sediment washed into catch basins, curb inlets, detention facilities, drywells, and other facilities can save money because sweeping is generally cheaper that removing sediment from facilities. Sweeping also helps protect facilities from clogging with sediment.

Maintenance Results

- R2 Prevent parking areas, roads, drainage systems, and drainage facilities from becoming pollutant sources.
- R5 Protect public safety and health.
- R10 Meet public expectations for aesthetics.

Procedures

Inspection

Inspect on a weekly basis, depending on traffic volumes.

Cleaning

Sweep the site to help keep sediment from entering storm sewer systems and water bodies.

Sweeping is especially useful for cleaning up work areas.

Sweeping can be as easy as using a couple of push brooms or as involved as using mechanical methods.

Materials Handling

Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations, including the Minimum Functional Standards for Solid Waste handling Chapter 173-304 WAC; guidelines for disposal of waste materials; and where appropriate, Dangerous Waste Regulations, Chapter 173-303 WAC.

Sweepings should be disposed of as solid waste or under a program permitted by the Southwest Washington Health District.

Exhibit 14 CUP22-02

PRE-APPLICATION MEETING NOTES

Brady & 16th Ave Commercial Project
PA21-54

Thursday, November 18, 2021
City Hall (no in-person meeting)
616 NE 4th Ave. Camas, WA. 98607

Applicant: Grant Hunter
16101 SW 72nd Avenue, Suite 135
Portland, OR 97224
503-220-8517
Email: granthunter@tilandschmidt.com

City of Camas: Lauren Hollenbeck, Senior Planner
Anita Ashton, Engineering Project Manager
Brian Smith, Building Official
Randy Miller, Fire Marshall

Location: Northwest corner of Brad Road and 16th Avenue
Camas, WA 98607
Parcel Number: 127357000

Zoning: Community Commercial (CC)

Description: The applicant is proposing the construction of 3 buildings to include a convenience store with car wash/gas station, drive thru coffee shop and retail space

---

NOTICE: Notwithstanding any representation by City staff at a pre-application conference, staff is not authorized to waive any requirement of the City Code. Any omission or failure by staff to recite to an applicant all relevant applicable code requirements shall not constitute a waiver by the City of any standard or requirement. [CMC 18.55.060 (C)] This pre-application conference shall be valid for a period of 180 days from the date it is held. If no application is filed within 180 days of the conference or meeting, the applicant must schedule and attend another conference before the City will accept a permit application. [CMC 18.55.060 (D)] Any changes to the code or other applicable laws, which take effect between the pre-application conference and submittal of an application, shall be applicable. [CMC 18.55.060 (D)]. A link to the Camas Municipal Code (CMC) can be found on the City of Camas website, http://www.cityofcamas.us on the main page under "City Codes".

PLANNING DIVISION LAUREN HOLLENBECK lhollenbeck@cityofcamas.us (360) 817-7253

Applicable codes for the proposed development include Title 16 Environment, Title 17 Land Development, and Title 18 Zoning of the Camas Municipal Code ("CMC"), which can be found on the city website. Please note it remains the **applicant's responsibility** to review the CMC and address all applicable provisions. The following pre-application notes are based on the application materials and site plan submitted to the City on November 1, 2021:

Exhibit 14 CUP22-02

Application Requirements

Your proposal will need to comply with the general application requirements per **CMC Section 18.55.110** as follows**:**

1. A completed city application form and required fee(s);
2. A complete list of the permit approvals sought by the applicant;

Fees will be based on the adopted fees at the time of land use application submittal. The current fees include the following:

1.	Site Plan Review	$2,876.00 + $68.00 per 1000 sf of GFA
2.	Major Design Review	$2,375.00
3.	SEPA	$810.00
4.	Archaeological Review	$137.00
5.	Fire Department Review	$424.00

Fees for building per permit are collected at the time of building permit submittal. Fees for engineering are collected at time of engineering plan approval.

6.	Building Permit and Plan Review	*based on the valuation of the project
7.	Engineering Review	3% of estimated construction costs

3. A current (within thirty days prior to application) mailing list and mailing labels of owners of real property within three hundred feet of the subject parcel, certified as based on the records of Clark County assessor;
4. A complete and detailed narrative description that describes the proposed development, existing site conditions, existing buildings, public facilities and services, and other natural features. The **narrative shall also explain how the criteria are or can be met**, and address any other information indicated by staff at the pre-application conference as being required;
5. Necessary drawings and reports- three sets and an electronic copy (send as a PDF by email or on a disc). Each report must be a separate pdf;
6. Copy of the pre-application meeting notes;

Site Plan Review

The application for Site Plan Review shall contain information outlined in CMC 18.18.040 (A-J). The application shall address in a **narrative** the criteria of approval CMC 18.18.060 (A-F). The site plan review development approval process is a Type II administrative decision. There are no building height, setback and lot coverage can be found in CMC 18.09.030 Table 1.

Major Design Review

Design Review is required for new developments in commercial zones pursuant to CMC Chapter 18.19.020 and reviewed by the Design Review Committee. The standards applicable to this property for Design Review are found in the Design Review Manual to include the *Standard Principles & Guidelines* <u>and</u> the *Specific Principles & Guidelines Commercial and Mixed Uses* including but not limited to:

- Building shall be used to define the streetscape. Building walls or fences visible from roadways should be articulated in order to avoid a blank look. The wall can be broken up by including some combination of window/display space, plantings and offsetting walls with two tone colors.
- On-site parking areas shall be placed to the interior of the development unless the development proves prohibitive.
- All parking shall be screened with landscaping. The drive-thru along street frontages shall be heavily landscaped.

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- The development adjacent to residential areas should be built with a size, scale and materials compatible with neighboring buildings. (Residential uses across the street)

A submittal for Design Review should include a narrative, site plan drawing, detailed landscape plan, exterior elevations, building materials and colors, lighting specs and plan, and sign plan (optional). A final design review decision is typically consolidated and issued with the Site Plan Review decision.

Landscaping Regulations

- A Tree Survey per CMC 18.13.045, which requires an inventory and assessment of existing trees prepared by a certified arborist or professional forester, is required if trees are proposed for removal.
- A Landscape, Tree and Vegetation plan must be submitted pursuant to CMC 18.13.050. A minimum 20 tree unit density per net acre (exclusive of critical area tracts) is required for new development per CMC 18.13.051 and shall be incorporated into the overall landscape plan.
- Landscape screening buffers shall be provided per CMC 18.13.055 Table 1. A 5-ft L1 landscape buffer is required along the property lines abutting commercial zones at the north and west property line. A 10-ft. L3 High screen landscape buffer will be required to screen the drive-thru from 16th Avenue.
- Landscaping for the parking lot shall comply the requirements in CMC 18.13.060 (A-H).

Parking Regulations

The proposed use will need to meet the automobile parking requirements pursuant to CMC Chapter 18.11. The number of off-street parking spaces is calculated based on the table at CMC 18.11.130 Standards as follows:

- Gas station with mini-market: 1 per nozzle plus 1 per 250 square feet of gross floor area
- Car wash: 2 spaces per stall, and 1 space per 2 employees
- Fast food restaurant/coffee kiosk: 1 space per 110 square feet of gross floor area, plus 6 stacking spaces for drive-thru lane
- Retail stores in general: Less than 5,000 square feet, 1 per 300 square feet. Greater than 5,000 square feet, 17 plus 1 per 1,500 square feet.

Per CMC 18.11.020(D), small car parking spaces are allowed at a maximum of 30% of the parking lot and can be small as 8’ by 15’ deep.

SEPA

Your proposal is not categorically exempt from the requirements of the State Environmental Policy Act (SEPA). Therefore, a SEPA environmental checklist is required.

Archeological Review

The site is in an area of moderate-high probability for the presence of archaeological objects as identified on Clark Co. GIS. If the site is within ¼ mile of an archaeological site, an archaeological predetermination will be required per CMC Section 16.31.070.A. Submit to the City proof of emailing or mailing the tribes per CMC 16.31.160.

ENGINEERING DIVISION AHMED YANKA ayanka@cityofcamas.us (360) 817-7258

General Requirements:

1. Civil site construction plans shall be prepared by a licensed Washington State Engineer in accordance with the *Camas Design Standards Manual (CDSM)* and CMC 17.19.040.
2. Per CMC 17.19.040.C.1 all utilities designed to serve the development shall be placed underground. This includes the dry utilities, such as power, fiber optics, cable, etc.

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3. *Engineering civil site improvements plans are not to be submitted until after land-use decision is issued.*
4. Engineering civil site improvement plans are to be submitted to Community Development (CDev) Engineering Dept. for review and approval.
5. The CDev Engineering Dept. is responsible for plan review (PR) and construction inspection (CI). A 3% PR&CI fee is collected by engineering for all infrastructure improvements.
   a. The 3% fee is based on a stamped engineer's estimate.
   b. The engineer's estimate is to include all improvements outside of the proposed building footprints.
   c. *Payment of the 1% plan review (PR) fee is required when the civil plans are submitted for first review*.
   d. *The 1st review will not begin until the 1% PR fee is paid.*
   e. *Payment of the 2% construction inspection (CI) fee is to be paid prior to release of approved construction drawings by the CDev Engineering Dept.*
6. *Building permit applications are not to be submitted until after final engineering plan approval, unless otherwise approved by the Building Official.*
7. The applicant will be required to purchase all permanent traffic control signs, street name signs, street lighting, and traffic control markings for the proposed development.
8. Work within the city right-of-way (ROW) will require an encroachment permit and approval of a traffic control plan (TCP), prior to start of any work. The encroachment permit and TCP is to be submitted to CDev engineering.
9. If applicable, existing wells and septic tanks and septic drain fields shall be abandoned in accordance with state and county guidelines per CMC 17.19.020 (A3).
10. Regulations for installation of public improvements, improvement agreements, bonding, final platting, final acceptance, etc. can be found at CMC 17.21.
11. The applicant will be responsible for ensuring that private utilities; underground power, telephone, gas, CATV, and associated appurtenances are installed.

Traffic/Transportation:

1. A transportation impact analysis (TIA) is required and shall be prepared in accordance with the City's adopted *Traffic Impact Study Guidelines* as outlined in the *CDSM*.
2. The Applicant will be required to have a traffic engineer analyze the following:
   a. Site distance at the applicant's access points onto NW Brady Road and NW 16th Avenue
   b. Vision clearance area is to be addressed, per CMC 18.17.030.
   c. An onsite traffic circulation plan showing ingress and egress, per CMC 17.19.040 (B.10.a). See 'On-site Parking Lot Requirements' under Streets.
   d. Address movement conflicts with nearby intersections and existing driveways.
   e. Provide trip AM and PM Peak distribution to and from the site down to less than 20 trips thru any given impacted intersection.
   f. Intersections to be analyzed will be based on trip distribution.
3. Per CDSM, Table 1 – Guideline for Geometry of Private Roadways:
   a. Note 2.c: Aisle dimensions: one-way aisles are a minimum of 15-feet wide; two-way aisles are a minimum of 24-feet wide.
   b. Note 2.d: Parking spaces are to be setback a minimum of 50-feet from back of sidewalk on an arterial.
4. A left-turn pocket from NW 16th Avenue onto the proposed development will be required and is to be addressed in the TIA.

Streets:

The proposed development is bordered by NW 16th Avenue on the south side and on the east side by NW Brady Road.

[NW 16th Avenue]:

1. NW 16th Avenue is classified as a 2 or 3 lane collector, with frontage improvements on the south side of the roadway only. The north side of the road has not been improved.
2. Per CMC 17.19.040.B.1, the applicant will be required to construct full-depth half-width street improvements along the frontage of the proposed development along the NW 16th Avenue frontage.
3. Per CMC 17.19.040.B.5, the applicant will be required to dedicate sufficient right-of-way for full half-width street improvements, typically 37-feet from centerline along the proposed frontage on the north side of NW 16th Avenue.
4. Per *CDSM Table 3, Access Spacing Standards* are 330-feet minimum and 600-feet max.
   There are two existing driveways located approximately 100-feet and 175-feet west of the proposed access off NW 16th Avenue. Additionally, the proposed access is approximately 300-feet from the intersection of NW 16th Avenue and NW Brady Road.
   a. The proposed location does not meet the minimum access spacing requirements. However, as the driveway access is located as far from the intersection of NW 16th Avenue & NW Brady Road as possible, the city engineer would be in support of a deviation from the minimum access spacing standards.
   b. The proposed access is to be a minimum 24-foot wide full ingress / egress access, with 25-feet curb radii on each side.

[NW Brady Road]:

5. NW Brady Road is a fully improved 3-lane arterial with two travel lanes and a center-turn pocket with sidewalk and planter strips on both sides.
6. No frontage improvements or right-of-way dedication will be required since the road is fully improved.
7. Per *CDSM Table 3, Access Spacing Standards,* 660-feet minimum and 1000-feet max.
   The proposed access off NW Brady Road is approximately 300-feet north of the intersection of NW Brady Road and NW 16th Avenue.
   a. The proposed access location does not meet the minimum access spacing requirements. However, as the driveway access is located as far from the intersection of NW Brady Road & NW 16th Avenue as possible, the city engineer would be in support of a deviation from the minimum access spacing standards.
   b. The proposed access is to be a minimum 24-foot wide limited access, with 25-feet curb radii on each side.
   c. Due to the existing left-turn pocket on NW Brady Road, at the intersection with NW 16th Avenue, this access will be restricted to a right-in / right-out only and is to be signed 'Left-turns are not permitted'.

[On-site Parking Lot Requirements]:

8. Per CDSM, Table 1 – Guideline for Geometry of Private Roadway:
   a. Note 2.c: Aisle dimensions: one-way aisles are a minimum of 15-feet wide; two-way aisles are a minimum of 24-feet wide.
   b. Note 2.d: Parking spaces are to be setback a minimum of 50-feet from back of sidewalk on an arterial and a minimum 40-feet from back of sidewalk on a collector.
9. Additional drive aisle widths may be required based on usage, truck sizes, on-site circulation plan, and input from Fire Marshall's Office.

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Stormwater:

1. The site of the proposed development is approximately 2.16 acres.
2. A preliminary stormwater report (TIR), in accordance with the latest edition of Ecology's *Stormwater Management Manual for Western Washington (current edition 2019 SWMMWW*), is required at time of application.
3. Per CMC 14.02 Stormwater Control, stormwater treatment and detention shall be designed in accordance with the latest edition of Ecology's *SWMMWW*.
4. Refer to Ecology's *Figure I-3.1 Flow Chart for Determining Requirements for New Development (Vol. I, Chapter 3)*.
    a. All development projects shall comply with Minimum Requirement (MR) #2 – Submittal of a Stormwater Pollution Prevent Plan (SWPPP).
    b. As the project results in 5,000 sf, or greater, of new plus replaced hard surface area; than Minimum Requirements (MR) #1- #9 will apply.
5. Ownership and maintenance of onsite stormwater facilities will be the responsibility of the property Owner, per CMC 17.19.040 (C3).
6. The City shall have right-of-entry for inspection purposes.
7. Onsite private storm easements, if required, are to be shown on the construction drawings.
8. Provisions are to be made for roof downspout controls. Stormwater from downspouts is not to be directed onto adjoining parcels. Reference Ecology's latest edition of the SWMMWW for roof downspout controls.
9. A designated concrete washout area (BMP C154, Vol. II, Chap. 3, pgs. 320-326) is to be shown on the site plans. The washout area is to be removed prior to issuance of final occupancy.

Erosion Control

1. The size of the proposed development is approximately 2.16 acres.
2. As the land-disturbing activities are greater than one acre, the applicant will be required to obtain an *NPDES Construction Stormwater General Permit* from Ecology, which includes the *Stormwater Pollution Prevention Plan (SWPPP)*. Copies of both are to be submitted to engineering prior to any land-disturbing activities.
3. The applicant will be responsible for all erosion and sediment control measures to ensure that sediment laden water does not leave the site or impact adjacent parcels.
4. Per CMC 17.21.030.B an erosion and sediment control (ESC) bond, in the amount 200% of the engineer's estimate for ESC measures, is to be submitted prior to any land-disturbing activities.
5. Mud tracking onto the road surface is discouraged and any mud tracking is to be cleaned up immediately.

Water:

1. There is an existing 12-inch water main located in NW 16th Avenue. There does not appear to be an existing water service stubbed from this water main to this parcel.
2. There is an existing 18-inch DIP water main located on the east side of NW Brady Road. There does not appear to be an existing water service stubbed from this water main to this parcel.
3. The applicant will be required to design and construct a minimum 8-inch ductile iron waterline for the proposed development.
4. The onsite water system shall be privately owned and maintained beyond the water meter by the property owner. The onsite fire line will require a Double Detector Check Valve (DDCV) which is to be located at the right-of-way.
5. Applicant shall demonstrate that there are adequate fire flows available for the development.
6. Onsite fire hydrants are to be private and shall be ordered and painted red from the factory.

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7. Irrigation systems will require a separate irrigation meter with Back Flow Device (BFD), which will be owned and maintained by the property owners.
8. Trenching and surface restoration within the public right-of-way is to be per CDSM Details G2 and G2A.
9. A 10-foot separation is required, within the right-of-way, between the waterline and sanitary sewer main.
10. Taps on the existing waterline are to be performed by a tapping Contractor approved by the City's Water/Sewer Dept. Approved list provided below.

<u>Sanitary Sewer:</u>

1. NW 16th Avenue: There is an existing 8-inch pressure sewer main located in the north side of NW 16th Avenue.
    - There <u>does not</u> appear to be an existing sewer lateral stubbed to this parcel from NW 16th Avenue.
2. NW Brady Road: There is an existing 10-inch PVC STEP sewer main located in NW Brady Road.
    - There appears to be an existing 6-inch STEP sewer lateral stubbed to the northern most corner of this parcel.
    - The applicant may be required to provide additional sewer laterals, one for each proposed use.
3. Trenching and surface restoration within the public right-of-way is to be per CDSM Details G2 and G2A.
4. The applicant will be responsible for the design, installation and maintenance of the private STEP sewer system that will serve the proposed development, per CMC 17.19.040 (C, 2, d.).
5. A 10-foot separation is required, within the right-of-way, between water service and sewer lateral.

<u>City Approved Tapping Contractors:</u>

1. A&A Drilling Services, Inc (water & pressure sewer):
    a. 16734 SE Kens Ct. #B, Milwaukie, OR 97267, 800-548-3827, http://www.aadrilling.com
2. Ferguson Waterworks (water only):
    a. 14103 NW 3rd Court, Vancouver, WA 98685, 360-896-8708, https://www.ferguson.com/branch/nw-3rd-ct-vancouver-wa-waterworks

<u>Parks/Trails:</u>

1. Not applicable.

<u>Garbage & Recycling:</u>

1. Location of onsite garbage and recycling receptacles is to be approved by the garbage and recycling providers.

<u>Impact Fees & System Development Charges (SDCs):</u>

1. The proposed development is located in the South District.
2. Impact Fees and SDCs are collected at time of building permit submittal.
3. The impact fees and SDCs noted below are for informational purposes only.
4. Impact fees and SDCs are adjusted on January 1st of each year.

<u>Impact Fees for 2021:</u>

Commercial use:

1. Traffic Impact Fees (TIF) - $3,555.00 per PM Peak Hour trip.
    a. Contact Engineering for estimated fees which will be based on usage and number of PM Peak Hour trips.

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- TIF credits are applicable and will be based on the number of PM Peak Hour trips generated by the new uses less the existing uses.

2. School Impact Fees (SIF) – Not applicable
3. Park/Open Space (PIF) – Not applicable
4. Fire (FIF) - $0.40 psf

<u>System Development Charges (SDCs) for 2021:</u>

1. Water
    a. 1” meter - $12,329.00 + $445.00 connection fee
    b. 1.5” meter - $24,657.00 + $851.00 connection fee
    c. 2” meter - $39,415.00 + Meter purchased and Installed by Developer
2. Sewer - Commercial
    a. 1” meter - $6,234.00 + $177.00 STEP/STEF Inspection
    b. 1.5” meter - $12,467.00 + $177.00 STEP/STEF Inspection
    c. 2” meter - $19,948.00 + $177.00 STEP/STEF Inspection
3. Sewer SDCs are based on the number and size of water meters.

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Report of Geotechnical Engineering Services

Camas Station
NW Brady Road & NW 16th Avenue
Camas, Washington

Prepared for

MAJ Development Corporation

February 7, 2022
0202499-006

HARTCROWSER
A division of Haley & Aldrich

A division of Haley & Aldrich

Exhibit 14 CUP22-02

Report of Geotechnical Engineering Services

Camas Station
NW Brady Road & NW 16th Avenue
Camas, Washington

Prepared for
MAJ Development Corporation

February 7, 2022
0202499-006

Prepared by
Hart Crowser, a division of Haley and Aldrich

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Report of Geotechnical Engineering Services

Camas Station
NW Brady Road & NW 16th Avenue
Camas, Washington

1.0 INTRODUCTION

Hart Crowser, a division of Haley and Aldrich, (Hart Crowser), is pleased to present this report to MAJ Development Corporation (MAJ) summarizing the results of our recent geotechnical field explorations, testing, and engineering analyses completed for the proposed development project located in Camas, Washington. Our work was completed in general accordance with our geotechnical engineering services agreement dated November 30, 2021.

The rectangular shaped property is a single approximately 2.2-acre parcel (127357000) on the west side of NW Brady Road, just north of NW 16th Avenue. The subject parcel is currently undeveloped and is covered primarily with trees, shrubbery, and grass. The configuration of the development is still being planned, although conceptually it will include up to 3 single-story buildings. Two retail buildings that are planned to be 2800 square feet and 4,000 square feet will be located on the northern portion of the property. The southern portion of the property will contain a 7,300 square foot convenience store and car wash along with a fueling station and corresponding underground fuel tanks. Associated parking, landscaping, and trash enclosures will be included in the development.

Based on our experience with similar developments, we anticipate that the buildings will be supported on shallow footings with structural loads up to 2.5 kips/lineal foot for strip footings and up to 75 kips for column footings. We anticipate that new paving will be constructed throughout the site, including asphalt drive aisles and parking stalls, and possibly concrete sidewalks and trash container pads.

Based on the sloping nature of the site, we anticipate that grading mass grading will be required with mass cuts on the order of 4 to 8 feet deep and mass fills of approximately 15 feet thick. Additionally, deeper excavations (up to approximately 20 feet) will be required for installation of fuel underground storage tanks (USTs) and utilities.

This report contains the results of our analysis and provides recommendations for design and construction of the proposed development. The first section of this report provides an overview of the project information discussed in the text. The main body of the report presents our geotechnical engineering findings and recommendations in detail. Figures are presented at the end of the text. The location of the site is shown on Figure 1, and the existing site layout and topography with the proposed developments overlain is shown on Figure 2. Supporting information is provided in the appendices. Appendix A contains site subsurface exploration logs, Appendix B contains the results of laboratory testing completed for our analysis, and Appendix C contains a historical geotechnical data from a prior report prepared by Hart Crowser for work on NW Brady Road.

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2.0 SCOPE OF SERVICES

The purpose of our geotechnical work was to evaluate the subsurface soil and groundwater conditions to aid in design and construction of the proposed development. Our scope of work was outlined in our proposal dated November 19, 2021, which generally included the following tasks:

- Reviewed readily available geologic, groundwater, and soil survey maps that cover the site vicinity.

- Conducted a field exploration program that included the following:
  - Marking the proposed exploration locations in the field and notifying the "One Call" service for public utility locates and engaging the services of a private utility locator for identifying on-site utilities.
  - Excavating 6 test pits to depths of 8.5 to 16 feet bgs.
  - Maintaining logs of the soils encountered in the explorations and collecting soil samples from the explorations.
  - Conducting 2 *in situ* infiltration tests at depths of 1.0 to 3.0 feet bgs.

- Conducted a program of laboratory testing on select soil samples. The laboratory tests conducted include moisture content, grain size distribution and Atterberg limits.

- Conducted engineering analysis to develop geotechnical design recommendations for infiltration systems, foundations, retaining walls, earthwork, pavements, and seismic design criteria.

- Evaluated code-based seismic hazards, including ground shaking and ground shaking amplification.

- Prepared this report outlining our findings and recommendations, including information related to the following:
  - Subsurface soil and groundwater conditions
  - Seismic hazards and design parameters
  - Site preparation and grading
  - Utility trench construction
  - Infiltration design parameters
  - Foundation design parameters
  - Lateral earth pressures
  - Pavement design

- Provided project management and support services, including coordinating staff and subcontractors and conducting telephone consultations and email communications with you and the design team.

3.0 SITE CONDITIONS

3.1 Geologic and Soil Mapping

The geology of the site is mapped in the United States Geologic Survey (USGS) Geologic *Map of the Camas Quadrangle, Clark County, Washington, and Multnomah County, Oregon* (Evarts and O'Connor 2008). The bedrock geology is mapped as “Basaltic Andesite of Prune Hill” (Qtbph), which are volcanic rocks of the Boring volcanic field and described as light to medium gray, microvesicular, basaltic andesite (Evarts and O’Connor 2008).

Based on available information regional groundwater in the project vicinity is greater than 100 feet below the ground surface. However, due to the presence of shallow bedrock, perched water may be encountered at the site. No nearby water well logs that encountered groundwater were found during our search of the Department of Ecology database. Nearby well logs were generally resource wells (e.g. geotechnical borings) which generally encountered clayey gravels, gravels and cobbles.

The near surface soils at the site are mapped by the U.S. Department of Agriculture (USDA) in the *Soil Survey of Clark County, Washington* (McGee 1972; USDA 2021) as mantled by Powell silt loam. The Powell unit is moderately well drained. The Powell soils are classified as hydrologic Soil Group D with a saturated hydraulic conductivity (permeability) of approximately 0.06 to 0.2 inches per hour in the most restrictive layer. Clark County (OTAK 2010) has classified the Powell silt loam as being part of Soil Group (SG) 3. As discussed in Section 6.0 Drainage Design Recommendations based on *in situ* soil characteristics and shallow perching water, it is our opinion that SG 4 is a more appropriate classification for the site soils.

3.2 Surface Conditions

The site is located at the northwest corner of NW 16th Avenue and NW Brady Road. The site is bound by single-family residential properties to the east, undeveloped property to the north, Prune Hill Sports Park to the south, and the recently closed Hidden Gardens Nursery to the west. The property is undeveloped and is covered in trees, shrubs, and grass.

The site slopes downward from the south to the north. The highest surveyed elevation of the site is about 525 feet (NAVD 88) located at the southwest corner of the site, and the lowest surveyed elevation of the site is 500 feet (NAVD 88) located at the northwest corner of the site.

3.3 Subsurface Conditions

3.3.1 General

Soil conditions interpreted from geologic maps and our explorations, in conjunction with soil properties inferred from field observations and laboratory tests, formed the basis for the conclusions and recommendations provided in this report.

We completed field explorations at the site by advancing six test pit excavations (designated TP-1 through TP-6) to depths of approximately 8.5 to 16.0 feet bgs. Two *in situ* soil infiltration tests were performed adjacent to test pits TP-2 (IT-2) and TP-5 (IT-1) at depths of approximately 3.0 to 1.0 feet bgs respectively.

The locations of the explorations are shown on Figure 2. Appendix A describes our field exploration procedures and presents field data and logs. Appendix B describes our laboratory testing procedures and results.

Based on the results of our explorations and visual field and laboratory observations of the site soils, the site is generally blanketed by residual soil derived from the underling basaltic andesite bedrock. The residual soil consists of an upper layer of lean clay that is underlain by very stiff gravelly clay, containing minor to moderate amounts of cobbles. Intact bedrock was not encountered in our explorations and is anticipated to be greater than approximately 15 feet bgs, though locally could be present at shallower depths. Detailed descriptions of the soils encountered are provided below.

3.3.2 Soils

Our explorations encountered 11 to 16 inches of topsoil throughout the site. Below the surface topsoil, we encountered residual soil. The uppermost layer of residual soil was between 6 and 8 feet thick and was gray-brown to yellow-brown lean clay. The consistency of the material determined from visual observation and excavator action indicate the material to be generally medium stiff to stiff. Moisture contents determined from laboratory testing varied between approximately 22 and 30 percent in this material. Fines content varied between approximately 88 and 92 percent.

Below the upper layer of residual soil, a lower layer was encountered that consisted of yellow-brown to red, clay with gravel and gravelly clay. These materials extended to depths of at least 16 feet bgs. The relative density/consistency of the material determined from visual observation and excavator action indicate the material is generally very dense/hard. Moisture contents determined from laboratory testing in the deeper residual soils ranged from approximately 20 to 28 percent. Fines content was approximately 57 percent for one sample from this layer. Grain size distribution analyses indicate that the material is classified as a gravelly clay with sand, however, based on the variability of the material observed during our explorations, we anticipate that this unit likely consists of clayey gravel and clay with gravel, as well. The material contained up to 20 percent of basaltic andesite cobbles. It was noted during lab testing that some of the gravels and cobbles were friable and could be broken down mechanically into smaller grain sizes.

Intact bedrock was not encountered in the explorations, though refer to the following section describing the condition of the bedrock that was encountered in nearby explorations.

3.3.3 Historical Borings

Historical borings from Hart Crower's previously completed project along Brady Road are generally consistent with the explorations at the site. Two borings, B-6 and B-8, were drilled adjacent to the current project site along Brady Road. Borings B-6 and B-8 indicates residual soil from below the pavement to explored depths of 5.5 feet and 16.5 feet, respectively.

Basaltic andesite was encountered below residual soil in historic borings and test pits to the north of the project site, including in test pit TP-1, located approximately 100 feet to the north of the subject site. That test pits encountered bedrock at a depth of 9 feet bgs. Several other test pits further from the site, encountered bedrock at depths of 7 to 15 feet bgs. The bedrock was described as consisting of slightly to highly weathered, gray to brown, moderately strong to very strong, slightly to moderately vesicular basaltic andesite. Cobbles consisting of basaltic andesite were also encountered within residual soils above intact bedrock.

Based on our review of these historical explorations and on available geologic information, we anticipate that intact bedrock is greater than 15 bgs at the subject site, though localized zones of intact rock could be encountered at shallower depths on site.

3.3.4 Groundwater

A regional groundwater table was not encountered during our explorations to a depth of 16 feet bgs. Based on our review of available groundwater data sources, we anticipate the groundwater at the site to be deep, greater than 100 feet bgs. However, during field exploration activities, we encountered ponding water and seepage in infiltration test hole IT-2 and test pits TP-2 through TP-6 at depths of 2 to 7 feet bgs. Seepage was observed to occur at the base of the topsoil layer and at the base of the upper layer of residual soil. Therefore, we expect to encounter perched water across the site, particularly during or after periods of rainfall.

3.3.5 Infiltration Testing

We performed two *in situ* infiltration tests at the project site. The tests were completed in shallow test holes advanced adjacent to the primary test pits. The infiltration tests were performed in general conformance with the methods prescribed in the City of Camas – Stormwater Design Standards Manual (Camas 2016). The results of the field testing and fines content and soil type are provided in Table 1. The drawdown and hydraulic conductivity values presented in Table 1 are not to be used for design but are provided to show the direct results of the field measurements and the calculated hydraulic conductivity.

Table 1 – Infiltration Test Data

Infiltration Test No.	Test Pit No.	Approximate Test Depth (feet)	Field Drawdown Rate (inches/hour)	Calculated Hydraulic Conductivity (inches/hour)	Soil Type (USCS)	Fines Content (percent)
IT-1	TP-2	3	0.7	0.15	CL	84.7
IT-2	TP-5	1	0[a]	0[a]	CL	93.2

Notes:

a. No infiltration observed during field testing. Perched water built up in the hole during testing.

The hydraulic conductivity of the on-site soils is sensitive to both the overall fines content as well as the relative size (gradation) of the sand particles. Both tests were performed in clay (CL).

Please refer to *Section 6.4 Infiltration Systems* for a discussion of our findings and recommendations regarding the design of infiltration systems.

3.4 Geologic and Seismic Hazards

3.4.1 Seismic Shaking

We evaluated potential seismic shaking at the site using data obtained from the U.S. Geologic Survey (USGS) Seismic Design Maps. The expected peak bedrock acceleration having a 2 percent probability of exceedance in 50 years (2,475-year return period) is 0.38 g. This value represents the peak acceleration on bedrock beneath the site and does not account for ground motion amplification due to site-specific effects. The peak ground acceleration (PGA) is determined by applying a site class factor to the peak bedrock acceleration. The PGA accounting for site amplification is PGA_M = 0.462 g. Refer to *Section 3.4.2 Site Classification* for a discussion of ground motion amplification.

We obtained a deaggregation of the seismic sources contributing to the expected peak bedrock acceleration shown above from the National Seismic Hazard Mapping Project website (USGS 2021a). Seismic sources contributing to this potential ground shaking include the shallow crustal faults of the Portland Hills fault system and the Cascadia Subduction Zone (CSZ) megathrust and intraplate sources. The data indicated that the "modal source" for shaking at the site at all potential periods of interest (0.0 to 2.0) is a magnitude 9.0+ earthquake epicentered at the CSZ approximately 94 kilometers from the site. The modal source generally signifies the earthquake with the highest contribution to the site earthquake hazard, in this instance a rupture along the CSZ.

3.4.2 Site Classification

The "Site Class" is a designation used by the 2018 International Building Code (IBC) and ASCE 7-16 to quantify ground motion amplification. The classification is based on the stiffness in the upper 100 feet of soil and bedrock materials at a site. The Washington State Department of Natural Resources (WSDNR) *Geologic Information Portal* (WSDNR 2021) maps the portion of the site to be developed as Site Class B. This is likely due to the mapping of shallow bedrock that is typically encountered in the area. However, during our explorations we did not encounter bedrock, and per section 3.3.3, we anticipate that bedrock is greater than 15 feet bgs. Therefore, due to the thick soil cover at our site, we recommend Site Class D.

3.4.3 Liquefaction

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles, resulting in the sudden loss of shear strength in the soil. Granular soils, which rely on interparticle friction for strength, are susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soils with low silt and clay contents are the most susceptible to liquefaction. Silty soils with low plasticity are moderately susceptible to liquefaction or cyclic softening under relatively higher levels of ground shaking. For any soil type, the soil must be saturated for liquefaction to occur.

Based on the clay-rich and generally stiff nature of the site soils, we consider the liquefaction potential of the site to be low.

3.4.4 Surface Fault Rupture

The nearest mapped active fault is the middle to late Quaternary Lacamas Lake Fault, located approximately 2.3 miles from the site (USGS 2021b). Therefore, we consider the risk of surface fault rupture at the site to be low.

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3.4.5 Earthquake-Induced Landsliding/Lateral Spreading

Based on the stiff to hard nature of the site soils, it is our opinion the potential for earthquake-induced landsliding and lateral spreading is very low.

4.0 CONCLUSIONS

Based on our explorations, testing, and analyses, it is our opinion that the site is suitable for the proposed development, provided the recommendations in this report are included in design and construction. We offer the following general summary of our conclusions.

- The site is generally blanketed by an approximately 6- to 8-foot-thick zone of medium stiff to stiff clay. The underlying soils generally consist of hard/very dense gravelly clay and clayey gravel. The soils are residual materials derived from the weathering of deeper bedrock materials and contains cobbles. Our explorations did not encounter intact bedrock to the maximum depth explored (16 feet), however, based on nearby explorations localized zones of bedrock may be encountered at shallower depths.

- The presence of cobbles (and potentially intact rock at depth) may make excavation difficult, particularly below 10 feet bgs.

- The site soils are clayey and moist, and will be easily disturbed during construction. The use of wet weather earthwork practices will likely be required at all times.

- A thick layer (up to 16 inches) of soft, organic-rich topsoil is present across the site. This material will need to be removed prior to the placement of fills, slabs, pavements, and/or foundations.

- The regional groundwater table is deep, though infiltrating surface water perches at shallow depth in the fine-grained residual soils. Our explorations encountered perched water at depths of 2 to 7 feet bgs. The project design should account for subsurface drainage systems to intercept perched water which may emerge from cut slopes or pads in cut areas, while the contractor should be prepared to encounter perched water across the site during construction.

- The site soils are suitable for support of structural improvements using conventional spread footing foundation systems.

- The site soils are clayey and are not suitable for infiltration of stormwater.

The following sections present our specific recommendations for structural and earthworks components of the project.

5.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

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5.1 Foundation Support Recommendations

5.1.1 General

Proposed structures (e.g. buildings, fuel canopies, trash enclosures, and other miscellaneous features) may be supported by conventional spread footings that bear on native soils or new fill. If undocumented fill, organic soils, or soft soils are encountered below foundations or slabs, then such materials should be removed and/or recompacted. New fill should be placed and compacted to a dense condition per *Section 8.0 Earthwork Recommendations* of this report.

The following recommendations are based on the assumption that maximum structural loads will be up to 75 kips for column footings and 2.5 kips per linear foot for continuous wall footings. If structural loads are greater, then we should be contacted to verify that our recommendations are appropriate.

5.1.2 Dimensions and Design Criteria

Spread footings may be designed using an allowable bearing pressure of 3,000 pounds per square foot (psf) for footings in native soil or on newly placed fill material. Continuous strip footings should have a minimum width of 1.25 feet, while isolated footings should have a minimum dimension of 2.0 feet. The bottom of perimeter footings should extend at least 16 inches below the adjacent exterior grade.

The bearing value provided above represents a net bearing pressure; the weight of the footings and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by one-third for short-term loads, such as wind or seismic forces.

5.1.3 Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressures on the sides of footings and by friction on the bearing surface. We recommend that passive earth pressures be calculated using an equivalent fluid density of 300 pounds per cubic foot (pcf). We recommend using a friction coefficient of 0.35 for foundations placed on native soil or 0.45 for foundations on a minimum 6-inch-thick aggregate base subgrade. The passive earth pressure and friction components may be combined, provided the passive component does not exceed two-thirds of the total. The lateral resistance values do not include safety factors.

5.1.4 Settlement

We estimate that total post-construction settlements should be less than approximately 1 inch, with differential settlement of half that amount between adjacent columns or over a 50-foot span for strip footings.

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5.1.5 Foundation Subgrade Preparation

Footing excavations should expose competent native soil or new engineered fill. If undocumented fill, soft soils, or organic materials are encountered, these materials should be removed and/or reworked (e.g., organics and debris removed and then recompacted). Refer to *Section 8.0 Earthwork Recommendations* of this report for guidelines related to the placement of structural fill at the site.

Prior to the placement of reinforcing steel in the footing excavations, all loose or disturbed soils should be removed. If water infiltrates and pools in the excavation, the water, along with any disturbed soil, should be removed before placing the reinforcing steel. If construction is undertaken during periods of rain, we recommend that a layer of imported granular material or a lean concrete mud mat be placed over the base of footing excavations, as water will tend to perch/pond within excavations. The granular material or lean concrete reduces subgrade disturbance from standing water and from foot traffic during forming and tying of reinforcing steel. Typically, 3 to 4 inches of granular material that is lightly compacted until well keyed provides sufficient protection from disturbance.

We recommend that Hart Crowser observe all foundation excavations before placement of aggregate or mud mat base to determine that bearing surfaces have been adequately prepared and that the soil conditions are consistent with those anticipated during design.

5.2 Canopy Foundation Support Recommendations

5.2.1 General

It is our understanding that drilled shafts or formed column (e.g., excavated and formed with sonotube) systems are the preferred foundation type to support the proposed fueling station canopy structure. If desired, spread footings as noted in the prior section can also be used to support the canopies. It is also our understanding that typical design axial downward loads for the canopy structure are approximately 25 kips per column but that uplift forces generally control design. Shaft foundations are typically 4 to 5 feet in diameter and generally 5 to 8 feet deep, depending upon subsurface conditions and design loads.

5.2.2 Axial Capacity

Shafts/columns that are founded in the upper residual soils (approximately 8 feet) may derive their support by side friction or end bearing. An allowable skin friction of 550 psf may be use or an end bearing of 3,500 psf. However, the upper 2 feet of the shaft should be ignored for both uplift and downward loads. If shafts/columns extend to the hard/very dense residual soil found approximately 8 feet below grade, an allowable end bearing of 10,000 psf may be assumed.

Uplift forces can also be resisted by the weight of the shafts. The full weight of the pier can be used in uplift calculations without application of a safety factor.

5.2.3 Lateral Resistance

Lateral loads on shafts can be resisted by passive earth pressures on the sides of shafts. We recommend that passive earth pressures be calculated using an equivalent fluid density of 300 pcf. Below a depth of 8 feet, a passive resistance of 500 pcf may be assumed. The passive resistance for individual shafts can be applied over 2 projected shaft diameters. We recommend that the upper 2 feet of the shaft be ignored for passive resistance. These passive resistance values do not have a factor of safety applied.

5.2.4 Settlement

Shafts designed and constructed as recommended are expected to experience static settlements of less than 1 inch under static loading for shafts design via frictional resistance, and less than 0.5 inch for end bearing shafts. Differential settlements of up to one half of the total settlement magnitude can be expected between adjacent footings supporting comparable loads.

5.2.5 Construction Considerations

The site soils are fine grained and shaft excavations should generally remain stable for short periods of time. However, if groundwater seepage is present, then the soils will tend to cave and slough in unsupported excavations. The contractor should be prepared to use casing if perched water is present. If seepage builds up in the base of the shaft excavation, then we recommend that a minimum 6 inch layer of clean, crushed rock be placed in the base of the shaft. Also, perched water that collects at the base of an excavated shaft should be removed just prior to the placement of concrete.

5.3 Floor Slabs

Satisfactory subgrade support for concrete slabs supporting up to 175 psf areal loading can be obtained from the new structural fill or native subgrade prepared in accordance with *Section 8.0 Earthwork Recommendations*.

A minimum 6-inch-thick layer of aggregate base should be placed over the prepared subgrade to assist as a capillary break. Aggregate base material placed directly below the slab should be 3/4- to 1-inch maximum size and have less than 5 percent fines. Flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier, if needed, should be based on discussions among members of the design team.

Slabs should be reinforced according to their proposed use and per the structural engineer's recommendations. Load-bearing concrete slabs may be designed assuming a modulus of subgrade reaction, k, of 200 pounds per square inch per inch, provided the site is prepared as recommended in this report.

In areas where structures are constructed over "cut" pads, it may be prudent to install a subslab drainage system to intercept seepage which may emanate from the subgrade. Refer to Section 6.3 Subsurface Drainage for additional discussion.

5.4 Seismic Design

We anticipate that seismic design will be in accordance with the 2018 IBC and ASCE 7-16 requirements. We obtained seismic design parameters from the U.S. Geologic Survey (USGS) Seismic Design Maps for

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Latitude 45.591 and Longitude -122.454 for the 2,475-year return period. The parameters provided in Table 2 are appropriate based on the assumption that ASCE 7-16 Chapter 11.4.7 Exceptions are applicable.

Table 2 – Seismic Design Parameters

Parameter	Value
Site Class	D
Spectral Response Acceleration, S_s	0.838 g
Spectral Response Acceleration, S_1	0.360 g
Site Coefficient, F_a	1.165
Site Coefficient, F_v	1.940 [a]
Spectral Response Acceleration (Short Period), S_{DS}	0.651 g
Spectral Response Acceleration (1-Second Period), S_{D1}	0.465 [a]
Highest Period of Peak Spectral Acceleration, 1.5Ts (s)	1.071 [b]
Maximum Considered Earthquake Peak Ground Acceleration, PGA	0.378 g
Site Coefficient, F_{PGA}	1.222
Site Modified PGA, PGA_M	0.462 g

Notes:

a. Site Class D with S_1 greater than or equal to 0.2 shall have a site-specific ground motion hazard analysis shall be performed unless excepted per ASCE 7-16 Section 11.4.8. Values in the table include all relevant exceptions and assume that no base isolation will be included in design of the foundations. F_v provided for calculation of T_s only.

b. Per exception 2 of ASCE 7-16, Section 11.4.8, provided the structure will not include base isolation, structures on Site Class D with S_1 greater than or equal to 0.2, the seismic response coefficient C_s is determined by Eq. (12.8-2) for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \geq T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$. The value shown includes the 1.5 multiplier for T_s.

5.5 UST Design Considerations

The USTs will be installed not be installed below the regional groundwater table, however, due to the presence of shallow perched seepage, it is our opinion that there is a high potential for UST excavations to fill up with perched water. Therefore, USTs should be designed to resist uplift forces. Uplift forces can be resisted by using gravity loads and anchors (e.g., thick concrete support slabs) or uplift resistance from deep foundation elements. If the use of deep foundation elements is desired for resistance to uplift, then additional analysis will be required.

5.6 Permanent Retaining Structures

Permanent retaining walls will be required to retain the slopes on the eastern and northern edges of the property, as well as select locations within the interior parking areas. Per City of Camas regulations, the maximum exposed retaining wall height allowed is 6 feet; therefore, terraced retaining wall will likely be required. We anticipate the terraced retaining walls will have a maximum combined height of approximately 12 feet. The retaining walls may consist of cast-in-place (CIP) concrete walls or modular block walls founded on native soils, imported borrow, or a layer of aggregate base over native soils. The walls should be designed and constructed in accordance with the following recommendations.

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5.6.1 CIP Walls

5.6.1.1 Earth Pressures

CIP concrete walls should be designed to resist wall backfill earth pressures as shown in Table 3. The designer should also include hydrostatic forces, as appropriate.

Table 3 – CIP Wall Earth Pressures

Retained Material	Condition	Horizontal Earth Pressure Coefficient	Lateral Pressure
Native Soil	Active – level backslope	$K_{\alpha} = 0.41$	45 pcf
	Active – 2H:1V backslope	$K_{\alpha} = 0.85$	94 pcf
	At-Rest	$K_0 = 0.58$	64 pcf
General Structural Fill	Active – level backslope	$K_{\alpha} = 0.28$	35 pcf
	Active – 2H:1V backslope	$K_{\alpha} = 0.44$	55 pcf
	At-Rest	$K_0 = 0.47$	59 pcf
Select Structural Fill	Active – level backslope	$K_{\alpha} = 0.24$	31 pcf
	Active – 2H:1V backslope	$K_{\alpha} = 0.35$	45 pcf
	At-Rest	$K_0 = 0.41$	54 pcf
All Backfill Seismic Surcharge	Active – level backslope	-	10H psf
	Active – 2H:1V backslope		15H psf
	At Rest	-	16H psf

Notes:

a. Native Soil assumed to have a unit weight of 110 pcf and a friction angle of 25 degrees.

b. General Structural Fill assumed to have a unit weight of 125 pcf, have a friction angle of 32 degrees, and be placed and compacted per *Section 8.0 – Earthwork Recommendations.*

c. Select Structural Fill assumed to have a unit weight of 130 pcf, have a friction angle of 36 degrees, and meet the specifications provided in WSS 9-03.12(2) – Gravel Backfill or WSS 9-03.12(4) – Gravel Backfill for Drains.

d. For the seismic condition, it was assumed that the active condition will be reached during the event as per the Mononobe-Okabe method. The seismic pressure should be modeled as a rectangular pressure centered at a height of 0.6 of the wall's height.

e. For intermediate backslopes between level and 2 horizontal to 1 vertical (2H:1V), linearly interpolate between the values provided.

For walls that can move at least 0.1 percent of its height (e.g., yielding wall), the design should use active pressures. Where walls are restrained from moving this distance, then they are considered "non-yielding" and should be designed with at-rest pressures.

The walls should be designed to resist surcharge loads from adjacent footings, equipment, materials, and vehicular loads placed within a 1H:1V projection from the base of wall.

5.6.1.2 CIP Foundations

The foundations for gravity retaining walls should be designed in accordance with *Section 5.1 Foundation Support Recommendations*.

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5.6.2 Modular Block Walls

5.6.2.1 Design Parameters

Modular block walls can consist of geogrid-reinforced mechanically stabilized earth (MSE) walls or gravity block walls. Modular block wall design should be based on the soil parameters presented in Table 4.

Table 4 – SE and Modular Block Wall Design Parameters

Material	Unit Weight, γ (pcf)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)
Reinforced Zone Fill	130	36	0
Retained Soil (*In Situ*)	110	25	50
Retained Soil (New Fill)	130	36	0
Foundation Soil (*In Situ*)	115	26	50
Foundation Soil (New Fill)	125	34	0

The “reinforced zone fill” used for backfill within the geogrid zone behind the MSE blocks should meet the specifications provided in Washington State Department of Transportation (WSDOT) *Standard Specifications* (WSS) 9-03.14(4) – Gravel Borrow for Geosynthetic Retaining Wall. “Foundation Soil (New Fill)” is new mass fills or an area of native soil that is overexcavated and replaced with new fill per Section 8.6 Structural Fill and Backfill. “Foundation soil (*in situ*)” should be competent native soils evaluated by Hart Crowser or their representative.

For the seismic evaluation of modular block retaining walls, the designer may assume an allowable displacement of 4 inches during seismic shaking. The determination of a horizontal seismic coefficient, k_h, should be based on the PGA adjusted for site class (PGA_M from Table 2). The vertical acceleration coefficient, k_V, may be assumed to be 0.

Modular block walls should be constructed in general accordance with the specifications provided in WSS 6-13 – Structural Earth Walls. In general walls over 4 feet tall will require reinforcing geosynthetic that has a length equal to approximately 70 percent of the wall height. Terraced retaining walls will need to be evaluated for global stability, though in general the reinforcing for the lower wall is sized as though it is the lower portion of a wall with a total height equal to the combined wall height. However, this will vary depending upon the spacing and height of the walls.

5.6.2.2 Modular Block Wall Foundations

The design of modular block wall foundations should be based on the soil parameters presented in Table 4. In order to satisfy global stability, the base of any block wall should be embedded no less than 18 inches below the lowest adjacent grade where there are slopes steeper than 4H:1V below the slope. Where there are no slopes below the walls, the base of block wall foundations should extend a minimum of 12 inches below lowest adjacent grade.

If the walls are founded on native soils, there is a potential that localized zones of soft, loose, or organic material may be present. Localized removal and replacement of such material may be required.

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All walls should be underlain by a minimum 6-inch-thick layer of compacted gravel. The gravel pad should extend at least 6 inches in front and behind the blocks.

5.6.3 Wall Drainage and Backfill

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent hydrostatic pressures above the groundwater table.

Unless the retaining walls are designed to resist earth pressures from native soils (as noted above), the backfill material placed behind the walls and extending a horizontal distance equal to at least half of the height of the retaining wall should consist of select granular retaining wall backfill.

A minimum 12-inch-wide zone of drain rock, extending from the base of the wall to within 6 inches of finished grade, should be placed against the back of all retaining walls. Perforated collector pipes should be embedded at the base of the drain rock. The drain rock should meet the requirements provided in *Section 8 Earthwork Recommendations*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the wall's drainage system.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D 1557. However, backfill located within a horizontal distance of 3 feet from retaining walls should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D 1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (e.g., jumping jack or vibratory plate compactors). If flat work (e.g., sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

Settlements of up to 1 percent of the wall height commonly occur immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of buildings directly above retaining walls be postponed at least 4 weeks after backfilling of the wall, unless survey data indicate that settlement is complete prior to that time.

6.0 DRAINAGE DESIGN RECOMMENDATIONS

6.1 Temporary Drainage

During mass grading at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the building site, the contractor should keep all footing excavations and building pads free of water.

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6.2 Surface Drainage

The finished ground surface around buildings should be sloped away from their foundations at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. They should not be attached to footing or subslab drains. Trapped planter areas should not be created adjacent to buildings without providing means for positive drainage (i.e., swales or catch basins).

We note that for evaluation of pre- and post-development runoff from the site the Western Washington Hydrology Model for Clark County (WWHMCC) as discussed in OTAK (2010) has identified the site soils (Powell silt loam) as being Clark County Hydrologic Soil Group (SG) 3. The WWHMCC notes that soils with mapped permeability rates of 0.2 to 0.63 inches/hour were mapped as SG 3, while soils with permeability rates less than 0.06 inches/hour were mapped as SG 4. The on-site Powell silt loam soils have an intermediate mapped permeability of 0.06 to 0.2 inches per hour. They were classified as SG 3 based on "…(*Soil Survey*) information indicating that this soil is moderately well drained with a moderate water capacity." However, based on our field infiltration testing indicating little to no infiltration, our laboratory testing indicating the soil is a clay, and the presence of shallow perching water, **the soils at the site are more appropriately classified as SG 4.**

6.3 Subsurface Drainage

As notes previously perched water and shallow seepage was encountered at the site. This is a common phenomenon in the project vicinity. Therefore, we recommend the use of subsurface drainage systems in "cut" areas, including in cut slopes and beneath structures in cut areas. The subsurface drainage system can consist of perimeter footing drains, subslab drains, or mid-slope subdrains, depending on the condition exposed in the field.

We also note that the use of irrigation and improper maintenance of surface drainage gradients adjacent to buildings can often result in adverse conditions which direct irrigation or surface runoff towards buildings. Because of the impermeable nature of the site soils, it would be prudent though not required, to install a perimeter footing drainage system around the proposed buildings. Alternatively, if a subslab radon barrier system is installed beneath slabs, then subdrainage can be incorporated into that system.

We recommend that Hart Crowser be provided an opportunity to review proposed grading plans and to identify areas where subdrainage may be appropriate.

We note that the discharges for subsurface drainage systems should not be tied directly into the stormwater drainage system unless mechanisms are installed to prevent backflow.

6.3.1 Footing Drain or Slope Subdrain

Where seepage is anticipated or identified on slopes or where a footing drain is to be installed around the perimeter of a building, a subdrain should be installed. The subdrain system should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 12 inches below the lowest adjacent grade adjacent to buildings or 2 feet below grade on slopes. A perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet specifications outlined in *Section 8.6 - Structural Fill and Backfill*.

6.3.2 Subslab Drain

A subslab drain is similar to a subdrain, but instead of a trench it consists of a layer of drain rock covering the subgrade beneath a slab. This rock blanket can replace the aggregate base required beneath slabs. Also, subslab radon collection systems can act as a blanket drain if properly detailed for drainage.

In general, subslab drains will include an 8- to 12-inch-thick layer of clean drain rock underlain by a layer drainage geotextile. Perforated drainage pipes should be embedded in the drain rock to collect water which gathers in the subgrade. The drain rock should be covered with a vapor barrier. Placement of a thin sand layer over the drain rock is often considered, though its use should be reviewed with the architect and flooring manufacturers.

6.4 Infiltration Systems

The results of on-site field infiltration testing are described in Section 3.3.5 Infiltration Testing. In general, we found that the soils are not suitable for infiltration with unfactored hydraulic conductivity values between 0.0 and 0.15 inches/hour. With a minimum soils correction factor of 2, the maximum allowable design infiltration rate would be 0.0 to 0.08 inches/hour. However, due to the variability of the test results, a higher soils correction factor would be identified, and the allowable design rate would likely be 0.04 inches/hour or less. As such, we consider the use of infiltration systems to be infeasible.

7.0 PAVEMENT DESIGN RECOMMENDATIONS

7.1 General

Our pavement design recommendations for the commercial pavement areas include options for conventional flexible AC or rigid PCC pavement. Our design thicknesses assume that new pavements will be supported by a subgrade prepared in conformance with *Section 8.0 Earthwork Recommendations* of this report.

We include our assumptions regarding traffic in the section below. If any of these assumptions are inaccurate, please contact us to develop updated recommendations.

7.2 Pavement Design Assumptions

We made the following assumptions regarding, and used the following parameters for, the design of the pavement sections.

- Traffic to the site will include the following:
  - Up to 5,000 passenger vehicles and light trucks per day distributed over several drive aisles
  - Up to 3 single unit delivery trucks (FHWA Class 5 or 6) per day
  - Up to 2 full size truck (FHWA Class 9) per day
  - Up to 5 fuel deliveries by double tanker truck (FHWA Class 12 or 13) per week

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- Based on the traffic loading noted above and a 2 percent annual growth rate, we estimate the 20-year design life equivalent single-axle loads (ESALs) to be approximately 100,000 for drive aisles.
- A resilient modulus of 8,000 pounds per square inch (psi) was estimated for a subgrade that has been moisture conditioned and compacted in conformance with *Section 8.0 Earthwork Recommendations* of this report.
- A resilient modulus of 25,000 psi was estimated for the base rock.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability and standard deviation of 85 percent and 0.45, respectively.
- Structural coefficients of 0.45 and 0.12 for the AC and base rock layers, respectively.
- Minimum moduli of rupture and elasticity of 570 and 3,600,000 psi, respectively, for conventional PCC.
- Minimum compressive strength of 4,000 psi for conventional PCC.

Also, construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed road sections, an allowance for additional traffic will need to be made in the design pavement section.

7.3 Pavement Sections

The AC pavement sections in Table 5 are minimum recommended material thicknesses.

Table 5 –AC Pavement Sections

Traffic Basis	AC Thickness (inches)	Aggregate Base Thickness (inches)
Drive Aisles	3.0	8.0
Parking Stalls	2.5	6.0

The PCC pavement sections in Table 6 include both reinforced and unreinforced sections and are valid for all of the traffic levels. The unreinforced PCC pavement would most typically be used in areas that receive “pass through” traffic, such as decorative cross-walks, etc.; whereas, the reinforced PCC pavement would typically be used as areas with extensive vehicular braking and increased long-term performance requirements, such as at the fueling stations.

Table 6 –PCC Pavement Sections

PCC Pavement Type	PCC Thickness (inches)	Aggregate Base Thickness (inches)
Unreinforced	5.0	6.0
Reinforced	6.0	6.0

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7.4 Pavement Materials

7.4.1 Flexible AC

Flexible AC should be 1/2-inch hot mix asphalt in conformance with the specifications provided in Washington State Department of Transportation (WSDOT) *Standard Specifications* (WSS) 5 04 – Hot Mix Asphalt and WSS 9 03.8 – Aggregates for Hot Mix Asphalt (WSDOT 2020). The AC binder should be PG 64-22 Performance Grade Asphalt Cement according to WSS 9-02.1(4) – Performance Graded Asphalt Binder. The AC should be placed with a minimum lift thickness of 1.5 inches and be compacted to at least 91 percent of Rice Density of the mix, as determined in accordance with American Society for Testing and Materials (ASTM) D 2041.

7.4.2 Rigid PCC

Rigid PCC pavement should meet the specifications provided in WSS 5 05 – Cement Concrete Pavement. The PCC should have a minimum compressive strength of 4,000 psi and nominal maximum aggregate size of 1.5 inches. The PCC should be constructed with a maximum joint spacing of 15 feet.

Unreinforced slabs should be interlocked at contraction joints (e.g., continuous slab with no dowels), although dowels should be used at construction and expansion joints. Reinforced PCC should have No. 4 bars at 24 inches on center, each way at the mid-depth of the PCC.

7.4.3 Aggregate Base

Imported granular material used as base aggregate (base rock) should meet the criteria specified in *Section 8.6 Structural Fill and Backfill* of this report. The base aggregate should be compacted to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

8.0 EARTHWORK RECOMMENDATIONS

8.1 General

Based on the sloping nature of the site, we anticipate that grading mass grading will be required with mass cuts on the order of 4 to 8 feet deep and mass fills of approximately 15 feet thick. Additionally, deeper excavations (up to approximately 20 feet) will be required for installation of fuel underground storage tanks (USTs) and utilities. We recommend that earthwork activities be conducted in accordance with the WSS (WSDOT 2021).

8.2 Site Preparation

8.2.1 Clearing and Grading

Initial site preparation and earthwork operations will include stripping and grading to establish subgrade elevation for improvements. We estimate the depth of soft, organic-rich material to be stripped is between 11 and 16 inches (average 14 inches). Actual stripping depths should be based on field observations at the time of construction. Stripped material should be transported off-site for disposal or stockpiled for use in landscaped areas.

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Trees and their root balls should be grubbed out to the depth of significant roots, which could exceed 3 to 5 feet bgs for the tall conifer trees. Depending on the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with compacted structural fill.

Any cavities resulting from removal of the unsuitable soils and/or previous establishments shall be cleared of debris and backfilled with structural fill.

8.2.2 Subgrade Preparation and Evaluation

Following stripping, site preparation, and rough grading, the suitability of the subgrade should be evaluated by proof rolling with a fully loaded dump truck or similar heavy rubber-tired construction equipment to identify any remaining soft, loose, or unsuitable areas. The proof roll should be conducted prior to placing new fill. Proof rolling should be observed by a representative of Hart Crowser who would evaluate the suitability of the subgrade and identify areas of yielding that are indicative of soft or loose soil. During wet weather or when the exposed subgrade is wet or unsuitable for proof rolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations and probing should be performed by Hart Crowser.

If soft or loose zones are identified during proof rolling or probing, these areas should be excavated to the extent indicated by Hart Crowser and replaced with structural fill.

If site preparation activities cause excessive subgrade disturbance, replacement with imported structural fill may be necessary. Disturbance to the subgrade should be expected if site preparation and earthwork are conducted during periods of excessive wet weather and/or when the moisture content of the surficial soil exceeds optimum.

8.3 Wet Soil/Wet Weather Construction

The near-surface site soils generally consist of silt, silty clay and clay. These materials are highly susceptible to becoming disturbed when they are wet or heavily trafficked. If not carefully executed, site preparation, utility trench work, and pavement construction can create extensive soft areas, and significant repair costs can result. Earthwork planning should include considerations for minimizing subgrade disturbance.

We anticipate that wet soils/wet weather earthwork practices will need to be employed at all times, regardless of the season. However, if earthwork is completed during rainy weather or during periods of high moisture content in the soil, then significant difficulties in trafficking and placement of fill will occur. In that case, the subgrade may need to be stabilized by removal and replacement with geotextile stabilization fabric and granular fill or cement amending of the *in situ* soil.

8.3.1 Removal and Replacement

Soft and/or wet soils can be removed and replaced with imported granular fill. Stabilization rock and possibly select granular fill can be used as the initial lift of structural fill over a softer subgrade. The native soil subgrade would be covered by a stabilization geotextile fabric and then covered with 12 to 18 inches of stabilization rock/select granular fill, depending upon the subgrade condition, finished grades, and the contractor's means and methods. This may require partial removal and replacement to meet design grades.

8.3.2 Soil Amendment with Cement

As an alternative to the use of imported granular material for structural fill, the on-site soils can be amended with Portland cement to obtain suitable support properties. Portland cement-amended soils are hard and have low permeability. They should not be used if runoff during construction cannot be properly controlled.

Treatment depths for subgrades, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. To protect the cement-treated surfaces from abrasion or damage, the finished surface is typically covered with 4 to 6 inches of imported granular material.

The actual thickness of the amended material, percentage of added cement, and thickness of imported granular material will depend on the anticipated subgrade usage, as well as the contractor's means and methods, and accordingly, should be the contractor's responsibility.

If the subgrade is be amended with cement, refer to *Section 8.6.7 Soil Amendment with Cement* for additional discussion.

8.3.3 Haul Roads

One method for minimizing subgrade disturbance during construction is through the use of temporary haul roads and staging areas. Based on our experience, between 12 and 18 inches of imported granular material is generally required to construct staging areas and haul roads that will support typical construction traffic. However, the actual thickness will depend on the contractor's means and methods, and accordingly, should be the contractor's responsibility. Additionally, a geotextile fabric may be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic to provide separation between the imported rock and native soils. The imported granular material and geotextile fabric should meet the specifications in *Section 8.6 Structural Fill and Backfill* of this report.

8.4 Excavation

8.4.1 General Excavations

Site soils are generally medium stiff to stiff within expected excavation depths. It is our opinion that conventional earthmoving equipment in proper working condition should be capable of making necessary general excavations for utilities, footings, and other earthwork. However, difficult excavation may be encountered where deeper, harder residual soils with cobbles or intact rock are encountered on site. The earthwork contractor should be responsible for providing equipment and following procedures as needed to excavate the site soils as described in this report.

Permanent slope excavations should have a maximum gradient of 2 horizontal to 1 vertical (2H:1V).

8.4.2 Temporary Excavation Stability

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Due to the potential for perched water near the ground surface, even shallow excavations will have a high susceptibility to sloughing, raveling, or caving. Open excavation techniques may be used for temporary excavations above the groundwater table. For planning purposes only, we expect that temporary cut slopes (but not trench excavations) may be excavated at an angle of 1H:1V or flatter. However, because of the variables involved, actual slope angles required for stability in temporary cut areas can only be estimated before construction. We recommend that stability of the temporary slopes used for construction be the responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the subsurface.

All temporary soil cuts associated with site excavations should be adequately sloped back to prevent sloughing and collapse, in accordance with Department of Occupational Safety and Health (DOSH) Chapter 296-155 Washington Administrative Code (WAC) Part N Excavation, Trenching and Shoring Occupational Safety and Health Administration (OSHA) guidelines.

The stability and safety of cut slopes depend on a number of factors, including:

- The type and density of the soil
- The presence and amount of any seepage
- Depth of cut
- Proximity and magnitude of the cut to any surcharge loads, such as stockpiled material, traffic loads, or structures
- Duration of the open excavation
- Care and methods used by the contractor

According to DOSH guidelines, we interpret the existing site soils as Type B.

It is the responsibility of the contractor to ensure that the excavation is properly sloped or braced for worker protection, in accordance with DOSH guidelines. To assist with this effort, for planning purposes only, we make the following recommendations regarding temporary excavation slopes.

- Protect the slope from erosion with plastic sheeting for the duration of the excavation to minimize surface erosion and raveling.
- Limit the maximum duration of open excavation to the shortest time period practicable.
- Place no surcharge loads (equipment, materials, etc.) within 10 feet of the top of any excavation or slope.

More restrictive requirements may apply depending on specific site conditions, which should be continuously assessed by the contractor.

If temporary sloping is not feasible due to site spatial constraints, excavations could be supported by internally braced shoring systems, such as a trench box, slide rail, or other temporary shoring. There are a variety of options available. We recommend that the contractor be responsible for selecting the type of shoring system to use. We note that trench boxes are a safety feature used to protect workers and do not

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prevent caving. If the excavations are left open for extended periods of time, then caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The voids between the trench boxes and the sidewalls of the trenches should be filled with sand or gravel before caving occurs.

8.4.3 Dewatering

As noted previously, groundwater seepage was observed at the site and is therefore likely within the expected depth of excavations and slope cuts at the project. Construction of utilities and mass excavations that extend below groundwater levels will require dewatering or water control systems. Pumping from sumps may be effective in removing water from the bases of trenches and open excavations, but will not prevent or reduce the greater risk of trench wall caving, sloughing, or basal instability caused by seepage.

Excavation or hauling equipment should not track below the groundwater table without dewatering systems in place. Also, fill, topsoil, treatment media, trench backfill, etc. should not be placed in ponded water. Therefore, dewatering points or trenches may be required to prevent water from ponding in excavations during construction. The contractor should be made responsible for temporary drainage of surface water and groundwater as necessary to prevent standing water and/or erosion at the working surface or in excavations.

The bases of excavations may be soft and/or unstable if groundwater is present. If that is the case, then stabilization material may need to be placed at the base of the excavations. Stabilization material should be placed to a minimum thickness of 12 inches or as needed to provide an adequate working surface and should meet the criteria discussed in *Section 8.6 – Structural Fill and Backfill*. The use of a geotextile separation fabric may be necessary below any stabilization material to help prevent the stabilization material from pushing into the unstable base materials.

8.5 Permanent Slopes

Permanent slopes should be completed in accordance with the specifications provided in WSS 2-03 – Roadway Excavation and Embankment and City standards. Permanent slopes up to approximately 6 feet tall are anticipated to be required for the project.

Permanent slopes should not exceed a gradient of 2H:1V. Where soft surficial soils are encountered in the exposed face of cut slopes, they may need to be excavated and replaced with structural fill, as described in *Section 8.2 – Site Preparation.* Also, where seepage is encountered at the face of cut slopes, it will be necessary to install a subdrain to collect the water, as discussed in *Section 6.0 – Drainage*.

Hardscape improvements (e.g., curbs) should be located at least 3 feet from the crest of slopes. The setback for the toe of building and wall foundations should be no less than 10 feet, unless the foundation design and construction takes into consideration soil creep and slope stability. Depending upon the slope gradient and structure setback from the crest of the slope, this requirement will affect the foundation embedment.

Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

8.6 Structural Fill and Backfill

Structural fill should be considered to include subgrade soils beneath buildings, foundations, slabs, and pavements and in other areas intended to support structures or within the influence zone of structures.

Fill should only be placed over a subgrade that has been prepared in conformance with the prior sections of this report. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic matter or other unsuitable materials and should meet specifications provided in the WSS (WSDOT 2021). A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill are provided below. All materials should be placed and compacted in lifts with maximum uncompacted thicknesses and relative densities as recommended in the tables that follow.

8.6.1 On-Site Soils

On-site, near-surface soils that might be used for fill generally consist of fine-grained, cohesive silt and clay. The materials have variable moisture contents, Atterberg limits, and organic contents. This material is not ideal for use of structural fill and should only be considered if earthwork is being completed during periods of extended dry weather, where the material can be aerated (dried).

If used as structural fill, the on-site materials will need to be moisture conditioned; free of debris, organic materials, and particles over 6 inches in diameter; and meet the specifications provided in WSS 9 03.14(3) – Common Borrow. Topsoil and organic material are not suitable for structural fill

8.6.2 Imported Select Structural Fill

Imported granular material used as structural fill should be pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in WSS 9 03.9(1) – Ballast, WSS 9 03.14(1) – Gravel Borrow, or WSS 9 03.14(2) – Select Borrow. However, the imported granular material should also have a maximum size of 2 inches, be angular and fairly well graded between coarse and fine material, have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve, and have at least two mechanically fractured faces.

If soft or loose materials are present, imported fill material may need to be separated from the native subgrade with a layer of subgrade geotextile that meets the specifications provided in WSDOT SS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization. The geotextile should be installed in conformance with the specifications provided in WSS 2-12 – Construction Geosynthetic.

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8.6.3 Aggregate Base

Imported granular material used as aggregate base (base rock) beneath pavements should be clean, crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine. The base aggregate should meet the specifications provided in WSS 9 03.9 – Aggregates for Ballast and Crushed Surfacing, depending upon application. For use beneath building slabs, the base rock should also meet the gradation of WSS 9 03.9(3) – Crushed Surfacing for “Base Course,” although should have less than 5 percent by dry weight passing a U.S. Standard No. 200 Sieve.

For use beneath conventional pavements or footings, the aggregate base should have a maximum particle size of 1 or 1.5 inches, while for use beneath buildings or sidewalk slabs should have a maximum particle size of 0.75 or 1 inch.

Aggregate base should be separated from the native subgrade with a layer of subgrade geotextile that meets the specifications provided in WSS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization. The geotextile should be installed in conformance with the specifications provided in WSS 2-12 – Construction Geosynthetic. (A separation fabric is not needed where the aggregate base bears on imported fill.)

8.6.4 Drain Rock

Drain rock used for subslab capillary breaks or subsurface drainage systems should consist of clean, crushed drain rock that meets the gradation specifications provided in WSS 9 03.12(4) – Gravel Backfill for Drains or WSS 9 03.1254) – Gravel Backfill for Drywells. However, the materials should have a maximum particle size of 1 inch.

The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in WSS 9 33.2 for drainage geotextiles. The geotextile should be installed in conformance with the specifications provided in WSS 2 12 – Construction Geosynthetic.

8.6.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well graded granular material with a maximum particle size of 1 inch and should meet the specifications provided in WSS 9 03.12(3) – Gravel Backfill for Pipe Zone Bedding and the pipe manufacturer.

Within pavement and slab subgrades, the remainder of the trench backfill up to the subgrade elevation can consist of the above 1-inch material or of granular material with a maximum particle size of 2.5 inches, less than 10 percent by dry weight passing the U.S. Standard No. 200 Sieve, and meeting the specifications provided in WSS 9 03.19 – Bank Run Gravel for Trench Backfill.

8.6.6 Stabilization Material

Imported material that is placed as a stabilization layer for haul roads or staging area should consist of a clean, angular, crushed rock, such as ballast or quarry spalls. The material should have a maximum particle size of 4 inches, a nominal size between 2 and 4 inches, less than 5 percent by dry weight passing the U.S.

Standard No. 4 Sieve, and at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material.

Material meeting the gradations of WSS 9-03.9(2) – Shoulder Ballast, WSS 9-03.12(1)B – Gravel Backfill for Foundations (Class B), WSS 9-03.12(5) – Gravel Backfill for Drains, WSS 9-13.1(2) – Light Loose Riprap, WSS 9-03.12(5) – Gravel Backfill for Drywells, or WSS 9-13.6 – Quarry Spalls is generally acceptable for use. Stabilization material should be placed in lifts between 12 and 18 inches thick and be compacted to a well-keyed condition with a smooth drum roller without using vibratory action.

Stabilization material should be separated from the subgrades with a layer of subgrade geotextile that meets the specifications provided in WSDOT SS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization. The geotextile should be installed in conformance with the specifications provided in WSS 2-12 – Construction Geosynthetic.

8.6.7 Soil Amendment with Cement

As an alternative to the use of imported granular material for structural fill, an experienced contractor may be able to amend the on-site soils with Portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Specific recommendations for soil amending, based on exposed site conditions, can be provided if necessary.

Portland cement-amended soils are hard and have low permeability. These soils do not drain well nor are they suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from off-site drainage facilities.

We recommended a 7-day unconfined compressive strength of at least 80 psi. To protect the cement-treated surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas.

For preliminary planning purposes, we estimate that 4 percent cement (by dry weight) will be required for amending of on-site soils for use as general structural fill. However, where amended soils will be used in the upper 12 to 18 inches of roadway subgrades, haul roads, or staging areas, we estimate the cement may need to be increased to 6 percent particularly during rainy periods. Actual percentages of cement will need to be based on *in situ* soil moisture contents and other field conditions at the time of amendment. The contractor should assuming an *in situ* soil unit weight of 110 pcf when estimating cement volumes.

The actual thickness of the amended material and imported granular material will depend on the anticipated traffic, as well as the contractor’s means and methods, and accordingly, should be the contractor’s responsibility.

It is not possible to amend soils during heavy or continuous rainfall. Work should be completed during suitable conditions. To prevent strength loss during curing, cement-amended soil should be allowed to cure for a minimum of 4 days prior to access by construction traffic.

In order to use wet on-site soils that would not otherwise be suitable for structural fill, they may be amended and placed as fill over a stabilized subgrade. Consecutive lifts of fill may be treated immediately after the previously lift has been amended and compacted (e.g., the 4-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, then the 4-day wait period is in effect.

8.7 Fill Placement and Compaction

Structural fill should be placed and compacted in accordance with the following guidelines.

- Place fill and backfill on a prepared subgrade that consists of firm, inorganic native soils or approved structural fill.

- Place fill or backfill in uniform horizontal lifts with a thickness appropriate for the material type and compaction equipment. Table 7 provides general guidance for lift thicknesses.

Table 7 – Guidelines for Uncompacted Lift Thickness

Compaction Equipment	Guidelines for Uncompacted Lift Thickness (inches)		
	On-Site Soil	Granular and Crushed Rock Maximum Particle Size ≤ 1½ inch	Crushed Rock Maximum Particle Size > 1½ inch
Plate Compactors and Jumping Jacks	4 – 8	4 – 8	Not Recommended
Rubber-Tire Equipment	6 – 8	10 – 12	6 – 8
Light Roller	8 – 10	10 – 12	8 – 10
Heavy Roller	10 – 12	12 – 18	12 – 16
Hoe Pack Equipment	12 – 16	18 – 24	12 – 16

Note: The above table is based on our experience and is intended to serve as a guideline. The information provided in this table should not be included in the project specifications.

- Use appropriate operating procedures to attain uniform coverage of the area being compacted.

- Place fill at a moisture content within approximately 3 percent of optimum as determined in accordance with ASTM D 1557. Moisture condition fill soil to achieve uniform moisture content within the specified range before compacting. Compact fill to the percent of maximum dry densities as noted in Table 8 below.

- Do not place, spread, or compact fill soils during freezing or unfavorable weather conditions. Frozen or disturbed lifts should be removed or properly recompacted prior to placement of subsequent lifts of fill soils.

Table 8 – Fill Compaction Criteria

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Fill Type	Percent of Maximum Dry Density Determined in Accordance with ASTM D 1557		
	0 – 2 Feet Below Subgrade	>2 Feet Below Subgrade	Pipe Bedding and Pipe Zone
Mass Fill: fine-grained soils	92	90	-----
Mass Fill: granular materials	95	90	-----
Aggregate Base	95	95	-----
Trench Backfill	95	92	90
Nonstructural Trench Backfill	90	88	-----
Nonstructural Zones	90	88	90

Note: “Nonstructural” areas are only located in landscaping zones, where the potential for localized trench settlement is acceptable to the owner.

During structural fill placement and compaction, a sufficient number of in-place density tests should be completed by Hart Crowser to verify that the specified degree of compaction is being achieved. For structural fill with more than 30 percent retained on the 3/4-inch sieve, Hart Crowser should visually verify proper compaction with a proof roll or other methods.

9.0 CONSTRUCTION OBSERVATIONS

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient monitoring of the contractor’s activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during subsurface explorations. Recognition of changed conditions often requires experience; therefore, Hart Crowser or their representative should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

We recommend that Hart Crowser be retained to monitor construction at the site to confirm that subsurface conditions are consistent with the site explorations and to confirm that the intent of project plans and specifications relating to earthwork and foundation construction are being met. In particular, we recommend that the foundation and building subgrades; subgrade beneath fills and pavements; and compaction of structural fills and aggregate bases be observed and/or tested by Hart Crowser.

10.0 LIMITATIONS

We have prepared this report for the exclusive use of MAJ Development Corporation and their authorized agents for the proposed Camas Station project in Camas, Washington. Our work was completed in general accordance with our Services Agreement dated November 30, 2021. Our report is intended to provide our opinion of geotechnical parameters for design and construction of the proposed project based on exploration locations that are believed to be representative of site conditions. However, conditions can vary significantly between exploration locations and our conclusions should not be construed as a warranty or guarantee of subsurface conditions or future site performance.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty, express or implied, should be understood.

Any electronic form, facsimile, or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

11.0 REFERENCES

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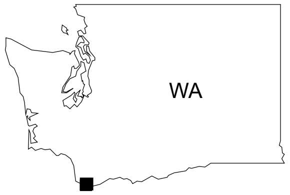

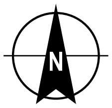

MAP SOURCE: ESRI
SITE COORDINATES: 45°35'28"N, 122°27'12"W

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CAMAS STATION DEVELOPMENT
NW 16TH AVENUE AND NW BRADY ROAD
CAMAS, WASHINGTON

VICINITY MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2022

FIGURE 1

GIS: \\haleyaldrich.com\share\pdx_data\Notebooks\0202499-006_MAJ_Camas_Station\GIS\Maps\2022_02\202499_006_0001_VICINITY_MAP.mxd - mschweitzer - 2/2/2022 7:32:34 PM

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LEGEND

●	INFILTRATION TEST
▚	TEST PIT
▭	PROPOSED BUILDING FOOTPRINT
⬚	SITE BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: "2021-154_SP11.DWG" PROVIDED BY TILAND SCHMIDT, 22 DECEMBER 2021
3. AERIAL IMAGERY SOURCE: NEARMAP, 28 AUGUST 2021

N

0 50 100
SCALE IN FEET

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CAMAS STATION DEVELOPMENT
NW 16TH AVENUE AND NW BRADY ROAD
CAMAS, WASHINGTON

SITE PLAN

FEBRUARY 2022

FIGURE 2

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APPENDIX A
Field Explorations

APPENDIX A
FIELD EXPLORATIONS

General

We evaluated subsurface conditions at the site by advancing six test pits and two infiltration test holes on December 15, 2021. The field explorations were coordinated and overseen by geotechnical staff from Hart Crowser who classified the various soil units encountered, obtained representative soil samples for geotechnical testing, recorded groundwater conditions, and maintained a detailed log of each exploration. Logs of the test pits are included in this appendix. Results of the laboratory testing are indicated on the exploration logs and are included in Appendix B.

Materials encountered in the explorations were classified in the field in general accordance with ASTM Standard Practice D 2488 “Standard Practice for the Classification of Soils (Visual-Manual Procedure).” Disturbed (“grab”) samples were collected from sidewalls or excavation spoils during test pit explorations and from the core samples in the push probe boring. Sampling intervals are shown on the exploration logs included in this appendix.

The exploration logs in this appendix show our interpretation of the exploration, sampling, and testing data. The logs indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on the *Figure A- 1 Key to Exploration Logs*. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

The approximate locations of the explorations are shown on Figure 2 of the report. Explorations were located in the field using a mapping grade Trimble GPS unit.

Test Pits

Six test pit explorations, designated TP-1 through TP-6, were performed on December 15, 2021. Test pit explorations were completed using a mini-trackhoe operated by Stratus Corporation of Gaston, Oregon. The explorations were continuously observed by geotechnical staff members from Hart Crowser, and detailed field logs of the test pits were prepared. Disturbed (“grab”) samples were collected from sidewalls or excavation spoils during test pit explorations. Sampling intervals are shown on the exploration logs included in this appendix.

Infiltration Testing

We conducted two infiltration tests designated IT-1 and IT-2 at the site adjacent to two test pits. IT-1 was conducted adjacent to TP5, and IT-2 adjacent to TP-3. The tests consisted of single-ring falling head infiltration tests, as referenced in and conducted in general accordance with the procedures in Camas (2016) and as briefly described below.

The primary test pits were excavated to a depth of approximately 6 feet or more below the base of the tests to verify subsurface conditions below the base of the test. The adjacent infiltration test pits were advanced adjacent to each primary test pit and cuttings/or grab samples generated from infiltration holes/pits were observed to verify that subsurface conditions were relatively consistent with the primary test pit excavation.

- At each test location, a 6-inch diameter PVC pipe was placed in the bottom of the test pit. The tip of the pipe was pushed into the soil approximately 6 or more inches to form a seal around the base of the pipe.
- The pipes were filled with water depths roughly corresponding to the anticipated inundation depth of potential infiltration systems and were allowed to saturate. The tests were allowed to saturate for a minimum of approximately four hours or until the draw-down rates had sufficiently stabilized, as described in the test procedure.
- After the saturation period, the infiltration rate was monitored until the rate stabilized.

The results of our infiltration tests are provided in Table 1 of the report. Please refer to the body of the report for a discussion of our findings and recommendations regarding the design of infiltration systems.

Sample Description

Identification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. ASTM D 2488 visual-manual identification methods were used as a guide. Where laboratory testing confirmed visual-manual identifications, then ASTM D 2487 was used to classify the soils.

Exhibit 14 CUP22-02

Relative Density/Consistency

Soil density/consistency in borings is related primarily to the standard penetration resistance (N). Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Relative Density	N (Blows/Foot)	SILT or CLAY Consistency	N (Blows/Foot)
Very loose	0 to 4	Very soft	0 to 1
Loose	5 to 10	Soft	2 to 4
Medium dense	11 to 30	Medium stiff	5 to 8
Dense	31 to 50	Stiff	9 to 15
Very dense	>50	Very stiff	16 to 30
		Hard	>30

Moisture

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

USCS Soil Classification Chart (ASTM D 2487)

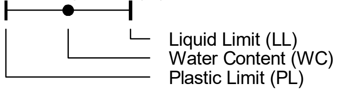
Major Divisions			Symbols		Typical Descriptions
			Graph	USCS	
Coarse Grained Soils More than 50% of Material Retained on No. 200 Sieve	Gravel and Gravelly Soils More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels *(<5% fines)*		GW	Well-Graded Gravel; Well-Graded Gravel with Sand
				GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Gravels *(5-12% fines)*		GW-GM	Well-Graded Gravel with Silt; Well-Graded Gravel with Silt and Sand
				GW-GC	Well-Graded Gravel with Clay; Well-Graded Gravel with Clay and Sand
				GP-GM	Poorly Graded Gravel with Silt; Poorly Graded Gravel with Silt and Sand
				GP-GC	Poorly Graded Gravel with Clay; Poorly Graded Gravel with Clay and Sand
		Gravels with Fines *(>12% fines)*		GM	Silty Gravel; Silty Gravel with Sand
				GC	Clayey Gravel; Clayey Gravel with Sand
	Sand and Sandy Soils More than 50% of Coarse Fraction Passing No. 4 Sieve	Sands with few Fines *(<5% fines)*		SW	Well-Graded Sand; Well-Graded Sand with Gravel
				SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Sands *(5-12% fines)*		SW-SM	Well-Graded Sand with Silt Well-Graded Sand with Silt and Gravel
				SW-SC	Well-Graded Sand with Clay; Well-Graded Sand with Clay and Gravel
				SP-SM	Poorly Graded Sand with Silt; Poorly Graded Sand with Silt and Gravel
				SP-SC	Poorly Graded Sand with Clay; Poorly Graded Sand with Clay and Gravel
		Sands with Fines *(>12% fines)*		SM	Silty Sand; Silty Sand with Gravel
				SC	Clayey Sand; Clayey Sand with Gravel
Fine Grained Soils More than 50% of Material Passing No. 200 Sieve	Silts			ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
				MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
	Silty Clay *(based on Atterberg Limits)*			CL-ML	Silty Clay; Silty Clay with Sand or Gravel; Gravelly or Sandy Silty Clay
	Clays			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
				CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
	Organics			OL/OH	Organic Soil; Organic Soil with Sand or Gravel; Sandy or Gravelly Organic Soil
Highly Organic *(>50% organic material)*				PT	Peat - Decomposing Vegetation - Fibrous to Amorphous Texture

Minor Constituents

	Estimated Percentage
Sand, Gravel	
Trace	<5
Few	5 - 15
Cobbles, Boulders	
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45

Soil Test Symbols

%F	Percent Passing No. 200 Sieve
AL	Atterberg Limits (%)



CA	Chemical Analysis
CAUC	Consolidated Anisotropic Undrained Compression
CAUE	Consolidated Anisotropic Undrained Extension
CBR	California Bearing Ratio
CIDC	Consolidated Drained Isotropic Triaxial Compression
CIUC	Consolidated Isotropic Undrained Compression
CK0DC	Consolidated Drained k0 Triaxial Compression
CK0DSS	Consolidated k0 Undrained Direct Simple Shear
CK0UC	Consolidated k0 Undrained Compression
CK0UE	Consolidated k0 Undrained Extension
CRSCN	Constant Rate of Strain Consolidation
DS	Direct Shear
DSS	Direct Simple Shear
DT	In Situ Density
GS	Grain Size Classification
HYD	Hydrometer
ILCN	Incremental Load Consolidation
K0CN	k0 Consolidation
kc	Constant Head Permeability
kf	Falling Head Permeability
MD	Moisture Density Relationship
OC	Organic Content
OT	Tests by Others
P	Pressuremeter
PID	Photoionization Detector Reading
PP	Pocket Penetrometer
SG	Specific Gravity
TRS	Torsional Ring Shear
TV	Torvane
UC	Unconfined Compression
UUC	Unconsolidated Undrained Triaxial Compression
VS	Vane Shear
WC	Water Content (%)

Groundwater Indicators

▽	Groundwater Level on Date or At Time of Drilling (ATD)
▼	Groundwater Level on Date Measured in Piezometer
○	Groundwater Seepage (Test Pits)

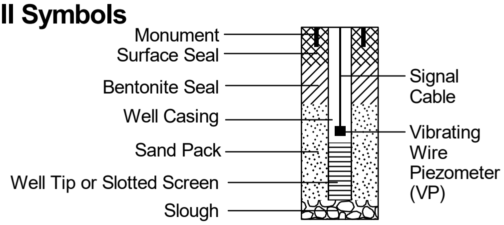
Sample Symbols

☒ 1.5" I.D. Split Spoon
◩ 3.0" I.D. Split Spoon
◧ Modified California Sampler

▮ Rock Core Run
☐ Sonic Core
◫ Thin-walled Sampler

☒ Grab
▥ Cuttings
◫ Push Probe

Well Symbols



HARTCROWSER
A division of Haley & Aldrich

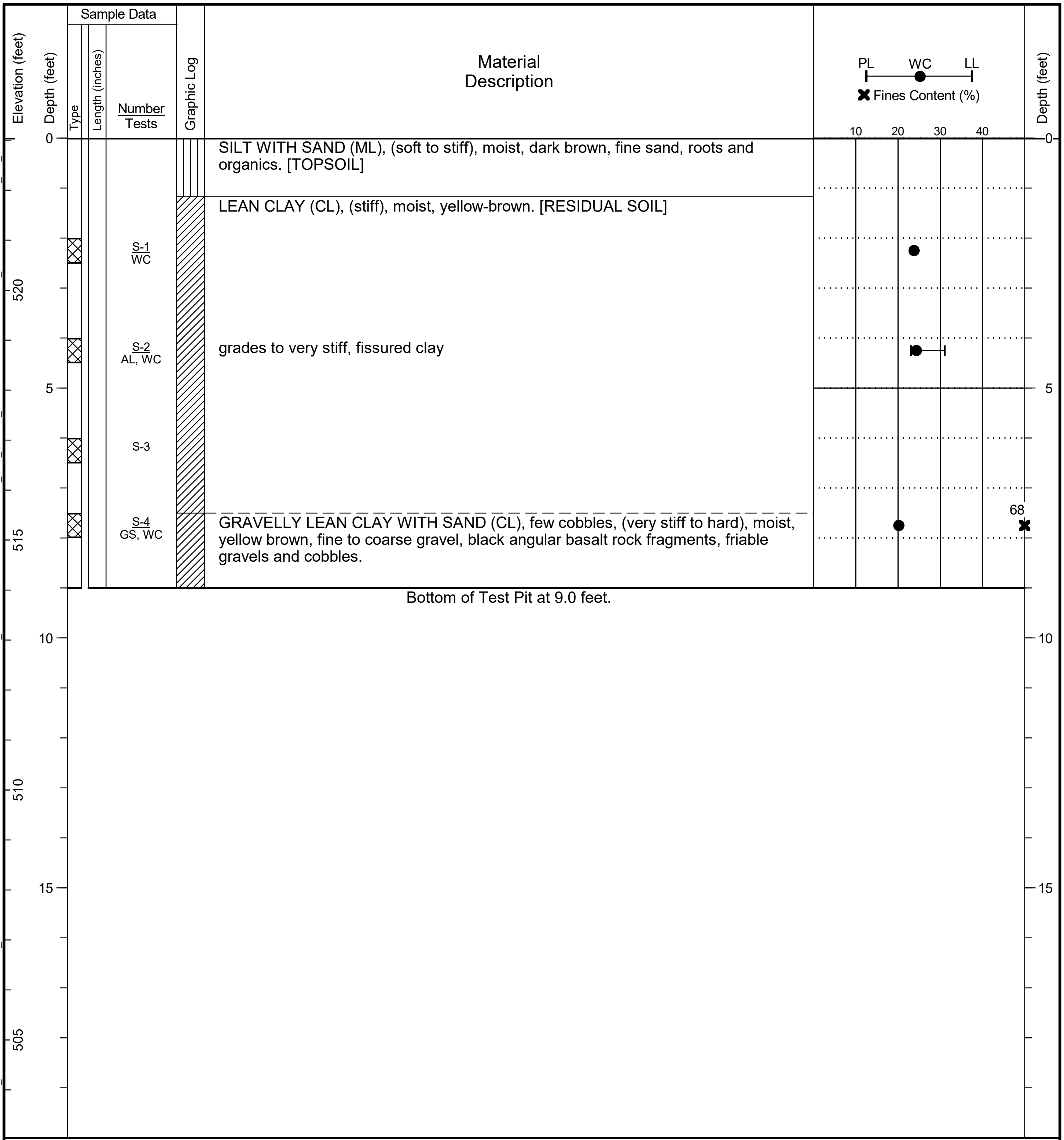
Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Key to Exploration Logs

Figure A-1
Sheet 1 of 1

Exhibit 14 CUP22-02

Date Started: 12/15/2021
Date Completed: 12/15/2021
Contractor/Crew: Stratus Corporation
Logged by: M. Parks
Checked by: L. Kevan
Rig Model/Type: Cat® 312E / Excavator
Location: Lat: 45.590912 Long: -122.452991 (WGS 84)
Total Depth: 9 feet
Depth to Seepage: Not Encountered
Ground Surface Elevation: 523.04 feet (NAVD 88)
Comments:



SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]

LEAN CLAY (CL), (stiff), moist, yellow-brown. [RESIDUAL SOIL]

grades to very stiff, fissured clay

GRAVELLY LEAN CLAY WITH SAND (CL), few cobbles, (very stiff to hard), moist, yellow brown, fine to coarse gravel, black angular basalt rock fragments, friable gravels and cobbles.

Bottom of Test Pit at 9.0 feet.

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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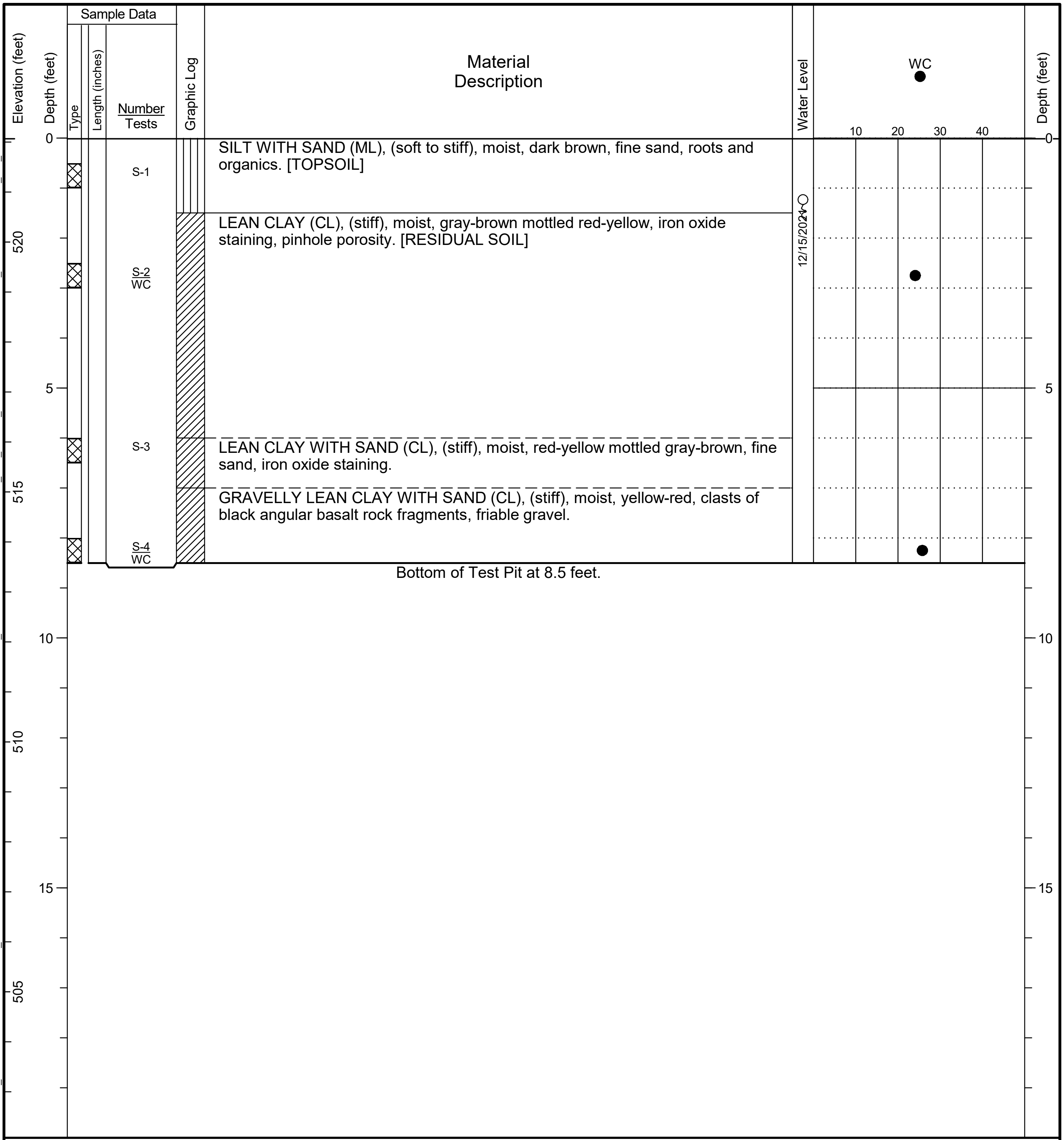
Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Test Pit Log
TP-1

Figure **A-2**
Sheet **1 of 1**

Date Started: 12/15/2021 Date Completed: 12/15/2021 Contractor/Crew: Stratus Corporation
Logged by: M. Parks Checked by: L. Kevan Rig Model/Type: Cat® 312E / Excavator
Location: Lat: 45.590869 Long: -122.453546 (WGS 84) Total Depth: 8.5 feet Depth to Seepage: 1.33 feet
Ground Surface Elevation: 522.08 feet (NAVD 88)
Comments:

Exhibit 14 CUP22-02



SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]

LEAN CLAY (CL), (stiff), moist, gray-brown mottled red-yellow, iron oxide staining, pinhole porosity. [RESIDUAL SOIL]

LEAN CLAY WITH SAND (CL), (stiff), moist, red-yellow mottled gray-brown, fine sand, iron oxide staining.

GRAVELLY LEAN CLAY WITH SAND (CL), (stiff), moist, yellow-red, clasts of black angular basalt rock fragments, friable gravel.

Bottom of Test Pit at 8.5 feet.

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Test Pit Log
TP-2

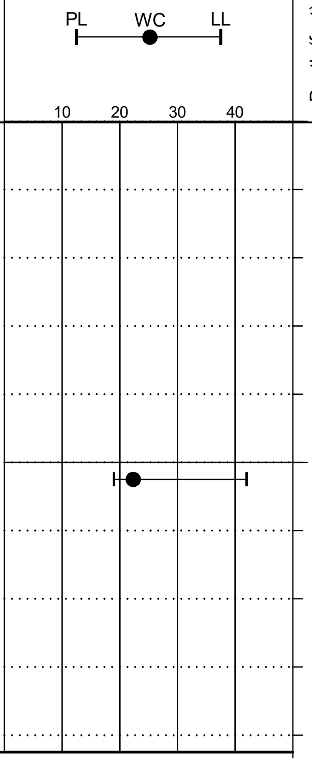
Figure **A-3**
Sheet **1 of 1**

HC TEST PIT - \\HALEYALDRICH.COM\SHARE\PDX_DATA\GEOMATICS\GINT\HC_LIBRARY.GLB - 2/2/22 19:45 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\0202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - mschweitzer

Date Started: 12/15/2021
Date Completed: 12/15/2021
Contractor/Crew: Stratus Corporation
Logged by: M. Parks
Checked by: L. Kevan
Rig Model/Type: Cat® 312E / Excavator
Location: Lat: 45.591216 Long: -122.453256 (WGS 84)
Total Depth: 9.25 feet
Depth to Seepage: 1.17 feet
Ground Surface Elevation: 517.77 feet (NAVD 88)
Comments: Infiltration test conducted at 3 feet. See text for additional details.

Exhibit 14 CUP22-02

Elevation (feet)	Depth (feet)	Sample Data: Type	Sample Data: Length (inches)	Sample Data: Number Tests	Graphic Log	Material Description	Water Level
	0					SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]	
						LEAN CLAY (CL), few sand, trace gravel, (very stiff), moist to wet, yellow-brown mottled gray-brown, iron oxide staining, pinhole porosity. [RESIDUAL SOIL]	12/15/2021
		☒		S-1			
515							12/15/2021
	5	☒		S-2 AL, WC			
						LEAN CLAY WITH SAND (CL), (very stiff), wet, yellow-brown mottled gray-brown, fine sand. trace gravel, trace cobbles	
		☒		S-3			
510							
						GRAVELLY LEAN CLAY WITH SAND (CL), (hard), moist, yellow-red, clasts of black angular basalat rock fragments, friable gravel.	
		☒		S-4			
						Bottom of Test Pit at 9.3 feet.	
	10						
505							
	15						
500							



Depth (feet): 0, 5, 10, 15

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

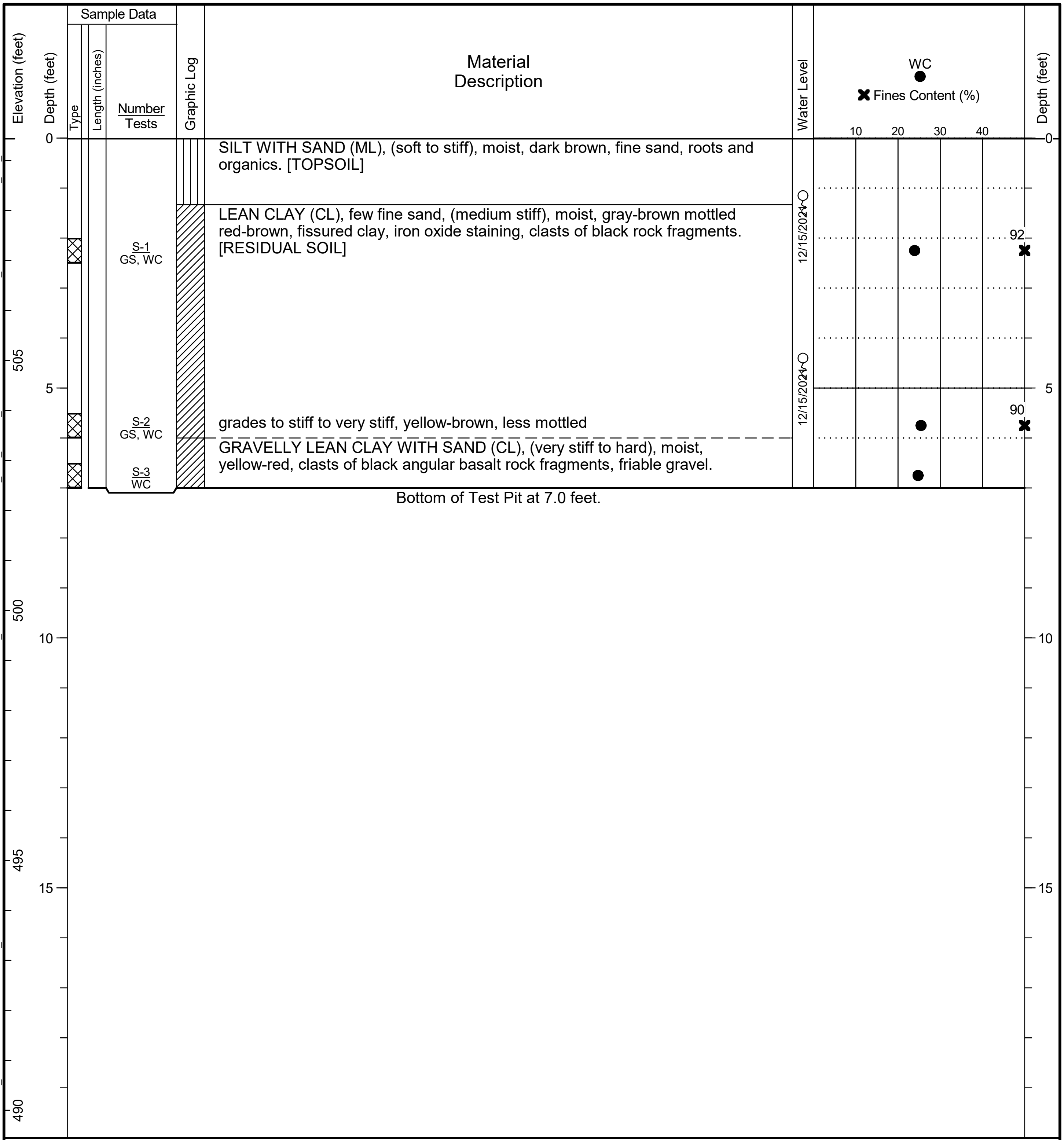
Test Pit Log
TP-3

Figure **A-4**
Sheet **1 of 1**

HC TEST PIT - \\HALEYALDRICH.COM\SHARE\PDX_DATA\GEOMATICS\GINT\HC_LIBRARY.GLB - 2/2/22 19:45 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\0202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - mschweitzer

Date Started: 12/15/2021
Date Completed: 12/15/2021
Contractor/Crew: Stratus Corporation
Logged by: M. Parks
Checked by: L. Kevan
Rig Model/Type: Cat® 312E / Excavator
Location: Lat: 45.591532 Long: -122.453053 (WGS 84)
Total Depth: 7 feet
Depth to Seepage: 1.25 feet
Ground Surface Elevation: 509.45 feet (NAVD 88)
Comments:

Exhibit 14 CUP22-02



Depth (feet)	Number / Tests	Material Description
0		SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]
	S-1 GS, WC	LEAN CLAY (CL), few fine sand, (medium stiff), moist, gray-brown mottled red-brown, fissured clay, iron oxide staining, clasts of black rock fragments. [RESIDUAL SOIL]
5	S-2 GS, WC	grades to stiff to very stiff, yellow-brown, less mottled
	S-3 WC	GRAVELLY LEAN CLAY WITH SAND (CL), (very stiff to hard), moist, yellow-red, clasts of black angular basalt rock fragments, friable gravel.

Bottom of Test Pit at 7.0 feet.

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Test Pit Log
TP-4

Figure **A-5**
Sheet **1 of 1**

HC TEST PIT - \\HALEYALDRICH.COM\SHARE\PDX_DATA\GEOMATICS\GINT\HC_LIBRARY.GLB - 2/2/22 19:45 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\0202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - mschweitzer

Exhibit 14 CUP22-02

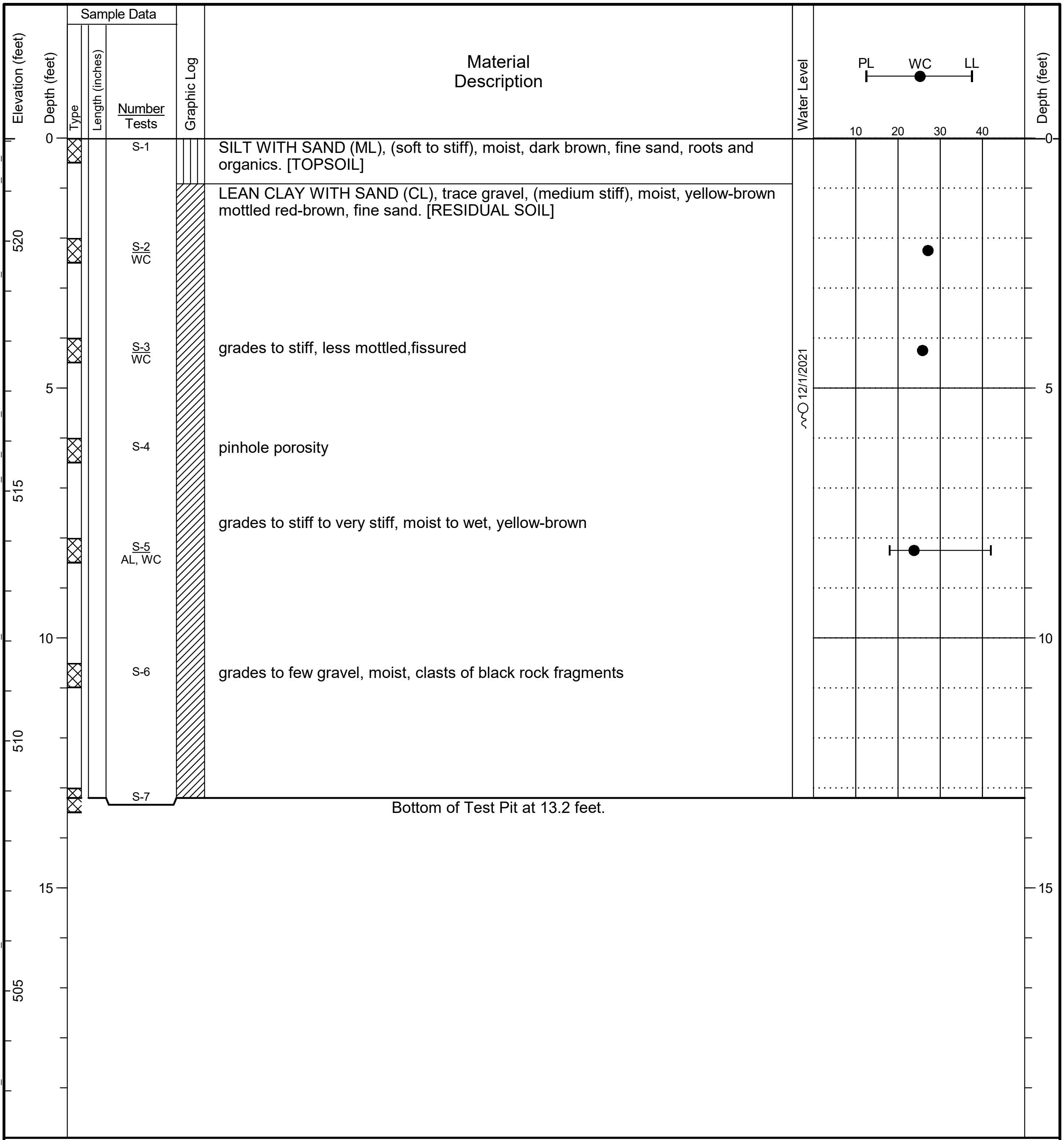
Date Started: 12/15/2021 Date Completed: 12/15/2021 Contractor/Crew: Stratus Corporation

Logged by: M. Parks Checked by: L. Kevan Rig Model/Type: Cat® 312E / Excavator

Location: Lat: 45.591587 Long: -122.453789 (WGS 84) Total Depth: 13.2 feet Depth to Seepage: 5.5 feet

Ground Surface Elevation: 522.06 feet (NAVD 88)

Comments: Infiltration test conducted at 1 foot. See text for additional details.



SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]

LEAN CLAY WITH SAND (CL), trace gravel, (medium stiff), moist, yellow-brown mottled red-brown, fine sand. [RESIDUAL SOIL]

grades to stiff, less mottled,fissured

pinhole porosity

grades to stiff to very stiff, moist to wet, yellow-brown

grades to few gravel, moist, clasts of black rock fragments

Bottom of Test Pit at 13.2 feet.

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Test Pit Log
TP-5

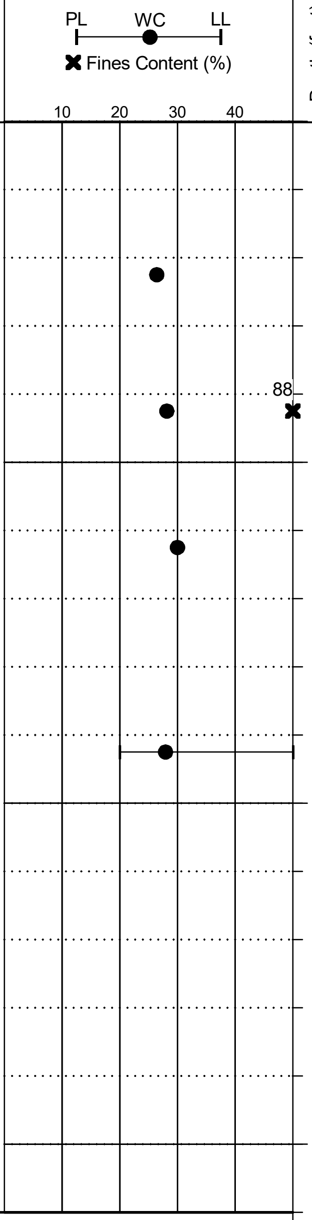
Figure **A-6**
Sheet **1 of 1**

Date Started: 12/15/2021 Date Completed: 12/15/2021 Contractor/Crew: Stratus Corporation
Logged by: M. Parks Checked by: L. Kevan Rig Model/Type: Cat® 312E / Excavator
Location: Lat: 45.591216 Long: -122.453576 (WGS 84) Total Depth: 16 feet Depth to Seepage: 8 feet
Ground Surface Elevation: 523.15 feet (NAVD 88)
Comments:

Exhibit 14 CUP22-02

Elevation (feet)	Depth (feet)	Sample Data Number Tests	Material Description	Water Level
	0		SILT WITH SAND (ML), (soft to stiff), moist, dark brown, fine sand, roots and organics. [TOPSOIL]	
			LEAN CLAY (CL), few fine sand, (stiff), moist, yellow-brown mottled brown, fissured clay, iron oxide staining, pinhole porosity, roots. [RESIDUAL SOIL]	
		S-1 WC		
520				
		S-2 GS, WC	grades to yellow-red mottled brown, fine sand, fissured clay, iron oxide staining, roots	
	5			
		S-3 WC	less mottled	
			grades to moist to wet, cemented, blocky	
515			FAT CLAY WITH GRAVEL (CH), few sand, (very stiff), moist, yellow-red, fine gravel, friable gravel.	12/15/2021
		S-4 AL, WC		
	10			
510				
		S-5	grades to red	
	15			
505				

Bottom of Test Pit at 16.0 feet.



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER
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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Test Pit Log
TP-6

Figure **A-7**
Sheet **1 of 1**

HC TEST PIT - \\HALEYALDRICH.COM\SHARE\PDX_DATA\GEOMATICS\GINT\HC_LIBRARY.GLB - 2/2/22 19:45 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - mschweitzer

Exhibit 14 CUP22-02

APPENDIX B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

General

Soil samples obtained from the explorations were transported to our laboratory and to a subcontracted laboratory (Northwest Testing, Inc.) and evaluated to confirm or modify field classifications, as well as to assess engineering properties of the soils encountered. Representative samples were selected for laboratory testing. The tests were performed in general accordance with the test methods of the ASTM or other applicable procedures. The test results are included in this appendix, and where noted, included on the exploration log in Appendix A. A summary of the test results is included on Figure B-1. The specific tests conducted are outlined below. (We note that the test results from Northwest Testing, Inc. have been incorporated with test results from our lab into the attached figures.)

Visual Classifications

Soil samples obtained from the explorations were visually classified in the field and in our geotechnical laboratory based on the Unified Soil Classification System (USCS) and ASTM classification methods. ASTM Test Method D 2488 was used to classify soils using visual and manual methods. ASTM Test Method D 2487 was used to classify soils based on laboratory test results.

Laboratory Test Results

Moisture Content

Moisture contents of samples were obtained in general accordance with ASTM Test Method D 2216. The results of the moisture content tests completed on samples from the explorations are presented on the exploration logs included in Appendix A and on Figure B-1 in this appendix.

Percent Fines

Fines content analyses were performed to determine the percentage of soils finer than the No. 200 sieve—the boundary between sand size particles and silt size particles. The tests were performed in general accordance with ASTM Test Method D 1140. The test results are indicated on the exploration logs included in Appendix A and on Figure B-1 in this appendix.

Grain Size Distribution

Grain size distribution analyses were conducted to determine the quantitative distribution of particle sizes in different soil samples. Fines content analyses were performed to determine the percentage of soils finer than the No. 200 sieve—the boundary between sand size particles and silt size particles. The tests were performed in general accordance with ASTM D 422, D 6913, and D 1140. The fines content test results are indicated on the exploration logs included in Appendix A. The test results are summarized on Figure B-1 in this appendix and the full grain size distribution test results are shown on Figure B-3 in this appendix.

Exhibit 14 CUP22-02

Atterberg Limits Testing

Atterberg limits (liquid limit, plastic limit and plasticity index) were obtained in general accordance with ASTM Test Method D 4318. The results of the Atterberg limits test completed from the explorations is presented on the exploration logs included in Appendix A, summarized on Figure B-1 in this appendix, and shown in detail on Figure B-2 in this appendix.

Exhibit 14 CUP22-02

Exploration	Sample ID	Depth	Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plastic Limit	Water Content (%)	USCS Group Symbol	Soil Description
IT-1	S-1	1.0	0.5	14.8	84.7			30.9	CL	LEAN CLAY WITH SAND
IT-2	S-1	3.0	0.0	6.8	93.2			28.2	CL	LEAN CLAY
TP-1	S-1	2.0						23.8		
TP-1	S-2	4.0				31	23	24.4	CL	LEAN CLAY
TP-1	S-3	6.0								
TP-1	S-4	7.5	20.0	12.4	67.6			20.2	CL	LEAN CLAY WITH GRAVEL
TP-2	S-1	0.5								
TP-2	S-2	2.5						24.1		
TP-2	S-3	6.0								
TP-2	S-4	8.0						25.8		
TP-3	S-1	2.0								
TP-3	S-2	5.0				42	19	22.3	CL	LEAN CLAY
TP-3	S-3	7.0								
TP-3	S-4	8.5								
TP-4	S-1	2.0	0.0	8.0	92.0			23.9	CL	LEAN CLAY
TP-4	S-2	5.5	0.0	9.7	90.3			25.5	CL	LEAN CLAY
TP-4	S-3	6.5						24.8		
TP-5	S-1	0.0								
TP-5	S-2	2.0						27.1		
TP-5	S-3	4.0						25.8		
TP-5	S-4	6.0								
TP-5	S-5	8.0				42	18	23.8	CL	LEAN CLAY
TP-5	S-6	10.5								
TP-5	S-7	13.0								
TP-6	S-1	2.0						26.4		
TP-6	S-2	4.0	0.0	11.7	88.3			28.2	CL	LEAN CLAY
TP-6	S-3	6.0						30.0		
TP-6	S-4	9.0				50	20	27.9	CH	FAT CLAY
TP-6	S-5	14.0								

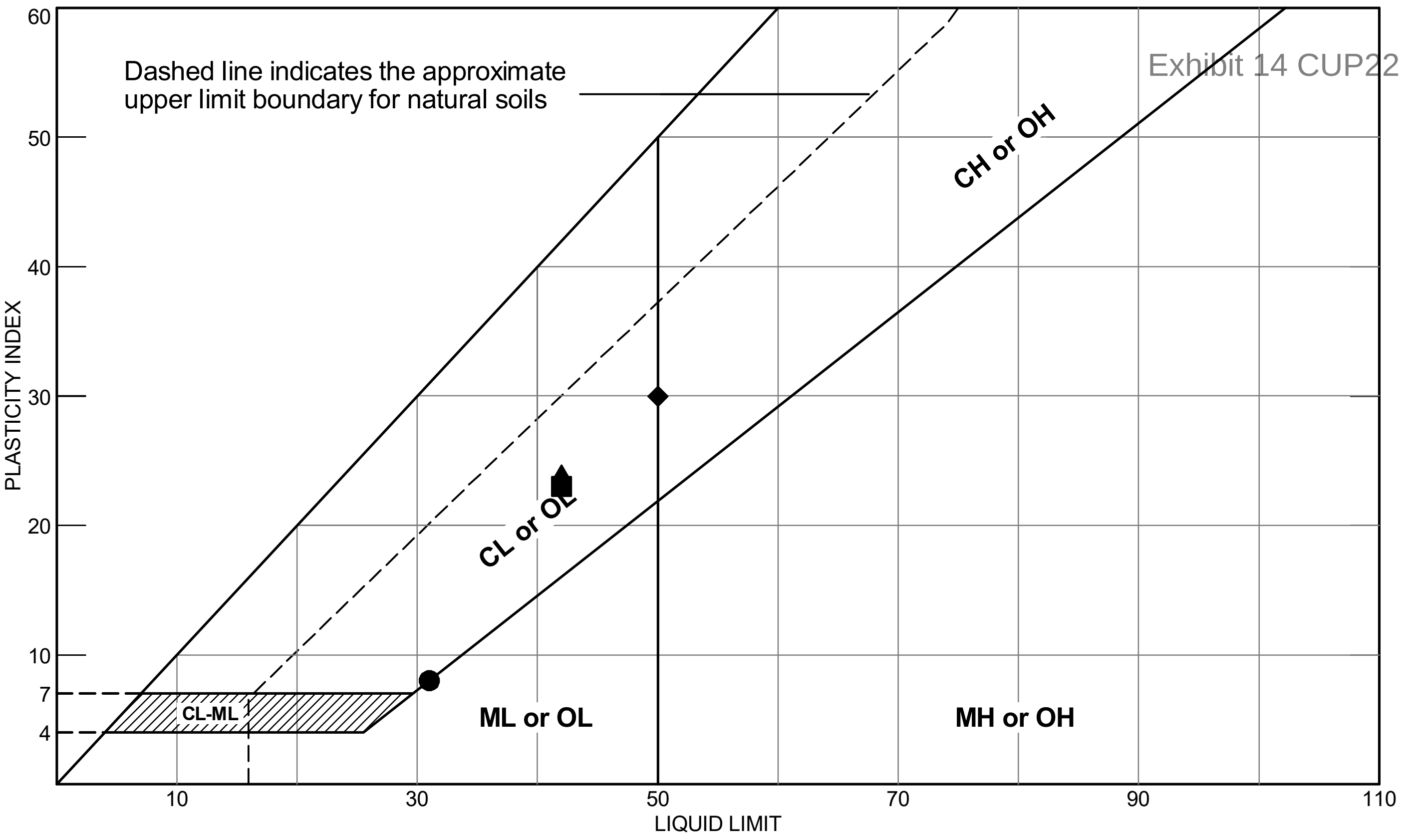
HARTCROWSER
A division of Haley & Aldrich

Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202-499-006

Summary of Laboratory Results

Figure **B-1**
Sheet **1 of 1**

Exhibit 14 CUP22-02



Location and Description	LL	PL	PI	-#200	MC%	USCS
● **Source:** TP-1 **Sample No.:** S-2 **Depth:** 4.0 to 4.5 LEAN CLAY	31	23	8	NT	24	CL
■ **Source:** TP-3 **Sample No.:** S-2 **Depth:** 5.0 to 5.5 LEAN CLAY	42	19	23	NT	22	CL
▲ **Source:** TP-5 **Sample No.:** S-5 **Depth:** 8.0 to 8.5 LEAN CLAY	42	18	24	NT	24	CL
◆ **Source:** TP-6 **Sample No.:** S-4 **Depth:** 9.0 to 9.5 FAT CLAY	50	20	30	NT	28	CH

Remarks:

● Borderline CL/ML
■
▲
◆ Borderline CH/CL

HARTCROWSER
A division of Haley & Aldrich

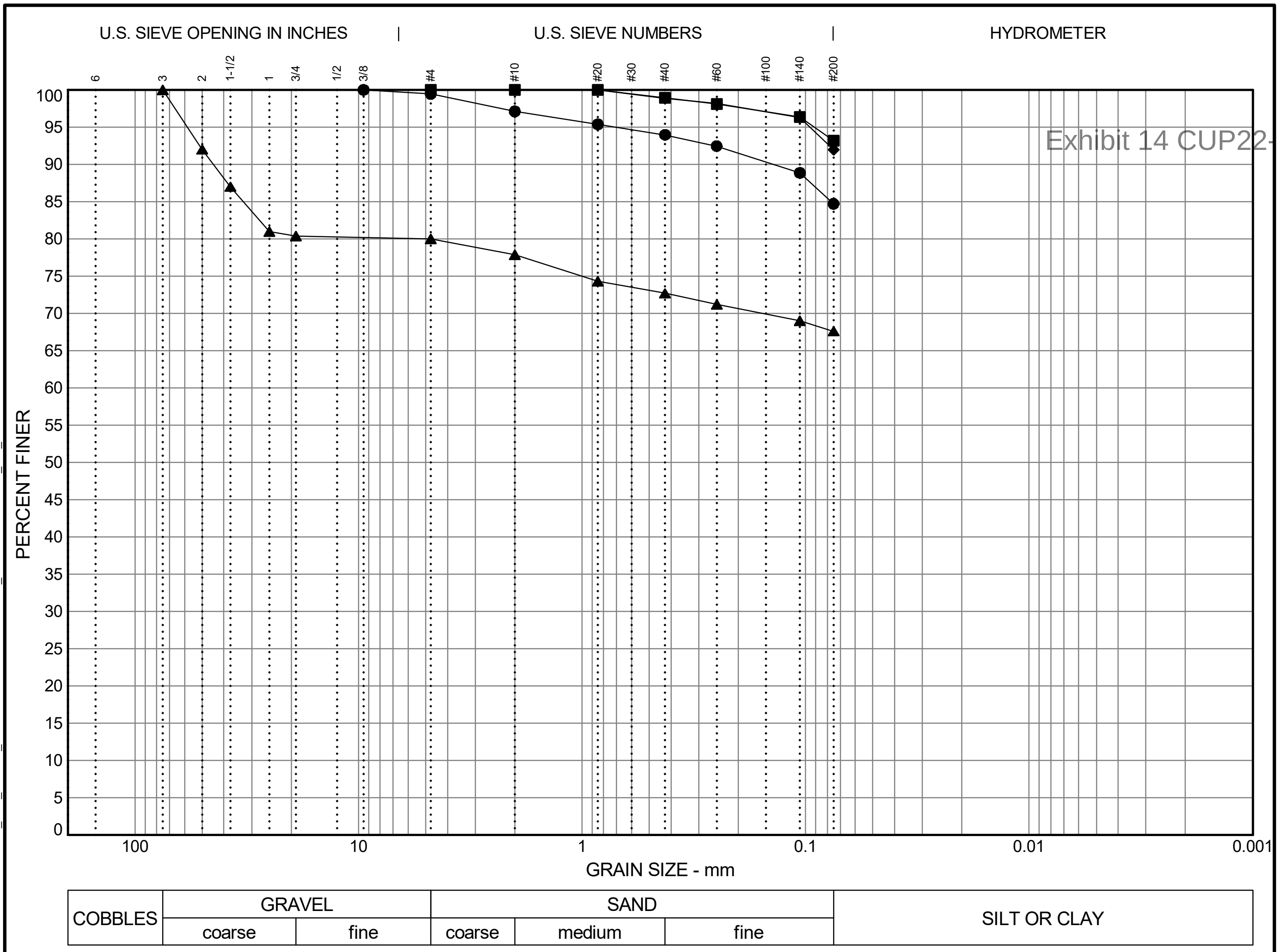
Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

Liquid Limit, Plastic Limit, and Plasticity Index

Figure B-2
Sheet 1 of 1

HC ATTERBERG LIMITS - \\HALEYALDRICH.COM\SHARE\SEA_DATA\GINT\HC_LIBRARY.GLB - 1/14/22 14:04 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\0202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - ahultz

Exhibit 14 CUP22-02



Location and Description	% Cobbles	% Gravel	% Sand	% Silt / % Clay	MC%	USCS
● **Source:** IT-1 **Sample No.:** S-1 **Depth:** 1.0 to 2.0 LEAN CLAY WITH SAND	0.0	0.5	14.8	84.7	31	CL
■ **Source:** IT-2 **Sample No.:** S-1 **Depth:** 3.0 to 4.0 LEAN CLAY	0.0	0.0	6.8	93.2	28	CL
▲ **Source:** TP-1 **Sample No.:** S-4 **Depth:** 7.5 to 8.0 LEAN CLAY WITH GRAVEL	0.0	20.0	12.4	67.6	20	CL
◆ **Source:** TP-4 **Sample No.:** S-1 **Depth:** 2.0 to 2.5 LEAN CLAY	0.0	0.0	8.0	92.0	24	CL

☒	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.077							
■										
▲			32.759							
◆										

Remarks:

● Scattered organics

■

▲ Note: Bulk sample contained 16.2 % +3-inch material (dry wt. basis). The +3-inch material was omitted for fractional classification.

◆

HARTCROWSER
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Project: Camas Station Development
Location: Camas, Oregon
Project No.: 0202499-006

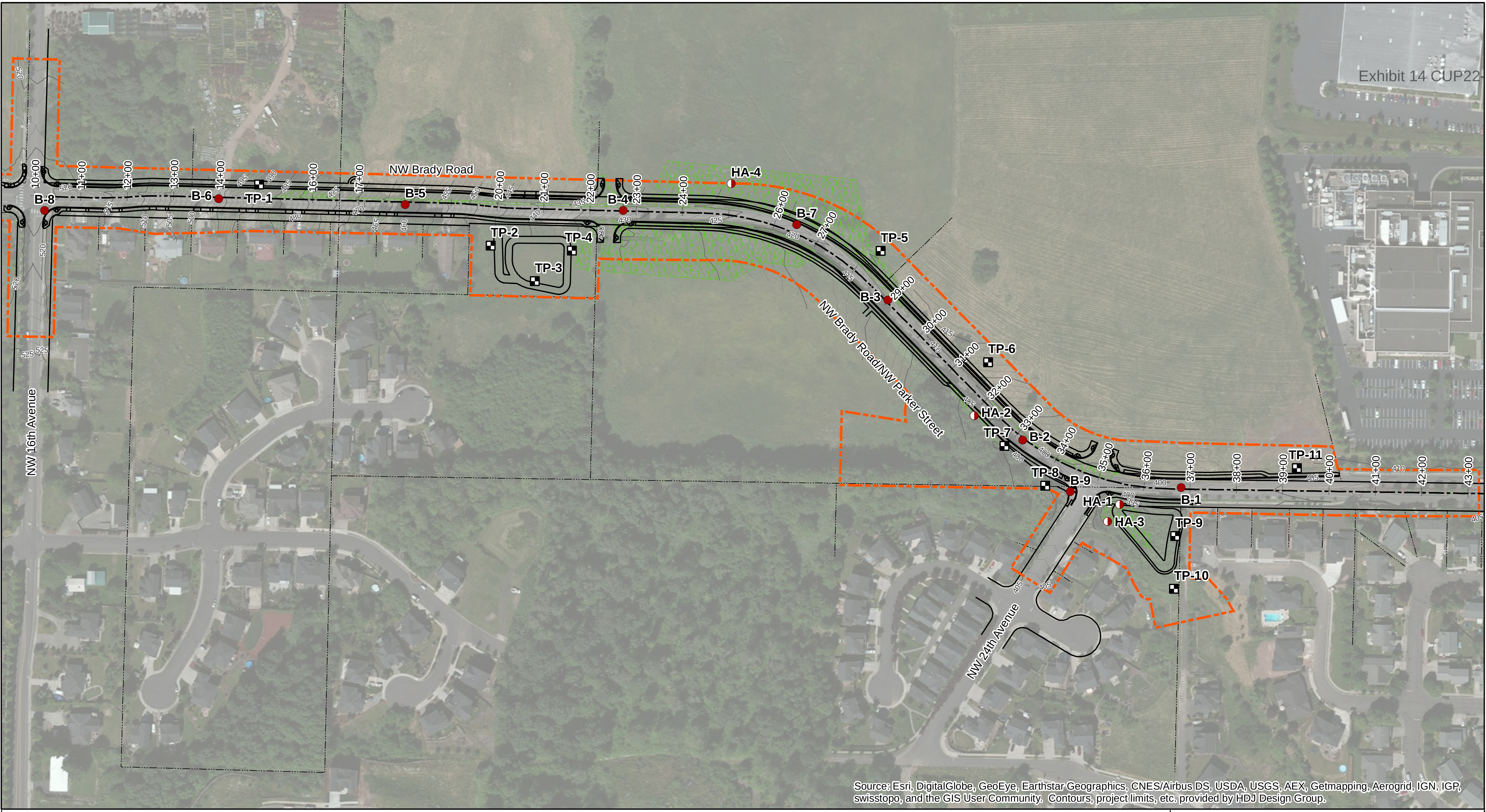
Particle-Size Analysis

Figure **B-3**
Sheet **1 of 1**

HC GRAIN SIZE - \\HALEYALDRICH.COM\SHARE\SEA_DATA\GINT\HC_LIBRARY.GLB - 2/3/22 10:16 - \\HALEYALDRICH.COM\SHARE\PDX_DATA\NOTEBOOKS\0202499-006_MAJ_CAMAS_STATION\FIELD DATA\PERM_GINT FILES\202499_006_EXPLORATIONS.GPJ - ahultz

APPENDIX C
Historical Exploration Logs

Exhibit 14 CUP22-02



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Contours, project limits, etc. provided by HDJ Design Group.

LEGEND

● Boring	---- Lot Boundary
◐ Hand-Auger Boring	— Edge of Right-of-Way
▣ Test Pit	— Elevation Contour
⬚ Project Limits	▨ Wetland (Mapped by Others)

N

0 100 200 400

Feet

NW Brady Road Improvements
Camas, Washington

Site Plan

154-000-002 4/17

HARTCROWSER

Figure
2

Document Path: F:\Notebooks\154000002_Brady Road Improvements\GIS\154000002_SP.mxd Date: 7/26/2016 User Name: melissaschweitzer

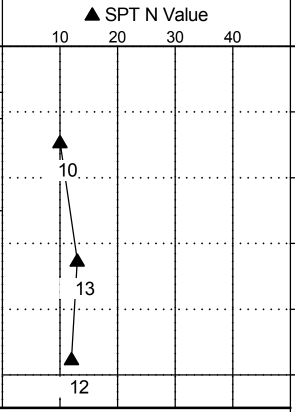
Exhibit 14 CUP22-02

Date Started: 1/13/15
Date Completed: 1/13/15
Logged by: R. Pirot
Checked by: D. Trisler
Location: N: 100,433.51 E: 1,140,527.40
Ground Surface Elevation: 496 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NGVD 29(47)
Comments:

Drilling Contractor/Crew: Dan J. Fischer Excavating, Inc.
Drilling Method: Solid-stem Auger
Rig Model/Type: Big Beaver
Hammer Type: Manual
Hammer Weight: 140
Hammer Drop Height: 30
Hammer Efficiency (%): Measured: NA
Estimated: NA
Auger Diameter: 3 inches
Casing Diameter: NA
Total Depth: 5.5 feet
Depth to Ground Water: Not Identified

Elevation (feet)	Depth (feet)	Blow Count	Type	Recovery	Length (inches)	Number Tests	Graphic Log	Material Description	SPT N Value	Depth (feet)
	0							Asphalt pavement (9-inch thick)		0
								Aggregate base (4-inch thick)		
495		10 5 5		13in.	18	S-1 SG		Stiff, moist, gray, SILT WITH SAND (ML), fine subangular sand. (Residual Soil)	10	
		7 7 6		17in.	18	S-2 SG		Stiff, moist, gray-brown, SILT WITH SAND (ML), fine subangular sand, iron oxide staining, low plasticity.	13	
	5	4 5 7		17in.	18	S-3 SG			12	5

Bottom of Borehole at 5.5 feet.



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

HARTCROWSER

Project: Brady Road Improvements
Location: Camas, Washington
Project No.: 154-000-002

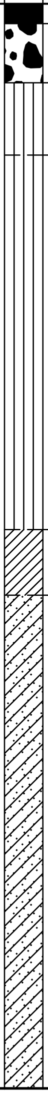
Boring Log
B-6

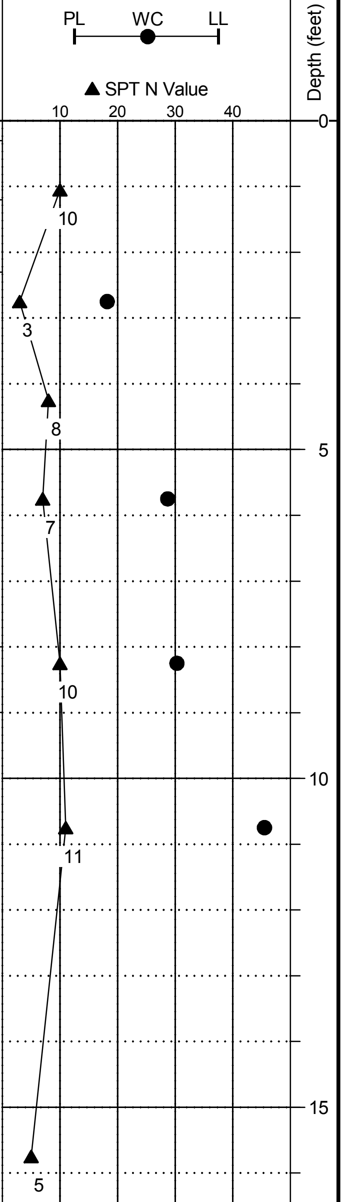
Figure **A-8**
Sheet **1 of 1**

Date Started: 1/14/15 Date Completed: 1/14/15
Logged by: R. Pirot Checked by: D. Trisler
Location: N: 100,057.05 E: 1,140,552.69
Ground Surface Elevation: 520 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NGVD 29(47)
Comments:

Drilling Contractor/Crew: Dan J. Fischer Excavating, Inc.
Drilling Method: Solid-stem Auger
Rig Model/Type: Big Beaver
Hammer Type: Manual
Hammer Weight: 140 Hammer Drop Height: 30
Hammer Efficiency (%): Measured: NA Estimated: NA
Auger Diameter: 3 inches Casing Diameter: NA
Total Depth: 16.5 feet Depth to Ground Water: Not Identified

Elevation (feet)	Depth (feet)	Blow Count	Type	Recovery	Length (inches)	Number Tests	Material Description
	0						Asphalt pavement (4-inch thick)
		6 7 3	☒	13in.	18	S-1 SG	Aggregate base (10-inch thick)
							Stiff, moist, yellow-brown, SILT WITH SAND (ML), fine sand, heavy iron oxide staining, low plasticity. (Residual Soil)
		2 2 1	☒	11in.	18	S-2 SG, WC	Soft to stiff, moist, gray-brown, SILT WITH SAND (ML), fine subangular sand, iron oxide staining, low plasticity.
		3 4 4	☒	15in.	18	S-3 SG	
515	5	3 3 4	☒	18in.	18	S-4 SG, WC	
							trace angular gravel/residual basalt fragments at 7.0 feet
		5 4 6	☒	17in.	18	S-5 AL, SG, WC	Stiff, moist, red-brown, SANDY LEAN CLAY (CL), fine to coarse subrounded to subangular sand, medium to high plasticity.
							Loose to medium dense, red to red-brown, CLAYEY SAND (SC), fine to coarse subrounded to subangular sand, heavy iron oxide staining, medium plasticity fines.
510	10	5 6 5	☒	18in.	18	S-6 SG, WC	
505	15	3 3 2	☒	18in.	18	S-7 SG	
							Bottom of Borehole at 16.5 feet.





General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
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HARTCROWSER
Project: Brady Road Improvements
Location: Camas, Washington
Project No.: 154-000-002

Boring Log
B-8

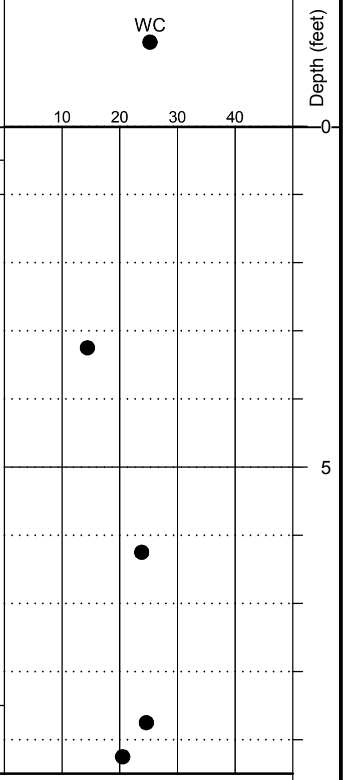
Figure **A-10**
Sheet **1 of 1**

Date Started: 6/28/16
Date Completed: 6/28/16
Excavation Contractor/Crew: Dan J. Fischer Excavating, Inc.
Logged by: A. Jones
Checked by: D. Trisler
Excavation Method:
Location: N: 100,520.34 E: 1,140,497.10
Rig Model/Type: John Deere 310E / Backhoe
Ground Surface Elevation: 491 feet
Total Depth: 9.5 feet
Depth to Ground Water: Not Encountered
Horizontal Datum: WA State Plane S, NAD 83, ft.
Comments:
Vertical Datum: NGVD 29(47)

Exhibit 14 CUP22-02

Elevation (feet)	Depth (feet)	Sample Data Type	Recovery	Length (inches)	Number Tests	Graphic Log	Material Description
491	0						Topsoil (6-inch thick)
							(Soft), moist, dark brown, SILT WITH SAND (ML), fine sand. (Colluvium)
490							(Very stiff to stiff), moist, brown, SILT WITH SAND (ML), fine sand, relict rock structure, vesicles. (Residual Soil)
		☒	6in.	6	S-1 PP, WC		(PP = 3.0 tsf)
							gray mottling and iron oxide staining below 4.0 feet
	5						
485		☒	6in.	6	S-2 WC		
		☒	6in.	6	S-3 WC		BASALTIC ANDESITE, moderately vesicular, moderately to highly weathered, moderately strong to strong (R3-R4). (Boring Lava Volcanics)
		☒	6in.	6	S-4 WC		

Bottom of Test Pit at 9.5 feet.



Elevation (feet): 490, 485, 480, 475
Depth (feet): 0, 5, 10, 15

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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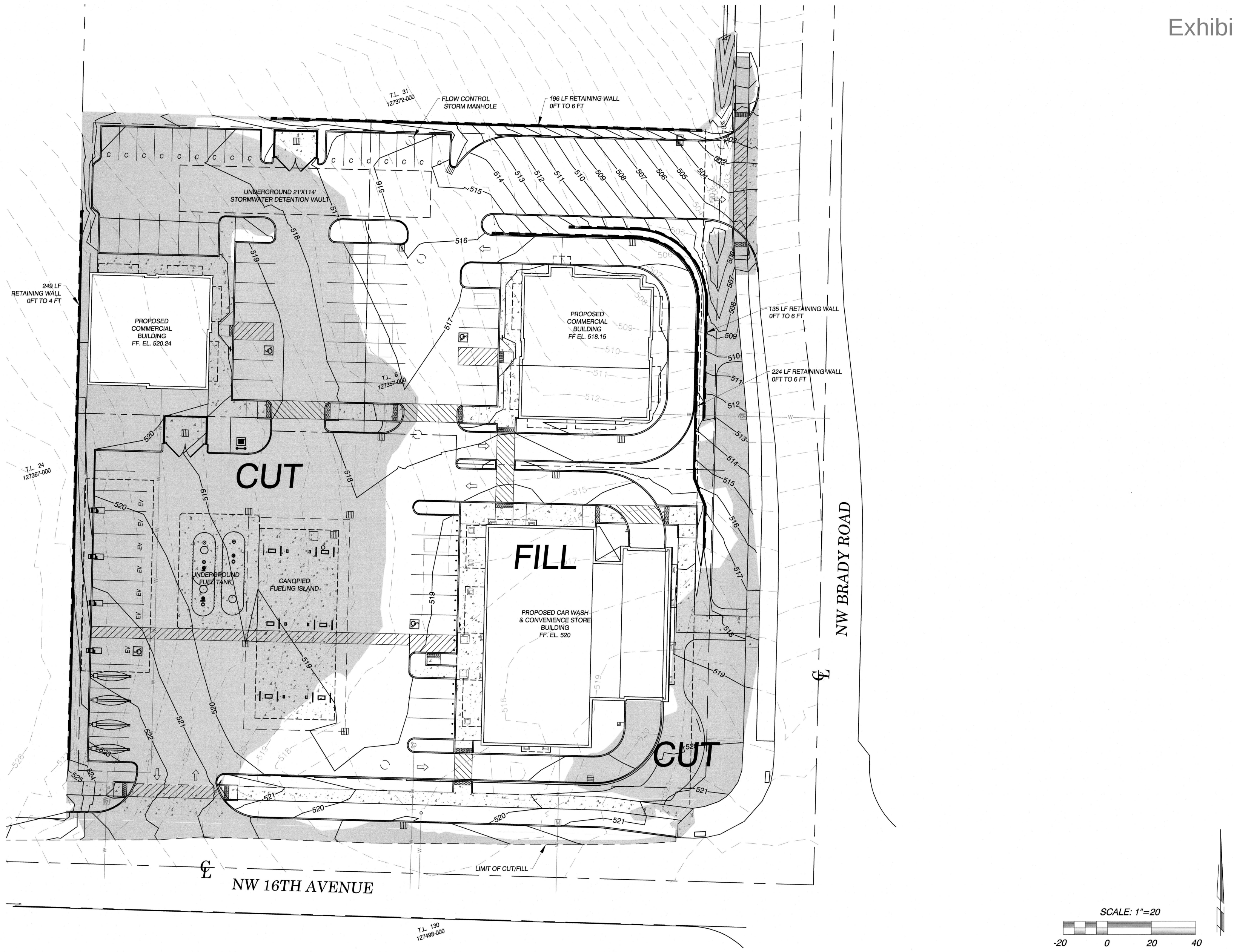
HARTCROWSER

Project: Brady Road Improvements
Location: Camas, Washington
Project No.: 154-000-002

Test Pit Log
TP-1

Figure **A-16**
Sheet **1 of 1**

Exhibit 14 CUP22-02



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CLIENT:

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FX:
CONTACT: GRANT HUNTER
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PRELIMINARY GRADING PLAN FOR:

CAMAS CROSSING

OLSON
LAND SURVEYORS
ENGINEERS
ENGINEERING INC. 222 E. EVERGREEN, VANCOUVER, WA 98660
360-695-1385
503-289-9936

PETER A. TUCK
31817
2/16/22

CHANGES / REVISIONS

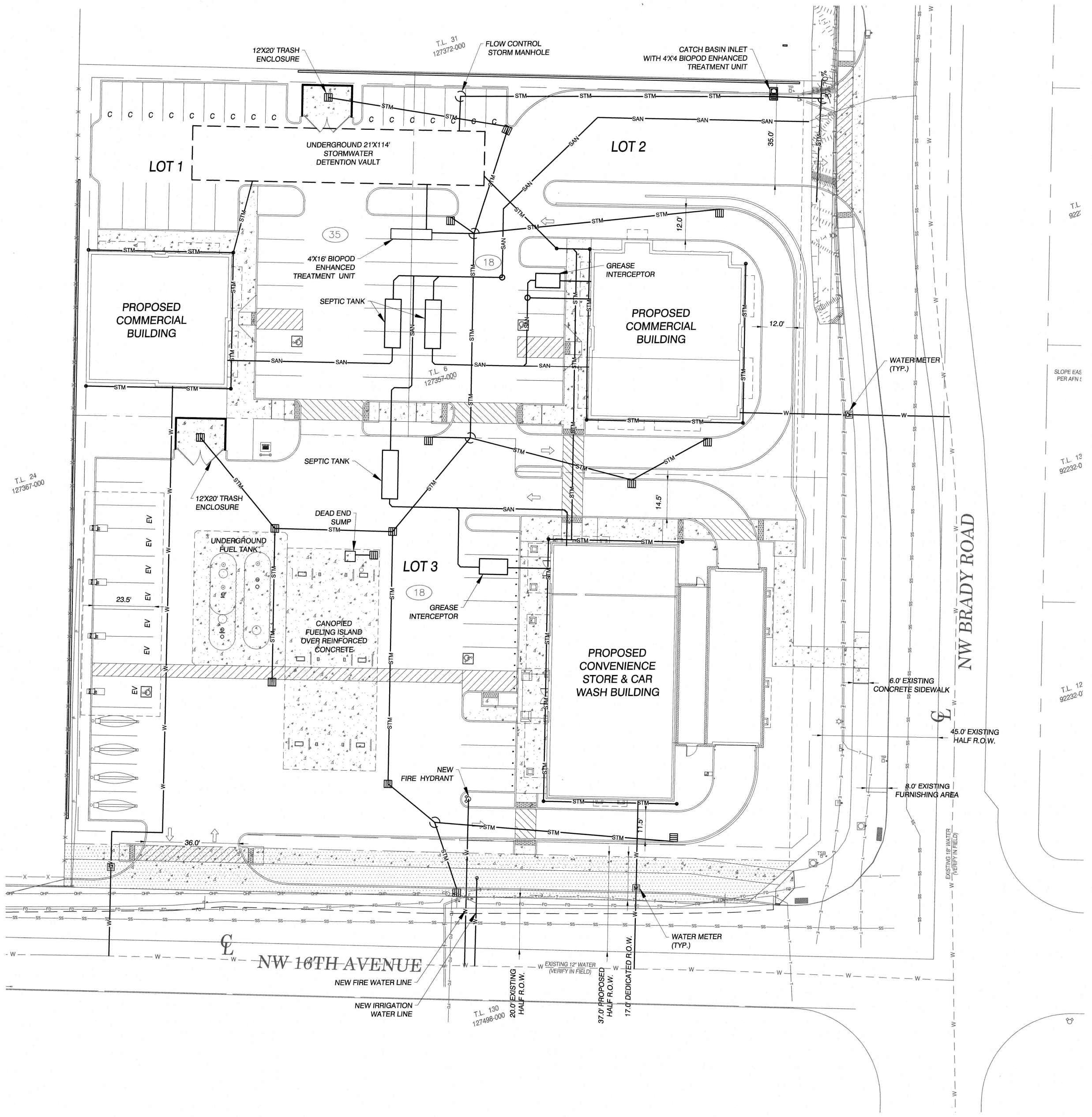
DESCRIPTION:	DATE:

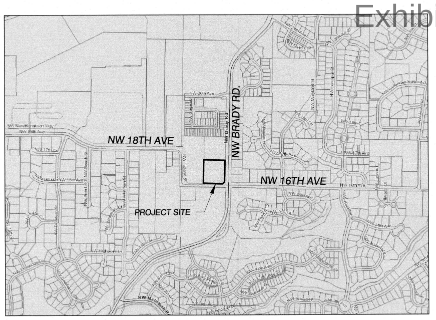
DESIGNED: PAT
DRAWN: SLH/PAT
CHECKED: PAT
DATE: JANUARY 2022
SCALE: H: 1"= 20'
V: N/A

CAMAS CROSSING
JOB NO.: A10320

SHEET
GR1.0

Exhibit 14 CUP22-02





VICINITY MAP

N.T.S.

PRELIMINARY UTILITY PLAN NOTES

STORMWATER:

1) SOIL ONSITE IS CLASSIFIED AS POWELL SILT LOAM(PoB).

2) ALL RUNOFF FROM THE PAVED AREAS, BOTH ONSITE AND FROM FRONTAGE IMPROVEMENTS ALONG NW 16TH AVENUE, WILL BE COLLECTED AND ROUTED TO A BIOPOD TREATMENT UNIT. BIOPOD UNIT WILL PROVIDE REQUIRED ENHANCED AND PHOSPHOROUS TREATMENT.

3) ALL RUNOFF FROM THE SITE EXCEPT NORTH DRIVEAY TO BE ROUTED TO THE ONSITE DETENTION. RUNOFF FROM NORTH DRIVEWAY WILL BE DISCHARGED WITHOUT DETENTION BUT ONSITE DTENTION WILL BE OVERSIZED TO COMPENSATE FOR THIS DISCHARGE. OVERCHARGE DISCHARGE RATES FROM THE SITE WILL BE DESIGNED TO MEET THE FORESTED DISCHARGE STANDARD.

4) STORMWATER ACCESS AND INSPECTION EASEMENTS WILL BE DEDICATED TO THE CITY OF CAMAS AS REQUIRED.

WATER NOTES:

1) A 12" WATER MAIN EXISTS IN NW. 16TH AVE. & A 18" DI WATER MAIN EXISTS IN NW. BRADY ROAD. A FIRE HYDRANT EXISTS IN THE SOUTHEAST CORNER OF THE DEVELOPMENT SITE. NO EXISTING METERS OR STUBS ARE PRESENT AROUND THE SITE. NEW STUBS SHALL BE INSTALLED FOR FIRE, COMMERCIAL & IRRIGATION USES.

2) A WATER EASEMENT IS REQUIRED ON LOT 3 FOR THE SERVICE OF LOT 2.

3) WATER EASEMENTS WILL BE GRANTED TO THE CITY OF CAMAS AS REQUIRED.

SANITARY NOTES:

1) AN 8" PRESSURE SANITARY MAIN EXISTS ON THE NORTH SIDE OF NW 16TH. AVE. A 10" PVC STEP SEWER MAIN EXISTS ALONG NW BRADY ROAD. A 6" PVC STEP STUB EXISTS IN THE FAR NORTHEAST CORNER OF THE PROPERTY.

2) SEPTIC TANKS WILL BE PROVIDED FOR EACH LOT IN ACCORDANCE WITH SIZING CRITERIA.

3) A GREASE INTERCEPTOR WILL BE INSTALLED FOR THE CONVENIENCE STORE & COFFEE SHOP.

4) SANITARY EASEMENTS SHALL BE GRANTED TO THE CITY OF CAMAS AS REQUIRED.

STREET NOTES:

1) NW 16TH AVE. IS CLASSIFIED AS A 2 OR 3 LANE COLLECTOR ROAD AND RUNS ALONG THE SOUTH SIDE OF THE PROPERTY. ROW DEDICATION, PAVEMENT, CURB, SIDEWALK AND LANDSCAPING FRONTAGE IMPROVEMENTS ARE PROPOSED.

2) NW BRADY ROAD IS CLASSIFIED AS AN ARTERIAL ROAD AND RUNS ALONG THE EAST SIDE OF THE PROPERTY. FRONTAGE IMPROVEMENTS HAVE ALREADY BEEN COMPLETED.

3) A COMMERCIAL ACCESS DRIVEWAY IS PROPOSED ON EACH STREET.

EROSION CONTROL NOTES:

1) EROSION CONTROL MEASURES WILL BE SHOWN ON THE FINAL PLANS AS REQUIRED BY THE CITY OF CAMAS.

SCALE: 1"=20

-20 0 20 40

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STREET-UTIL.STB

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PRELIMINARY PLAN FOR:

CAMAS CROSSING

OLSON LAND SURVEYORS
ENGINEERS
ENGINEERING INC. 222 E. EVERGREEN, VANCOUVER, WA 98660
360-695-1385
503-289-9936

PETER A. TUCK
31817

2/16/22

CHANGES / REVISIONS

DESCRIPTION:	DATE:

DESIGNED: PAT

DRAWN: SLH/PAT

CHECKED: PAT

DATE: JANUARY 2022

SCALE: H: 1"= 20'
V: N/A

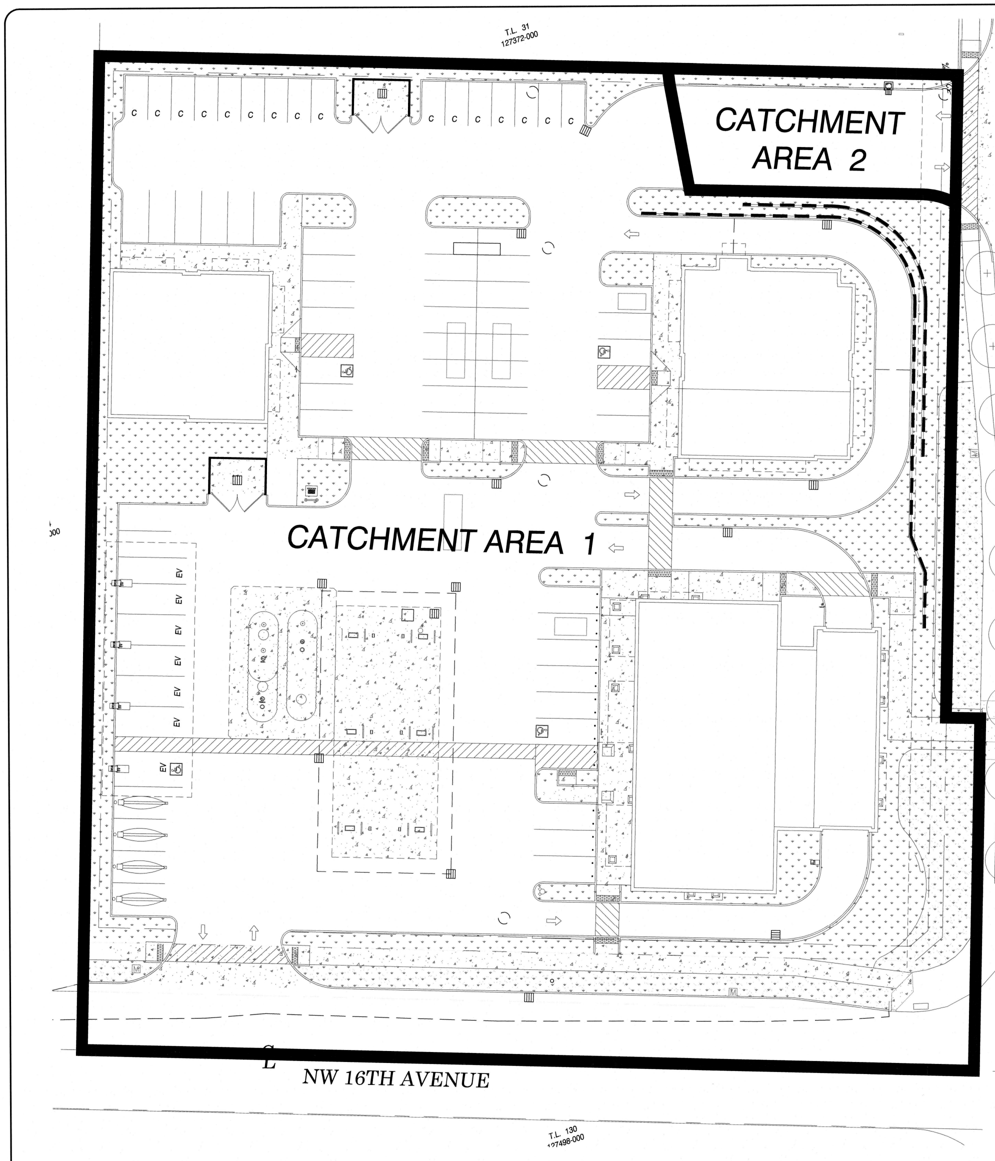
CAMAS CROSSING

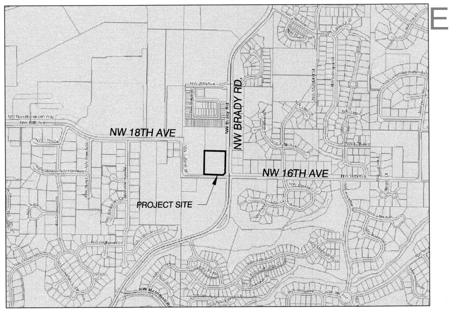
JOB NO.: A10320

SHEET

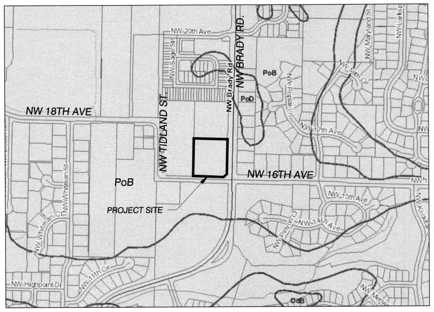
P1.0

Exhibit 14 CUP22-02





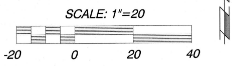
VICINITY MAP
N.T.S.



SOILS MAP
N.T.S.

CATCHMENT BASIN SUMMARY

CATCHMENT AREA 1 -	0.333 AC BUILDING AREA 1.333 AC PAVEMENT AREA 0.152 AC SIDEWALK 0.425 AC LANDSCAPE AREA 2.244 AC TOTAL AREA
CATCHMENT AREA 2 -	0.079 AC PAVEMENT AREA 0.011 AC LANDSCAPE AREA 0.091 AC TOTAL SITE AREA



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PRELIMINARY CATCHMENT AREA PLAN FOR:
CAMAS CROSSING

OLSON LAND SURVEYORS
ENGINEERS
ENGINEERING INC. 222 E. EVERGREEN, VANCOUVER, WA 98660
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CHANGES / REVISIONS

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SCALE: H: 1"= 20'
V: N/A

CAMAS CROSSING

JOB NO.: A10320

SHEET
CP1.0