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300 BUILDING
LARSON AUTO GROUP
300 RIVER ROAD, PUYALLUP, WA 98371

Drainage Report

MC# LARS0001
1/19/2022

Drainage Report

1/19/2022

Prepared for:

Larson Automotive Group

Attn: Mr. Mark Nelson

7815 South Tacoma Way, WA 98409

(253) 475-4816

Civil Engineer:

Momentum Civil

1145 Broadway, Suite 1150

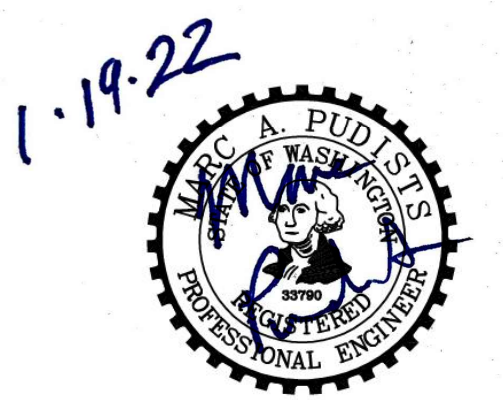
Tacoma, WA 98402

Prepared by: J. Kyle Murphy, P.E.

Under the Direction of: Marc Pudists, P.E.

Email: MarcP@momentumcivil.com

Phone: 253-319-1505



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Section 1 - Project Overview

The project proponent, Larson Automotive Group, is applying for permits for the construction of a new vehicle sales showroom which will provide an additional 5,300 square feet of retail space compared to the original showroom. Other project improvements include: relocation of an existing commercial driveway fronting on 4th Street NW; removal of an unused existing commercial driveway fronting on River Road; rehabilitation of an existing commercial driveway to meet current ADA standards; onsite paving replacement to blend grades with the building addition; onsite cement concrete pathways for pedestrian usage; minor frontage improvements to 4th Street NW and River Road; and a half-street grind and overlay along the 4th Ave NW frontage.

The project is located on Pierce County parcel numbers 0420214010 (Parcel A), 0420214027 (Parcel B), and 0420281154 (Parcel C) at 300 River Road in Puyallup, WA 98371. It should be noted that minimal storm drain piping will be installed on Parcel C and that parcels A and B will be combined into one parcel with a combined area of 2.33 acres. Please refer to Figure 1 on the next page for the project Vicinity Map.

For this project, a Civil Construction permit, Right-of-Way permit for driveway modifications, Building permit, and Lot Combination permit are anticipated for project approval by the City of Puyallup. No additional permits are anticipated for this development at this time. Site Plan approval and SEPA have already occurred and an MDNS has been issued.

This project will adhere to the following stormwater documents and their stated requirements:

- City of Puyallup Phase II Municipal Permit (NPDES Permit);
- City of Puyallup Municipal Code (PMC)
- City of Puyallup Design Standards (Version 2019)
- City of Puyallup Stormwater Management Plans (Comprehensive Plans, Basin Plans, and/or Water Clean-up Plans);
- The parameters and Minimum Requirements set forth in the DOE 2014 Stormwater Management Manual for Western Washington (known herein as the “Manual”).

The subject parcels are situated within the South Puyallup Basin and discharges stormwater into the public drainage system. Minimum Requirements #1-9 will be applied to this project.

Figure 1 - Vicinity Map

Disclaimer: The map features are approximate and have not been surveyed. Additional features not yet mapped may be present. Pierce County assumes no liability for variations ascertained by formal survey.

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Section 2 – Existing and Proposed Conditions Summary

Existing Conditions

The project site is bounded by River Road to the north, 4th Street NW to the west, a commercial (automotive) development to the east, and single-family residences to the south.

The site has previously been developed and is currently used as a vehicle sales and service center. Due to previous development, the site is predominantly paved (in excess of 90% impervious surface coverage) and there are two existing buildings situated on parcel 0420214010. One of the buildings is currently used as a vehicle sales center, and the other is used for service and maintenance of the vehicle fleet.

In general, the site has gentle grades (less than 5% in any direction) and slopes from southeast to northwest. There is approximately three (3) feet of fall across the entire site with no abrupt grade changes.

The project site has a frontage along River Road approximately 437 feet in length and a frontage along 4th Street NW approximately 510 feet in length. These street frontages have already been fully developed according to the development standards consistent with their roadway classifications. Additionally, the site has an existing commercial driveway fronting off 4th Street NW, and two existing commercial driveway approaches fronting off River Road, but only one of the driveways fronting off River Road is currently being used. The westerly River Road driveway approach does not have proper intersection spacing, is unused, and will be removed as part of this project.

In the existing condition, onsite stormwater runoff generally flows via overland sheet flow into the public drainage system within River Road and 4th Street NW. The existing buildings have downspouts with splash blocks which direct flows away from the buildings and onto the pavement.

There are two existing catch basins located on the southern portion of the site which collect onsite stormwater runoff. It is not known at this time where runoff is conveyed from these catch basins. These catch basins appear to be functioning adequately and no improvements or land disturbance are planned in the catchment area of these basins.

Please see Figure 2 for representation of the existing conditions.

Soils Properties

According to the USDA web soil survey, the project site is almost exclusively underlain with xerorthents fill, which is comprised of artificial fill and/or dredge soils.

According to the site-specific geotechnical report by GeoResources dated 5/28/2021, infiltration is not feasible for this project site due to low infiltration rates. Please see Appendix D for the geotechnical report.

Wells and Septic Tanks

No wells or septic tanks are located onsite.

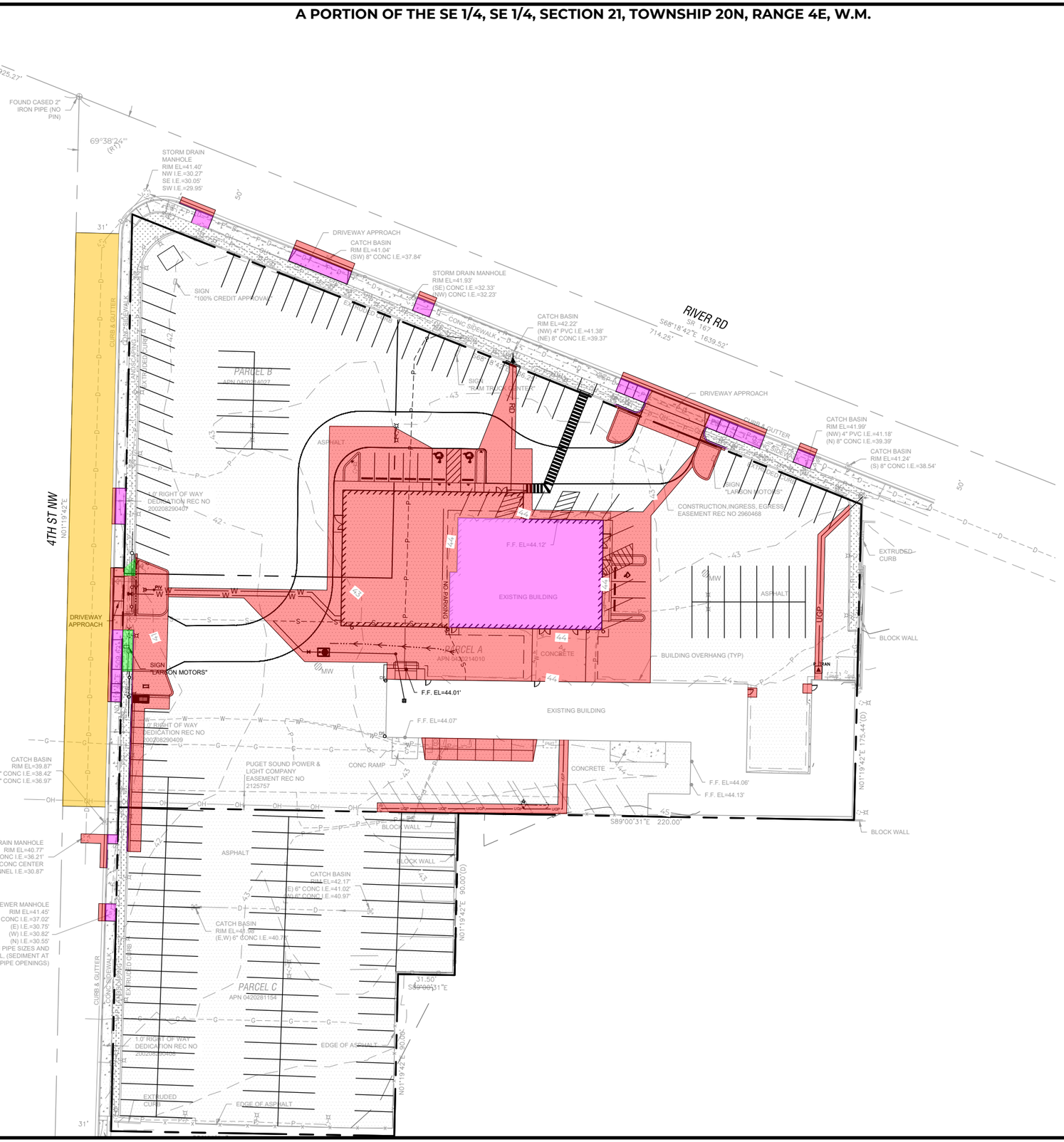
Floodplain Analysis

The project does not lie within the 100-year flood plain according to FEMA FIRM panel 0333E for Pierce County.

Critical Areas

There are no critical areas located onsite. Similarly, there are no mapped or identified critical areas located within ¼ mile downstream of the project discharge point according to Pierce County GIS records

A PORTION OF THE SE 1/4, SE 1/4, SECTION 21, TOWNSHIP 20N, RANGE 4E, W.M.



NORTH

30 0 15 30 60

(FEET)

REPLACED SURFACE COVERAGE SUMMARY

SURFACE DESCRIPTION	AREA (SQ. FT)
EXISTING PGHS	24,785+/-
EXISTING NON-PGHS	6,480+/-
TOTAL HARD SURFACE	**31,265+/-**
EXISTING LANDSCAPING	185+/-
GRIND AND OVERLAY	7,530+/-
TOTAL DISTURBED AREA	**38,980+/-**

FLOW DIRECTION

EG MAJOR CONTOUR 285.0

EG MINOR CONTOUR 286.0

NO	DATE	REVISION DESCRIPTION	BY	CK

PERMIT SET

300 BUILDING - LARSON AUTOMOTIVE GROUP
CASTINO ARCHITECTURE

EXISTING CONDITIONS BASIN MAP

300 RIVER ROAD
CITY OF PUYALLUP

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: M. PUDISTS
DESIGNED BY: K. MURPHY
DRAWN BY: K. MURPHY

HORZ. DATUM: NAD83(11)
VERT. DATUM: NAVD88

DATE: 1/18/2022

PROJECT NO. LARS-0001

SHEET NO. 1 OF 1

REFERENCE NO. FIG2

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By: Kyle Murphy
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Proposed Conditions

The proposed development will demolish the existing 5,500 square foot vehicle sales showroom and replace with it a new showroom with an increased footprint of approximately 5,300 square feet. The new building will protrude further north and west of the existing footprint while maintaining the existing southern and eastern building footprints. The expansion of the showroom will reduce the size of the existing parking lot by a commensurate amount, thus reducing the PGIS area. Minor regrading and pavement replacement will occur adjacent to the new building addition to accommodate the new construction. Existing drainage patterns will be maintained.

An existing porte-cochere/service drive is located between the two existing buildings. In the developed condition, this feature will be fully enclosed with walls. Since the existing concrete pad for this service drive is already a localized high point, no drainage disruption is anticipated by walling this area.

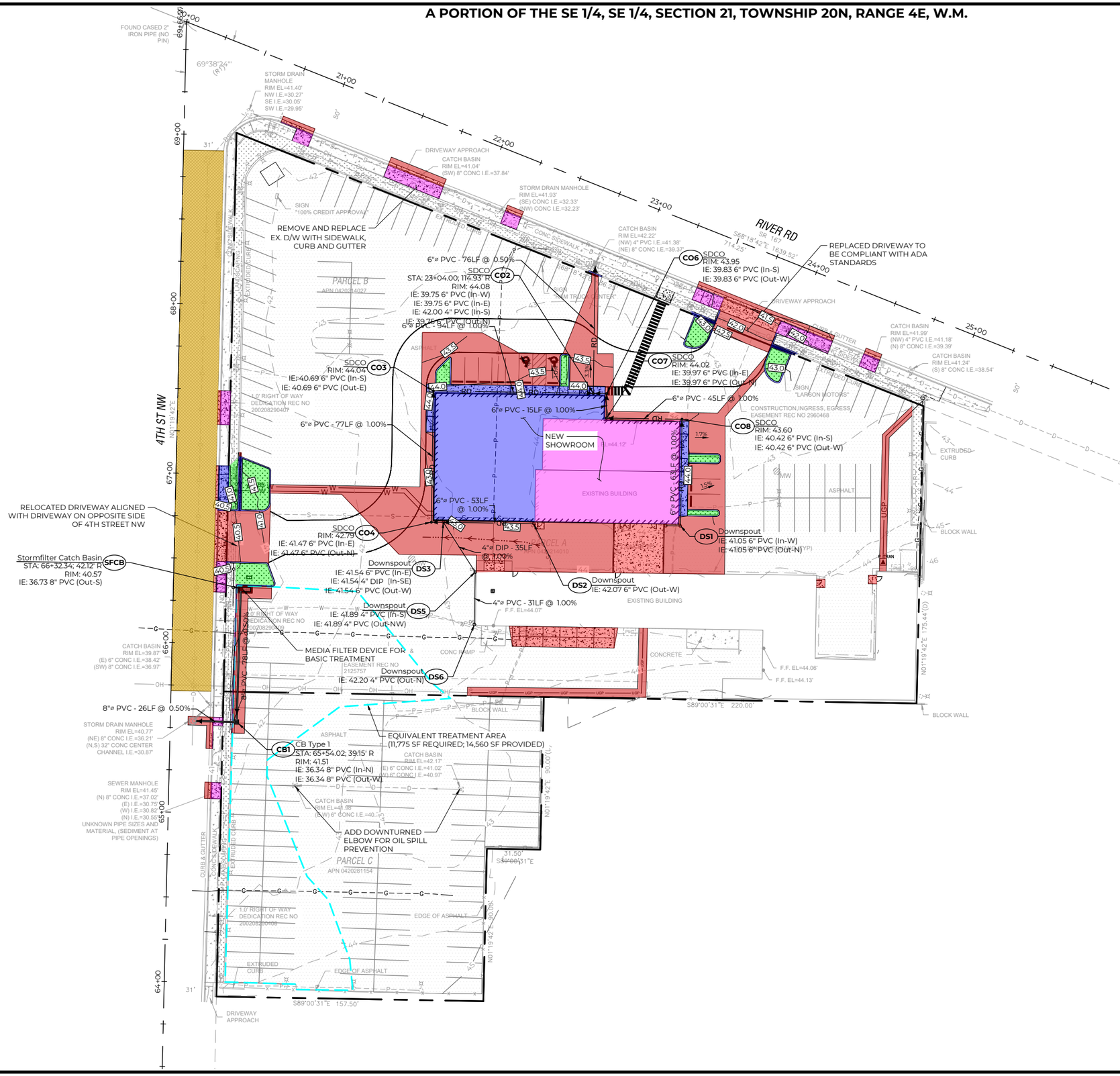
The new roof drain system for the showroom will be tightlined to an existing catch basin located behind the back of walk within the street frontage of River Road. Additionally, downturned elbows will be installed within the two existing onsite catch basin structures to provide spill protection and oil control.

As conditions of site development, the commercial driveway located off 4th Street NW will be relocated approximately 25 feet to the south so that it aligns with the opposing property driveway. The western most commercial driveway located off River Road will be removed and replaced with raised pedestrian sidewalk; and the eastern most commercial driveway located off River Road will be rehabilitated to be ADA compliant.

Minor improvements to the right-of-way will include sidewalk panel replacement and curb/gutter replacement as directed by the City Inspector. As part of the required improvements to 4th Street NW, a half-street grind and overlay will be performed for approximately 325 linear feet along the frontage of the site (along Parcels A and B).

Please see Figure 3 for representation of the proposed conditions.

A PORTION OF THE SE 1/4, SE 1/4, SECTION 21, TOWNSHIP 20N, RANGE 4E, W.M.



PROPOSED SURFACE COVERAGE SUMMARY

SURFACE DESCRIPTION	AREA (SQ. FT)
REPLACED PGIS	16,845+/- SF
REPLACED NON-PGHS	6,330+/- SF
EXISTING PGIS TO NON-PGHS	6,800+/- SF
TOTAL NEW + REPLACED HARD SURFACE	**29,975+/- SF**
PGIS TO LANDSCAPING	1,475+/- SF
TOTAL SOFTSCAPING	**1,475+/- SF**
4TH STREET GRIND AND OVERLAY	7,530+/- SF
TOTAL DISTURBED AREA	**38,980+/- SF**
EQUIVALENT TREATMENT AREA	14,560 SF

FG MAJOR CONTOUR 285.0
FG MINOR CONTOUR 286.0
EG MAJOR CONTOUR 285.0
EG MINOR CONTOUR 286.0

NO	DATE	REVISION DESCRIPTION	BY	CK

PERMIT SET

300 BUILDING - LARSON AUTOMOTIVE GROUP
CASTINO ARCHITECTURE

PROPOSED BASIN MAP

300 RIVER ROAD
CITY OF PUYALLUP

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PROJECT NO. LARS-0001

SHEET NO. 1 OF 1

REFERENCE NO. FIG3

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By: Kyle Murphy
By: Kyle Murphy
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Section 3 – Offsite Analysis

Upstream Tributary Sub-basin

There are no offsite tributary areas upstream of the site.

Downstream Analysis

A qualitative analysis has been performed for this project site. Momentum Civil Staff visited the site on May 10, 2021, and performed a qualitative analysis extending ¼ mile downstream from the project threshold discharge point.

In general, stormwater runoff leaves the site and enter the public drainage system within 4th Street NW or River Road. From thence, flow is directed via gutter flow or piped connection to the corner of 4th Street NW and River Road. A 36-inch pipe directs flow from the south quadrant of the intersection to the north of River Road; from there flow is conveyed in a 48-inch diameter pipe within 4th Street NW; from there flow is conveyed in a 54-inch diameter pipe within 4th Street NW; from there flow is discharged via outfall into the Puyallup River. No problems with the downstream drainage system are known to exist at this time, and since this development project will decrease the amount of impervious surface tributary to the downstream conveyance system (and thus peak runoff flows), no downstream capacity problems are anticipated to occur as a result of this project.

Please see Figure 4 for representation of the Offsite Qualitative Analysis.

FIGURE 4: OFFSITE ANALYSIS

SOURCES:
AERIAL - GOOGLE EARTH
PIPES - PUYALLUP GIS

Section 4 – Discussion of Minimum Requirements and Site Layout

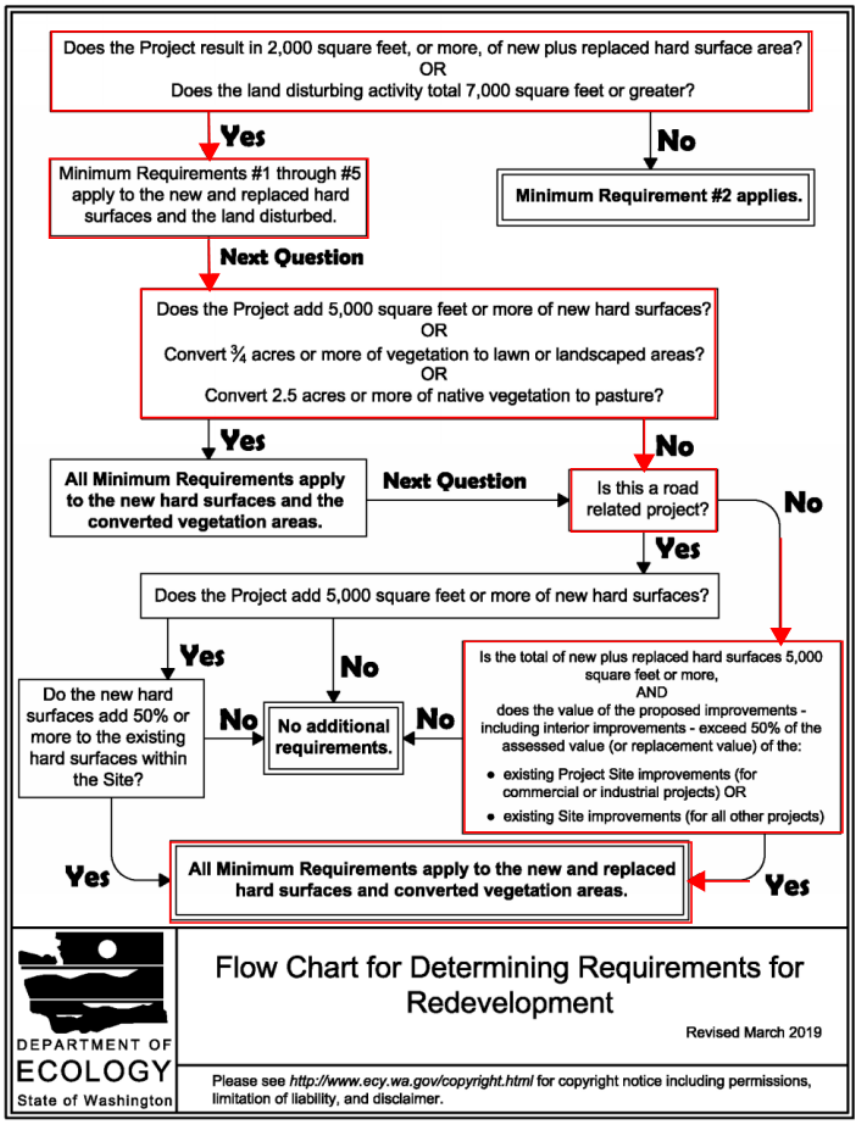
Stormwater Minimum Requirements Summary

According to Figure 3.4 of Appendix I of the Western Washington Phase II Municipal Stormwater Permit, this project requires Minimum Requirements 1-9 to be met. Since this project will add over 5,000 square feet of replaced hard surfaces, and since the valuations of improvements, including interior improvements, exceeds 50% of the assessed value of the existing site improvements, all Minimum Requirements apply for this redevelopment project.

See Figure 5 for the completed flow chart for determining the Minimum Requirements applicable for this redevelopment project.

Figure 5: Flow Chart Determining Requirements for Redevelopment

Figure 4: Flow Chart for Determining Requirements for Redevelopment



MR #1 – Preparation of Stormwater Site Plans

A stormwater Site Plan has been prepared in accordance with the DOE requirements. This storm drainage report and the associated future civil engineering plans will fulfill this requirement.

MR #2 – Construction Stormwater Pollution Prevention Plan (CSWPPP)

A Temporary Erosion and Sediment Control Plan has been prepared as part the civil plans for this project which describe project specific measures to take based on the Department of Ecology's Best Management Practices. Control measures conform to the requirements as set forth in the DOE 2014 Stormwater Management Manual for Western Washington.

After the project has been awarded to a bidder, but prior to construction, a Construction Stormwater Pollution Prevention Plan will be completed by the Contractor for this project.

MR #3 – Source Control of Pollution

Construction phase Best Management Practices (BMPs) will be detailed in the final Construction Drawings. These BMPs represent the minimum expected control measures for the interim construction site conditions. The contractor shall be responsible for adjusting and maintaining these BMPs as required by the site conditions.

According to the DOE Manual, permanent/operational source control BMPs applicable to this site include, but are not limited to:

- S411 BMPs for Landscaping and Lawn/Vegetation Management
- S412 BMPs for Loading and Unloading Areas for Liquid or Solid Material
- S414 BMPS for Maintenance and Repair of Vehicles and Equipment
- S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems
- S420 BMPs for Painting/Finishing/Coating or Vehicles/Buildings/Equipment
- S421 BMPs for Parking and Storage of Vehicles and Equipment
- S426 BMPs for Spills of Oil and Hazardous Substances

MR #4 – Preservation of Natural Drainage Systems and Outfalls

In the existing condition, stormwater runoff generally leaves the site via sheet-flow into the public right-of-way drainage system. The proposed drainage pattern will be maintained, while reducing the amount of sheet-flow leaving the site over the sidewalk by adding a new piped connection to the public drainage system. The proposed method of discharge from the site will not cause any adverse impacts to downstream receiving waterbodies or downgradient properties.

MR #5 – Onsite Stormwater Management

This project will employ list approach #2 per the DOE Manual. Since this project is situated within a flow control exempt watershed (Puyallup River), this project does not have to consider bioretention, rain gardens, permeable pavement, and full

dispersion. The abridged List #2 approach is shown in Table 1 below. Furthermore, the low infiltration capacity of the onsite soils and proximity to existing paving make pervious paving and storm infiltration infeasible at the site. Soils on site were determined to have an infiltration rate of less than 0.3 inches per hour (please refer to Appendix D for the Geotechnical Report).

Table 1: List Approach #2 Onsite Management BMPs for Projects Triggering MR #1-9

BMP	Feasible?	Limitations on Feasibility
Lawn and Landscaped Areas:		
T5.13: Post Construction Soil Quality and Depth	Y	None. This BMP will be employed on all lawn/landscaped areas affected by this project.
Roofs		
T5.10A: Downspout Full Infiltration	N	Per the geotechnical report, infiltration is not deemed feasible for onsite stormwater management.
T5.10B: Downspout Dispersion Systems	N	Lack of vegetative flowpath
T5.10C: Perforated Stub-Out Connections	N	Per the geotechnical report, infiltration is not deemed feasible for onsite stormwater management.
Other Hard Surfaces		
T5.12: Sheet Flow Dispersion	N	Lack of vegetative flow path for flow attenuation.
T5.11: Concentrated Flow Dispersion	N	Lack of vegetative flow path for flow attenuation.

MR #6 – Runoff Treatment

This project will result in over 5,000 square feet of new and replaced pollution generating hard surface area and will therefore employ runoff treatment. Because this project discharges indirectly to the Puyallup River, and since the Puyallup River requires only Basic treatment according to Table I-C.1 of Appendix C, Volume I, of the Manual, this project will provide basic treatment.

A media filter device (Stormfilter® Catch Basin) will be installed near the southwest corner of parcel 0420214010 which will treat an equivalent area which is greater than the new and replaced PGIS area. The media filter device will discharge treated flows into the public storm catch basin located within 4th Street NW. The device will operate in an “offline” configuration and high flows will bypass treatment; all flows up to and including the 6-month 24-hour storm event will be treated. Please see Figure 3 for the media filter device location and equivalent basin area. Please refer to Appendix E for the WWHM results used in sizing the water quality device.

MR #7 – Flow Control

Since this project ultimately discharges to the Puyallup River which is a flow control exempt waterbody, and since the downstream conveyance system is entirely manmade, this project is flow control exempt, assuming that the downstream public conveyance system has adequate capacity.

Since this project will not result in an increase in stormwater runoff generated onsite, and since the downstream conveyance system does not show any indication of flooding or failure, no downstream capacity problems are anticipated that are associated with this development.

MR #8 – Wetlands Protection

There are no wetlands present onsite or within a ¼ mile downstream of the site. Thus, minimum requirement #8 does not apply to this project.

MR #9 – Operation and Maintenance

An operation and maintenance manual has been included within this report under Appendix F.

Section 5 – Permanent Stormwater Control Plan

The roof drain system for the building expansion will be tightlined to an existing catch basin located behind the back of walk within the street frontage of River Road. The roof drain system has a minimum pipe diameter of 6-inches and a minimum pipe slope of 1.0% for all roof drain pipes.

The two existing catch basin structures located on Parcel C (0420281554) will be outfitted with downturned elbows to provide spill protection and oil control.

A media treatment device (Stormfilter® Catch Basin) will be installed on Parcel C (042081554) which will treat an equivalent area that is greater than the new and replaced PGIS. Stormwater runoff will be collected by an upstream catch basin which will be located near an existing low point onsite - the location of the driveway onto 4th Street NW. Previously, stormwater runoff left the site via sheet-flow runoff at this location, but with the proposed improvements, stormwater will be collected, conveyed, treated and discharged offsite via a piped connection.

The newly constructed onsite conveyance system has been sized to convey the 100-year 24-hour storm event without overtopping any structure rims or surcharging any onsite pipe runs. The hydrologic and hydraulic modeling methods are consistent with the City of Puyallup City Standards and employed Autodesk software (Storm and Sanitary Sewer Analysis) to perform the analysis.

The Santa Barbara Unit Hydrograph Methodology (SBUH) was used to determine peak runoff flows. The 100-year 24-hour storm event (Type 1-A rainfall distribution) was selected with a cumulative rainfall depth of 4.1 inches. For simplicity, all basins onsite were modeled as 100% impervious with a curve number of 98 and a time of

concentration of 5-minutes. Three sub-basins were created for the model: sub-basin 1 and 2 represent the showroom roof area split evenly between the two pipe runs surrounding the building; and sub-basin 3 which is tributary to CB1 and the downstream Stormfilter®. Lastly, a manning's N value of 0.012 was assigned to each pipe in the system,

According to the simulation results, no pipes are surcharged, and no structures flooded for the 100-year storm event. Please refer to Appendix B for the conveyance calculations and output results from Storm and Sanitary Sewer Analysis software.

List of Appendices

Appendix A - Civil Engineering Plans

[Under Separate Cover]

Appendix B - Conveyance Calculations

Project Description

File Name ..... Larson Jeep.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Santa Barbara UH
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods ...	NO

100-year event conveyance calculations using Storm and Sanitary Analysis (Autodesk).

Analysis Options

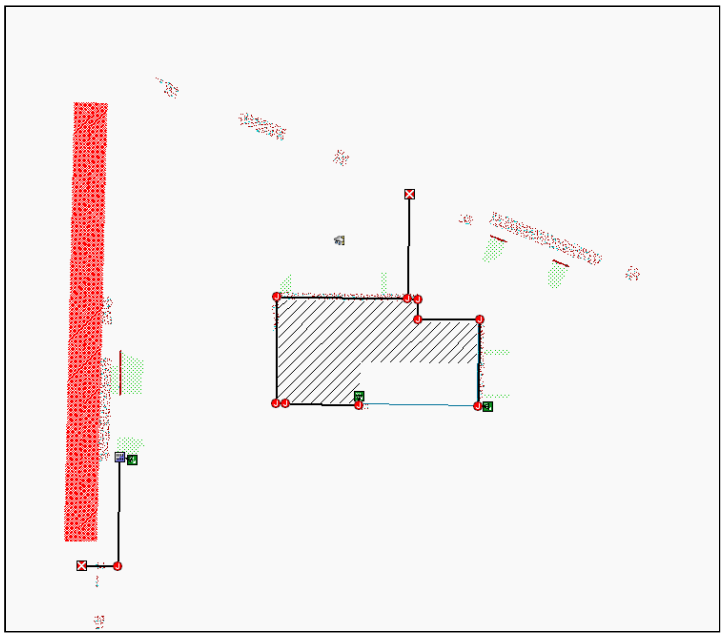
Start Analysis On	Nov 17, 2021	00:00:00
End Analysis On	Nov 18, 2021	00:00:00
Start Reporting On	Nov 17, 2021	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	14
Junctions	10
Outfalls	3
Flow Diversions	0
Inlets	1
Storage Nodes	0
Links.....	11
Channels	0
Pipes	11
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

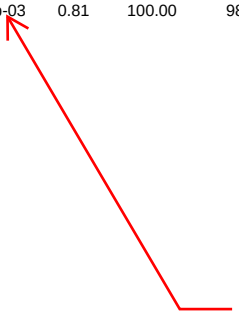
Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	TS-100	Cumulative	inches	Washington	Pierce	100	4.10	SCS Type IA 24-hr



Subbasin Summary

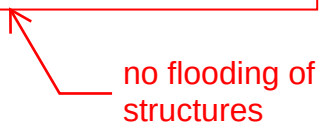
SN	Subbasin ID	Area (ac)	Impervious Area (%)	Impervious Area Curve Number	Pervious Area Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	0.12	100.00	98.00	76.00	4.09	3.85	0.46	0.12	0 00:05:00
2	Sub-02	0.12	100.00	98.00	76.00	4.09	3.85	0.46	0.12	0 00:05:00
3	Sub-03	0.81	100.00	98.00	76.00	4.09	3.85	3.11	0.78	0 00:05:00



sub-basin 3 is tributary to CB1 and the downstream biopod; sub-basin 1 and 2 represent the showroom roof split evenly between the two pipe runs for the roof drain system.

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	BIO1	Junction	36.34	41.52	36.34	41.52	0.00	0.78	37.31	0.00	4.21	0 00:00	0.00	0.00
2	CO2	Junction	39.75	44.08	39.75	44.08	0.00	0.23	40.01	0.00	4.07	0 00:00	0.00	0.00
3	CO3	Junction	40.69	44.04	40.69	44.04	0.00	0.12	40.84	0.00	3.19	0 00:00	0.00	0.00
4	CO4	Junction	41.47	42.79	41.47	42.79	0.00	0.12	41.62	0.00	1.17	0 00:00	0.00	0.00
5	CO6	Junction	39.83	43.95	39.83	43.95	0.00	0.12	39.98	0.00	3.97	0 00:00	0.00	0.00
6	CO7	Junction	39.97	44.02	39.97	44.02	0.00	0.12	40.12	0.00	3.89	0 00:00	0.00	0.00
7	CO8	Junction	40.42	43.60	40.42	43.60	0.00	0.12	40.57	0.00	3.04	0 00:00	0.00	0.00
8	DS1	Junction	41.05	41.59	41.05	41.59	0.00	0.12	41.20	0.00	0.39	0 00:00	0.00	0.00
9	DS2	Junction	42.07	42.61	42.07	42.61	0.00	0.12	42.22	0.00	0.39	0 00:00	0.00	0.00
10	DS3	Junction	41.54	42.08	41.54	42.08	0.00	0.12	41.69	0.00	0.39	0 00:00	0.00	0.00
11	Out-1Pipe - (12) - 6.0 inch PVC Pipe	Outfall	39.37					0.23	39.63					
12	Out-1Pipe - (20) - 8.0 inch PVC Pipe	Outfall	36.21					0.78	36.68					
								0.00	36.21					



Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	BIO1-OUT	Pipe	BIO1	Out-1Pipe - (20) - 8.0 inch PVC Pipe	26.13	36.34	36.21	0.5000	8.000	0.0120	0.78	0.93	0.84	2.98	0.47	0.70	0.00	Calculated
2	C02-OUT	Pipe	CO2	Out-1Pipe - (12) - 6.0 inch PVC Pipe	76.39	39.75	39.37	0.5000	6.000	0.0120	0.23	0.43	0.54	2.23	0.26	0.52	0.00	Calculated
3	CB1-OUT	Pipe	CB1	BIO1	79.07	37.24	36.84	0.5000	8.000	0.0120	0.78	0.93	0.84	2.97	0.47	0.70	0.00	Calculated
4	CO3-OUT	Pipe	CO3	CO2	94.38	40.69	39.75	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
5	CO4-OUT	Pipe	CO4	CO3	77.42	41.47	40.69	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
6	CO6-OUT	Pipe	CO6	CO2	7.95	39.83	39.75	1.0000	6.000	0.0120	0.12	0.60	0.19	2.36	0.15	0.30	0.00	Calculated
7	CO7-OUT	Pipe	CO7	CO6	14.51	39.97	39.83	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
8	CO8-OUT	Pipe	CO8	CO7	44.62	40.42	39.97	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
9	DS1-OUT	Pipe	DS1	CO8	62.91	41.05	40.42	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
10	DS2-OUT	Pipe	DS2	DS3	53.25	42.07	41.54	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated
11	DS3-OUT	Pipe	DS3	CO4	7.07	41.54	41.47	1.0000	6.000	0.0120	0.12	0.61	0.19	2.38	0.15	0.30	0.00	Calculated

Appendix C - Construction Stormwater Pollution Prevention Plan (C-SWPPP)

[SUBMITTED UNDER SEPARATE COVER]

Appendix D - Geotechnical Report

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May 28, 2021

Larson Automotive Group
7815 South Tacoma Way
Tacoma, Washington 98409

Attn: Mark Nelson

Geotechnical Engineering Report
Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154
Doc ID: LarsonAutomotive.LarsonJeep.RG

INTRODUCTION

This geotechnical engineering report presents the results of our site observations, subsurface explorations, laboratory test results, literature review, engineering analyses, geotechnical recommendations, and design criteria for the proposed showroom to be constructed on the above referenced parcels at 300 River Road in Puyallup, Washington. The approximate site location is shown on the Site Location Map, Figure 1.

Our understanding of the project is based on our conversations with Jim Castino of Castino Architecture and Marc Pudists of Momentum Civil Engineering Consultants, the provided *Proposed Site Plan* prepared by Goree dated March 23, 2021, our understanding of the City of Puyallup (the City) development codes, and our experience in the area. We understand that you propose to demolish the northern portion of the existing showroom, then construct a larger showroom that extends north and west of the existing footprint. We further understand the structure will be a lightly loaded one-story, metal framed structure. A copy of the proposed site plan is attached as our Site & Exploration Plan, Figure 2.

Given the encountered subsurface conditions, we anticipate that shallow foundations will be sufficient to support the proposed structure if the subgrade is improved. In addition, we anticipate that a portion of the subsurface soils could be susceptible to liquefaction during an earthquake. Because of the amount of proposed hard surfacing associated with the project, the City requires a *Soils Report* be prepared in accordance with the *2014 Stormwater Management Manual for Western Washington* (SWMMWW), which includes in-situ infiltration testing and wet season groundwater monitoring.

PURPOSE & SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and conclusions for the proposed development. Specifically, the scope of services included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;
2. Exploring surface and subsurface conditions by reconnoitering the site and monitoring the drilling of 4 borings at selected locations across the site;
3. Describing surface and subsurface conditions, including soil type, depth to groundwater, and an estimate of seasonal high groundwater levels;
4. Addressing the City of Puyallup Critical Areas Ordinance (Title 21), as appropriate;

5. Providing geotechnical conclusions and recommendations regarding seismic hazards, including liquefaction analysis;
6. Providing geotechnical conclusions and recommendations regarding site grading activities, including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut slopes and drainage and erosion control measures;
7. Providing conclusions regarding shallow foundations and floor slab support and design criteria, including bearing capacity and subgrade modulus as appropriate;
8. Providing conclusions regarding the feasibility of typical ground improvement methods, as appropriate;
9. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2014 *Stormwater Management Manual for Western Washington* (SMMWW) and City Municipal code (City of Puyallup Municipal Code Chapter 21.10), including a preliminary design infiltration rate based on grain size analysis, as applicable; as applicable;
10. Performing groundwater monitoring during the wet season defined by the 2014 SMMWW (December 21 through March 21)
11. Providing a standard duty hot mix asphalt (HMA), heavy duty Portland cement concrete (PCC), pervious concrete, and porous asphalt pavement section designs based on traffic data provided by you;
12. Providing recommendations for erosion and sediment control during wet weather grading and construction; and,
13. Preparing a written *Geotechnical Engineering Report* summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data.

The above scope of work was completed in accordance with our *Proposal for Geotechnical Engineering Services* dated April 14, 2021. We received written authorization to proceed with our scope of services from you on April 16, 2021.

SITE CONDITIONS

Surface Conditions

The site consists of three contiguous parcels at 300 River Road in Puyallup, Washington within an area of commercial and residential development. The site is currently developed with existing showroom and service buildings and paved parking areas. Based on the Pierce County Public GIS website, the subject parcels when combined, are irregular in shape and measure approximately 150 to 405 feet wide (east to west) by 175 to 510 feet long (north to south), and encompass about 3.05 acres. The site is bounded by commercial development to the east, residences to the south, 4th Street Northwest to the west, and River Road to the north.

Based on Pierce County GIS data and our site observations, the ground surface at the site gently slopes down to the north at inclinations of less than 2 percent. Total topographic relief across the site is on the order of 8 feet, and topographic relief across the project area is on the order of 4 feet. The site is paved. The existing site configuration and topography is shown on the Site Vicinity Map, Figure 3.

The site is developed with buildings and paved parking areas. No planters or vegetation were

present on site. No seeps, springs, or standing water was observed, nor were any areas of exposed soils or active erosion observed at the site at the time of our April 23, 2021 site reconnaissance.

Site Soils

The USDA Natural Resource Conservation Survey (NRCS) Web Soil Survey maps most of the site as underlain by Xerothrents fill (48A) soils and the southwest portion of the site as underlain by Puyallup fine sandy loam (31A) soils. An excerpt from the NRCS soils map for the site area is included as Figure 4.

The Xerothrents fill soils typically consist of modified ground or artificial fill associated with past site grading activities, and form on slopes of 0 to 1 percent. These soils are listed as having "no" to a "slight" erosion hazard when exposed and are not listed in a hydrologic soils group. The Puyallup soils are derived from alluvium and have a "slight" erosion hazard when exposed. These soils form on slopes of 0 to 3 percent, and are included in hydrologic soils group A.

Site Geology

The draft *Geologic Map of the Puyallup 7.5-Minute Quadrangle, Washington* (Troost, in review) maps the site as being underlain by alluvium (Qal). An excerpt of the above referenced map is included as Figure 5.

The alluvium soils typically consist of a poorly sorted, lightly stratified mixture of silt and sand that may contain localized deposits of clay and gravel that were deposited by fluvial processes. The alluvial deposits are considered normally consolidated and can have a range of infiltration potential. No areas of landslides or landslide debris are mapped on or within the vicinity of the site.

Subsurface Explorations

On April 23, 2021, we monitored the drilling of four borings to depths of about 16 to 51 feet below the existing ground surface. The borings were drilled by a licensed drilling contractor operating a track-mounted drill rig working under subcontract to GeoResources. Table 1 below summarizes the location, depth, and elevations of our borings.

TABLE 1:
APPROXIMATE LOCATION, DEPTH, AND ELEVATION OF BORINGS

Boring Number	Approximate Location	Ground Surface Elevation[1] (feet)	Depth Explored (feet)	Termination Elevation[1] (feet)
B-1	Proposed showroom	43	51.5	-8.5
B-2	East of showroom	43	16.5	26.5
B-3	West of service building	43	16.5	26.5
B-4	Southwest parking area	43	16.5	26.5

Notes: [1]Surface elevation estimated from Pierce County Public GIS datum: NAVD 88

The specific location and depth of our borings were determined in the field based on the proposed development and was adjusted based on site access limitations. A field representative from

our office continuously monitored the drilling, maintained a log of the subsurface conditions encountered, and obtained representative soil samples. Our field personnel also observed pertinent site features on and adjacent to the site. Representative soil samples obtained from the explorations were placed in sealed plastic bags and taken to our laboratory for further examination and testing as deemed necessary. Borings B-1 and B-3 were backfilled with bentonite chips and abandoned by the driller in accordance with Washington Department of Ecology requirements. Borings B-2 and B-4 were completed as groundwater observation wells so that we can monitor groundwater elevations during the wet winter months (October through April) as required by the City.

During drilling, soil samples were obtained at 2½ and 5 foot depth intervals in accordance with Standard Penetration Test (SPT) as per the test method outlined by ASTM D1586. The SPT method consists of driving a standard 2-inch-diameter split-spoon sampler 18-inches into the soil with a 140-pound hammer. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count". The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The approximate location of our exploration is shown on the attached Site & Exploration Plan, Figure 3. The locations indicated on Figure 3 were estimated based on taping and pacing from locatable site features. Our subsurface explorations indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of any variation would not become evident until additional explorations are performed or until construction activities have begun. Surface elevations were interpolated based on available topographic information. As such, our boring locations and elevations should only be considered accurate to the degree implied by our measuring methods. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our borings are included as Figures A-2 through A-5.

Subsurface Conditions

At the locations of our explorations we encountered subsurface conditions that generally confirmed the mapped stratigraphy at the site. In general, our borings encountered about 4 inches of asphalt over several inches of sand and gravel fill. Boring B-2 encountered about 1 foot of gravel with silt, sand, and cobbles in a medium dense, moist condition underlying the pavement section, which we interpret to be fill. Underlying the fill, our borings encountered up to 30 feet of interbedded silt and silty sand in a medium stiff or loose to medium dense, moist to wet condition. We interpret these soils to be consistent with the mapped alluvial deposits.

Borings B-2, B-3, and B-4 terminated in the fine grained alluvial deposits. Boring B-1 extended through the fine grained deposits and encountered about 19 feet of brown well-graded sand with silt and gravel in a medium dense, wet condition. Underlying the well-graded sand, boring B-1 encountered grayish brown silty sand in a loose, wet condition to the full depth explored. We interpret these soils to be consistent with coarse grained alluvial deposits.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the borings to estimate index engineering properties of the encountered soils. Laboratory testing included visual

soil classification per ASTM D2488 and ASTM D2487, moisture content determinations per ASTM D2216, and grain size analyses per ASTM D6913 standard procedures. Samples were also submitted to a third party analytical laboratory for organic content testing per ASTM D2974 and cation exchange capacity (CEC) testing per SW846 9081. Test results are included in Appendix B and summarized below in Table 2.

TABLE 2:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

Soil Type	Sample	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)	Organic Matter (percent)	CEC (mEQ/ 100g)
Sandy silt (ML)	B-1, S-5, D: 15 ft	0.2	38.9	60.9	ND	ND
Silty sand (SM)	B-1, S-7, D: 25 ft	0.0	61.4	38.6	ND	ND
Sand with silt (SW-SM)	B-1, S-10, D: 40 ft	33.7	59.1	7.2	ND	ND
Sandy silt (ML)	B-3, S-2, D: 5 ft	0.0	45.6	54.4	2.16	11.0
Sandy silt (ML)	B-4, S-2, D: 5 ft	0.0	25.7	72.6	2.39	7.20
Notes: ND = Not Determined						

Two samples of the near surface soils were submitted to an independent analytical laboratory to determine the potential of the site soils to provide water quality treatment. The near-surface soils were determined to have an organic content of 2.16 to 2.39 percent and a cation exchange capacity (CEC) of 7.20 to 11.0 milliequivalents per 100 grams, and therefore meets treatment requirements.

Groundwater Conditions

Groundwater was encountered in all of our borings at approximately 11 feet below existing grades. However, variability observed in the upper site soils, including interbedded silt and sand alluvial soils, likely results in a complex shallow groundwater regime at the site. Table 3 below summarizes the depths and elevations of groundwater encountered in our explorations. We anticipate fluctuations in the local groundwater levels will occur in response to precipitation patterns, off site construction activities, and site utilization.

Groundwater monitoring wells were installed in borings B-2 and B-4 and will be monitored through the 2021 to 2022 wet season. We will prepare a report addendum at the end of the wet season with additional readings.

TABLE 3:
APPROXIMATE DEPTHS AND ELEVATIONS OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Boring Number	Depth to Groundwater (feet)	Elevation of Groundwater (feet)	Date Observed
B-1	11.0	32.0	ATD (April 23, 2021)
B-2	11.0	32.0	ATD (April 23, 2021)
B-3	11.0	32.0	ATD (April 23, 2021)
B-4	11.0	32.0	ATD (April 23, 2021)

Notes:
[1] = Surface elevation estimated by interpolating between contours presented on the Pierce County GIS website
ATD = At time of drilling

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on our site observations and data review, subsurface explorations and our engineering analysis, it is our opinion that the proposed redevelopment of the site is feasible from a geotechnical standpoint, provided the recommendations included herein are incorporated into the project plans. Infiltration of stormwater does not appear feasible at the existing site grades.

Erosion Hazards per PMC 21.06.1210(3)(a)

The Puyallup Municipal Code defines erosion hazard areas that include those identified by the U.S. Department of Agriculture Natural Resources Conservation Service as having a moderate to severe, severe, or very severe erosion hazard because of natural characteristics, including vegetative cover, soil texture, slope, gradient, and rainfall patterns, or human-induced changes to natural characteristics.

Based on the NRCS Web Soil Survey, the site is underlain by Xerothents fill (48A) and Puyallup fine sandy loam (31A), which are described as having "slight" erosion hazards when exposed. Based on the above, it is our opinion that the site does <u>not</u> meet the technical definition of an erosion hazard area.

Seismic Hazards per PMC 21.06.1210(3)(b)

The City of Puyallup Municipal Code Chapter 21.06 defines seismic hazard areas as "areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless, loose, or soft-saturated soils of low density, typically in association with a shallow ground water table".

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure. The increase in pore water pressure is induced by seismic vibrations. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sands and granular silts that are below the groundwater table. The soils encountered at the site generally consisted of silty sands and silts in a loose to medium dense/medium stiff to stiff condition to depths of about 31 feet below the ground surface. Groundwater levels have been observed or interpreted to be about 11 feet below the existing ground surface at the site. Because the site is underlain by

loose to medium dense, saturated sands, it is our opinion that the site meets the technical definition of a seismic hazard area and has the potential to liquefy during a seismic event. Additional recommendations regarding the potential for liquefaction at the site are included in the "**Liquefaction Analysis**" portion of this report.

Volcanic Hazards per PMC 21.06.1210(3)(c)

The PMC Chapter 21.06 defines volcanic hazard areas as "those areas subject to pyroclastic flows, lava flows, debris avalanche, and inundation by debris flows, lahars, mudflows, or related flooding resulting from volcanic activity". Volcanic hazard areas shall be classified as Case I or Case II lahars, as identified in the report *Sedimentology, Behavior, and Hazards of Debris Flows at Mount Rainier, Washington,* U.S. Geological Survey Professional Paper 1547, 1995. The site is mapped as being located with an Inundation Zone for Case II Lahars. In our opinion, the site is at similar risk of inundation via lahar, mudflow, or lava flow as the existing development in the area.

Seismic Design

Based on the encountered subsurface conditions and the geologic units mapped at the site, we interpret the structural site conditions to correspond to a Seismic Site Class "F" in accordance with the 2018 IBC (International Building Code) and ASCE 7-16, Chapter 20, Section 20.3. Seismic Site Class "F" is defined by the average standard shear wave velocity of the upper 100 feet of soil being less than 600 feet per second or where liquefaction is likely to occur in the design seismic event. Provided the buildings have a resonant frequency of 0.5 seconds or less and our recommendations to mitigate the liquefaction hazard are incorporated, the values for Site Class "D" may be used and a site response analysis is not required.

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002, 2008, and 2014. The PSHA ground motion results were obtained from the *ATC Hazard by Location* website. The results are summarized in Table 4, below, with the relevant parameters as provided by the 2018 IBC design.

TABLE 4:
2018 IBC Parameters for Design of Seismic Structures

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period
Mapped SRA	S_s = 1.276
Site Coefficients (Site Class D)	F_a = 1.000
Maximum Considered Earthquake SRA	S_{MS} = 1.276
Design SRA	S_{DS} = 0.850

Peak Ground Acceleration

The mapped peak ground acceleration (PGA) for this site is 0.5g. To account for site class, the PGA is multiplied by a site amplification factor (F_{PGA}) of 1.1. The resulting site modified peak ground acceleration (PGA_M) is 0.55g. In general, estimating seismic earth pressures (k_h) by the Mononobe-Okabe

method or seismic inputs for slope stability analysis are taken as 33 to 50 percent of the PGA_M, or 0.18g to 0.27g.

Liquefaction Analysis

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in saturated soils and subsequent loss of strength in the deposit of soil so affected. In general, soils that are most susceptible to liquefaction include loose to medium dense "clean" to silty sands and granular silts that are below the water table. A review of the *Liquefaction Susceptibility Map of Pierce County, Washington* indicates the site soils have a "high" liquefaction potential (Figure 6). Details of our Liquefaction Analysis are included in Appendix C.

We performed liquefaction analyses using the computer program "Liquefy Pro" from CivilTech Corporation, with seismic inputs for the site for the mapped maximum considered geometric mean (MCE_G) peak ground acceleration, per ASCE 7-16 of 0.50g and a magnitude of 7.2. Groundwater was assumed to be at 11 feet below existing grades, based on the groundwater levels measured in our subsurface explorations. Based on these assumptions, we estimate a potential total settlement on the order of 10 to 12 inches could result from liquefaction during the maximum considered earthquake. It is our opinion that liquefaction can be partially mitigated during foundation preparation as described in the "**Liquefaction Mitigation Considerations**" section of this report.

Our liquefaction analyses only account for approximately the upper 50 feet of the site subsurface profile. Potentially liquefiable soils may underlie the soils observed in our borings within 100 feet of the ground surface. There may be potential for additional liquefaction induced settlements on the order of 6 inches above the above estimate if this condition is correct.

Our explorations indicate the subsurface conditions at specific locations only, and the subsurface conditions can vary across the site. It is our opinion that the above listed assumptions are suitable for the site, and that the subsurface conditions encountered are representative. If subsurface conditions that vary from our explorations exist at the site, the above assumptions and associated calculated settlements may no longer be valid. Should variable subsurface conditions be encountered during construction and earthwork activities, we should be notified and allowed to review and revise our assumptions and calculations.

Liquefaction Mitigation Considerations

As discussed above, liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in saturated soils and subsequent loss of strength in the deposit affected.

In general, soils that are susceptible to liquefaction include loose to medium dense "clean" to silty sands and granular silts that are below the water table. Two general approaches to mitigation of liquefaction induced settlement are to address the causes or to address the results. Addressing the causes typically involves ground improvement techniques that densify the soil or provide a means to dissipate the excess pore water pressure. Addressing the results of liquefaction induced settlement typically involves stiffening the upper soil layers and the foundation elements to reduce the potential differential settlement. Below we discuss options for the mitigation of liquefaction induced settlement.

Stiffened Foundation

The potential for liquefaction induced settlement can be partially mitigated by stiffening the upper layer of soil and/or stiffening the foundation elements. Geotechnical research suggests that a layer of non-liquefiable soils directly below the foundation elements can partially mitigate the potential damage from liquefaction induced settlement (Ishihara and Seed, 1998).

We recommend a mat of structural fill be constructed to support the footings. Such a mat could be constructed by either raising grades after stripping the structural areas or by overexcavating and replacing. Using either method, we recommend a structural biaxial or triaxial geogrid with a minimum allowable tensile strength of 1,000 plf be placed on the exposed native soils and minimum thickness of 3 feet of non-liquefiable structural fill placed above the geogrid. The fill should be compacted with a large mechanical compactor such as a vibratory roller or hoe-pack in accordance with the "**Structural Fill**" section of this report. The structural fill mat should extend a minimum horizontal distance of at least 5 feet beyond the footing edges. Where the spacing between foundation elements is greater than 10 feet, we recommend the mat area be extended laterally to create a continuous mat of structural fill below the building. Where excavations extend below the groundwater table, or where the soils are wet, 4 to 6 inch quarry spalls should be placed on top of the geogrid and bucket-tamped until firmly set. The quarry spalls should extend at least 1 foot above the groundwater table.

In addition to soil replacement, seismic ties, grade beams, or other approved methods should be used to stiffen the foundation to reduce the potential for differential settlement. A typical overexcavation detail is included as Figure 7.

Subgrade soil improvements, as described above, can help to reduce the overall and differential settlement within a building footprint during a liquefaction event; however, the soils below the improvements still have the potential to liquefy, and therefore the risk of settlement is not completely eliminated. We recommend that, at a minimum, the shallow soils at the site are removed and a structural fill mat as described above should be placed below shallow foundations for the proposed residences.

Soil Densification

The potential for liquefaction induced settlement can be mitigated by densifying the soils susceptible to liquefaction by using a ground improvement technique, such as aggregate piers (stone columns). Aggregate piers consist of constructing a pattern of subsurface columns comprised of coarse aggregate to displace and densify surrounding soils. Regardless of type or contractor, aggregate piers are installed by driving down to the design depth and backfilling the cavity with compacted granular soil. The aggregate is deposited in lifts and compacted using vertical dynamic impact energy. This process is repeated lift by lift until a column of aggregate is constructed from the design depth to the ground surface.

By adjusting the spacing, diameter, and depth of the aggregate piers, the potential magnitude of the liquefaction induced settlement can be reduced by varying amounts. Typical aggregate pier dimensions range from about 24 to 36 inches. In our opinion, aggregate piers would provide favorable support for spread footings and slab-on-grade floors, thereby eliminating the need for overexcavation and replacement. We recommend that the aggregate pier designer ensure that the piers have sufficient depths and widths to provide the bearing capacities for the design loads. Once the grid of

aggregate piers has been installed, the shallow foundation elements can be constructed directly on top of the piers.

Because of the equipment used to install aggregate pier elements, there is typically a large mobilization cost that makes this option have a higher installation cost, but the amount of structural fill and off-haul is considerably less, providing an offset cost savings.

Shallow Foundation Support

We do not recommend that shallow foundation elements be founded directly on the native alluvial soils encountered at the site. Instead, we recommend shallow foundations be supported as described in the "**Liquefaction Mitigation Considerations**" on either a reinforced earth fill or on improved ground (soil densification or stone columns) as describe above. We recommend a minimum width of at least 16 inches for continuous wall footings. Because of the risk of settlement during a seismic event we recommend that isolated spread footings not be used. As stated above, we recommend grade beams or other approved methods should be used to reduce the potential for differential settlement.

Footings founded on non-liquefiable structural fill can be designed using an allowable soil bearing capacity of 1,500 psf (pounds per square foot); footings founded on aggregate piers can be designed using an allowable soil bearing capacity of 2,500 psf. These values are for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

All exterior footing elements should be embedded at least 18 inches below grade for frost protection. Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.30 be used to calculate friction between the concrete and the appropriately prepared structural fill. Passive pressure may be determined using an allowable equivalent fluid density of 250 pcf (pounds per cubic foot) for foundations backfilled with adequately compacted structural fill that extends a minimum horizontal distance of 3 feet beyond the edge of footing. Factors of safety have been applied to these values.

Post construction settlement below footings designed and constructed as recommended herein should be on the order of 1 inch for the anticipated load conditions, with differential settlements along 50 feet of continuous footings of 0.75 inches or less.

The post construction consolidation settlement is separate from potential liquefaction induced settlement. Because the majority of the upper soils encountered at the site were granular, most of the settlement should occur essentially as loads are being applied; however, some fine grained soils were encountered in the upper 15 feet of our explorations, and these soils have the potential to consolidate over a longer period of time. Based on our experience with similar soils, we anticipate that the majority of the post construction consolidation settlement should occur within 3 to 5 months of completion of construction, and may be on the order of 2 inches where the native soils are not over-excavated or aggregate piers are not used.

Floor Slab Support

Slab-on-grade floors, where constructed, should be supported on the improved subgrade soils prepared as described above. Areas of significant organics should be removed. If a soil densification

technique such as aggregate piers is used, a structural slab may be used to span between the aggregate piers.

We recommend that floor slabs be directly underlain by a minimum 4 inch thickness capillary break material such as coarse sand, pea gravel, or crushed rock containing less than 2 percent fines. The capillary break material should be placed in one lift and compacted to an unyielding condition.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where the slab elements are underlain by the silty alluvial subgrade, or where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab or where slabs are present below heated, enclosed spaces.

A subgrade modulus of 200 pci (pounds per cubic inch) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be ½- inch or less over a span of 50 feet.

Pavement Recommendations

We understand that either flexible pavement consisting of hot mix asphalt (HMA) or rigid pavement consisting of Portland cement concrete (PCC) may be used for the new onsite pavement associated with the development.

Pavement Subgrades

Pavement subgrade areas should be prepared by removing any soft or deleterious material down to firm and unyielding soils in accordance with the "**Site Preparation**" section of this report. The prepared subgrade should be evaluated by proof-rolling with a fully-loaded dump truck or equivalent point load equipment. Soft, loose, or wet areas that are identified should be recompacted or removed, as appropriate. Over-excavated areas should be backfilled with compacted structural fill. Where fill is placed, the upper 2 feet of roadway subgrade should have a maximum dry density of at least 95 percent, as determined in accordance with the ASTM D1557.

Pavement Section Design

We have prepared this analysis in accordance with the 1993 AASHTO flexible and rigid pavement design methods. The AASHTO 93 design method quantifies traffic loading in terms of 18-Kip ESALs (equivalent single axle loads). The estimated ESALs over the entire design life were determined using the assumed traffic data and vehicle loads, and extending the daily value over a 20- or 40-year design life.

We understand that the proposed paved surfaces will consist of either hot mix asphalt (HMA) or Portland cement concrete (PCC) pavement. The pavement sections are designed to support traffic loading from personal vehicles and delivery trucks, as well as two daily trips from heavier vehicles, such as car carrier trucks/trailers. These assumptions should be verified prior to construction, and, if the assumptions contained herein are not correct, we should be notified and allowed to review our calculations. Additional loading may contribute to shortened design life of the pavement section.

We anticipate subgrade soils will consist of in-situ or recompacted native alluvial soils. Table 5, below, summarizes our assumptions and inputs for the design of the concrete and asphalt sections, and Table 6, below, summarizes the recommended pavement section thickness.

TABLE 5:
Input Data for Pavement Design

Parameter	HMA Section	PCC Section
Design Life (years)	20	40
Design Traffic Load (ESALs)	33,000	84,000
Initial Serviceability	4.2	4.5
Terminal Serviceability	2.3	2.5
Reliability, R	85%	80%
Elastic Modulus, E (ksi)	N/A	4,000
Modulus of Subgrade Reaction, k (pci)	N/A	200
Resilient Modulus, Base Course (ksi)	28	N/A
Resilient Modulus, Subgrade (ksi)	6	N/A
Layer Coefficient, HMA (a_1)	0.44	N/A
Layer Coefficient Base Course (a_2)	0.13	N/A
Drainage Coefficient (Cd)	1.0	1.0

Notes:
ESALs - Equivalent Single Axle Loads
ksi – kips per square inch
pci – pounds per cubic inch

TABLE 6:
Minimum Section Thickness Recommendations

Section	Standard HMA	Standard PCC
Pavement	3	6
CSBC or CSTC	7	6[1]

Notes:
CSBC – Crushed Surface Base Course
CSTC – Crushed Surface Top Course
[1] Leveling course as needed below PCC (typically about 4 to 6 inches of crushed rock)

The above recommended section thickness meets the AASHTO 93 design standards based on the assumed traffic loading. Additional loading may contribute to premature failure of the pavement section.

Pavement Frost Conditions

Frost-susceptible soils are generally considered as having greater than 3 percent particle size (by weight) finer than 0.02 millimeter (mm). Soil with a fines content not exceeding 7 percent passing the No. 200 sieve, based on the minus ¾-inch fraction, can normally be expected to have 3 percent or less finer than 0.02 mm. Based on the soils observed during our construction monitoring, most of the near-surface soils could be considered frost-susceptible. Based on information provided in the WSDOT Pavement Policy, we recommend assuming the frost depth would be about 18 inches. For

both rigid and flexible pavements, WSDOT recommends that the total depth of the pavement section be at least 50 percent of the frost depth. Our recommended pavement section are thicker than 9-inches and therefore should provide adequate frost protection.

Pavement Materials and Construction

In general, the aggregate base course, HMA, and PCC should be constructed in accordance with WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications, 2020). HMA should conform to Section 5-04 in the WSDOT Standard Specifications and the PCC should conform to Section 5-05 of the WSDOT Standard Specifications. We recommend that crushed rock used as CSBC in pavement sections consist of material of approximately the same quality as "crushed surfacing (base course)" (or better) described in Section 9-03.9(3) of the WSDOT Standard Specifications. We further recommend that CSBC material be compacted to at least 95 percent of the MDD based on the modified Proctor procedure (ASTM D1577).

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped away from structures. The site should also be carefully graded to ensure positive drainage away from all structures and property lines. We recommend that foundation drains are installed for any new structures in accordance with IBC 1805.4.2. The roof drains should not be connected to the foundation drains.

Infiltration Recommendations

Per the 2012 Stormwater Management Manual for Western Washington (SWMMWW), Volume III, Section 3.1.1, infiltration facilities require a minimum vertical separation of 3 feet from the bottom of the proposed facility to the top of a seasonal high groundwater table or other low permeability surface. Additionally, pervious pavement shall not create saturated conditions within 1 foot of the bottom of the proposed facility per Volume V, BMP T5.15.

The soils encountered in our borings are consistent with soils unconsolidated by glacial advance. We therefore used the grain size analysis method (Massmann, 2003) to calculate design infiltration rates for the native site soils. The shallow soils generally consist of silt with somewhat variable fines contents of 54 to 73 percent. Based on the results of the grain size analyses, the siltier soils encountered have an infiltration rate of less than 0.3 inches per hour and meet the criteria for a hydraulic restriction layer. Based on the above, onsite infiltration does not appear feasible.

Per the 2012 SWMMWW, a minimum cation exchange capacity of 5 milliequivalents per 100 grams of soil and 1 percent organic content is required for soils to provide adequate water quality treatment to the stormwater. The near-surface soils were determined to have an organic content of 2.16 to 2.39 percent and a cation exchange capacity (CEC) of 7.20 to 11.0 milliequivalents per 100 grams, and therefore meets treatment requirements.

Alternative stormwater management methods, such as detention or dispersion, should be considered for this project in accordance with the 2012 SWMMWW. All minimum setback requirements and infeasibility criteria per the 2012 SWMMWW should be considered prior to the selection of any stormwater facility for the proposed development.

EARTHWORK RECOMMENDATIONS

Site Preparation

As the site is already developed, it appears that site has been stripped of organic surface soils. Any area to be filled, graded, or developed should be cleared of any other deleterious materials including any existing structures, pavements, foundations, or abandoned utility lines. We anticipate that stripping depths on the order of 12 inches may be required to remove the pavement and gravel base encountered across the site. Stripping depths may be deeper where topographic depressions exist. Where placement of fill material is required, the stripped and exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of any fill. Excavations for debris removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after stripping is completed and prior to placement of structural fill and or base coarse material. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a ½-inch-diameter steel T-probe during wet weather conditions.

Any soft, loose, or otherwise unsuitable areas delineated during proof-rolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. Any areas of old fill material encountered should be evaluated during grading operations to determine if they need mitigation, recompaction, or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Fill should be compacted to at least 95 percent of the maximum dry density (MDD) as determined by the Modified Proctor test in accordance with ASTM D1557.

The appropriate lift thickness will depend on the fill characteristics and the compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction, and that our representative be present during site grading activities to observe the work and perform field density tests, as appropriate.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. Structural fill placed should below foundations, at a minimum, should consist of granular, non-liquefiable material. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend use of well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the 3/4-inch sieve, such as "*Gravel Backfill for Walls*" (9-03.12(2)) or "*Bank Run Gravel for Trench Backfill*" (9-03.19). If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, material containing up to 8 percent fines (material passing the No. 200 sieve, based on the minus ¾-inch fraction) will be acceptable; the fines should be non-plastic. GeoResources should review submittals for import fill to assess the liquefaction potential.

Material placed for structural fill should be free of debris, organic matter, trash, and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, granular, non-organic, onsite soil may be considered for use as structural fill, provided it meets the criteria described above in the "**Structural Fill**" section of this report and can be compacted as recommended. As stated above, soils with moderate to high fines content should not be re-used as structural fill below proposed structures. If the soil material is over-optimum in moisture content when excavated, it will be necessary to aerate or dry the soil prior to placement as structural fill. The soils encountered in our explorations were generally observed to be moist to saturated, and will likely require aeration if used as structural fill. We recommend that native soils not be used as structural fill for the stiffened foundation option because they do not meet the definition of a non-liquefiable soil.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation.

All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington Industrial Safety and Health Act (WISHA, WAC 296-155-66401) regulations, the soils on the site would be classified as Type C soils.

According to WISHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1.5H:1V (Horizontal: Vertical), or flatter from the toe to top of the slope. It should be recognized that slopes of this nature do ravel and require occasional maintenance. All exposed slope faces should be covered with a durable reinforced plastic membrane, jute matting, or other erosion control mats during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the top of the slope.

Where it is not feasible to slope the site soils back at the recommended inclinations, a shoring system should be considered. Where retaining structures are greater than 4-feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be engineered per Washington Administrative Code (WAC 51-16-080 item 5).

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Dewatering Considerations

Depending on the depth of utilities to be installed at the site and the timing of construction, we anticipate some trenches may be below seasonal high groundwater levels. During the winter months, October through May, static groundwater may be less than 8 feet below the ground surface. This level can change based on seasonal variation in precipitation. Dewatering may be necessary where significant groundwater is encountered. We recommend that earthwork activities, including utility trenching, occur during the drier summer months, June through September.

Where groundwater seepage levels within trench excavations exceeds levels that can be easily mitigated with conventional dewatering sumps/pumps, other methodology should be utilized. This may include reducing the open trench area, larger pumps, well points, or dewatering wells. Based on the time of year and the site-specific conditions encountered, additional and more specific recommendations can be provided. If dewatering volumes become significant, permits may be required for discharge. A dewatering design is not included in our scope of work or provided in this report.

Utility Trench Construction

Based on the level of groundwater and moisture content of the site soils at the time of construction, it may be necessary to mitigate soft or wet soil conditions within the trench excavations and use a select granular backfill. If soft or wet soil conditions are encountered in the trench area or at the trench bottom, we recommend the follow mitigation options be considered:

- Geotextile fabric placed on the bottom of the trench and covered with the normal bedding material. A common geotextile used in this application is a US Fabrics US200 (or an approved equivalent), commonly referred to as a Driveway Fabric.
- Pipe-sleds are commonly placed on the trench bottom where wet soft/wet soils are encountered. This typically requires a minor over-excavation to accommodate the thickness of the sled.
- Similar to pipe-sleds, quarry spall wraps consist of approximately 12 inches of 2- to 4-inch quarry spalls (crushed rock) placed on and wrapped with a geotextile fabric. A specific fabric type is determined at the time of excavation based on the ground conditions. Bedding material is typically placed above the spalls and fabric.
- Over-excavate and replace, typically with a select sand and gravel or crushed rock with a fabric wrap. The thickness of select material and type of fabric are determined based on ground conditions.

The goal of ground improvement for utility support is to provide sound support for the utility pipe and minimize potential differential settlement, which could result in deflections, “bellies” or depressions in the utility pipe. At the same time, the supporting media should not add significant additional weight relative to the soil it replaces, which could induce additional settlement.

Erosion Control

Erosion protection measures should be in place prior to beginning construction or earthwork activities. Erosion hazards can be mitigated by implementing appropriate Best Management Practices outlined in the 2012 SWMMWW.

Wet Weather Earthwork Recommendations

In the Puget Sound area, wet weather generally begins about mid-October and continues through about May, although rainy periods could occur at any time of year. It is encouraged that earthwork be scheduled during the dry weather months of June through September. Most of the soils at the site contain sufficient fines to produce an unstable mixture when wet. Such soil is highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil. However, should wet weather/wet condition earthwork be unavoidable, the following recommendations are provided:

- The ground surface in and surrounding the construction area should be sloped to promote positive drainage away from work areas, structures, and property lines, and to prevent ponding of water.
- Work areas or slopes should be covered with plastic when not being worked. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soils and placement and compaction of clean structural fill could be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with a backhoe, or equivalent, and locate them so that equipment does not pass over the excavated area. Thus, subgrade disturbance caused by equipment traffic would be minimized.
- Fill material should consist of clean, well-graded sand and gravel, of which not more than 5 percent fines by dry weight passes the No. 200 mesh sieve, based on wet sieving the fraction passing the ¾-inch mesh sieve. The gravel content should range from between 20 and 50 percent retained on a No. 4 mesh sieve. The fines should be non-plastic.
- No exposed soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible.
- In-place soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil (see soil gradation requirements in the "**Structural Fill**" section of this report).
- Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in wet weather/wet condition earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.
- Grading and earthwork should not be completed during periods of heavy, continuous rainfall.

We recommend that the above requirements for wet weather/wet condition earthwork be incorporated into the contract specifications.

Additional Services and Construction Observation

Additionally, we recommend GeoResouces be retained to observe the geotechnical aspects of construction, particularly the ground improvements, fill placement and compaction, and drainage activities, including the drainage facilities. This observation would allow us to verify the subsurface conditions as they are exposed during construction and to determine that work is accomplished in accordance with our recommendations. If conditions encountered during construction differ from those anticipated, we can provide recommendations for the conditions encountered.

LIMITATIONS

We have prepared this report for Larson Automotive, Castino Architecture, Momentum Civil Engineering Consultants, and other members of the design team for use in evaluating a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors. Our report, conclusions and interpretations are based on data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

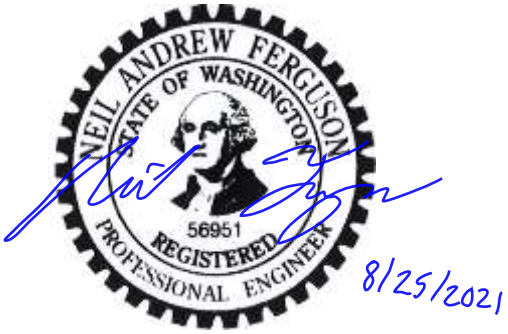
If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated working for you on this project. Please do not hesitate to call at your earliest convenience if you have any questions or comments.

Respectfully submitted,

GeoResources, LLC

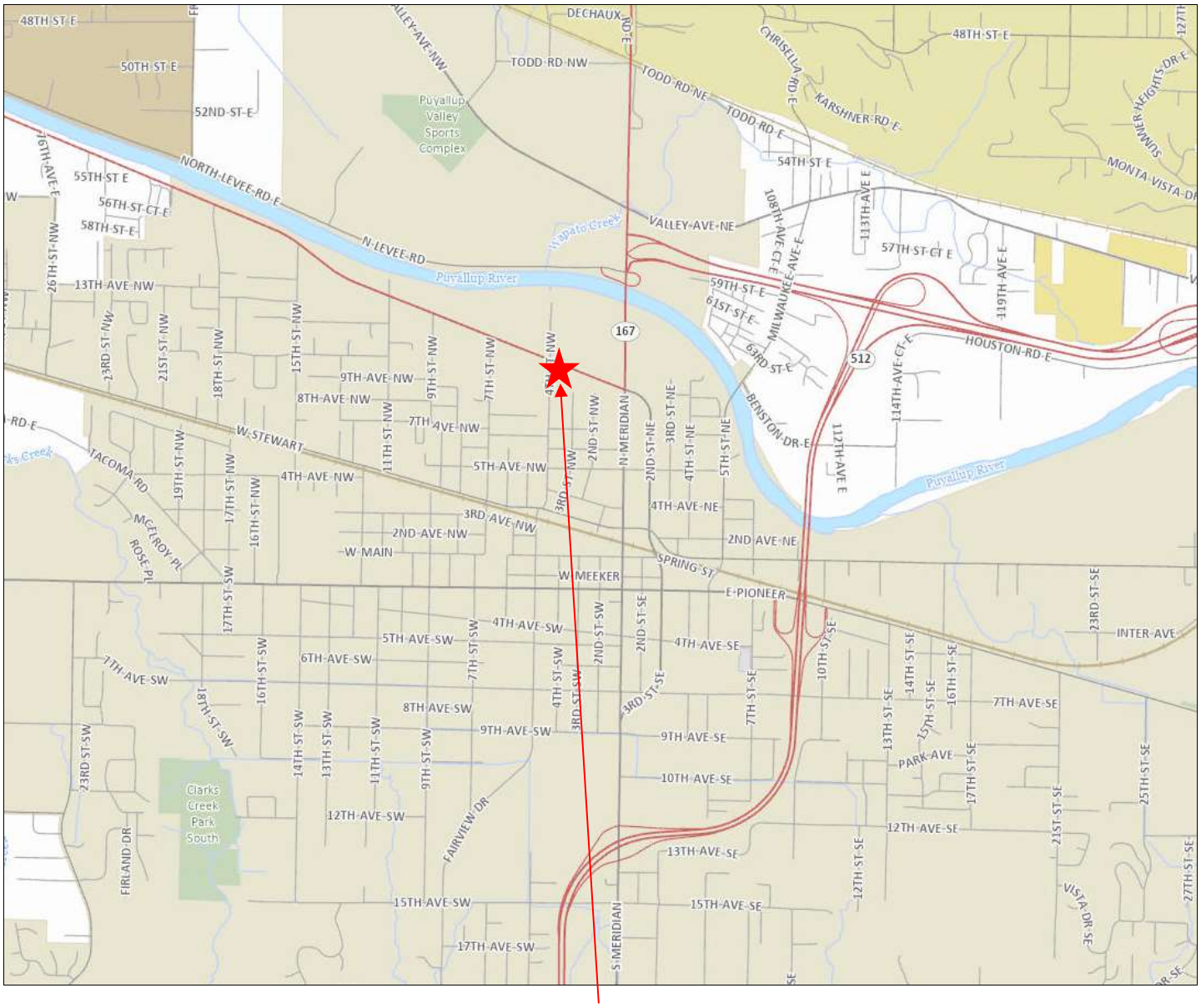


Neil Ferguson, PE
Project Geotechnical Engineer

Keith S. Schembs, LEG
Principal

Eric W. Heller, PE , LG
Senior Geotechnical Engineer

NAF:KSS:EWH/naf
Doc ID: LarsonAutomotive.LarsonJeep.RG
Attachments:
Figure 1: Site Location Map
Figure 2: Site Vicinity Map
Figure 3: Site and Exploration Plan
Figure 4: NRCS Soils Map
Figure 5: Geologic Map
Figure 6: Liquefaction Susceptibility Map
Figure 7: Typical Over Excavation Detail
Appendix A –Subsurface Explorations
Appendix B – Laboratory Test Results
Appendix C – Liquefaction Analysis



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

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Site Location Map

Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010

Doc ID: LarsonAutomotive.Jeep.F	May 2021	Figure 1

Notes:

Approximate location and number of boring

Scale: 1" = 60'

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Site & Exploration Plan
Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154

Doc ID: LarsonAutomotive.Jeep.F	May 2021	Figure 2

Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

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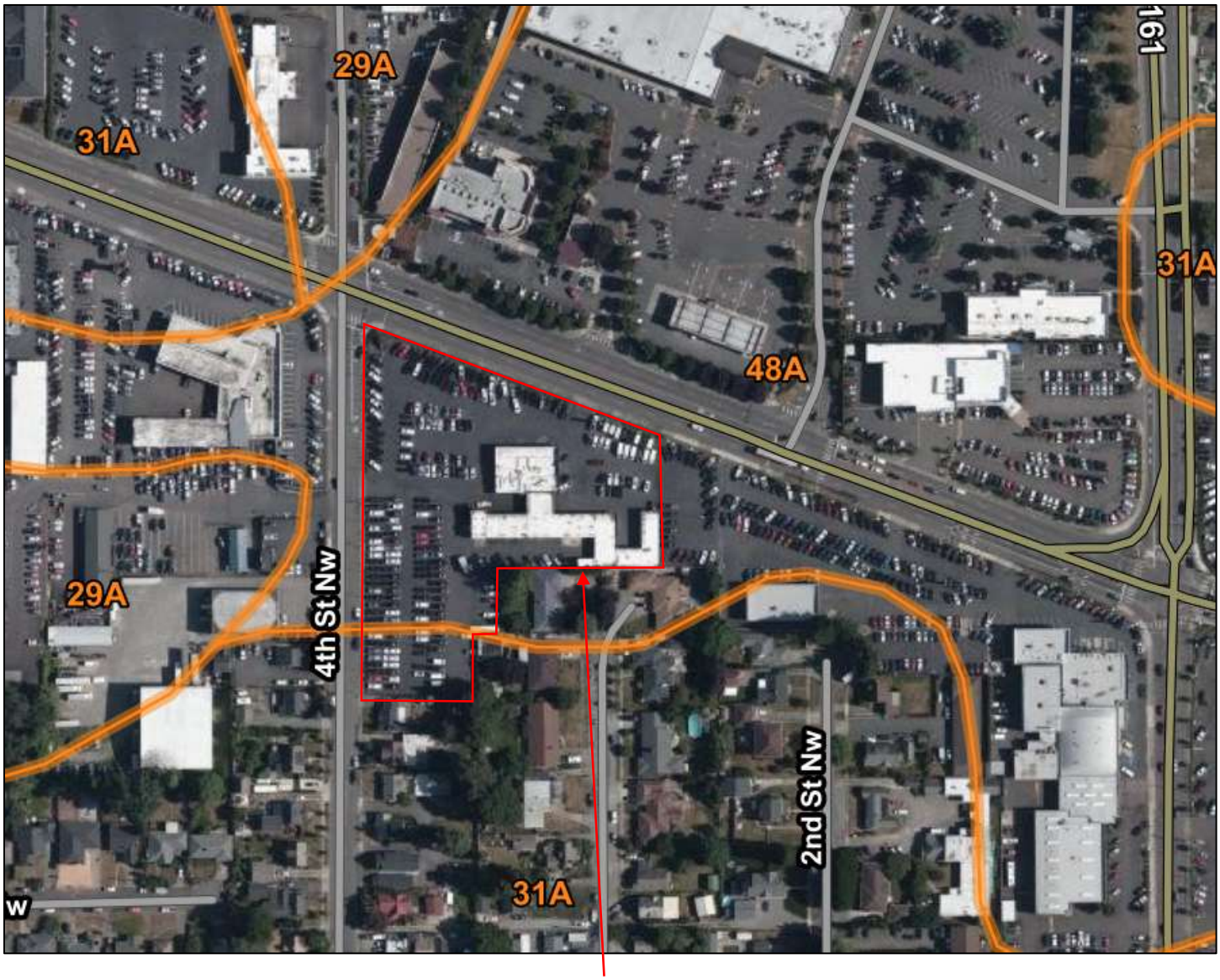
Site Vicinity Map

Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154

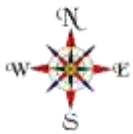
Doc ID: LarsonAutomotive.Jeep.F	May 2021	Figure 3



Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
31A	Puyallup fine sandy loam	Alluvium	0 to 3	Slight	A
48A	Xerothrents fill	Artificial fill and/or dredge spoils	0 to 1	Slight	N/A



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NRCS Soils Map

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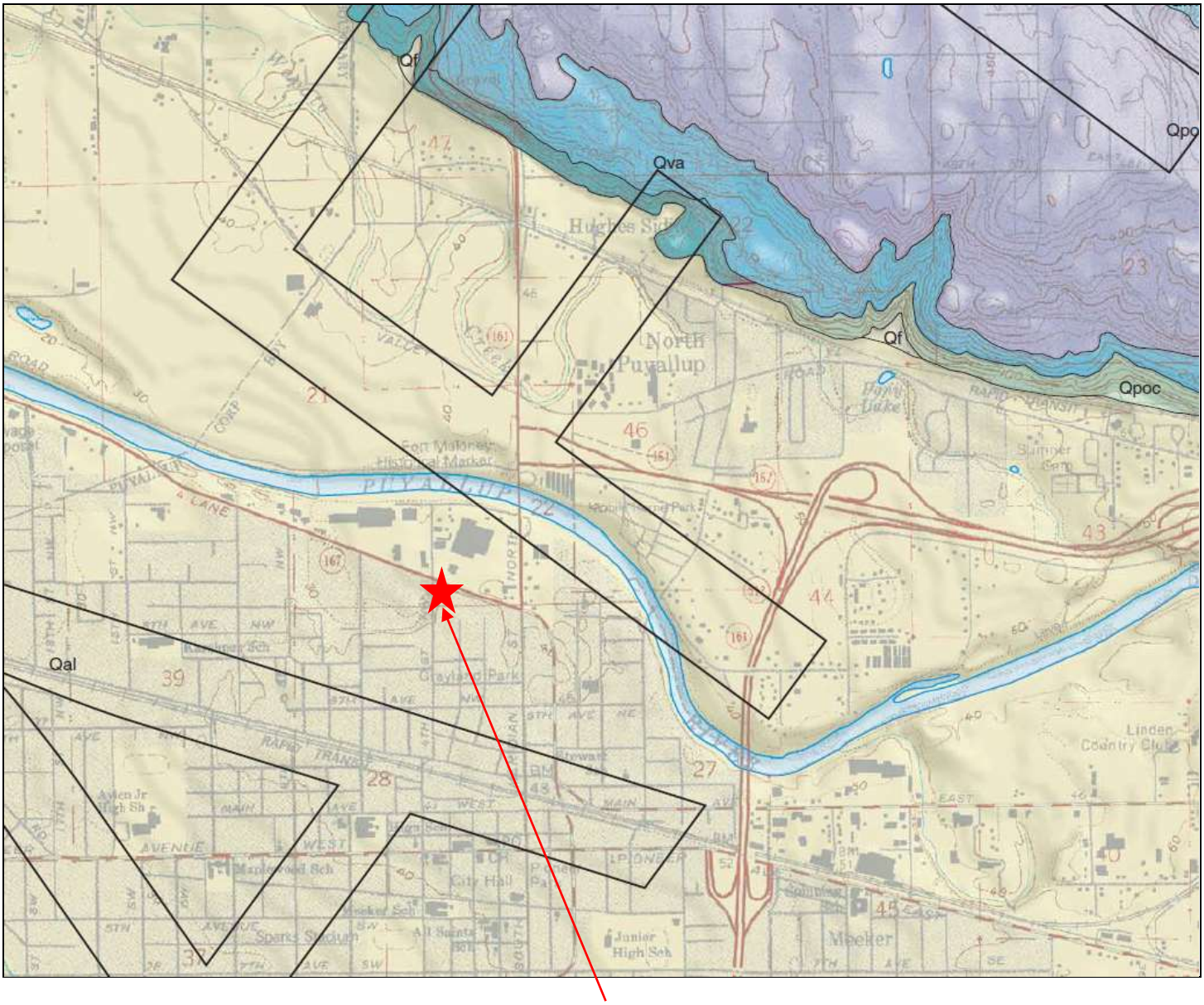

Approximate Site Location

An excerpt from the draft the *Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington* by K.G. Troost (in review)

Qal	Alluvium

Not to Scale

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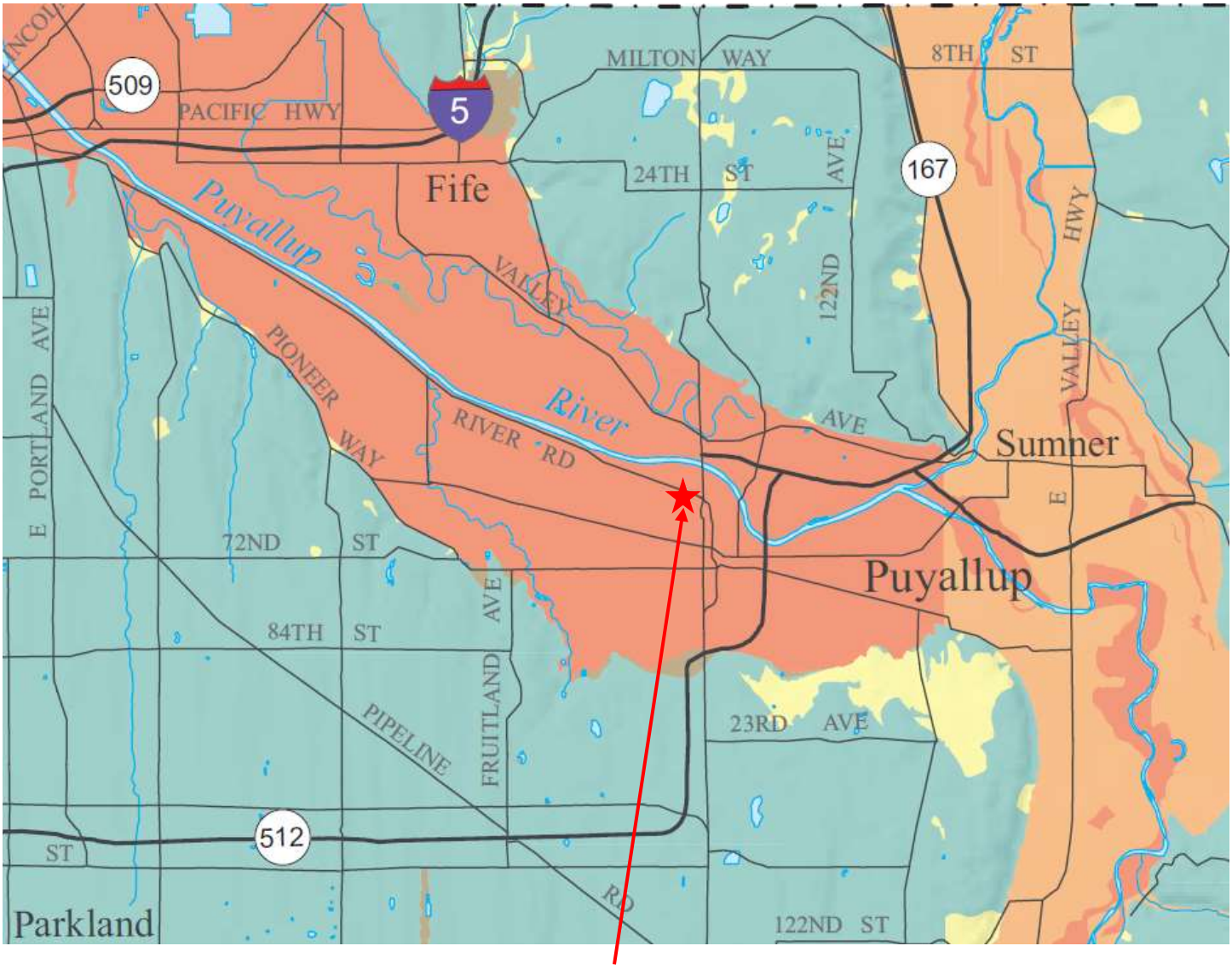
Geologic Map

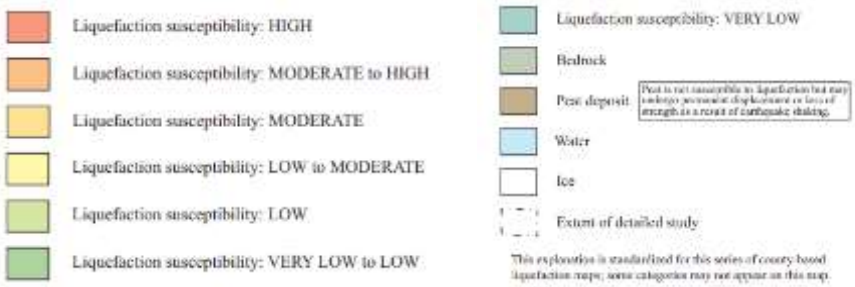
Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154

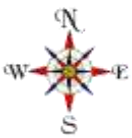
Doc ID: LarsonAutomotive.Jeep.F	May 2021	Figure 5



Approximate Site Location

An excerpt from the *Liquefaction Susceptibility Map of Pierce County, Washington*
by Palmer et. Al., (September 2004)





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Liquefaction Susceptibility Map

Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154

Doc ID: LarsonAutomotive.Jeep.F	May 2021	Figure 6

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Commercial Development
300 River Road
Puyallup, Washington
PN: 0420214010, 0420214027, 0420281154

TOTAL DEPTH:	16.5	**DRILLING METHOD:**	Hollow-stem auger	**LOGGED BY:**	NAF
TOP ELEVATION:	43	**DRILLING COMPANY:**	Boretec	**HAMMER TYPE:**	Cathead
LATITUDE:		**DRILL RIG:**	TD 85	**HAMMER WEIGHT:**	140 lb
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
0		Asphalt over sand and gravel (fill)					Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50			
	40	Tan mottled sandy SILT (medium stiff to stiff, moist) (alluvium) (ML)		1				3 2 3		
4		Gray silty fine SAND with interbedded mottled tan sandy SILT (medium dense, moist becomes wet at 11 feet) (alluvium) (SM/ML)		2			72.6	2 4 7		
	36			3				2 3 4		
8				4				4 2 5	▽	
	32									
12										
	28			5				7 7 7		
16		Bottom of Boring Completed4/23/21								
	24									
20										
	20									
24										

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Commercial Development
300 River Rd
Puyallup, WA

LOG OF BORING B-4

JOB: Larson.Jeep

GeoResources, LLC | **FIG. A-5**

TOTAL DEPTH:	16.5	**DRILLING METHOD:**	Hollow-stem auger	**LOGGED BY:**	NAF
TOP ELEVATION:	43	**DRILLING COMPANY:**	Boretec	**HAMMER TYPE:**	Cathead
LATITUDE:		**DRILL RIG:**	TD 85	**HAMMER WEIGHT:**	140 lb
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
0		Asphalt over sand and gravel (fill)					Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50			
		Gray SILT (medium stiff, moist) (alluvium) (ML)								
	40			1				3 3 6		
4										
		Gray silty fine SAND with interbedded mottled tan sandy SILT (medium dense, moist becomes wet at 11 feet) (alluvium) (SM/ML)		2				4 5 6		
	36									
8				3				7 8 10		
				4				4 4 7	▽	
	32									
12										
	28			5				8 11 6		
16										
		Bottom of Boring Completed4/23/21								
	24									
20										
	20									
24										

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Commercial Development
300 River Rd
Puyallup, WA

LOG OF BORING B-3

JOB: Larson.Jeep *Sheet of 5*

GeoResources, LLC **FIG. A-4**

TOTAL DEPTH:	16.5	**DRILLING METHOD:**	Hollow-stem auger	**LOGGED BY:**	NAF
TOP ELEVATION:	43	**DRILLING COMPANY:**	Boretec	**HAMMER TYPE:**	Cathead
LATITUDE:		**DRILL RIG:**	TD 85	**HAMMER WEIGHT:**	140 lb
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Blow Count
0	43	Asphalt over sand and gravel (fill)			
		GRAVEL with some sand and cobbles (medium dense, moist) (fill) (GP)			
	40	Brown silty SAND interbedded with mottled tan sandy SILT (loose/medium stiff , moist becomes wet at 11 feet) (alluvium) (SM/ML)		1	4 4 4
4				2	4 6 5
	36			3	4 5 5
8				4	4 3 2
	32				
12					
	28			5	5 8 9
16		Bottom of Boring Completed4/23/21			
	24				
20					
	20				
24					

TEST RESULTS: Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50

Ground Water ▽

Well Schematic

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Commercial Development
300 River Rd
Puyallup, WA

LOG OF BORING B-2

JOB: Larson.Jeep *Sheet of 5*

GeoResources, LLC **FIG. A-3**

TOTAL DEPTH:	51.5	**DRILLING METHOD:**	Hollow-stem auger	**LOGGED BY:**	NAF
TOP ELEVATION:	43	**DRILLING COMPANY:**	Boretec	**HAMMER TYPE:**	Cathead
LATITUDE:		**DRILL RIG:**	TD 85	**HAMMER WEIGHT:**	140 lb
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
0		Asphalt over sand and gravel (fill)					Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50			
	40	Grayish brown silty SAND (loose, moist) (alluvium) (SM)		1			▲	2 2 3		
4				2			▲	4 6 7		
	36	Grayish brown poorly-graded SAND with some silt (loose, moist) (alluvium) (SP-SM)		3			▲	2 3 5		
8		Brown to gray silty fine SAND interbedded with sandy SILT (loose/medium stiff, moist becomes wet at 11 feet) (alluvium) (SM/ML)		4			▲	3 3 5	▽	
	32									
12										
	28			5			▲ 60.9 ◇	8 9 10		
16										
	24									
20				6			▲	3 2 4		
	20									
24				7			▲ ◇	4 5		

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Commercial Development
300 River Rd
Puyallup, WA

LOG OF BORING B-1

JOB: Larson.Jeep *Sheet of 5*

GeoResources, LLC **FIG. A-2**

TOTAL DEPTH:	51.5	**DRILLING METHOD:**	Hollow-stem auger	**LOGGED BY:**	NAF
TOP ELEVATION:	43	**DRILLING COMPANY:**	Boretec	**HAMMER TYPE:**	Cathead
LATITUDE:		**DRILL RIG:**	TD 85	**HAMMER WEIGHT:**	140 lb
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
							Plastic Limit ⊢—⊣ Liquid Limit % Water Content ● % Fines (<0.075mm) ◇ Penetration - ▲ (blows per foot) 10 20 30 40 50			
	16							7		
28										
	12	Brown well-graded SAND with some silt and gravel (medium dense, wet) (coarse-grained alluvium) (SW-SM)		8				2 3 6		
32										
	8			9				13 8 10		
36										
	4									
40				10				11 7 9		
	0									
44				11				15 13 9		
	-4									
48										
	-8	Grayish brown silty SAND (loose, wet) (SM)		12				4 4 5		
52		Bottom of Boring Completed4/23/21								

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Commercial Development
300 River Rd
Puyallup, WA

LOG OF BORING B-1

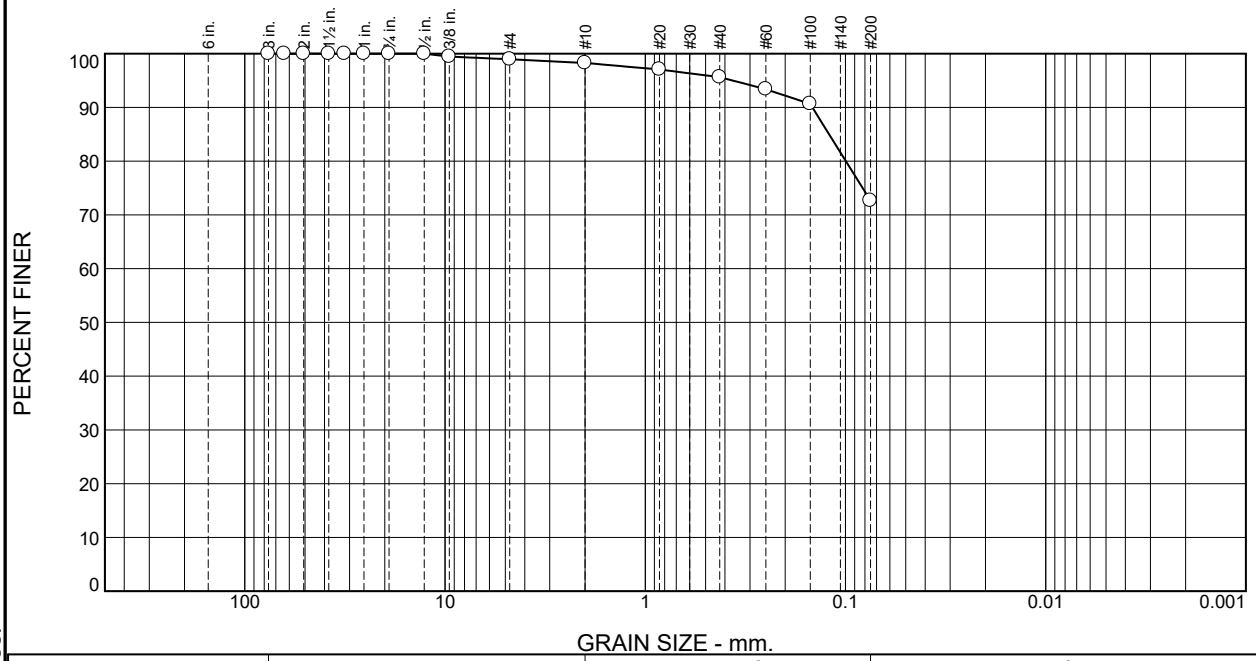
JOB: Larson.Jeep *Sheet of 5*

GeoResources, LLC **FIG. A-2**

Appendix B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	1.7	2.7	23.0	72.6	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	100.0		
.75	100.0		
.5	100.0		
0.375	99.5		
#4	99.0		
#10	98.3		
#20	97.1		
#40	95.6		
#60	93.4		
#100	90.6		
#200	72.6		

* (no specification provided)

Material Description

silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

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

Coefficients

D_{90}= 0.1463 D_{85}= 0.1207 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 28.2%

Date Received: 4/23/21 **Date Tested:** 4/27/21

Tested By: NAF/CJB

Checked By: KSS

Title: PM

Source of Sample: B-4 **Depth:** 5
Sample Number: 2

Date Sampled: 4/23/21

GeoResources, LLC

Fife, WA

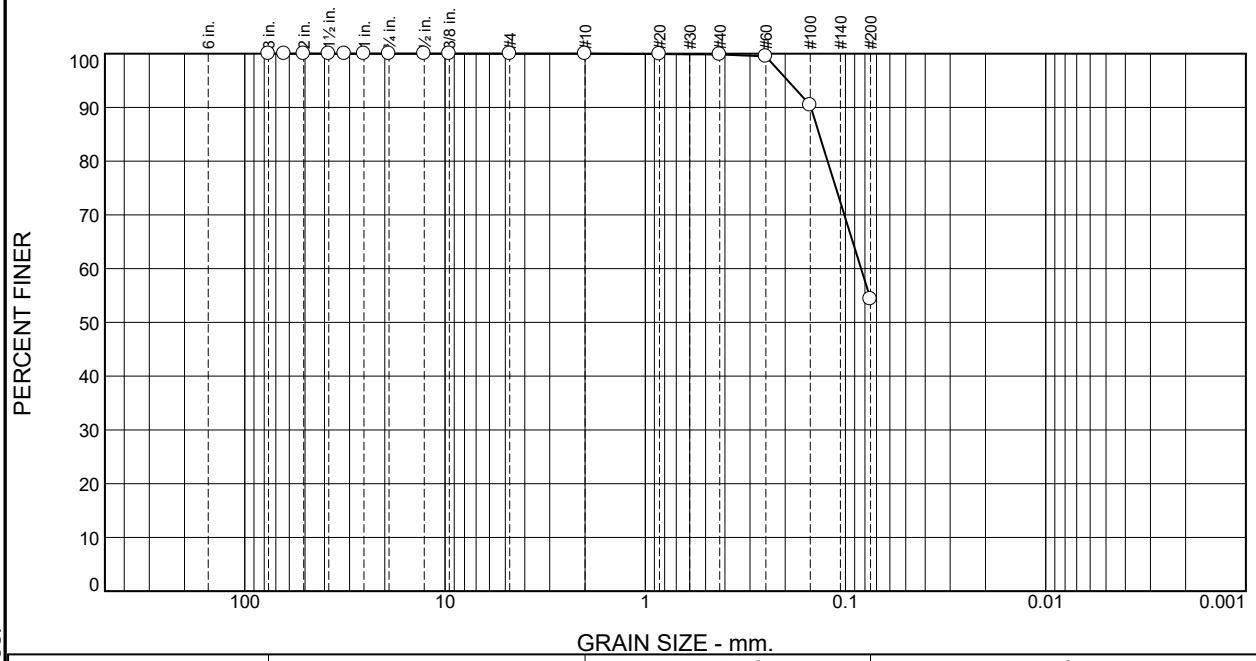
Client: Larson Automotive
Project: Proposed Commercial Development

Project No: Larson.Jeep **Figure**

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

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	0.0	0.2	45.4	54.4	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	100.0		
.75	100.0		
.5	100.0		
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.8		
#60	99.5		
#100	90.4		
#200	54.4		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

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

Coefficients

D_{90}= 0.1488 D_{85}= 0.1352 D_{60}= 0.0836
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 17.4%

Date Received: 4/23/21 **Date Tested:** 4/27/21

Tested By: NAF/CJB

Checked By: KSS

Title: PM

Source of Sample: B-3 **Depth:** 5
Sample Number: 2

Date Sampled: 4/23/21

GeoResources, LLC

Fife, WA

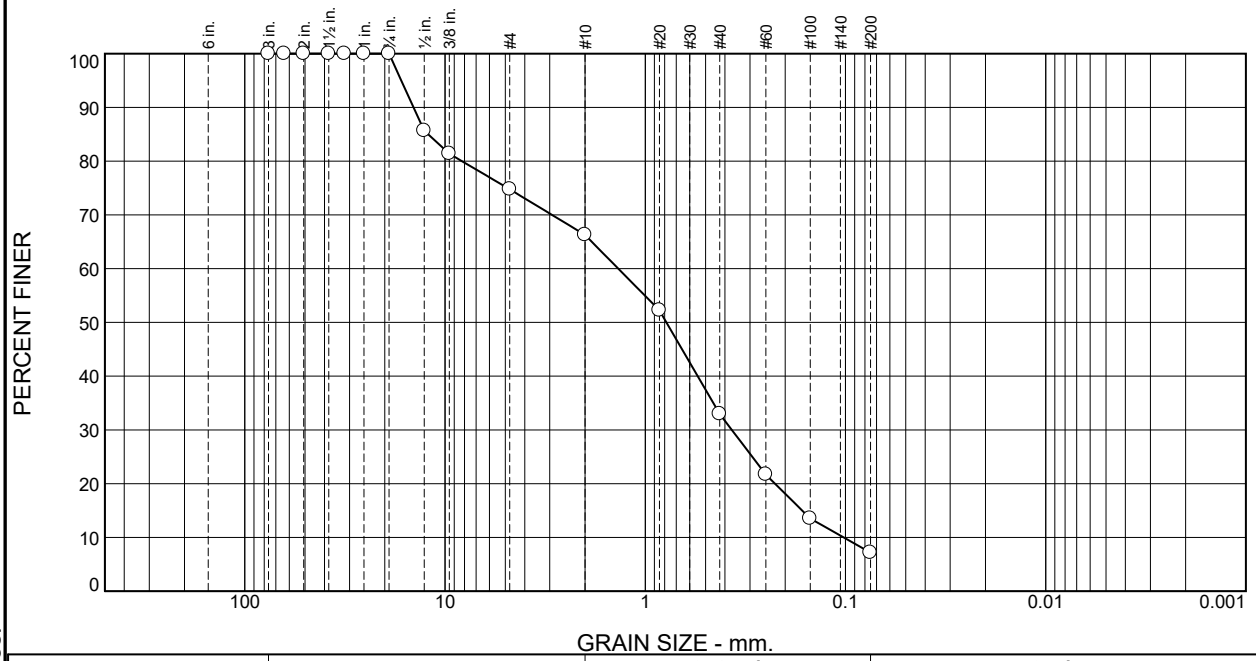
Client: Larson Automotive
Project: Proposed Commercial Development

Project No: Larson.Jeep **Figure**

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

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	33.7	33.3	25.8	7.2	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	100.0		
.75	100.0		
.5	85.7		
0.375	81.4		
#4	74.8		
#10	66.3		
#20	52.2		
#40	33.0		
#60	21.7		
#100	13.5		
#200	7.2		

* (no specification provided)

Material Description

well-graded sand with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SW-SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 14.3597 D_{85}= 12.1511 D_{60}= 1.3636
D_{50}= 0.7841 D_{30}= 0.3696 D_{15}= 0.1645
D_{10}= 0.1022 C_u= 13.34 C_c= 0.98

Remarks

Natural Moisture: 13.3%

Date Received: 4/23/21 **Date Tested:** 4/28/21

Tested By: NAF/CJB

Checked By: KSS

Title: PM

Source of Sample: B-1 **Depth:** 40
Sample Number: 10

Date Sampled: 4/23/21

GeoResources, LLC

Fife, WA

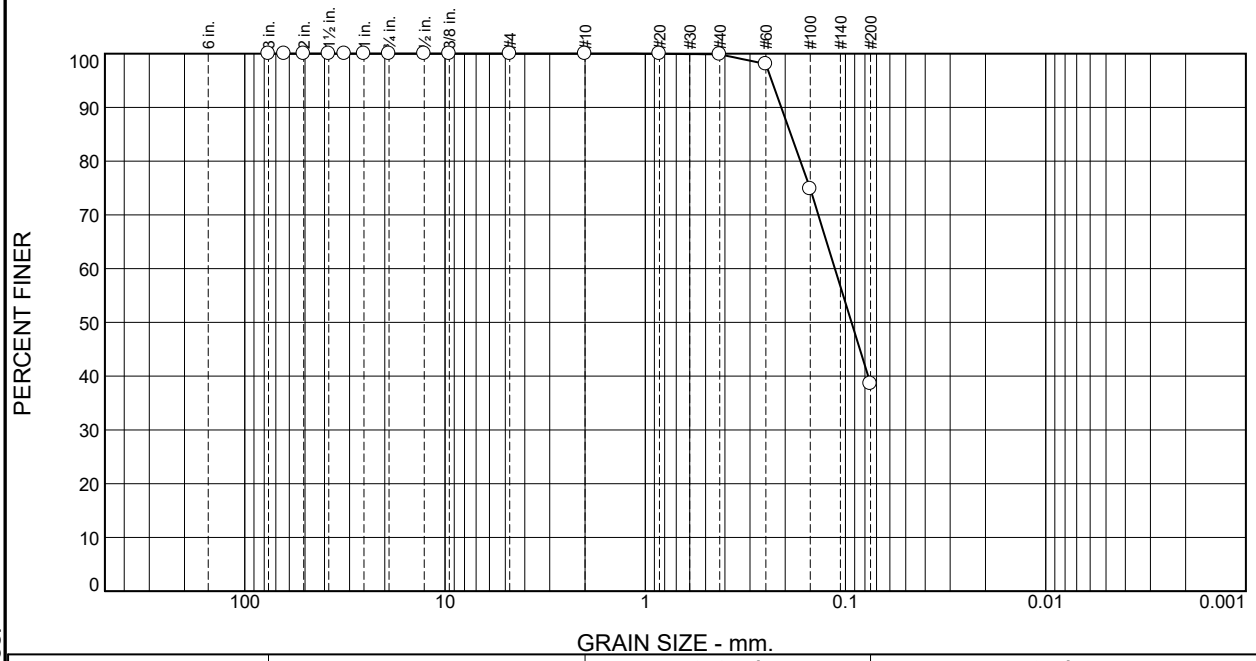
Client: Larson Automotive
Project: Proposed Commercial Development

Project No: Larson.Jeep **Figure**

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

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	0.0	0.1	61.3	38.6	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	100.0		
.75	100.0		
.5	100.0		
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	98.1		
#100	74.9		
#200	38.6		

* (no specification provided)

Material Description

silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

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

Coefficients

D_{90}= 0.2093 D_{85}= 0.1875 D_{60}= 0.1129
D_{50}= 0.0933 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 32.4%

Date Received: 4/23/21 **Date Tested:** 4/23/21

Tested By: NAF/CJB

Checked By: KSS

Title: PM

Source of Sample: B-1 **Depth:** 25
Sample Number: 7

Date Sampled: 4/23/21

GeoResources, LLC

Fife, WA

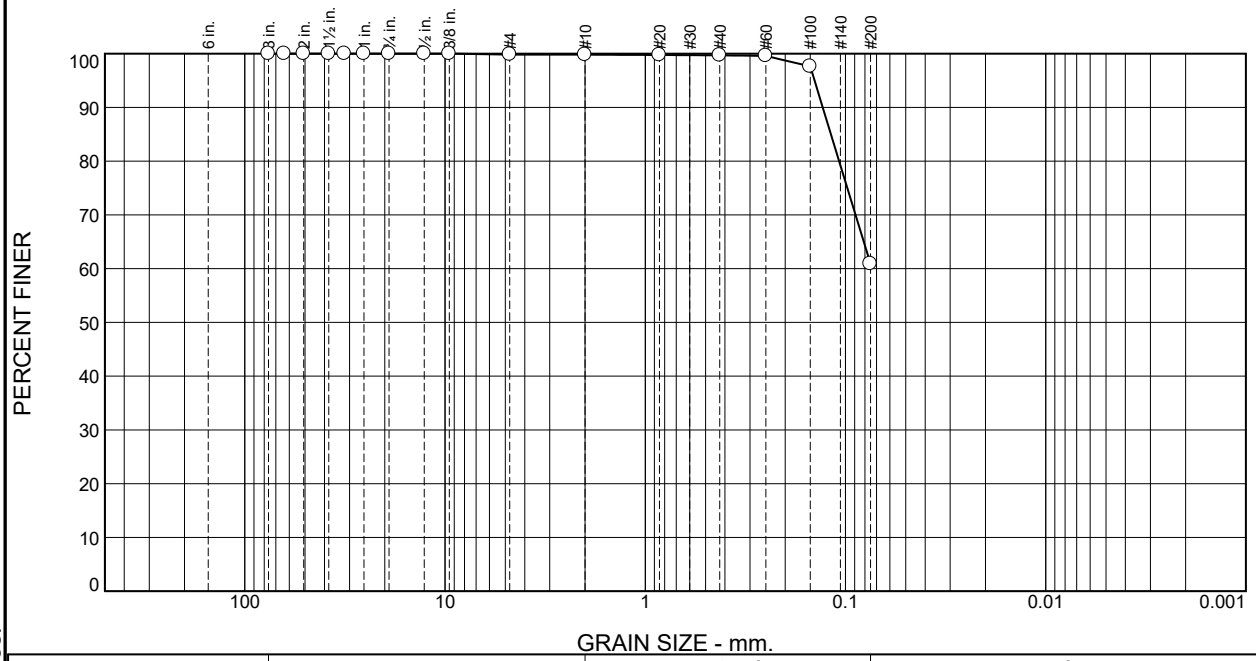
Client: Larson Automotive
Project: Proposed Commercial Development

Project No: Larson.Jeep **Figure**

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

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	0.2	0.1	38.8	60.9	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	100.0		
.75	100.0		
.5	100.0		
0.375	100.0		
#4	99.8		
#10	99.8		
#20	99.8		
#40	99.7		
#60	99.6		
#100	97.6		
#200	60.9		

* (no specification provided)

Material Description

sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

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

Coefficients

D_{90}= 0.1299 D_{85}= 0.1182 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 30.75%

Date Received: 4/23/21 **Date Tested:** 4/28/21

Tested By: NAF/CJB

Checked By: KSS

Title: PM

Source of Sample: B-1 **Depth:** 15
Sample Number: 5

Date Sampled: 4/23/21

GeoResources, LLC

Fife, WA

Client: Larson Automotive
Project: Proposed Commercial Development

Project No: Larson.Jeep **Figure**

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

Tested By: _____ **Checked By:** _____

Appendix C

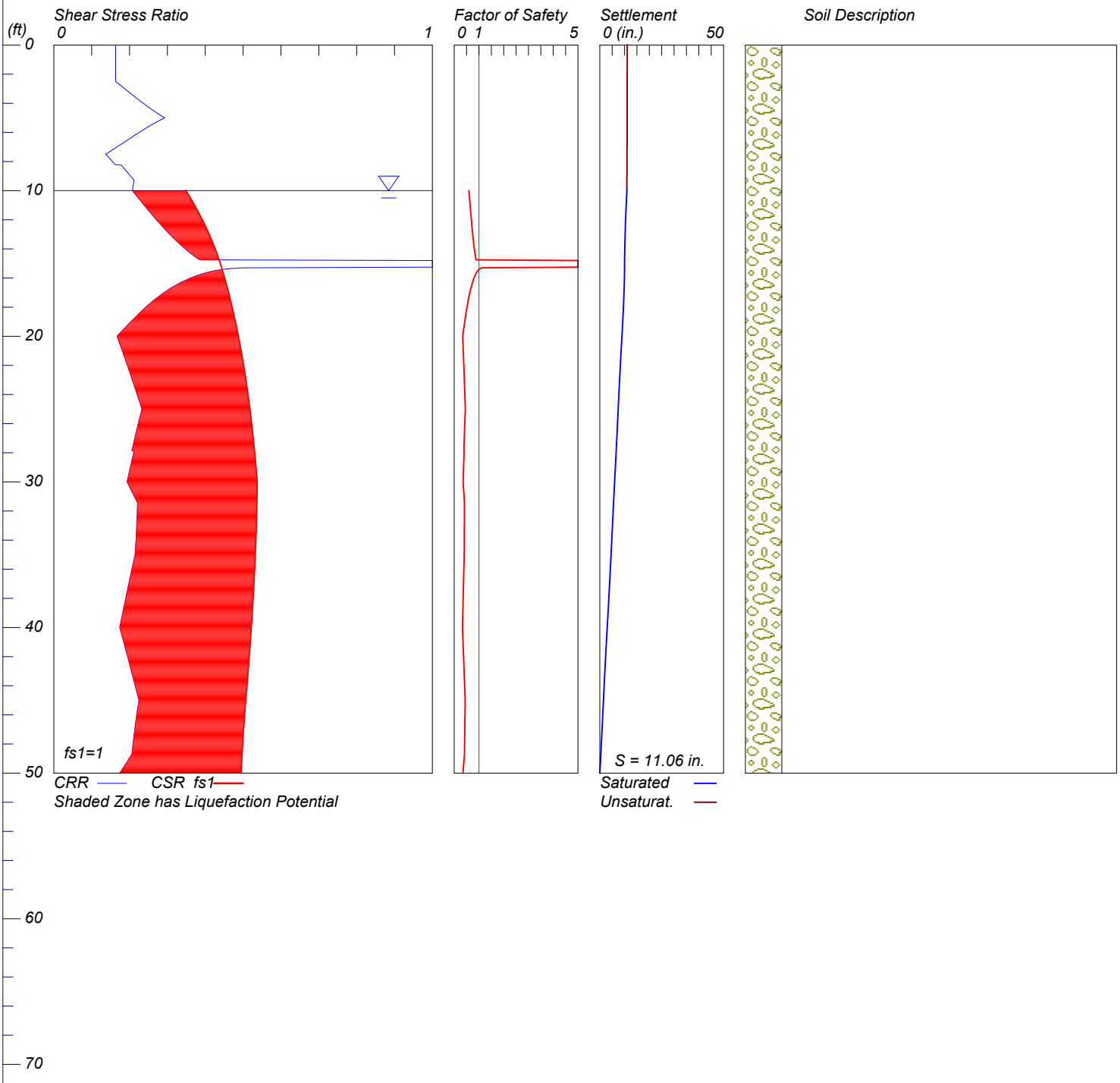
Liquefaction Analysis

LIQUEFACTION ANALYSIS

Larson Jeep

Hole No.=B-1 Water Depth=10 ft

Magnitude=7.2
Acceleration=0.55g



Appendix E - WWHM Report

WWHM2012

PROJECT REPORT

Project Name: Water Quality Flowrate
Site Name: 300 Building
Site Address: 300 River Road
City : Puyallup, WA
Report Date: 11/9/2021
Gage : 42 IN EAST
Data Start : 10/01/1901
Data End : 09/30/2059
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
ROADS FLAT	0.344
Impervious Total	0.344
Basin Total	0.344

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.344

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)	
2 year	0.125981	
5 year	0.168675	
10 year	0.199644	
25 year	0.241963	
50 year	0.275879	
100 year	0.311908	← Maximum Flow to Filter

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0382 **acre-feet**
On-line facility target flow: 0.0538 **cfs.**
Adjusted for 15 min: 0.0538 **cfs.**
Off-line facility target flow: 0.0313 **cfs.**
Adjusted for 15 min: 0.0313 **cfs.**

A Stormfilter system with dual cartridges can accommodate a water quality design flowrate of .033 cubic feet per second (cfs) for basic water quality treatment which is more than the off-line facility target flow of .0313 cfs.

Appendix F - Operation and Maintenance Manual

Project Information

Address: **300 River Road,**

Puyallup, WA 98371

System Description

Onsite stormwater runoff is primarily handled via overland sheet-flow. The below grade drainage components consist of a media filter device located in the southwest corner of parcel 0420214010 which collects and treats runoff prior to discharge into the nearby public catch basin within 4th Street NW. Additionally, the showroom building has roof drain lines which are tightlined to a PVC pipe which runs from the north face of the building to a storm cleanout near the north property line. From thence, stormwater runoff is discharged into an existing public catch basin located behind the back of walk within River Road.

The site will be maintained in compliance with the DOE Stormwater Management Manual for Western Washington (2014). The following pages contain descriptions of the maintenance needs for the components of the drainage system. A maintenance checklist for all system components should be completed on the following schedule:

Monthly from November through April

Once in later summer (preferably in September)

After any major storm (use 1-inch in 24-hours as a guideline)

Responsible Party: _____

Phone: _____

Note: A copy of this Operation and Maintenance Manual is to be kept onsite at all times and be available for inspection upon request by the City of Puyallup.

Description of Stormwater Facilities

Catch Basins – Catch basins are underground concrete structures typically provided with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two catch basin types.

Both catch basin types typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also provided with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils within the basin.

Compost Amended Soil – Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. Compaction from construction can reduce the soils natural ability to provide these functions. Establishing a minimum soil quality and depth in the post-development landscape can regain some of these stormwater functions including increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals. Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals.

Stormfilter® Catch Basin - Stormfilters are underground concrete or steel structures that may have a slotted grate structure to collect stormwater runoff in addition to a solid lid over the filter unit. Within the device, the structure is divided into at least three compartments: the inlet chamber with sump, the media filter chamber, and the outlet chamber. An overflow weir wall will also be present between the inlet chamber and outlet chamber which allows high flows to bypass the media filter altogether. Stormfilters have media beds that have a finite lifespan and need to be replaced on the order of 3-5 years for the device to operate properly.

Cost Estimate for Maintenance

The cost estimate below assumes one worker and necessary equipment would cost $1,000 per day in labor ($200) and equipment costs ($800).

Table 2: Cost Estimate for Storm Maintenance

Maintenance Activity	Frequency	Annualized Cost
Catch Basin/Stormfilters		
Clear all trash/debris/vegetation blocking basin opening	Monthly	$300
Remove sediment exceeding 60% of sump depth	2x/year	$600
Inspect for damage to frame or structure walls	Annually	$100
Replace Media Filter	Annually	$1,000
Estimate of Total Annual Cost		$2,000

Stormwater Facility Maintenance Log

Use copies of this log sheet to track when maintenance checks occur, and which items, if any are repaired and altered. The completed sheets will serve as a record of past maintenance activities and will provide valuable information on how your facilities are operating. This information will be useful for future requirements regarding the types of facilities that are installed. Keep all log sheets in a designated area so that others can easily access them.

Site Name:	300 Building Larson Auto Group	Date: _____	Time: _____
Site Address:	300 River Road, Puyallup, WA 98371	Weather Condition:	_____
Checked By:	_____		

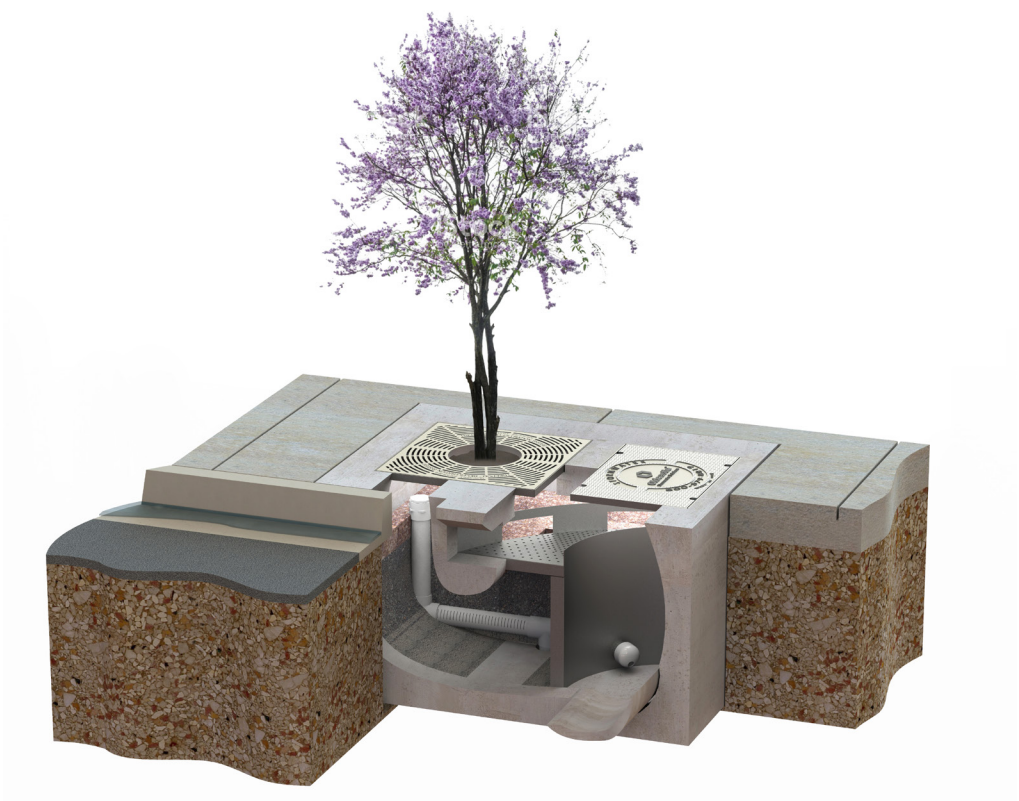
Part of Facility Checked	Observations (Things To Be Done)	Follow-up Actions Taken	Date Action Taken

Oldcastle Infrastructure™
A CRH COMPANY

BIOPOD™ SYSTEM

WITH STORMMIX™ MEDIA

Inspection and Maintenance Guide



Water

BioPod™ Biofilter with StormMix™ Biofiltration Media

Description

The BioPod™ Biofilter System (BioPod) is a stormwater biofiltration treatment system used to remove pollutants from stormwater runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters unless treatment is provided. The BioPod system uses proprietary StormMix™ biofiltration media to capture and retain pollutants including total suspended solids (TSS), metals, nutrients, gross solids, trash and debris as well as petroleum hydrocarbons.

Function

The BioPod system uses engineered, high-flow rate filter media to remove stormwater pollutants, allowing for a smaller footprint than conventional bioretention systems. Contained within a compact precast concrete vault, the BioPod system consists of a biofiltration chamber and an optional integrated high-flow bypass with a contoured inlet rack to minimize scour. The biofiltration chamber is filled with horizontal layers of aggregate (which may or may not include an underdrain), biofiltration media and mulch. Stormwater passes vertically down through the mulch and biofiltration media for treatment. The mulch provides pretreatment by retaining most of the solids or sediment. The biofiltration media provides further treatment by retaining finer sediment and dissolved pollutants. The aggregate allows the media bed to drain evenly for discharge through an underdrain pipe or by infiltration.

Configuration

The BioPod system can be configured with either an internal or external bypass. The internal bypass allows both water quality and bypass flows to enter the treatment vault. The water quality flows are directed to the biofiltration chamber while the excess flows are diverted over the bypass weir without entering the biofiltration chamber. Both the treatment and bypass flows are combined in the outlet area prior to discharge from the structure. BioPod units without an internal bypass are designed such that only treatment flows enter the treatment structure. When the system has exceeded its treatment capacity, ponding will force bypass flows to continue down the gutter to the nearest standard catch basin or other external bypass structure.

The BioPod system can be configured as a tree box filter with tree and grated inlet, as a planter box filter with shrubs, grasses and an open top, or as an underground filter with access risers, doors and a subsurface inlet pipe. The optional internal bypass may be incorporated with any of these configurations. In addition, an open bottom configuration may be used to promote infiltration and groundwater recharge. The configuration and size of the BioPod system is designed to meet the requirements of a specific project.

Inspection & Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Without maintenance, excessive pollutant buildup can limit system performance by reducing the operating capacity of the system and increasing the potential for scouring of pollutants during periods of high flow.

Some configurations of the BioPod may require periodic irrigation to establish and maintain vegetation. Vegetation will typically become established about two years after planting. Irrigation requirements are ultimately dependent on climate, rainfall and the type of vegetation selected.

Maintenance Frequency

Periodic inspection is essential for consistent system performance and is easily completed. Inspection is typically conducted a minimum of twice per year, but since pollutant transport and deposition varies from site to site, a site-specific maintenance frequency should be established during the first two or three years of operation.

Inspection Equipment

The following equipment is helpful when conducting BioPod inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure

Inspection Procedures

BioPod inspections are visual and are conducted without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers or tree grates are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided on page 6) to determine whether maintenance is required:

- If the BioPod unit is equipped with an internal bypass, inspect the contoured inlet rack and outlet chamber and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Stormwater at (800) 579-8819 to determine appropriate corrective action.
- Note whether the curb inlet, inlet pipe, or – if the unit is equipped with an internal bypass – the inlet rack is blocked or obstructed.
- If the unit is equipped with an internal bypass, observe, quantify and record the accumulation of trash and debris in the inlet rack. The significance of accumulated trash and debris is a matter of judgment. Often, much of the trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.
- If it has not rained within the past 24 hours, note whether standing water is observed in the biofiltration chamber.
- Finally, observe, quantify and record presence of invasive vegetation and the amount of trash and debris and sediment load in the biofiltration chamber. Erosion of the mulch and biofiltration media bed should also be recorded. Sediment load may be rated light, medium or heavy depending on the conditions. Loading characteristics may be determined as follows:
    - Light sediment load – sediment is difficult to distinguish among the mulch fibers at the top of the mulch layer; the mulch appears almost new.
    - Medium sediment load – sediment accumulation is apparent and may be concentrated in some areas; probing the mulch layer reveals lighter sediment loads under the top 1” of mulch.
    - Heavy sediment load – sediment is readily apparent across the entire top of the mulch layer; individual mulch fibers are difficult to distinguish; probing the mulch layer reveals heavy sediment load under the top 1” of mulch.

Often, much of the invasive vegetation and trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.

Maintenance Indicators

Maintenance should be scheduled if any of the following conditions are identified during inspection:

- The concrete structure is damaged or the tree grate or access cover is damaged or missing.
- The curb inlet or inlet rack is obstructed.
- Standing water is observed in the biofiltration chamber more than 24 hours after a rainfall event (use discretion if the BioPod is located downstream of a storage system that attenuates flow).
- Trash and debris in the inlet rack cannot be easily removed at the time of inspection.
- Trash and debris, invasive vegetation or sediment load in the biofiltration chamber is heavy or excessive erosion has occurred.

Maintenance Equipment

The following equipment is helpful when conducting BioPod maintenance:

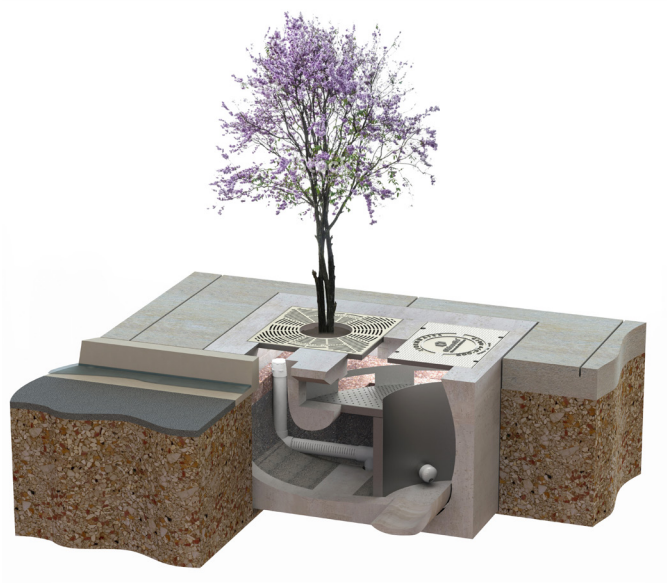
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Rake, hoe, shovel and broom
- Bucket
- Pruners
- Vacuum truck (optional)

Maintenance Procedures

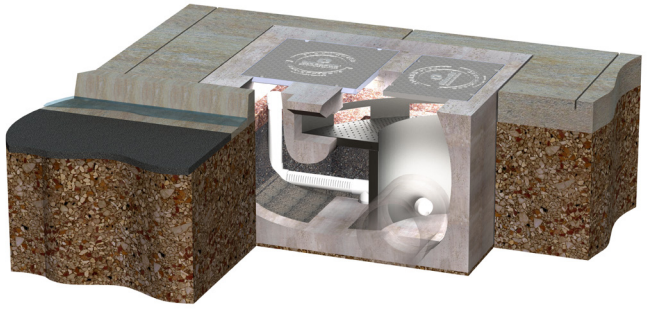
Maintenance should be conducted during dry weather when no flows are entering the system. All maintenance may be conducted without entering the BioPod structure. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove all trash and debris from the curb inlet and inlet rack manually or by using a vacuum truck as required.
- Remove all trash and debris and invasive vegetation from the biofiltration chamber manually or by using a vacuum truck as required.
- If the sediment load is medium or light but erosion of the biofiltration media bed is evident, redistribute the mulch with a rake or replace missing mulch as appropriate. If erosion persists, rocks may be placed in the eroded area to help dissipate energy and prevent recurring erosion.
- If the sediment load is heavy, remove the mulch layer using a hoe, rake, shovel and bucket, or by using a vacuum truck as required. If the sediment load is particularly heavy, inspect the surface of the biofiltration media once the mulch has been removed. If the media appears clogged with sediment, remove and replace one or two inches of biofiltration media prior to replacing the mulch layer.
- Prune vegetation as appropriate and replace damaged or dead plants as required.
- Replace the tree grate and/or access covers and sweep the area around the BioPod to leave the site clean.
- All material removed from the BioPod during maintenance must be disposed of in accordance with local environmental regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.

Natural, shredded hardwood mulch should be used in the BioPod. Timely replacement of the mulch layer according to the maintenance indicators described above should protect the biofiltration media below the mulch layer from clogging due to sediment accumulation. However, whenever the mulch is replaced, the BioPod should be visited 24 hours after the next major storm event to ensure that there is no standing water in the biofiltration chamber. Standing water indicates that the biofiltration media below the mulch layer is clogged and must be replaced. Please contact Oldcastle Infrastructure at (800) 579-8819 to purchase the proprietary StormMix™ biofiltration media.

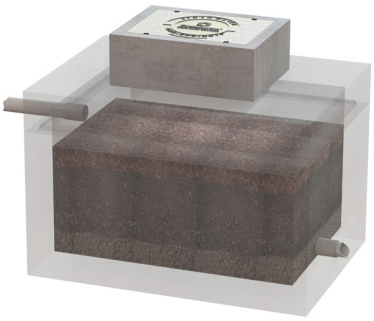


BioPod Tree Module



BioPod Media Module

BioPod Planter Module



BioPod Media Vault

BioPod Inspection & Maintenance Log

BioPod Model_____ **Inspection Date**_____

Location_____

Condition of Internal Components Notes:

☐ Good ☐ Damaged ☐ Missing

Curb Inlet or Inlet Rack Blocked Notes:

☐ Yes ☐ No

Standing Water in Biofiltration Chamber Notes:

☐ Yes ☐ No

Trash and Debris in Inlet Rack Notes:

☐ Yes ☐ No

Trash and Debris in Biofiltration Chamber Notes:

☐ Yes ☐ No

Invasive Vegetation in Biofiltration Chamber Notes:

☐ Yes ☐ No

Sediment in Biofiltration Chamber Notes:

☐ Light ☐ Medium ☐ Heavy

Erosion in Biofiltration Chamber Notes:

☐ Yes ☐ No

Maintenance Requirements

☐ **Yes - Schedule Maintenance** ☐ **No - Schedule Re-Inspection**

Table V-4.5.2(5) Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks. Frame is sit-

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	ting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into	Mechanism opens with

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Working	frame have less than 1/2 inch of thread.	proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accu-	Sediment depth exceeds 0.25-inches.	No sediment depos-

Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	mulation on Media.		its which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.

Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and mis-aligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.