Green Canopy

STORMWATER SITE PLAN

SUNNYSIDE VILLAGE COHOUSING
AUGUST 19, 2022

Site Location:
Sunnyside Village
3121 66th Ave NE
Marysville, WA 98270

Prepared for:
Sunnyside Village Cohousing

Prepared by:
MIG Design Company
119 Pine Street, Suite 400
Seattle, WA 98101

MIG Project No. 15170

Green Canopy
Sunnyside Village Cohousing

STORMWATER SITE PLAN

AUGUST 19, 2022

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1.0 PROJECT OVERVIEW

Sunnyside Village Cohousing (Owner) is proposing a new cohousing community (Project) consisting of detached residential buildings and shared communal buildings.

The Project is located within the City of Marysville.

The Project is located at 3121 66th Ave NE, Marysville, WA 98270 (see Figure 1a – Vicinity Map and Figure 1b – Area Map). The site is bounded by 66th Avenue NE and an existing stormwater detention pond to the north, and existing private properties to the east, south, and west. The site is currently occupied by a single house, detached garage, and storage sheds.

The parcel is 4.75 acres. The Snohomish County Parcel Number is 29050300402100.

Proposed civil utility improvements include a watermain extension, water services, sanitary sewer, and installation of surface stormwater water quality treatment and flow control facilities. Surface improvements will include grading, roadway and walkway paving, and associated landscaping and site furnishing. Proposed development includes utility and roadway improvements in 66th Ave NE.

Surface water management has been designed to comply with the **2019 Stormwater Management Manual for Western Washington (SWMMWW)** as amended by the City of Marysville per City of Marysville Chapter 4 Drainage and Erosion Control Design Standards, dated December 2016.

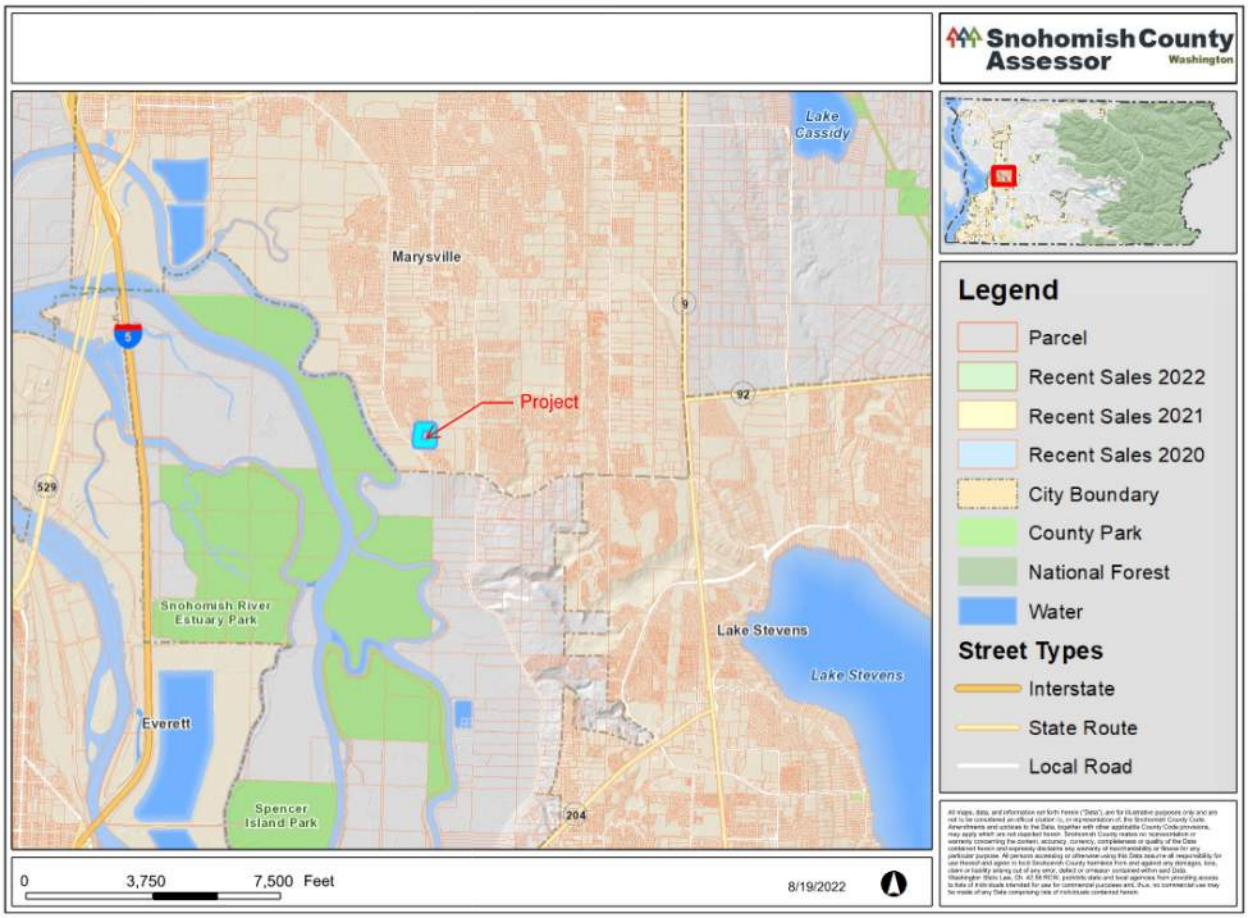


Figure 1a – Vicinity Map
Snohomish County Accessor GIS Map

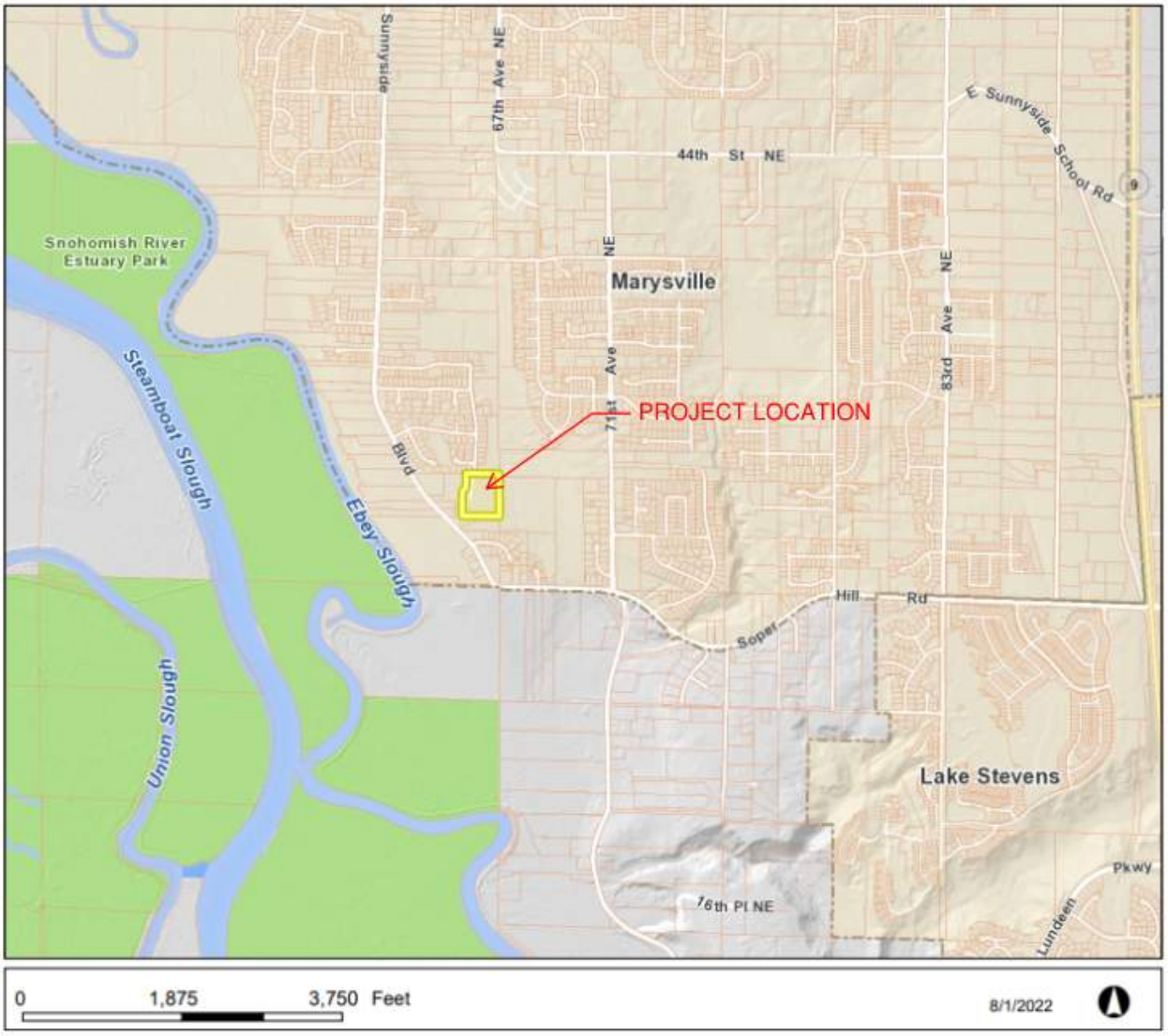


Figure 1b – Area Map
Snohomish County Accessor GIS Map

2.0 EXISTING CONDITIONS SUMMARY AND OFF-SITE ANALYSIS

2.1 Pre-developed Conditions Summary

The existing 4.75-acre site includes a paved driveway and buildings, with surrounding lawn and vegetation. See Figure 2 – Existing Conditions.

Wetlands are located within the site and on the east side of the parcel that extend into the adjacent parcel. See Section 2.3 – Off-Site Analysis. No flow control or water quality treatment is currently provided for the Project Site.

The Project's storm water discharges will be required to discharge storm water from the site per the Flow Control Performance Standard per Minimum Requirement #7, which requires the developed condition to release stormwater at rates relative to the predeveloped Forest condition. A summary of the Pre-developed condition is provided in Table 1, below.

Table 1 – Pre-developed Conditions Summary

Description	**Area (acres)**
Pre-developed Area (Till Forest)	4.75
Subtotal of Pre-developed Area:	**4.75**
Total Pre-developed Area	***4.75***

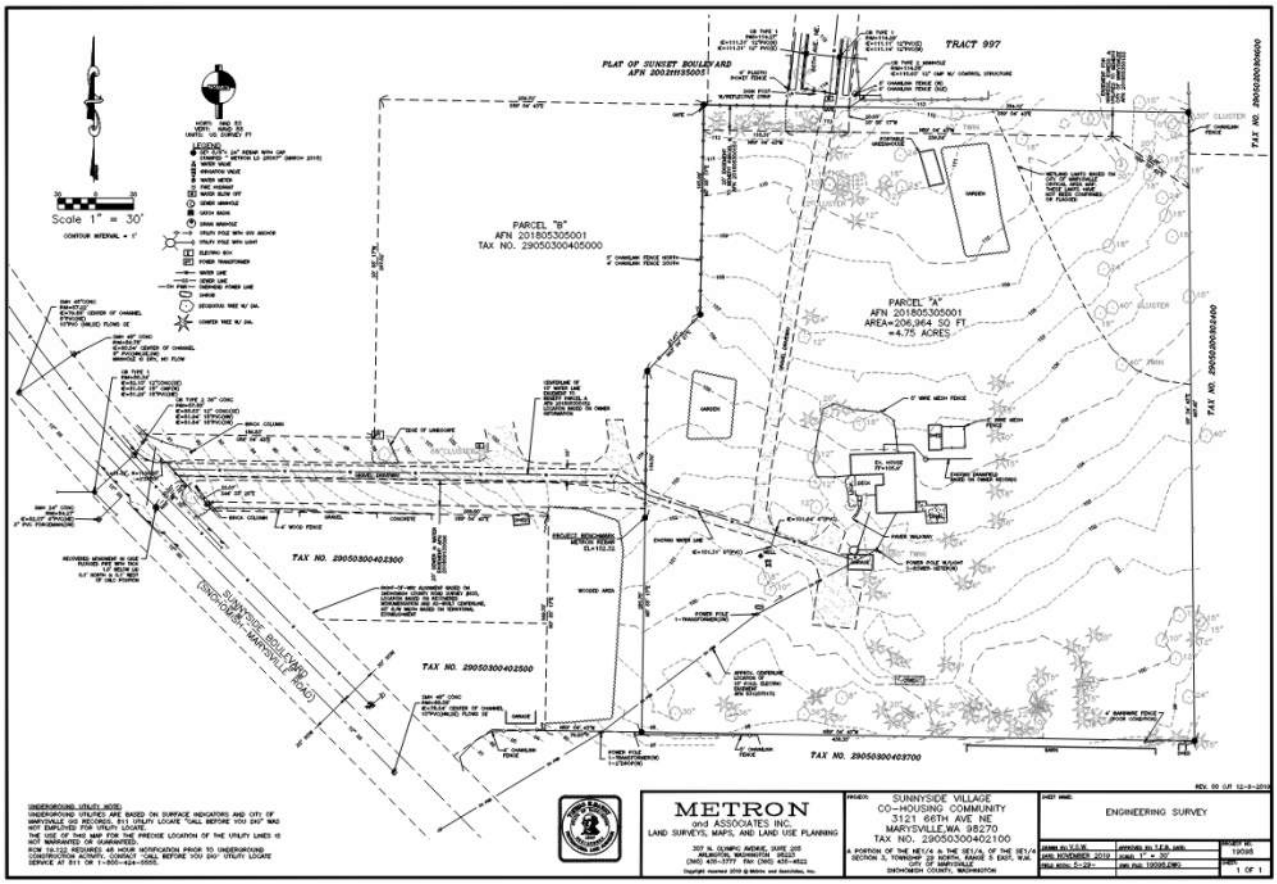


Figure 2 – Existing Conditions

2.2 Geotechnical Report and Soils

See Appendix C – Geotechnical Report for report prepared by GeoEngineers, Inc. dated December 23, 2020 for geotechnical explorations and findings of glacial till and perched groundwater seepage.

2.3 Off-site Analysis

The parcel is located in the Snohomish Watershed.

The parcel does not receive run-on from adjacent properties.

The parcel contains 4 documented wetlands. Wetlands A, B and D are classified as Category IV with 35-foot buffers. Wetland C is classified as Category II with a 75-foot buffer. See Figure 3 – Existing Wetlands. See Sensitive Areas report prepared by GeoEngineers for documentation, mitigation and preservation of wetlands.

The majority of stormwater runoff sheetflows toward the southeast of the parcel, and then by overland flow and open channel flow with the Sunnyside Creek Basin on the City of Marysville's March 2007 Stream Classifications map. The area discharges to King Creek, which is classified by the City of Marysville as "F". King Creek discharges to Ebey Slough, which flows north to discharge to Puget Sound north of Everett. See Figure 4 – Off-Site Analysis.

Stormwater runoff on the west edge of the project discharges to a storm drain located along Sunnyside Boulevard to the southwest, which discharges to King Creek. Both drainage areas converge within ¼-mile of the parcel.

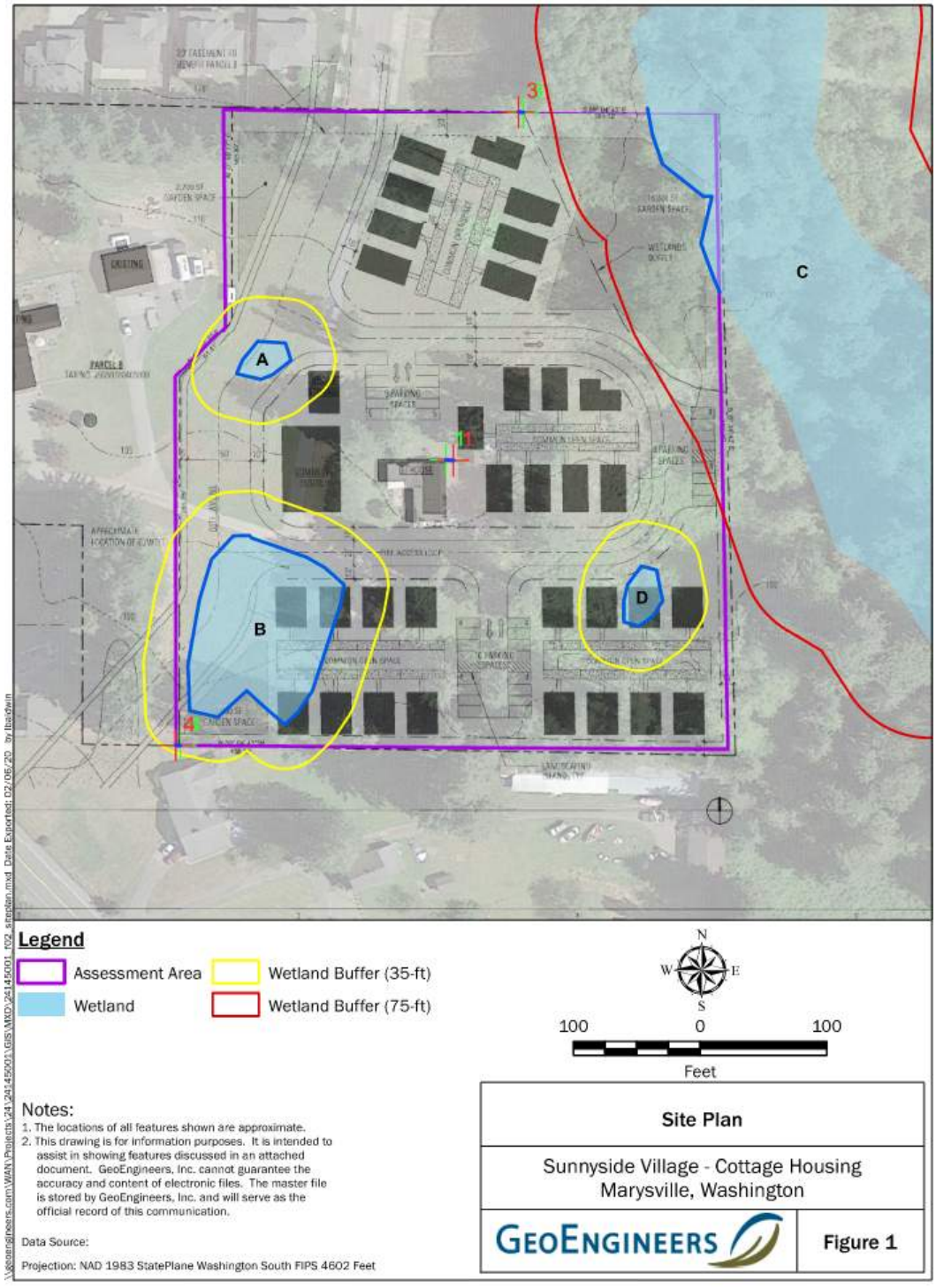


Figure 3 – Existing Wetlands

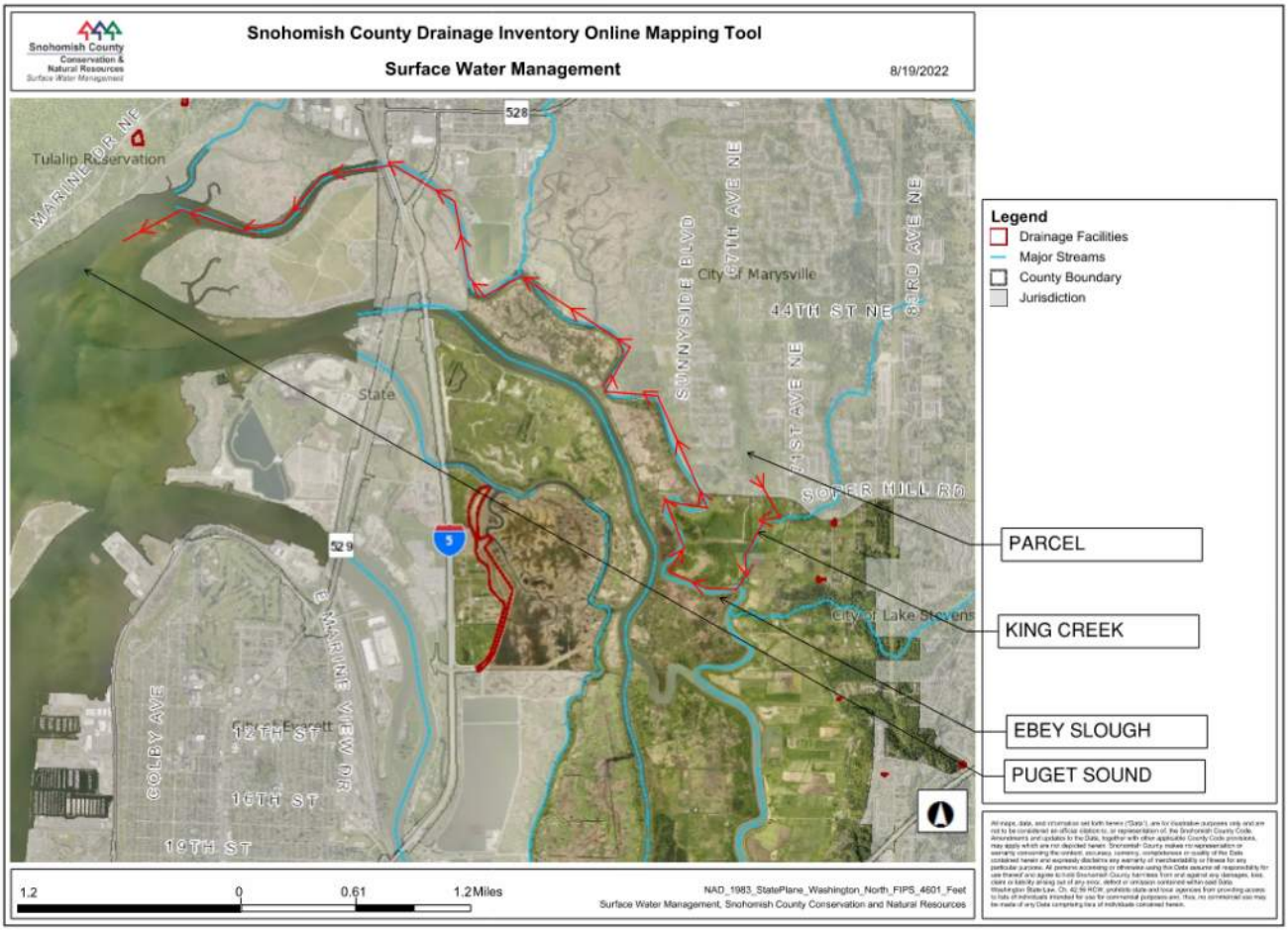


Figure 4 – Off-Site Analysis

3.0 DEVELOPED CONDITION SUMMARY

3.1 Developed Condition

The Developed condition includes demolishing the existing pavement and buildings and redeveloping with 32 residential buildings, new sidewalks and a private road, parking lots, and community buildings.

Improvements include dedicating right of way for extending 66th Ave NE.
A summary of proposed conditions is provided in Table 2, below. See Figure 5 – Developed Conditions and Figure 6 – Developed Drainage Subbasins.

Table 2 – Developed Conditions Summary

Description	Area (acres)
Building/Roof	1.09
Impervious Vehicular Paving	0.42
Impervious Sidewalk/Pathways	0.40
Impervious Parking Areas	0.33
Hard Surface Areas Subtotal:	**2.24**
Landscape/Lawn/Gardens/Orchards	1.98
Converted Vegetation Subtotal:	**1.98**
Wetland buffer to remain undisturbed:	***0.53***
Subtotal of Basin Area Flowing to Flow Control Facility	***4.75***
Total Mitigated + Existing to Remain Drainage Basin Area	***4.75***

The Project will involve more than 7,000 square feet of land disturbing activity.

Proposed stormwater drainage improvements consist of area drains, underdrains, catch basins, pipes, downspout dispersal, and downspout connections for collection and conveyance of stormwater runoff designed in accordance with City of Marysville Standards. See Appendix B - Plans.

This Project will maintain natural drainage patterns with proposed storm drainage conveyance and flow control facilities discharging at or near existing discharge points to a creek on the east side of the project area.

Pollution generating hard surface and adjacent areas discharging to PGHS areas will be conveyed to water quality treatment facilities for Enhanced water quality treatment.

Stormwater runoff from the developed part of the site will be conveyed to a stormwater detention vault located under the southeast parking lot. See Figure 6 – Developed Drainage Subbasins. Discharge from the detention vault will be via a Dispersal Trench and overland flow at the natural point of discharge. A stormwater duplex pump system will be required to convey stormwater from the detention vault's flow control structure to the dispersal trench.

Figure 5 – Developed Condition

Figure 6 – Developed Drainage Subbasins

4.0 MINIMUM REQUIREMENTS

The Project is designed under the Department of Ecology 2019 Stormwater Management Manual for Western Washington (SWMMWW). Figures I-3.1 in the SWMMWW define the requirements for the Project. See Figure 7.

New Development:
According to Figure I-3.1 in the SWMMWW, Minimum Requirements 1 through 9 will be applied to the new hard surfaces and converted vegetated areas.

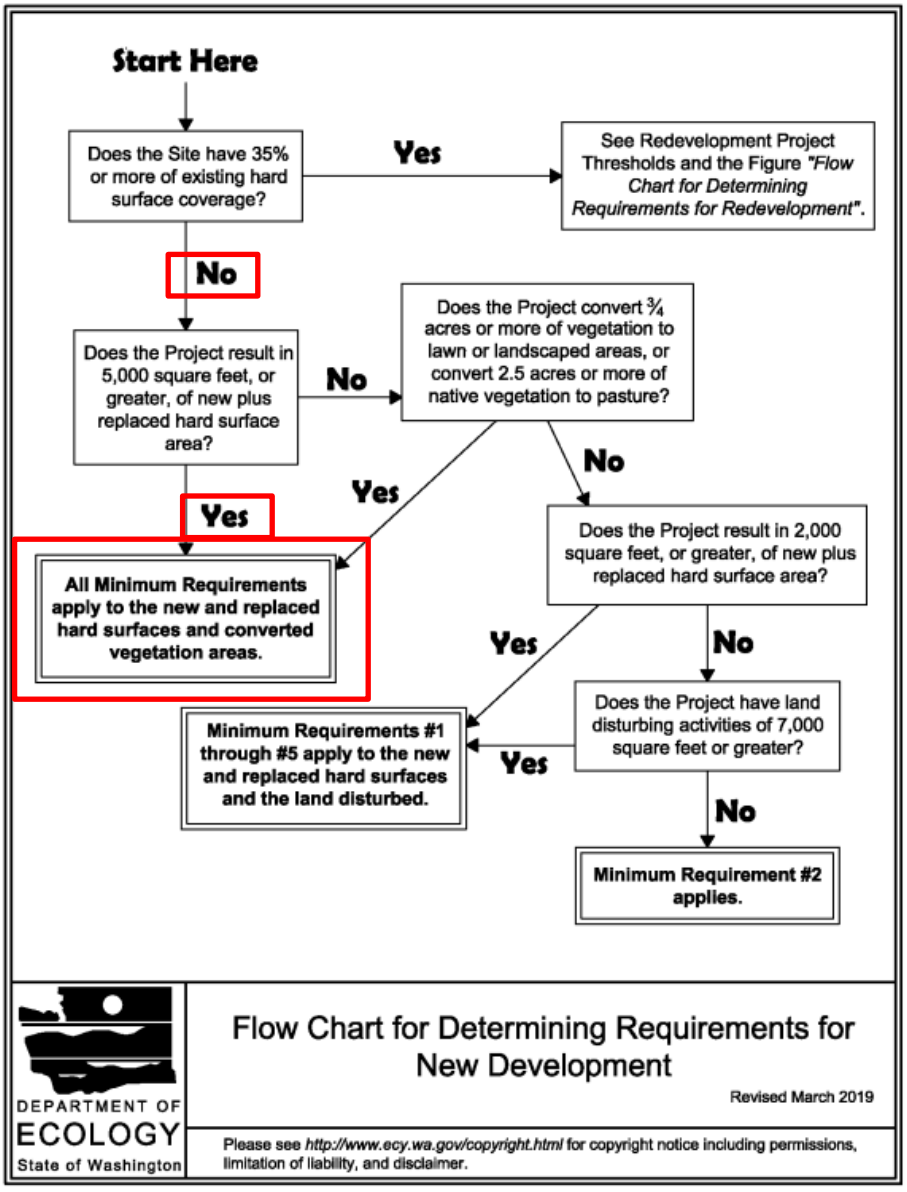


Figure 7 – Flow Chart for Determining Requirements for New Development

Each of these minimum requirements will be addressed as follows:

MR #1: Preparation of Stormwater Site Plans – *All projects meeting the thresholds in (SWMMWW) I-3.3 shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with Chapter 3 of SWMMWW.*

The project results in 5,000 square feet, or greater, of new plus replaced hard surface area and therefore is required to prepare a Stormwater Site Plan.

MR #2: Construction Stormwater Pollution Prevention Plan (SWPPP) – *All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Stormwater Site Plan.*

The Project results in 2,000 square feet or more of new plus replaced hard surface area and therefore is required to prepare a Construction Stormwater Pollution Prevention Plan (SWPPP). A draft SWPPP will be prepared for the Building Permit submittal. The final SWPPP will be completed by the contractor.

MR #3: Source Control of Pollution – *All known, available, and reasonable Source Control BMPs must be applied to all projects. Source Control BMPs must be selected, designed, and maintained in accordance with this manual*.

Operational BMPs and Structural Source Control BMPs will be included in the SWPPP.

MR #4: Preservation of Natural Drainage Systems and Outfalls – *Natural drainage patterns shall be maintained, and discharges from the Project Site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the Project Site must not cause a significant adverse impact to downstream receiving water and downgradient properties. All outfalls require energy dissipation*.

Existing drainage outfalls will be preserved within ¼-mile downstream. Discharge at the natural location for the site will be maintained at the southeast portion of the site.

MR #5: On-site Stormwater Management – *Projects shall employ Stormwater Management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on site to the extent feasible without causing flooding or erosion impacts*.

In accordance with SWMMWW Table I-3.1, the project will use the List #2 approach. See Figure 8.

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

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

Figure 8 – SWMMWW On-Site Management Requirements

See Section 5.1 – On-Site Stormwater Management.

MR #6: Runoff Treatment – *Projects shall employ Runoff Treatment BMPs in accordance with the following thresholds, standards, and requirements to remove pollutants from stormwater runoff. The following Threshold Discharge Areas (TDAs) require construction of Runoff Treatment BMPs. If a TDA meets any of the following thresholds, Runoff Treatment BMPs are required. The project proponent must demonstrate that the TDA does not meet either of the following thresholds for Runoff Treatment BMPs to not be required for that TDA.*

- *TDAs that have a total of 5,000 square feet or more of pollution-generating hard surface (PGHS), or*
- *TDAs that have a total of ¾ of an acre or more of pollution-generating pervious surfaces (PGPS)—not including permeable pavements, and from which there will be a surface discharge in a natural of man-made conveyance system from the site.*

The project has a Threshold Discharge Area of more than 5,000 square feet of pollution-generating hard surface, therefore runoff treatment is required.

The Project will not be a High-Use Site, therefore Oil Control Treatment will not be required.

Enhanced water quality treatment will be required in accordance with City of Marysville Municipal Code Chapter 14.15.050.6.b.ii since the parcel discharges to conveyance systems tributary to fresh waters that have existing aquatic life use (King Creek classified as F).

See Section 5.2 – Water Quality Treatment

MR #7: Flow Control – *Projects shall employ Flow Control BMPs in accordance with the following thresholds, standards, and requirements to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The following TDAs require construction of Flow Control BMPs to achieve the Flow Control Performance Standard. If a TDA meets any of the following thresholds, Flow Control BMPs are required. The project proponent must demonstrate that the TDA does not meet any of the following thresholds for Flow Control BMPs to not be required for that TDA.*

- *TDAs that have a total of 10,000 square feet or more of effective impervious surfaces, or*
- *TDAs that convert ¾ acres or more of native vegetation, pasture, scrub/shrub, or unmaintained non-native vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture, and from which there is a surface discharge in a natural or man-made conveyance system from the TDA, or*
- *TDAs that through a combination of effective hard surfaces and converted vegetation areas cause a 0.15 cubic feet per second (cfs) or greater increase in the 100-year flow frequency as estimated using an approved continuous simulation model and 15-minute time steps.*

The Project has a total of 10,000 square feet or more of effective impervious area and is subject to the Flow Control Performance Standard requirement. In accordance with Ecology Section I-3.4.7 MR7, the Flow Control Performance Standard will be required.

See Section 5.3 – Flow Control Facilities

MR #8: Wetlands Protection – *Projects shall employ Stormwater Management BMPs in accordance with the following thresholds, standards, and requirements to reduce the impacts of stormwater runoff to wetlands. This Minimum Requirement applies only to TDAs whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system.*

Stormwater from the Project site does not discharge into a wetland, therefore wetland protection is not required.

MR #9: Operation and Maintenance – *An operation and maintenance manual that is consistent with the provisions in Chapter 5 of SWMMWW shall be provided for proposed Runoff Treatment and Flow Control BMPs. The party (or parties) responsible for maintenance and operation shall be identified in the operation and maintenance manual. At private facilities, a copy of the operation and maintenance manual shall be retained on site or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.*

The Owner will be responsible for required regular maintenance of proposed storm drainage facilities, as required by the City of Marysville.

An Operation & Maintenance Manual has been completed for all Flow Control and BMP used. See Appendix E – Operations and Maintenance Manual.

5.0 PERMANENT STORMWATER CONTROL

5.1 On-site Stormwater Management

The Project will use the List #2 approach in accordance with SWMMWW Table I-3.1.

- Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section Chapter 4 of Volume V
    - BMP T5.30, Full Dispersion, is infeasible as less than 65% of the site will be protected in a forest or native condition.
    - BMP T5.10A, Downspout Full Infiltration System, does not need to be considered since Full Dispersion Infeasible under BMP T5.30

- Permeable Pavement in accordance with BMP T5.15 in Chapter 5 of Volume V
    - BMP T5.15 is infeasible due to infeasibility criteria: “Where professional geotechnical evaluation recommends infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding”

- Bioretention in accordance with BMP T7.30 in Chapter 5 of Volume V
    - BMP T7.30 is infeasible due to infeasibility criteria: “Where the field testing indicates potential bioretention sites have a measured (aka initial) native soil saturated hydraulic conductivity less than 0.30 inches per hour”

- Sheet Flow Dispersion in accordance with BMP T5.12 in Chapter 3 of Volume V, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 3 of Volume V
    - BMP T5.11, Concentrated Flow Dispersion, and BMP T5.12, Sheet Flow Dispersion, are used for runoff. Runoff will be collected with site storm drainage conveyance systems to be routed to the detention vault.

5.2 Water Quality Treatment Facilities

The Project will be required to provide Enhanced water quality treatment for stormwater runoff from pollution generating hard surfaces.

Oldcastle BioPod Biofilter System has received The Washington State Department of Ecology’s General Use Level Designation (GULD) for Basic (TSS), Dissolved Metals (Enhanced), and Phosphorus Treatment, and are proposed for the Project. See Appendix F – Water Quality Treatment.

5.3 Flow Control Facilities

The Project has been designed to meet SWMMWW Flow Control Performance Standard requirement in which stormwater discharges are to match developed discharge durations to predeveloped durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The Pre-developed condition to be matched shall be a forested land cover for the 4.75 acre parcel.

The Developed condition is modeled as 0.530 acres of wetland buffer zone that will be undeveloped, and the remaining 4.22 acre development area.

See Figure 9 – Developed Site Areas for subbasin and area delineation.

A continuous runoff model using MGS Flood software modele peak flows and flow durations in order to size the required flow control detention vault and associated flow control structure so that the developed discharge rates comply with SWMMWW Flow Control Performance Standard requirement.

See Figure 10 – Predeveloped and Developed Runoff Summary and Appendix A – Flow Control Facilities Calculations.

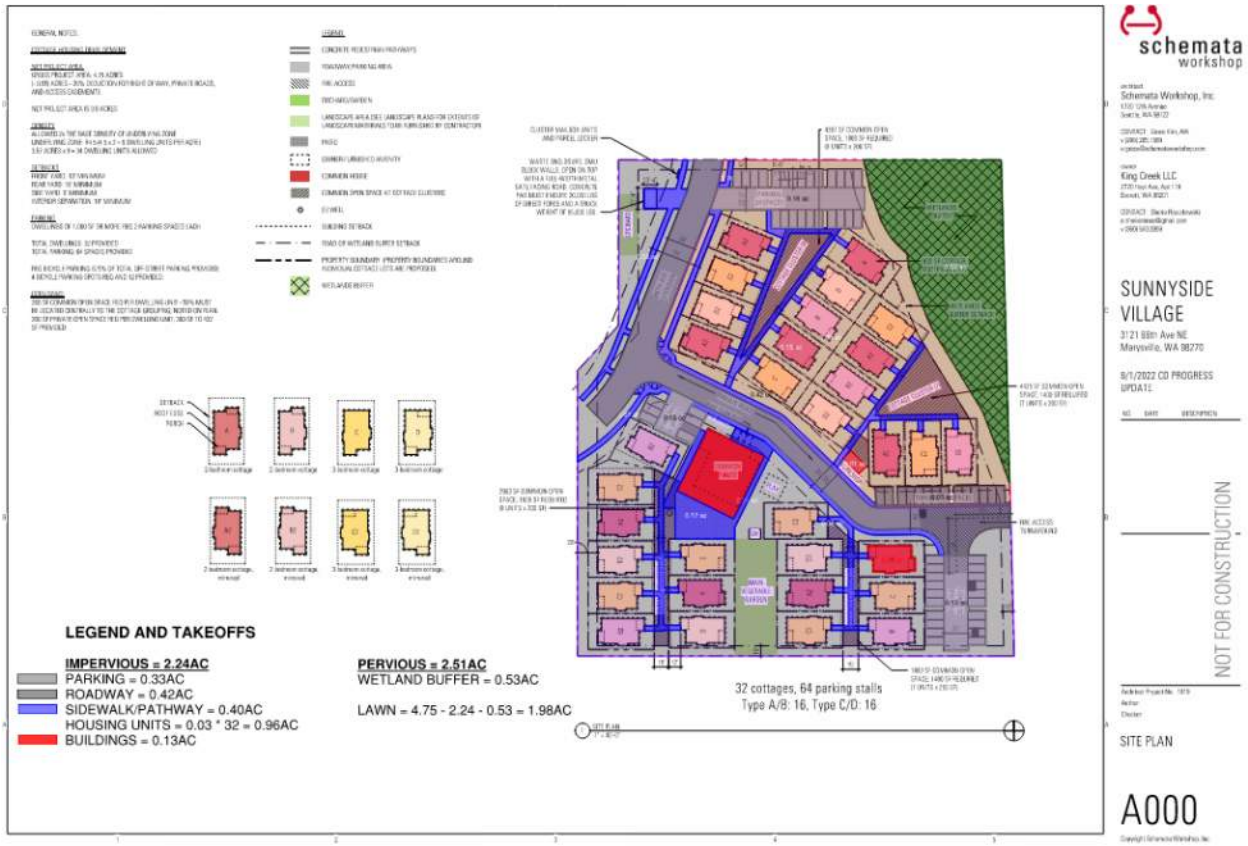


Figure 9 – Developed Site Areas

***** Point of Compliance Flow Frequency Data *****

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.101	2-Year	5.469E-02
5-Year	0.165	5-Year	8.822E-02
10-Year	0.222	10-Year	0.110
25-Year	0.282	25-Year	0.148
50-Year	0.360	50-Year	0.157
100-Year	0.390	100-Year	0.178
200-Year	0.607	200-Year	0.179
500-Year	0.898	500-Year	0.180

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

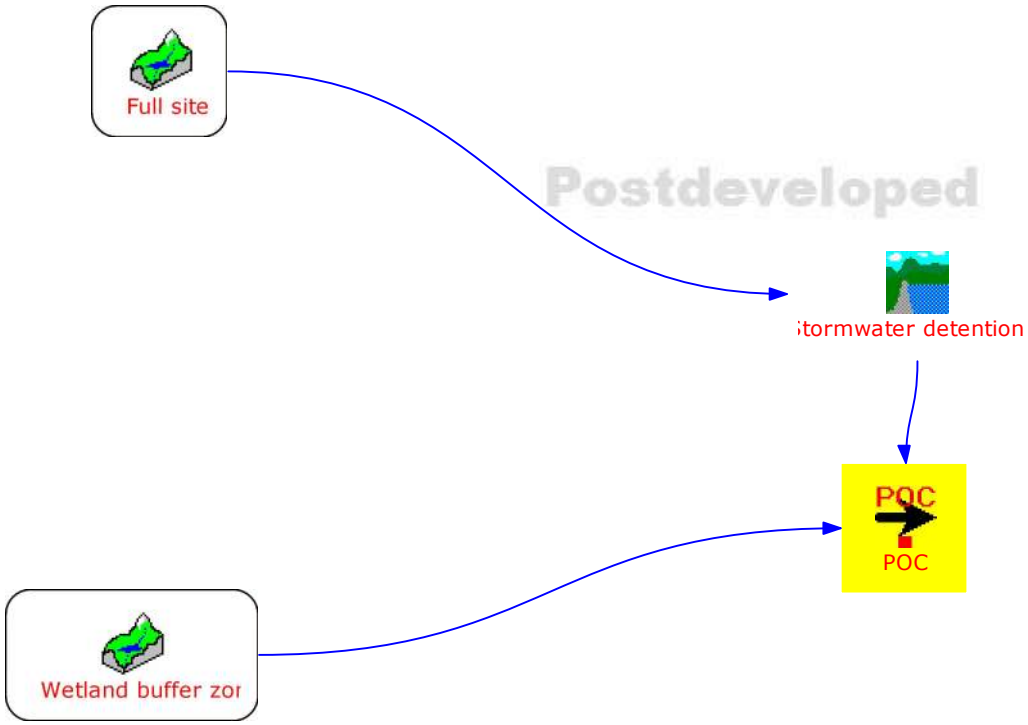
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-9.1%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-9.1%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-44.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

Figure 10 – Pre-Developed and Developed Peak Flow Runoff Summary

APPENDIX A

Flow Control Facility Calculations


Full site
Postdeveloped
tormwater detention
POC
POC
Wetland buffer zor

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.58
Program License Number: 200910004
Project Simulation Performed on: 08/18/2022 11:09 AM
Report Generation Date: 08/18/2022 11:14 AM

Input File Name: 2022-08-17 Full site model with wetland bypass.fld
Project Name: Sunnyside Cohousing
Analysis Title:
Comments: 2022-08-16
Modeled as one site; wetland buffer bypass

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 15
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 3
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	4.750	4.750
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	4.750	4.750

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	4.750

Subbasin Total 4.750

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Full site ----------

	-------Area (Acres) --------
Till Grass	1.980
Impervious	2.240
Subbasin Total	4.220

---------- Subbasin : Wetland buffer zone ----------

	-------Area (Acres) --------
Till Forest	0.530
Subbasin Total	0.530

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 2

Link Name: Stormwater detention
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	112.50
Max Pond Elevation (ft)	:	113.00
Storage Depth (ft)	:	12.50
Pond Bottom Length (ft)	:	120.0
Pond Bottom Width (ft)	:	42.7
Pond Side Slopes (ft/ft)	:	Z1= 0.00 Z2= 0.00 Z3= 0.00 Z4= 0.00
Bottom Area (sq-ft)	:	5124.
Area at Riser Crest El (sq-ft)	:	5,124.
(acres)	:	0.118
Volume at Riser Crest (cu-ft)	:	64,050.
(ac-ft)	:	1.470
Area at Max Elevation (sq-ft)	:	5124.
(acres)	:	0.118
Vol at Max Elevation (cu-ft)	:	66,612.

(ac-ft) : 1.529

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.000
Riser Crest Elevation : 112.50 ft

Hydraulic Structure Geometry

Number of Devices: 3

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 0.87
Orientation : Horizontal
Elbow : Yes

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 107.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

---Device Number 3 ---
Device Type : Circular Orifice
Control Elevation (ft) : 110.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

Link Name: POC
Link Type: Copy
Downstream Link: None

**************************FLOOD FREQUENCY AND DURATION STATISTICS*********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2
Number of Links: 2

*************Groundwater Recharge Summary ***************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	819.038
Total:	819.038

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Full site		241.977
Subbasin: Wetland buffer zone		91.387
Link:	Stormwater detention	Not Computed
Link:	POC	0.000
Total:		333.364

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 5.184 ac-ft/year, Post Developed: 2.110 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 2

********** Link: POC **********

2-Year Discharge Rate : 0.055 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 999.00 cfs
Off-line Design Discharge Rate (91% Exceedance): 999.00 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 1450.50
Inflow Volume Including PPT-Evap (ac-ft): 1450.50
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 1450.50
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: POC

***** Point of Compliance Flow Frequency Data *****

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.101	2-Year	5.469E-02
5-Year	0.165	5-Year	8.822E-02
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200-Year	0.607	200-Year	0.179
500-Year	0.898	500-Year	0.180

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-9.1%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-9.1%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-44.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

APPENDIX B

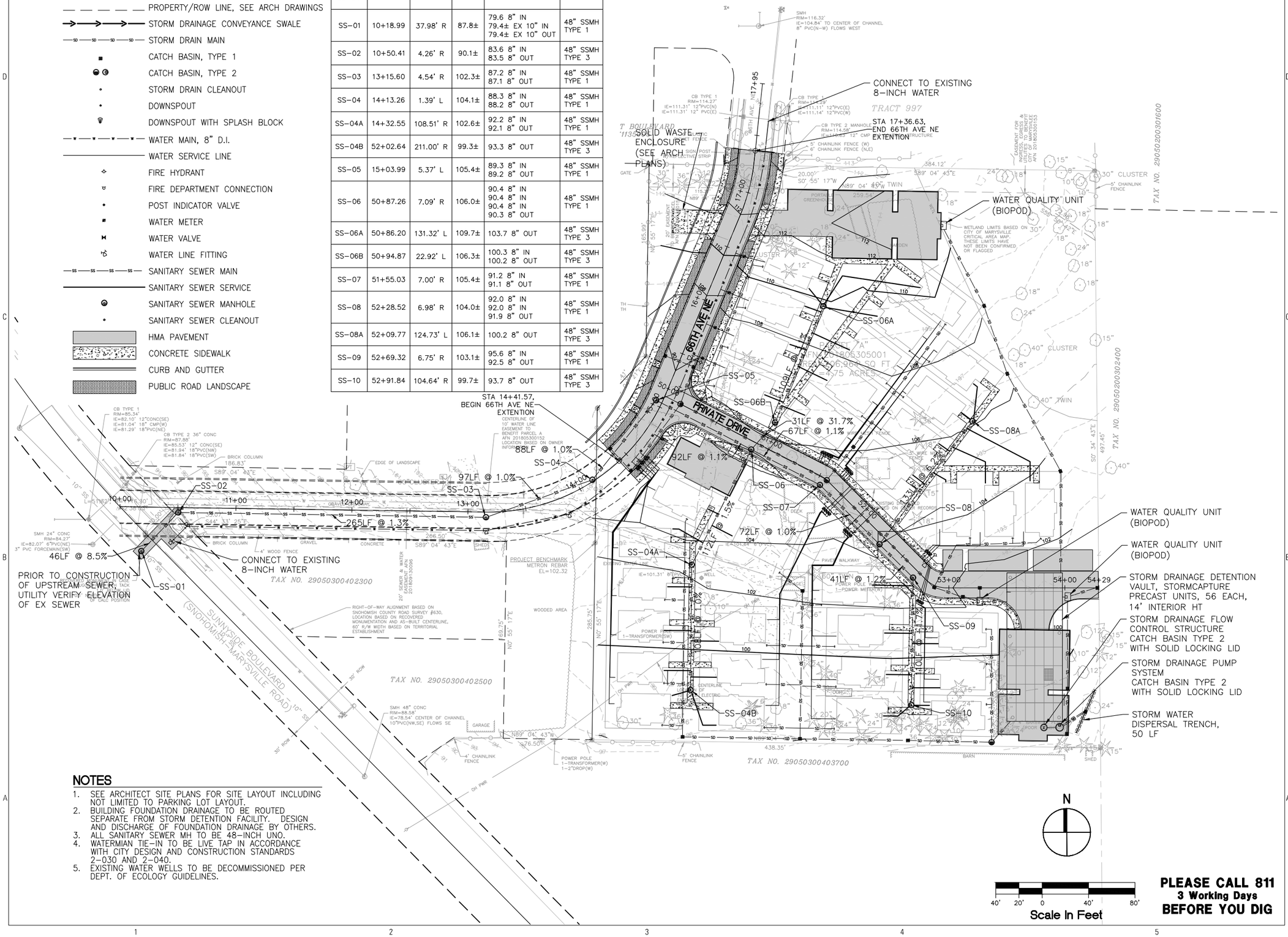
Plans

LEGEND

- CONSTRUCTION CENTERLINE
- PROPERTY/ROW LINE, SEE ARCH DRAWINGS
- STORM DRAINAGE CONVEYANCE SWALE
- STORM DRAIN MAIN
- CATCH BASIN, TYPE 1
- CATCH BASIN, TYPE 2
- STORM DRAIN CLEANOUT
- DOWNSPOUT
- DOWNSPOUT WITH SPLASH BLOCK
- WATER MAIN, 8" D.I.
- WATER SERVICE LINE
- FIRE HYDRANT
- FIRE DEPARTMENT CONNECTION
- POST INDICATOR VALVE
- WATER METER
- WATER VALVE
- WATER LINE FITTING
- SANITARY SEWER MAIN
- SANITARY SEWER SERVICE
- SANITARY SEWER MANHOLE
- SANITARY SEWER CLEANOUT
- HMA PAVEMENT
- CONCRETE SIDEWALK
- CURB AND GUTTER
- PUBLIC ROAD LANDSCAPE

SANITARY SEWER STRUCTURE TABLE

ID ##-##	STATION	OFFSET	RIM	IE	NOTES
SS-01	10+18.99	37.98' R	87.8±	79.6 8" IN 79.4± EX 10" IN 79.4± EX 10" OUT	48" SSMH TYPE 1
SS-02	10+50.41	4.26' R	90.1±	83.6 8" IN 83.5 8" OUT	48" SSMH TYPE 3
SS-03	13+15.60	4.54' R	102.3±	87.2 8" IN 87.1 8" OUT	48" SSMH TYPE 1
SS-04	14+13.26	1.39' L	104.1±	88.3 8" IN 88.2 8" OUT	48" SSMH TYPE 1
SS-04A	14+32.55	108.51' R	102.6±	92.2 8" IN 92.1 8" OUT	48" SSMH TYPE 1
SS-04B	52+02.64	211.00' R	99.3±	93.3 8" OUT	48" SSMH TYPE 3
SS-05	15+03.99	5.37' L	105.4±	89.3 8" IN 89.2 8" OUT	48" SSMH TYPE 1
SS-06	50+87.26	7.09' R	106.0±	90.4 8" IN 90.4 8" IN 90.4 8" IN 90.3 8" OUT	48" SSMH TYPE 1
SS-06A	50+86.20	131.32' L	109.7±	103.7 8" OUT	48" SSMH TYPE 3
SS-06B	50+94.87	22.92' L	106.3±	100.3 8" IN 100.2 8" OUT	48" SSMH TYPE 3
SS-07	51+55.03	7.00' R	105.4±	91.2 8" IN 91.1 8" OUT	48" SSMH TYPE 1
SS-08	52+28.52	6.98' R	104.0±	92.0 8" IN 92.0 8" IN 91.9 8" OUT	48" SSMH TYPE 1
SS-08A	52+09.77	124.73' L	106.1±	100.2 8" OUT	48" SSMH TYPE 3
SS-09	52+69.32	6.75' R	103.1±	95.6 8" IN 92.5 8" OUT	48" SSMH TYPE 1
SS-10	52+91.84	104.64' R	99.7±	93.7 8" OUT	48" SSMH TYPE 3



NOTES

1. SEE ARCHITECT SITE PLANS FOR SITE LAYOUT INCLUDING NOT LIMITED TO PARKING LOT LAYOUT.
2. BUILDING FOUNDATION DRAINAGE TO BE ROUTED SEPARATE FROM STORM DETENTION FACILITY. DESIGN AND DISCHARGE OF FOUNDATION DRAINAGE BY OTHERS.
3. ALL SANITARY SEWER MH TO BE 48-INCH UNO.
4. WATERMAIN TIE-IN TO BE LIVE TAP IN ACCORDANCE WITH CITY DESIGN AND CONSTRUCTION STANDARDS 2-030 AND 2-040.
5. EXISTING WATER WELLS TO BE DECOMMISSIONED PER DEPT. OF ECOLOGY GUIDELINES.

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SUNNYSIDE VILLAGE

3121 66th Ave NE
Marysville, WA 98270

LUA Submittal
August 19, 2022

NO.	DATE	DESCRIPTION

MARK DUANE DAVIES — STATE OF WASHINGTON — 21611 — REGISTERED PROFESSIONAL ENGINEER — 8-19-22

NOT FOR CONSTRUCTION

Architect Project No: 1819
Author:
Checker:

CIVIL SITE PLAN

C-1

Plotted: Aug 19, 2022 - 3:42:49pm By: jeffc
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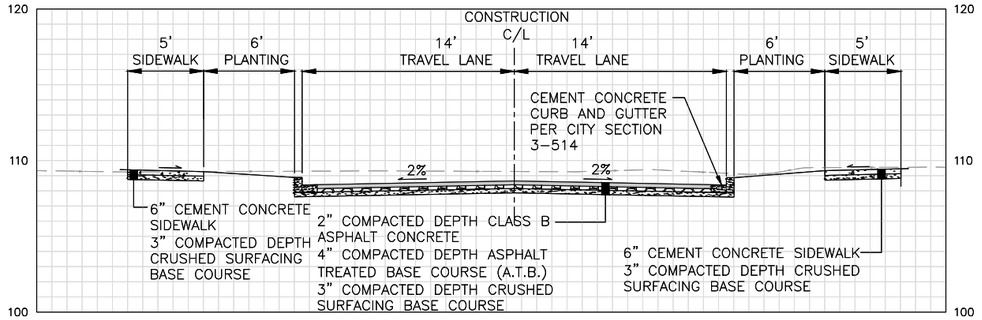
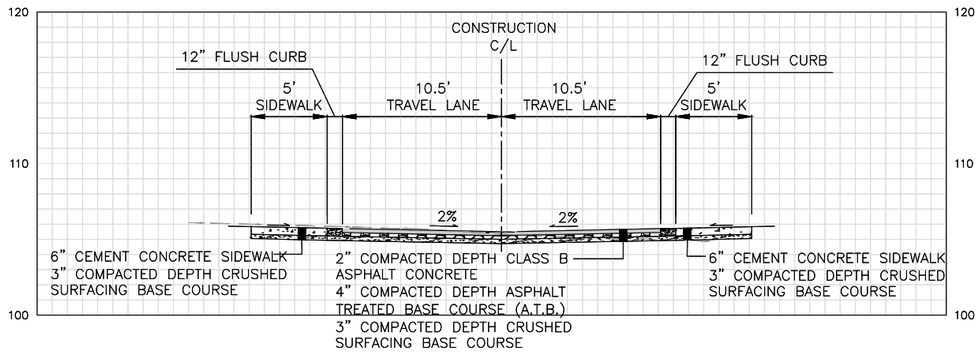
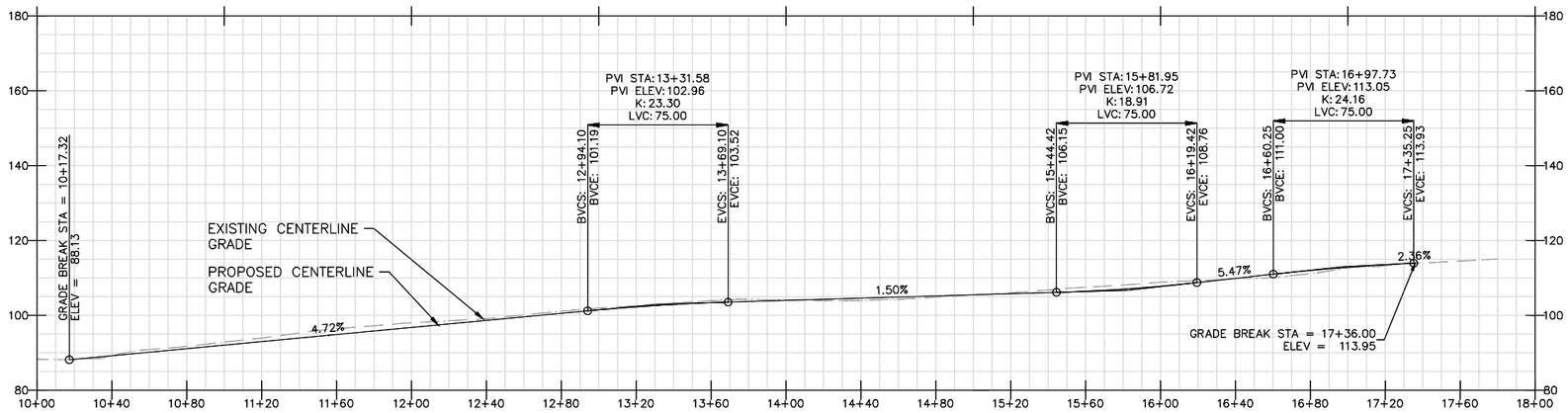
66TH AVE TYPICAL SECTION



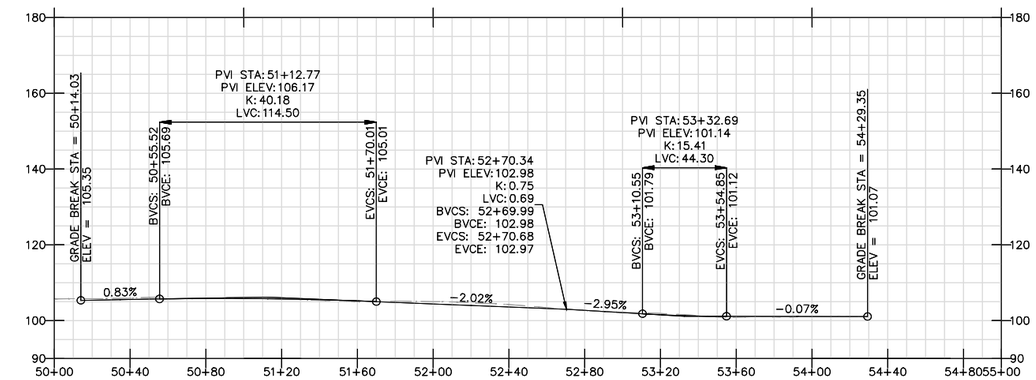
PRIVATE ROAD TYPICAL SECTION

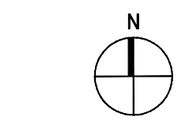


66th Ave NE



PRIVATE ROAD





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STATE OF WASHINGTON
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8/19/22

NOT FOR CONSTRUCTION

Architect Project No: 1819
Author:
Checker:

TYPICAL SECTIONS AND ROADWAY PROFILES

C-2

Plotted: Aug 19, 2022 - 3:43:05pm By jeff
File: Z:\shared\seattle - pioneer\1_Projects\15106\15170 Sunnyside Cohousing\CAD\Current\15170 SUN-C2-Sheet.dwg Layout: Layout1

APPENDIX C

Geotechnical Report

Geotechnical Engineering Services

Sunnyside Village Cohousing Development
Marysville, Washington

for
Sunnyside Village Cohousing
c/o Urban Evolution, LLC

December 23, 2020

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Services

Sunnyside Village Cohousing Development
Marysville, Washington

for
Sunnyside Village Cohousing
c/o Urban Evolution, LLC

December 23, 2020

GeoEngineers

17425 NE Union Hill Road, Suite 250
Redmond, Washington 98052
425.861.6000

Geotechnical Engineering Services

Sunnyside Village Cohousing Development
Marysville, Washington

File No. 24145-001-00

December 23, 2020

Prepared for:

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c/o Urban Evolution, LLC
911 East Pike Street, Suite 310
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Attention: Julie Howe

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Robert C. Metcalfe, PE, LEG
Principal

CWM:RCM:mce

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LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services for use in design of the proposed Sunnyside Village Cohousing project located in Marysville, Washington. The proposed project site is shown relative to surrounding physical features in the Vicinity Map, Figure 1, and the Site Plan, Figure 2.

1.1. Project Description

We understand that the 4.75-acre property located at 3121 66th Avenue NE is being planned to be developed with 30 to 34 cottages, each of which will be around 700 to 1,200 square feet in size. The existing house on the property will remain and be used as the common house for the community. We also understand the project team is in the process of changing the layout design of the community.

The cottages are planned to be supported on conventional shallow spread foundations and there will be no below-grade structures as part of the development. Associated improvements for the project consist of sidewalks/hardscape, parking stalls and access drive lanes, landscaping and community gardens, and new underground utility construction.

1.2. Purpose and Scope

The purpose of our geotechnical services is to evaluate soil and groundwater conditions as a basis for developing geotechnical design criteria for the proposed development. Field explorations and laboratory testing were performed to identify and evaluate subsurface conditions at the site to develop engineering recommendations for use in design of the project. Our services were completed in general accordance with our proposal dated September 30, 2019.

2.0 FIELD EXPLORATIONS AND LABORATORY TESTING

2.1. Field Explorations

Subsurface conditions were evaluated through a field exploration program that consisted of excavating and sampling 11 test pits and completing one hand auger. The test pits and hand auger were completed on January 27, 2020. The test pits were completed using a rubber-tired backhoe subcontracted to GeoEngineers. The hand auger was completed using a 3-inch-diameter manually operated hand auger. The approximate locations of the explorations are shown on Figure 2.

The test pits, designated TP-1 through TP-11, were completed to depths ranging from 3 to 6.5 feet below the existing ground surface. The hand auger, designated HA-1, was completed to a depth of 2.5 feet below the existing ground surface before practical refusal was met. Locations of the explorations were determined in the field by using a hand-held global positioning system (GPS) unit. Elevations at the exploration locations were interpolated from the site survey developed by Metron and Associates in November 2019. The respective ground surface elevations are shown on the exploration logs in Appendix A. Appendix A includes logs of the test pits and hand auger (Figures A-2 through A-13) and details of the subsurface explorations performed.

2.2. Laboratory Testing

Soil samples obtained from the explorations were transported to GeoEngineers' laboratory and evaluated to confirm or modify field classifications, as well as to evaluate engineering properties of the soil. Representative samples were selected for laboratory testing consisting of moisture content and fines content (material passing the U.S. No. 200 sieve). The tests were performed in general accordance with test methods of the American Society for Testing and Materials (ASTM) and other applicable procedures. A description of the laboratory testing and the test results are presented in Appendix B.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The site is generally rectangular in shape and is bounded by 66th Avenue NE and a stormwater detention pond to the north, and existing properties to the east, south and west. The site is currently occupied by a single-story family house (to be used as the community house), detached one car garage and an associated storage shed. All of these structures are situated near the middle of the site. Two small gardens are located on the west and north sides of the site. A small "A-Frame" structure covered in plastic is present directly west of the northern garden. Various other amenities such as an old swing set structure, picnic tables, play-frame structures, etc. are located around the site.

Site grades slope down gently to the south, from approximate Elevation 112 feet at the north end of the site to approximately Elevation 99 feet at the south end of the site. A majority of the site is covered in grass, with the exception of the southeast corner of the site where recent clearing work has left exposed soil and blackberry bushes. A large debris pile consisting of cleared trees, logs and vegetation is located in the southeast corner of the site. Small and large coniferous and deciduous trees border the site and surround the single-story family house. Gravel driveways run from the north (off 66th Avenue NE) and west sides of the site and meet near the front of the single car garage. An overhead power line runs from the southeast corner of the site to the garage. An underground waterline follows the east-west running driveway before turning north under the garage and feeding into the house. We also understand a septic system exists east of the existing house.

3.2. Geology

Published geologic information for the project vicinity includes a United States Geological Survey (USGS) map of the Marysville Quadrangle, Snohomish County, Washington (USGS 1985). Mapped soils in the immediate project vicinity consist of glacially consolidated Vashon Till deposits (glacial till). Older alluvium deposits are mapped southeast of the site.

Glacial till is generally a non-sorted, non-stratified mixture of sand, gravel and silt that has been overridden by several thousand feet of ice. It typically has high shear strength, low consolidation and low permeability characteristics in the undisturbed state. It typically develops a "weathered" zone where seasonal groundwater perches on top of the relatively impermeable unweathered till and the perched groundwater occurs as seepage following the site topography.

The older alluvium deposits generally consist of stratified sand and gravel deposited by streams flowing from the uplands to the east. These deposits lie at the bases of the slopes along the east and west sides of the broad Marysville valley.

3.3. Subsurface Conditions

3.3.1. Soil Conditions

Fill associated with past grading activities and native glacial till deposits were encountered below existing grades in the explorations completed at the site. Our observations included the following.

3.3.1.1. Sod and Topsoil

Approximately 1 to 6 inches of sod and topsoil was observed in the explorations completed at the site. The sod and topsoil consist of a matrix of grass, silty soil, roots and organic material.

3.3.1.2. Fill/Weathered Glacial Till Soils

Fill and/or weathered glacial till was observed below the sod and topsoil. These soils generally consist of medium dense to dense/medium stiff to very stiff silty fine to medium sand/sandy silt with varying amounts of gravel and roots with occasional organic matter. The fill and weathered glacial till thickness ranges from approximately 2 to 3.5 feet below existing site grades. These soils may consist of reworked glacially consolidated soils (fill) that were graded during the original site development or weathered glacially consolidated soils, and the distinction between the soils is difficult.

3.3.1.3. Glacial Till

Relatively unweathered glacial till was encountered below the fill and weathered till in all of the test pits completed at the site. The glacial till extended to the depths explored. The relatively unweathered glacial till generally consists of dense to very dense silty sand with variable gravel and cobble content. The transition from the unweathered glacial till and the overlying weathered glacial till is difficult to distinguish in most areas.

Although not encountered in our explorations, boulders are common in glacially consolidated soils and should be anticipated during construction.

3.3.2. Groundwater Conditions

Shallow perched groundwater seepage was encountered in a majority of the explorations completed at the site. Seepage flow rates on the order of 0.5 to 2 gallons per minute (gpm) were noted during excavation activities. The groundwater seepage was generally perched on top of the dense glacial till deposits within the fill and weathered glacial till. The perched groundwater is expected to vary as a function of season, precipitation and other factors.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our subsurface exploration program, geotechnical laboratory testing, analyses and experience on other similar projects, we conclude that the proposed Sunnyside Village Cohousing project can be constructed satisfactorily as planned with respect to geotechnical elements. The primary geotechnical considerations for the project are summarized below:

- The site is classified as Site Class C, in accordance with the 2018 International Building Code (IBC).
- Shallow foundations can be constructed on the glacially consolidated soils. Allowable bearing pressures of 3,000 pounds per square foot (psf) may be used for footings bearing on native undisturbed medium dense to very dense glacial till. An allowable bearing pressure of 3,000 psf may also be used where

imported structural fill is placed below footings, if needed, that extends to the native glacially consolidated soils.

- Conventional slabs-on-grade are considered appropriate and should be underlain by a 4-inch-thick layer of capillary break consisting of clean crushed rock with negligible fines and sand content.
- The on-site soils generally contain a high percentage of fines (silt and clay) ranging from 14 to 34 percent, based on our laboratory tests, and are highly moisture sensitive. Therefore, reuse of on-site soils should only be planned in the normal dry season (June through September).
- We anticipate that long-term design infiltration rates will be less than 0.2 inches per hour within the native glacial till. On-site infiltration testing will be needed if infiltration facilities are planned as part of the project.

These geotechnical considerations are discussed in greater detail, and conclusions and recommendations for the geotechnical aspects of the project are presented in the following report sections.

4.1. Earthquake Engineering

4.1.1. Seismicity

The Puget Sound area is located near the convergent continental boundary known as the Cascadia Subduction Zone (CSZ), which extends from mid-Vancouver Island to Northern California. The CSZ is the zone where the westward advancing North American Plate is overriding the subducting Juan de Fuca Plate. The interaction of these two plates results in two potential seismic source zones: (1) the Benioff source zone and (2) the CSZ interplate source zone. A third seismic source zone, referred to as the shallow crustal source zone, is associated with the north-south compression resulting from northerly movement of the Sierra Nevada block of the North American Plate.

Shallow crustal earthquakes occur within the North American Plate to depths up to 15 miles. Shallow earthquakes in the Puget Sound region are expected to have durations ranging up to 60 seconds. Four magnitude 7 (or greater) known shallow crustal earthquakes have occurred in the last 1,100 years in the Cascadia region; two of these occurred on Vancouver Island and two in Western Washington. The northeast-southwest trending Southern Whidbey Island fault zone is mapped approximately 9 miles southwest of the site.

The Benioff zone is characterized as being capable of generating earthquakes up to magnitude (M) 7.5. The Olympia 1949 (M = 7.1), the Seattle 1965 (M = 6.5) and the Nisqually 2001 (M = 6.8) earthquakes are considered to be Benioff zone earthquakes. The recurrence interval for large earthquakes originating from the Benioff source zone is believed to be shorter than for the shallow crustal and CSZ source zones; on average, damaging Benioff zone earthquakes in Western Washington occur every 30 years or so.

The CSZ is considered as being capable of generating earthquakes of magnitudes 8 to 9. No earthquakes on the CSZ have been instrumentally recorded; however, through the geologic record and historical records of tsunamis in Japan, it is believed that the most recent CSZ event occurred in the year 1700. Recurrence intervals for CSZ interplate earthquakes are thought to be on the order of 400 to 600 years.

4.1.2. Seismic Hazards

We evaluated the site for seismic hazards including liquefaction, lateral spreading and fault rupture. Our evaluation indicates the site does not have liquefiable soils present and therefore, also has little to no risk of liquefaction-induced ground disturbance, including lateral spreading. There are no mapped faults in the immediate vicinity of the site, with the exception of the Southern Whidbey Island fault zone mapped approximately 9 miles southwest of the site. Our opinion is that there is a low risk of fault displacement resulting in ground rupture at the surface.

4.1.3. 2018 IBC Seismic Design Information

We recommend the use of the 2018 IBC parameters listed in Table 1 for soil profile type, short period spectral response acceleration (S_S), 1-second period spectral response acceleration (S_1) and seismic coefficients (F_A and F_V) for the project site.

TABLE 1. 2018 IBC PARAMTERS

2018 IBC Parameter	Recommended Value
Soil Profile Type	C
Mapped MCE_R Spectral Response Acceleration at Short Period, S_s (g)	1.123
Mapped MCE_R Spectral Response Acceleration at 1-second period, S_1 (g)	0.399
Short Period Site Coefficient, F_a	1.2
Long Period Site Coefficient, F_v	1.5

4.2. Shallow Foundations

We recommend that the proposed buildings be supported on shallow spread footings founded on the medium dense to very dense glacial till encountered in our explorations. Shallow spread footings may also be supported on properly compacted structural fill extending down to the medium dense to very dense glacial till. Existing fill and unsuitable weathered glacial soils should be removed from under the planned buildings foundations.

For shallow foundation support, we recommend widths of at least 18 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed buildings. The design frost depth in the Puget Sound area is 12 inches; therefore, we recommend that exterior footings for the buildings be founded at least 18 inches below lowest adjacent finished grade. Interior footings should be founded at least 12 inches below bottom of slab or adjacent finished grade.

The following recommendations for the building foundations are based on the subsurface conditions observed in the explorations.

4.2.1. Allowable Bearing Pressures

Unsuitable soils consisting of fill, topsoil and/or highly weathered glacial soils will vary across the site and must be removed from below planned footings. Based on our explorations, these unsuitable soils range from approximately 2 to 3.5 feet below existing site grades. Therefore, depending on the foundation

locations and design elevations, up to 2 feet of overexcavation under the footings may be necessary. We recommend the following:

- **Shallow Foundations on Medium Dense Glacial Till:** For foundations extending to and bearing on competent undisturbed medium dense to very dense native glacial till, foundations may be designed using an allowable soil bearing pressure of 3,000 psf for isolated spread footings and continuous footings.
- **Shallow Foundations on Structural Fill:** For foundations bearing on properly placed and compacted structural fill extending down to medium dense to very dense glacial soils, foundations may be designed using an allowable soil bearing pressure of 3,000 psf for isolated spread footings and continuous footings.

The allowable bearing pressures presented above apply to the total dead and long-term live loads and may be increased up to one-third for short-term live loads such as wind or seismic forces.

Overexcavated areas below building foundations should be backfilled with structural fill consisting of imported gravel borrow where 3,000 psf is used. Where structural fill is placed below footings, the fill should extend beyond the edges of the foundations by the depth of the overexcavation.

4.2.2. Settlement

Post-construction settlement of shallow footings supported on native soils or on properly compacted structural fill as recommended above should be limited to less than 1 inch, and differential settlement between comparably loaded column footings or along a 25-foot section of continuous wall footing should be less than ½ inch. We expect most of the footing settlements will occur as loads are applied. Loose or disturbed soils not removed from footing excavations prior to placing concrete will result in additional settlement.

4.2.3. Lateral Resistance

Lateral foundation loads may be resisted by passive resistance on the sides of the footings and by friction on the base of the footings. Frictional resistance may be computed using a coefficient of friction of 0.4 applied to vertical dead-load forces. Passive resistance may be computed using an equivalent fluid density of 350 pounds per cubic foot (pcf). The allowable passive resistance is for horizontal soil conditions in front of the footing and is applicable, provided that the footings are surrounded by structural fill or constructed neat against native glacial soils. The structural fill should be compacted to at least 95 percent of the maximum dry density (MDD) determined in accordance with ASTM D 1557. Passive pressure resistance should be calculated from the bottom of adjacent floor slabs or below a depth of 1 foot, where the adjacent area is unprotected, as appropriate. The allowable frictional resistance and passive resistance values presented above include a factor of safety of about 1.5.

If soils adjacent to footings are disturbed during construction, the disturbed soils must be recompacted, otherwise the lateral passive resistance value must be reduced.

4.2.4. Footing Drains

We recommend perimeter footing drains be installed around the proposed buildings. The perimeter drains should be installed at the base of the exterior footings. The perimeter drains should consist of at least

4-inch-diameter perforated pipe placed on a 4-inch bed of, and surrounded by, 6 inches of drainage material enclosed in a nonwoven geotextile filter fabric such as Mirafi 140N (or approved equivalent). The perimeter drains should be provided with cleanouts. The footing drainpipe should be installed at least 18 inches below the top of the adjacent floor slab. The drainage material should consist of "Gravel Backfill for Drains" per Section 9-03.12(4) of the 2020 Washington State Department of Transportation (WSDOT) Standard Specifications. We recommend the drainpipe consist of either heavy-wall solid pipe (SDR-35 PVC, or equal) or rigid corrugated smooth interior polyethylene pipe (ADS N-12, or equal). We recommend against using flexible tubing for footing drainpipes. The perimeter drains should be sloped to drain by gravity, if practicable, to a suitable discharge point, preferably a storm drain. We recommend the cleanouts be covered and placed in flush mounted utility boxes. Water collected in roof downspout lines must not be routed to the footing drain lines.

4.2.5. Construction Considerations

We recommend that the excavations for the footings be completed with an excavator equipped with a smooth-edge bucket to minimize subgrade disturbance. Immediately prior to placing concrete, all debris and loose soils that accumulated in the footing excavations during forming and steel placement must be removed. Debris or loose soils not removed from the footing excavations will result in increased settlement.

If wet weather construction is planned, we recommend that all footing subgrades be protected using a lean concrete mud mat or 2-inch layer of clean crushed gravel. The mud mat or gravel layer should be placed the same day that the footing subgrade is excavated and approved for foundation support.

4.3. Slab-on-Grade Floors

4.3.1. Subgrade Preparation

We recommend that concrete slabs-on-grade be constructed on a gravel layer to provide uniform support and drainage, and to act as a capillary break. We expect that slab-on-grade floors can be supported on: (1) medium dense to very dense native glacial soils encountered in our explorations, or (2) properly compacted structural fill extending down to these materials, or (3) suitable on-site soils. Prior to placing the gravel layer, the subgrade should be proof-rolled, as described in Section 4.4. The exposed subgrade should be evaluated during construction and compacted to a firm and unyielding condition, although unsuitable soils should be removed and replaced with structural fill, where needed.

4.3.2. Design Parameters

A 4-inch-thick capillary break layer of 1-inch-minus clean crushed gravel with negligible sand and silt (WSDOT 9-03.1(4)C, Grading No. 67) should be placed to provide uniform support and form a capillary break beneath the slabs. For slabs designed as a beam on an elastic foundation, a modulus of subgrade reaction of 75 pounds per cubic inch (pci) may be used for subgrade soils, prepared as recommended above. This value assumes the slabs are bearing directly on structural fill placed over medium dense to dense native glacial soils and will require evaluation during construction.

If water vapor migration through the slabs is objectionable, the capillary break gravel layer should be covered with heavy plastic sheeting at least 10-mil thick to act as a vapor retarder. This will be desirable where the slabs are in occupied spaces or will be surfaced with tile or will be carpeted. It may also be prudent to apply a sealer to the slab to further retard the migration of moisture through the floor.

The contractor should be made responsible for maintaining the integrity of the vapor barrier during construction. Additional water proofing measures that may be needed should be evaluated during design.

4.4. Earthwork

4.4.1. Excavation Considerations

Planned final site grades may be close to the existing grades. Based on the subsurface soil conditions encountered in our explorations, we expect the soils at the site may be excavated using conventional heavy-duty construction equipment. Dense to very dense glacial till can be difficult to excavate. Glacial deposits in the area commonly contain cobbles and boulders that may be encountered during excavation. Accordingly, the contractor should be prepared to deal with cobbles and boulders.

The fill and native soils contain sufficient fines (material passing the U.S. Standard No. 200 sieve) to be highly moisture-sensitive and susceptible to disturbance, especially when wet. Ideally, earthwork should be undertaken during extended periods of dry weather (June through September) when the surficial soils will be less susceptible to disturbance and provide better support for construction equipment. Dry weather construction will help reduce earthwork costs and increase the potential for using the native soils as structural fill.

Trafficability on the site is not expected to be difficult during dry weather conditions. However, the native soils will be susceptible to disturbance from construction equipment during wet weather conditions and pumping and rutting of the exposed soils under equipment loads may occur and could potentially generate significant quantities of mud if not protected.

4.4.2. Clearing and Site Preparation

Construction of the planned buildings and associated site improvements will require demolition of utilities and significant clearing and stripping. We expect that there will be demolition of the existing underground utilities and septic system. Gravel from stripping of the driveway may be reused as backfill, provided it meets the requirements outlined in Section 4.4.5.

Areas to be developed or graded should be cleared of surface and subsurface deleterious matter including debris, shrubs, trees and associated stumps and roots greater than 1-inch diameter. Graded areas should be stripped of organic materials and topsoil. Based on our explorations and site observations, we estimate that stripping depths will be on the order of 2 to 6 inches to remove topsoil within existing landscape and lawn areas. Greater stripping depths will be needed in more densely vegetated areas and where large tree root systems exist.

The stripped organic soils can be stockpiled and used later for landscaping purposes or may be spread over disturbed areas following completion of grading. If spread out, the organic strippings should be placed in a layer less than 1-foot thick, should not be placed on slopes greater than 3H:1V (horizontal:vertical) and should be track-rolled to a uniformly compacted condition. Materials that cannot be used for landscaping or protection of disturbed areas should be removed from the project site.

4.4.3. Abandoning Utilities

The following recommendations apply to abandoning underground utility pipes at the site prior to vertical construction:

- All utility pipes greater than or equal to 8 inches in diameter and located below building areas may be left in place, provided they are fully grouted.
- All utilities less than 8 inches in diameter and located beneath building areas may be left in place, provided that they are capped and/or plugged with grout.
- Utility structures should be removed, and associated pipes capped/plugged to prevent the movement of groundwater.
- Utility pipes encountered outside of building areas during redevelopment activities should be plugged, capped, or removed to prevent movement of groundwater.

Abandoned utility lines under proposed buildings should be identified during construction and the existing trench backfill should be removed and replaced as follows:

- Utility pipes and existing trench backfill located below planned foundations should be removed entirely and be replaced with structural fill or lean concrete.
- Utility pipes and existing trench backfill located below planned floor slabs should be removed and recompacted to a depth of 3 feet below the bottom of the slab. The excavations should be backfilled with structural fill compacted to at least 95 percent of the MDD per ASTM D 1557 for floor slab areas and foundations designed for a maximum allowable bearing pressure of 3,000 psf.

4.4.4. Earthwork Subgrade Preparation

Prior to placing new fills, pavement base course materials or gravel below on-grade floor slabs, subgrade areas should be proof-rolled to locate any soft or pumping soils. Prior to proof-rolling, all unsuitable soils should be removed from below building footprints and new hardscape areas. Proof-rolling can be completed using a piece of heavy tire-mounted equipment, such as a loaded dump truck. During wet weather, the exposed subgrade areas should be probed to determine the extent of soft soils. If soft or pumping soils are observed, they should be removed and replaced with structural fill.

After completing the proof-rolling, the subgrade areas should be recompacted to a firm and unyielding condition, if possible. The degree of compaction that can be achieved will depend on when the construction is performed. If the work is performed during dry weather conditions, we recommend that all subgrade areas be recompacted to at least 95 percent of the MDD in accordance with the ASTM D 1557 test procedure (modified proctor). If the work is performed during wet weather conditions, it may not be possible to recompact the subgrade to 95 percent of the MDD. In this case, we recommend that the subgrade be compacted to the extent possible without causing undue weaving or pumping of the subgrade soils.

Subgrade disturbance or deterioration could occur if the subgrade is wet and cannot be dried. If the subgrade deteriorates during proof-rolling or compaction, it may become necessary to modify the proof-rolling or compaction criteria or methods.

4.4.4.1. Subgrade Protection

Site soils contain significant fines content (silt/clay) and will be highly sensitive and susceptible to moisture and equipment loads. Once stripping activities are complete, the exposed subgrade soils can deteriorate rapidly in wet weather and under equipment loads.

The contractor should take necessary measures to prevent site subgrade soils from becoming disturbed or unstable. Construction traffic during the wet season should be restricted to specific areas of the site, preferably areas that are protected with a thick gravel layer and are not susceptible to wet weather disturbance.

Protecting the existing soils with a thin layer of crushed rock will not be adequate during the wet season and the subgrade will still deteriorate under equipment loads. The contractor may also consider leaving subgrade areas about 12 inches higher in elevation until subgrade preparation work is ready in order to protect subgrade soils from deterioration.

4.4.5. Structural Fill

All fill, whether existing on-site soils or imported soil, that will support floor slabs, pavement areas or foundations, or be placed in utility trenches are classified as structural fill and should generally meet the criteria for structural fill presented below. The suitability of soil for use as structural fill depends on its gradation and moisture content.

4.4.5.1. Materials

Structural fill material quality varies, depending upon its use, as described below:

- Structural fill placed below foundations, floor slabs or as subbase material below pavement areas should meet the criteria for gravel borrow as described in Section 9-03.14(1) of the 2020 WSDOT Standard Specifications.
- Structural fill placed to raise site grades outside of building areas or to backfill utility trenches should meet the criteria for common borrow as described in Section 9-03.14(3) of the 2020 WSDOT Standard Specifications during dry weather conditions (typically June through September). Common borrow materials are highly moisture sensitive. For wet weather construction (October through May), structural fill placed to raise site grades or in utility trenches should meet the criteria for gravel borrow, as described in Section 9-03.14(1) of the 2020 WSDOT Standard Specifications, except that the fines content (material passing the US No. 200 sieve) should not exceed 5 percent.
- Structural fill placed as crushed surfacing base course (CSBC) below pavements should conform to Section 9 03.9(3) of the 2020 WSDOT Standard Specifications.
- Structural fill placed as capillary break below slabs should consist of 1-inch-minus clean crushed gravel with negligible sand or silt in conformance with Section 9-03.1(4)C, grading No. 67 of the 2020 WSDOT Standard Specifications.

4.4.5.2. Reuse of On-site Soils

Based on the samples collected from our explorations, the moisture content of the native glacial till is typically near the optimum moisture content for compaction. However, the soils are highly moisture sensitive and can be difficult to compact during periods of wet weather or if impacted by groundwater seepage. Therefore, we recommend that they be used as Common Borrow only during periods of extended dry weather from June through September. Soils with significant organic content (above 3 percent) should not be used as structural fill.

The moisture content of the fill soils encountered in our explorations are well above the optimum moisture content for compaction. In addition, the soils contain sufficient organic material and are not suitable for reuse as structural fill.

4.4.6. Fill Placement and Compaction Criteria

Structural fill should be mechanically compacted to a firm, non-yielding condition. Structural fill should be placed in loose lifts not exceeding 12 inches in thickness if using heavy compactors and 6 inches if using hand-operated compaction equipment. The actual lift thickness will be dependent on the structural fill material used and the type and size of compaction equipment. Each lift should be moisture-conditioned to within 2 percent of the optimum moisture content and compacted to the specified density before placing subsequent lifts. Compaction of all structural fill at the site should be in accordance with the ASTM D 1557 (modified proctor) test method. Structural fill should be compacted to the following criteria:

1. Structural fill placed below floor slabs and foundations, and against foundations, should be compacted to at least 95 percent of the MDD.
2. Structural fill in new pavement and hardscape areas, including utility trench backfill, should be compacted to at least 90 percent of the MDD, except that the upper 2 feet of fill below final subgrade should be compacted to at least 95 percent of the MDD, as shown in the Compaction Criteria for Trench Backfill, Figure 3.
3. Structural fill placed as crushed rock base course below pavements should be compacted to 95 percent of the MDD.
4. Non-structural fill, such as fill placed in landscape areas, should be compacted to at least 90 percent of the MDD.

4.4.7. Weather Considerations

The on-site soils and common borrow contain a sufficient percentage of fines (silt and clay) to be highly moisture sensitive. When the moisture content of these soils is more than a few percent above the optimum moisture content, these soils become muddy and unstable, operation of equipment on these soils will be difficult and it will be difficult or impossible to meet the required compaction criteria. Additionally, disturbance of near-surface soils should be expected if earthwork is completed during periods of wet weather. It will be preferable to schedule site preparation and earthwork activities during periods of dry weather when the soils will be less susceptible to disturbance and provide better support for construction equipment.

The wet weather season in the Puget Sound region generally begins in October and continues through May; however, periods of wet weather may occur during any month of the year. The optimum earthwork period for these types of soils is typically June through September. If wet weather earthwork is unavoidable, we recommend the following:

- Structural fill placed during the wet season or during periods of wet weather should consist of imported gravel borrow with less than 5 percent fines (material passing the U.S. No. 200 sieve).
- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area.
- The ground surface should be graded such that areas of ponded water do not develop.

- The contractor should take measures to prevent surface water from collecting in excavations and trenches.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting or similar means.
- Measures should be taken to prevent on-site soils and soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- The contractor should cover all soil stockpiles that will be used as structural fill with plastic sheeting.
- Construction and foot traffic should be restricted to specific areas of the site, preferably areas that are surfaced with materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.

4.4.8. Utility Trenches

Trench excavation, pipe bedding and trench backfilling should be completed using the general procedures described in the 2020 WSDOT Standard Specifications or other suitable procedures specified by the project civil engineer. The glacial deposits and fill soils encountered at the site are generally of low corrosivity, based on our experience in the Puget Sound area.

Utility trench backfill should consist of structural fill and should be placed in lifts of 12 inches or less (loose thickness) when using heavy compaction equipment or 6 inches or less when using hand-operated equipment, such that adequate compaction can be achieved throughout the lift. Each lift must be compacted prior to placing the subsequent lift. Prior to compaction, the backfill should be moisture-conditioned to within 2 percent of the optimum moisture content, if necessary. The backfill should be compacted in accordance with the criteria discussed above and as shown on Figure 3.

4.4.9. Pavement Subgrade Preparation

We recommend that the subgrade soils in new pavement areas be prepared and evaluated, as described in Sections 4.4.4 and 4.5. In cut areas in medium dense to very dense glacial till, we recommend that the exposed subgrade be proof-rolled. Where existing fill or loose to medium dense native soils exist, we recommend that the upper 12 inches of the existing site soils be compacted to at least 95 percent of the MDD per ASTM D 1557 and then proof-rolled prior to placing pavement section materials. If the subgrade soils are loose or soft, it may be necessary to excavate the soils and replace them with structural fill, gravel borrow or gravel base material. Based on our explorations, the subgrade soils are expected to consist of fill, weathered native soils and relatively unweathered glacial till. Pavement subgrade conditions should be observed and proof-rolled during construction to evaluate the presence of unsuitable subgrade soils and the need for overexcavation.

4.4.10. Excavations

Temporary open cut slopes will likely be used for underground utilities. The stability of open cut slopes is a function of soil type, groundwater seepage, slope inclination, slope height and nearby surface loads.

The use of inadequately designed open cuts could impact the stability of adjacent work areas, existing utilities and endanger personnel.

The contractor performing the work has the primary responsibility for the protection of workers and adjacent improvements. In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to variable soil and groundwater conditions. Therefore, the contractor should have the primary responsibility for deciding whether or not to use open cut slopes for much of the excavations rather than some form of temporary excavation support, and for establishing the safe inclination of the cut slope. Acceptable slope inclinations for utilities and ancillary excavations should be determined during construction. Because of the diversity of construction techniques and available shoring systems, the design of temporary shoring is most appropriately left up to the contractor proposing to complete the installation. Temporary cut slopes and shoring must comply with the provisions of Title 296 Washington Administration Code (WAC), Part N, "Excavation, Trenching and Shoring."

4.4.10.1. Temporary Slopes

For planning purposes, temporary unsupported cuts more than 4 feet high may be inclined at 1.5H:1V maximum steepness in the fill and weathered glacial soils. Steeper slopes, up to 1H:1V, are feasible for cuts made in the very dense glacial till. Flatter slopes may be necessary if seepage is present on the face of the cut slopes or if localized sloughing occurs.

The above guidelines assume that surface loads such as traffic, construction equipment, stockpiles or building supplies will be kept away from the top of the cut slopes a sufficient distance so that the stability of the excavation is not affected. We recommend that this distance be at least 5 feet from the top of the cut for temporary cuts made at 1.5H:1V or flatter, and no closer than a distance equal to one half the height of the slope for cuts made at 1H:1V.

Temporary cut slopes should be planned such that they do not encroach on a 1H:1V influence line projected down from the edges of nearby or planned foundation elements.

Water that enters the excavation must be collected and routed away from prepared subgrade areas. We expect that this may be accomplished by installing a system of drainage ditches and sumps along the toe of the cut slopes. Some sloughing and raveling of the cut slopes should be expected. Temporary covering, such as heavy plastic sheeting with appropriate ballast, should be used to protect these slopes during periods of wet weather. Surface water runoff from above cut slopes should be prevented from flowing over the slope face by using berms, drainage ditches, swales or other appropriate methods.

If temporary cut slopes experience excessive sloughing or raveling during construction, it may become necessary to modify the cut slopes to maintain safe working conditions. Slopes experiencing problems can be flattened, regraded to add intermediate slope benches, or additional dewatering can be provided if the poor slope performance is related to groundwater seepage.

4.4.11. Permanent Slopes

We recommend that permanent cut or fill slopes be constructed at inclinations of 2H:1V or flatter. To achieve uniform compaction, we recommend that fill slopes be overbuilt at least 2 feet and subsequently cut back to expose properly compacted fill. Permanent slopes constructed at 3H:1V or flatter provide better conditions for future maintenance.

To reduce erosion, newly constructed slopes should be planted or hydroseeded shortly after completion of grading. Until the vegetation is established, some sloughing and raveling of the slopes should be expected. This may require localized repairs and reseeding. Temporary covering, such as clear heavy plastic sheeting, jute fabric, loose straw or erosion control blankets (such as American Excelsior Curlex 1 or North American Green SC150) could be used to protect the slopes during periods of rainfall.

4.4.12. Sedimentation and Erosion Control

In our opinion, the erosion potential of the on-site soils is low to moderate. Construction activities including stripping and grading will expose soils to the erosion effects of wind and water. The amount and potential impacts of erosion are partly related to the time of year that construction actually occurs. Wet weather construction will increase the amount and extent of erosion and potential sedimentation.

Erosion and sedimentation control measures may be implemented by using a combination of interceptor swales, straw bale barriers, silt fences and straw mulch for temporary erosion protection of exposed soils. All disturbed areas should be finish graded and seeded as soon as practicable to reduce the risk of erosion. Erosion and sedimentation control measures should be installed and maintained in accordance with the requirements of the City of Marysville.

4.5. Pavement Recommendations

4.5.1. Subgrade Preparation

We recommend the subgrade soils in new pavement areas be prepared and evaluated, as described in Section 4.4.4. All new pavement and hardscape areas should be supported on subgrade soils that have been proof-rolled or probed, and approved by the geotechnical engineer. If the exposed subgrade soils are loose or soft, it may be necessary to excavate localized areas and replace them with structural fill or gravel base course. Pavement subgrade conditions should be observed during construction and prior to placing the base course materials in order to evaluate the presence of zones of unsuitable subgrade soils and the need for overexcavation and replacement of these zones.

4.5.2. New Hot-Mix Asphalt Pavement

In light-duty pavement areas (e.g., automobile parking), we recommend a pavement section consisting of at least a 2-inch thickness of ½-inch hot-mix asphalt (HMA) (PG 58-22) per WSDOT Sections 5-04 and 9-03, over a 4-inch thickness of densely compacted crushed rock base course per WSDOT Section 9-03.9(3). In heavy-duty pavement areas (e.g., main access drive), we recommend a pavement section consisting of at least a 3-inch thickness of ½-inch HMA (PG 58-22) over a 6-inch thickness of densely compacted crushed rock base course. The base course should be compacted to at least 95 percent of the MDD (ASTM D 1557). We recommend that a proof-roll of the compacted base course be observed by the geotechnical engineer of record prior to paving. Soft or yielding areas observed during proof-rolling may require overexcavation and replacement with compacted structural fill.

The pavement sections recommended above are based on our experience. Thicker asphalt sections may be needed. based on the City of Marysville requirements or based on actual traffic data.

4.5.3. Asphalt-Treated Base

If pavements are constructed during the wet seasons, consideration may be given to covering the areas to be paved with asphalt-treated base (ATB) for protection. Light-duty pavement areas should be surfaced with

at least 3 inches of ATB, and heavy-duty pavement areas should be surfaced with at least 6 inches of ATB. Prior to placement of the final pavement sections, we recommend the ATB surface be evaluated and areas of ATB pavement failure be removed, and the subgrade repaired. If ATB is used and is serviceable when final pavements are constructed, the CSBC can be eliminated, and the design portland cement concrete (PCC) or asphalt concrete pavement thickness can be placed directly over the ATB. The contractor may need to increase the thickness of these recommended ATB sections, based on planned heavy equipment and construction traffic loading.

4.6. Drainage Considerations

The contractor should anticipate shallow perched groundwater conditions may develop and seepage may enter excavations, depending on the time of year construction takes place, especially in the spring and winter months. However, we expect this seepage water can be handled by digging interceptor trenches in the excavations and pumping from sumps. The seepage water if not intercepted and removed from the excavations will make it difficult to place and compact structural fill and may destabilize cut slopes.

All paved and landscaped areas should be graded so surface drainage is directed away from the buildings to appropriate catch basins.

Water collected in roof downspout lines must not discharge into or be routed to the perforated pipes intended for footing or wall drainage.

4.7. Infiltration Considerations

Based on our analysis, it is our opinion that the on-site native glacial soils have a very low infiltration capacity. The majority of the soils across the site are composed of glacially consolidated, dense glacial till with a relatively high fines content, which limits the infiltration capacity. The results of laboratory testing consisting of percent fines tests indicated that the fines content (material passing the U.S. No. 200 sieve) typically ranges from about 14 to 34 percent. Due to the density of the native glacial soils and relatively high fines content, infiltration should be assumed to be very low when designing infiltration systems. We recommend a preliminary long-term design infiltration rate of not more than 0.2 inches per hour be used for design of the infiltration facilities in the native glacial soils.

If infiltration facilities will be used for this project, we recommend that in-situ testing, such as pilot infiltration tests (PIT), be completed in accordance with the governing jurisdictional requirements to more accurately determine the infiltration capacity of the soil.

5.0 RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

Throughout this report, recommendations are provided where we consider additional geotechnical services to be appropriate. These additional services are summarized below:

- GeoEngineers should be retained to provide additional recommendations for design of stormwater infiltration facilities, including performing pilot infiltration testing, if infiltration is being considered at the site.
- GeoEngineers should be retained to review the project plans and specifications when complete to confirm that our design recommendations have been implemented as intended.

- During construction, GeoEngineers should observe and evaluate the suitability of foundation subgrades, observe removal of unsuitable soils, evaluate the suitability of floor slab and pavement subgrades, observe installation of subsurface drainage measures including footing drains, observe and test structural backfill including trench backfill, and provide a summary letter of our construction observation services. The purposes of GeoEngineers construction phase services are to confirm that the subsurface conditions are consistent with those observed in the explorations and other reasons described in Appendix C, Report Limitations and Guidelines for Use.

6.0 LIMITATIONS

We have prepared this report for the exclusive use of Sunnyside Village Cohousing, Urban Evolution, and their authorized agents for the planned Sunnyside Village Cohousing project in Marysville, Washington. The data and report should be provided to prospective contractors for the bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

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

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

Please refer to Appendix C for additional information pertaining to use of this report.

7.0 REFERENCES

ASCE 7-16, 2016, "Minimum design loads for buildings and other structures."

International Code Council, "International Building Code," 2018.

United States Geological Survey map of the Marysville quadrangle, Snohomish County, Washington, 1985.

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Washington State Department of Ecology, "Stormwater Management in Western Washington, Volume III, Hydrologic Analysis and Flow Control Design/BMPs," December 2014.

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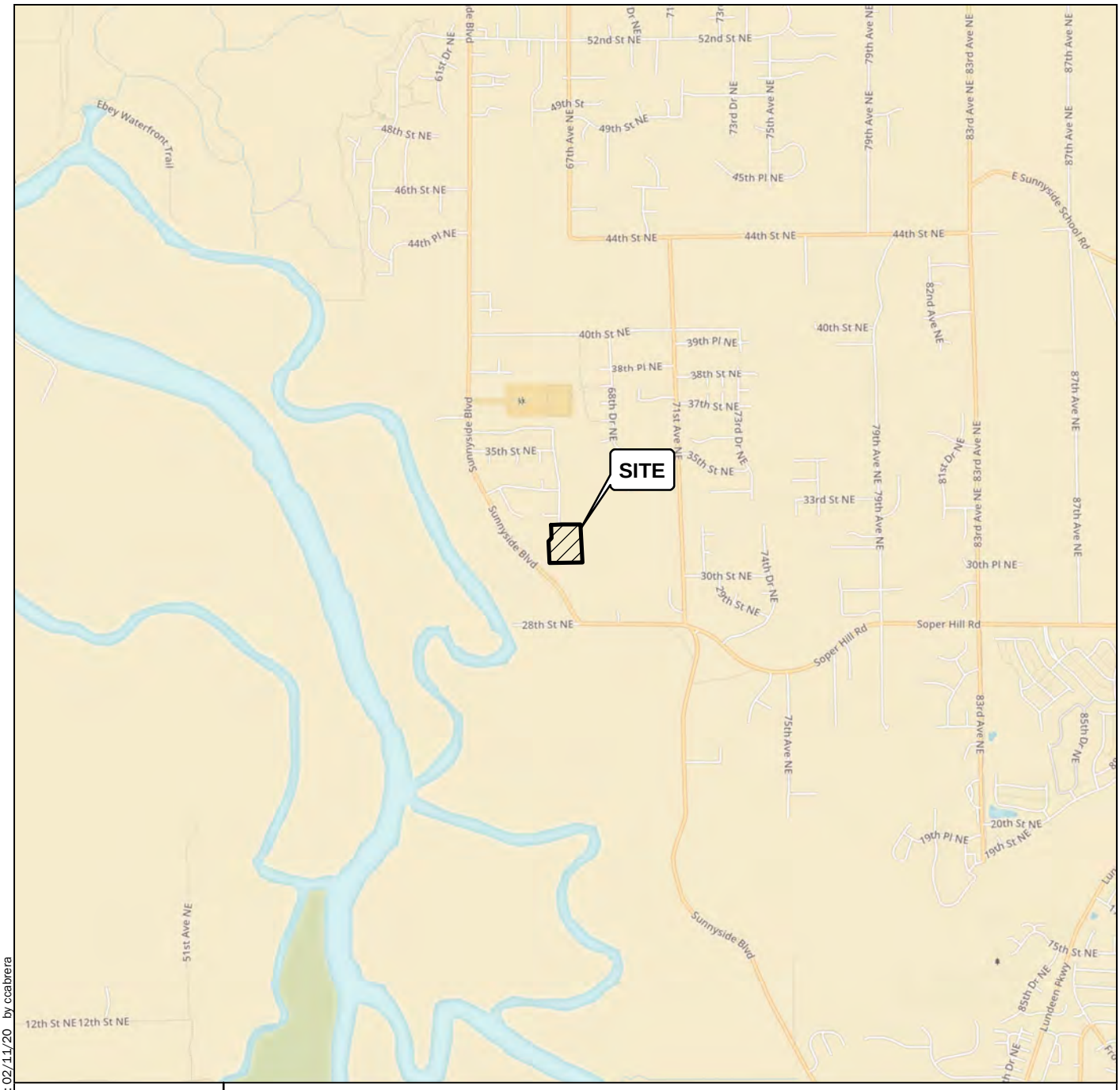
FIGURES

GeoEngineers



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Vicinity Map

Sunnyside Village Cohousing
Marysville, Washington

GeoEngineers

Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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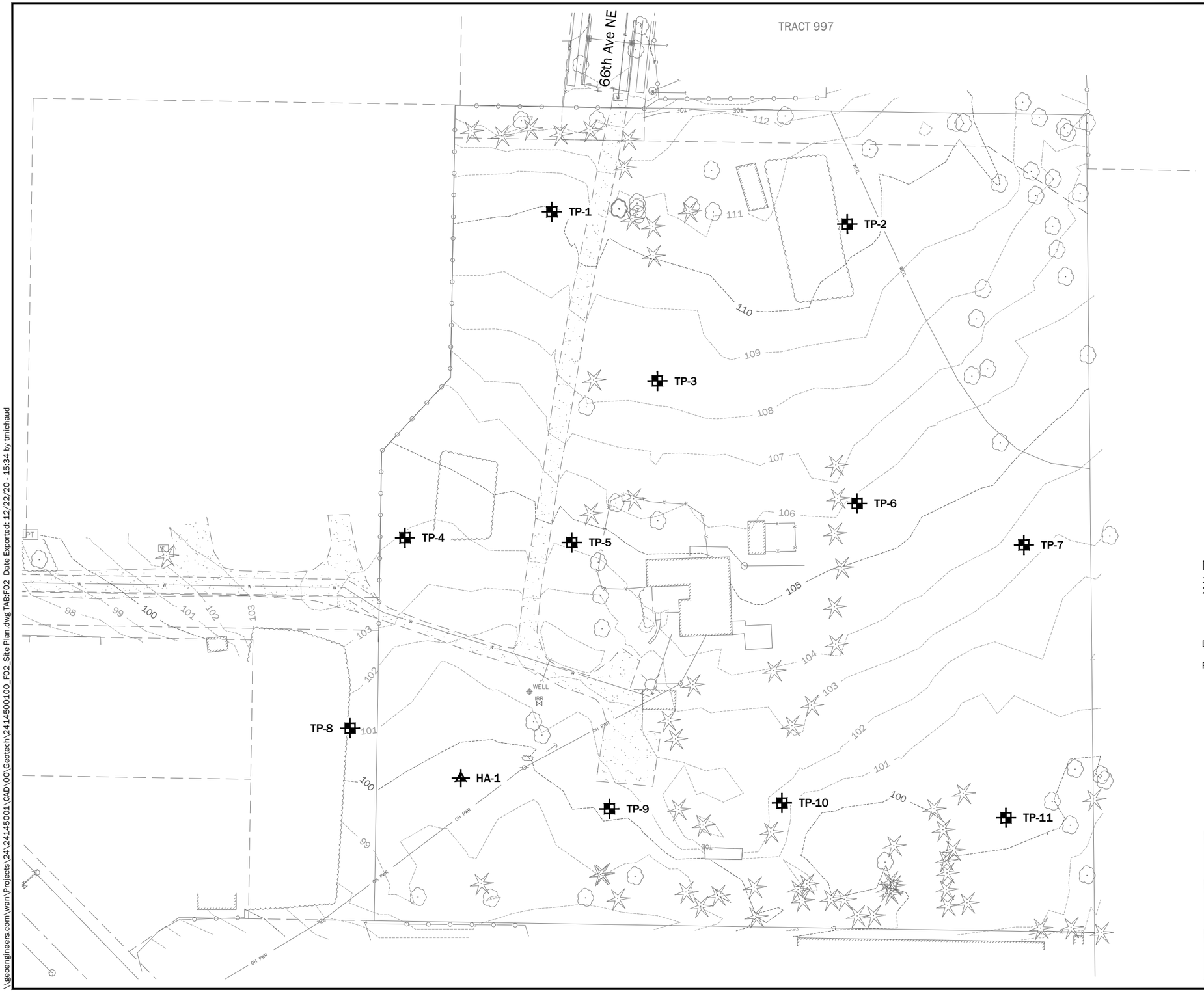

Legend

TP-1 Test Pit by GeoEngineers, Inc., 2020

HA-1 Hand Augur by GeoEngineers, Inc., 2020

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Survey from Metron and Associates dated November 2019.

Projection: NAD83 Washington State Planes, North Zone, US Foot

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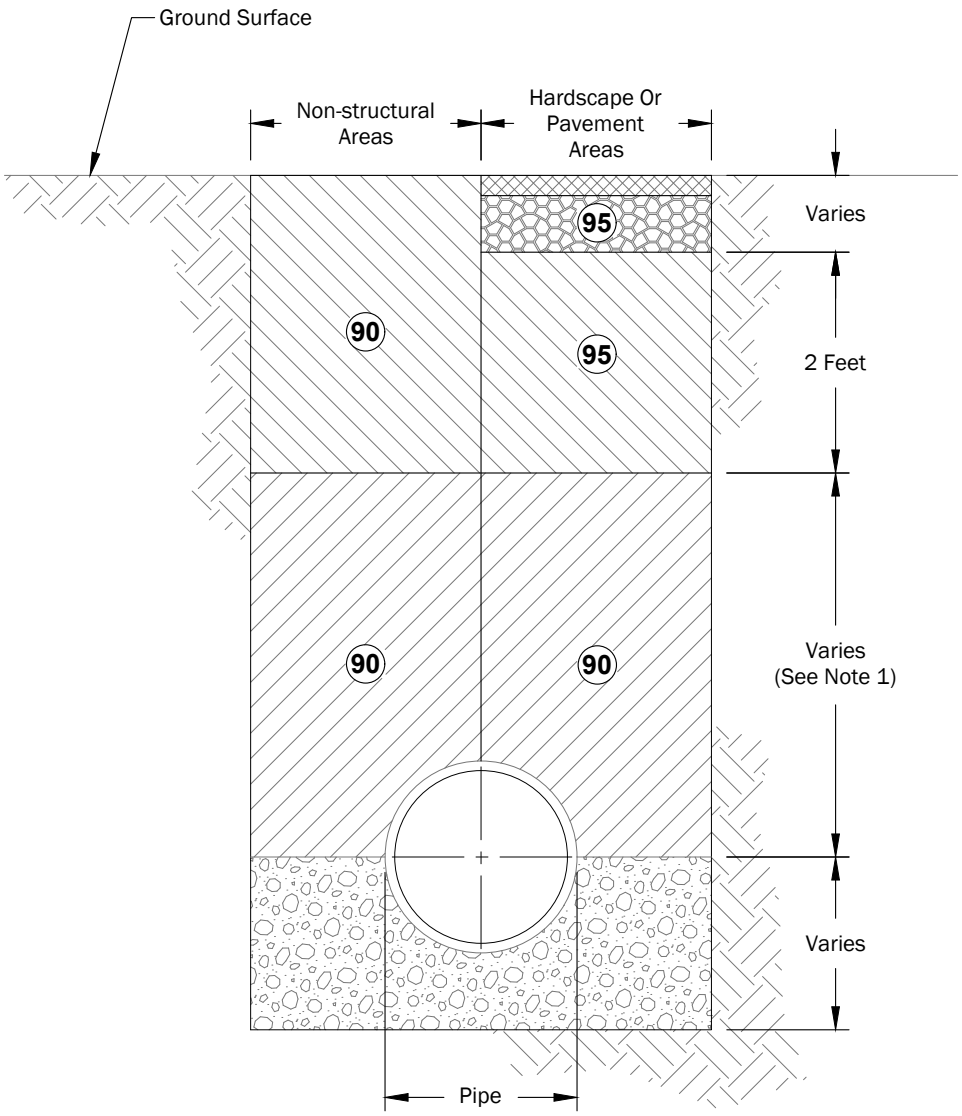
Site Plan

Sunnyside Village Cohousing
Marysville, Washington

GeoEngineers

Figure 2



Not To Scale

Legend

95	Recommended Compaction as a Percentage of Maximum Dry Density, by Test Method ASTM D1557 (Modified Proctor)
	Concrete or Asphalt Pavement
	Base Course
	Trench Backfill
	Pipe Bedding

Notes:

1. All backfill under building areas should be compacted to at least 95 percent per ASTM D1557.

Compaction Criteria for Trench Backfill

Sunnyside Village Cohousing
Marysville, Washington

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Figure 3

APPENDICES

GeoEngineers

APPENDIX A
Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface soil and groundwater conditions were explored by excavating 11 test pits (TP-1 through TP-11) and completing one hand auger (HA-1) on January 27, 2020. The test pits were completed to depths ranging from 3 to 6.5 feet below existing grades. The hand auger was completed to a depth of 2.5 feet.

Test Pits

The test pits were completed using a rubber tire-mounted Komatsu WB 140 backhoe owned and operated by Kelly's Excavating under subcontract to GeoEngineers. The test pit locations were determined in the field using a hand-held GPS. The approximate test pit locations are shown on Figure 2. The test pits were continuously monitored by a geotechnical engineer from our firm who reviewed and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. Disturbed samples of representative soil types were obtained from the excavator bucket at representative depths before probing the bottom of the pit with a ½-inch-diameter steel probe rod to provide a measure of the relative density of granular soils and the relative consistency of cohesive soils. Soils encountered in the test pits were classified in the field in general accordance with ASTM International (ASTM) D 2488, the Standard Practice for Classification of Soils, Visual-Manual Procedure, which is summarized in Figure A-1, Key to Exploration Logs. Logs of the test pits are provided in Figures A-2 through A-12.

Hand Augers

A hand auger was continuously monitored by a geotechnical engineer from our firm who reviewed and classified the soils encountered, obtained representative soil samples and observed groundwater conditions. The hand auger location was determined in the field using a hand-held GPS and the approximate location is shown on Figure 2. The soils encountered were generally sampled at 1-foot vertical intervals with a 3-inch inside-diameter, manually-operated hand auger. Soils encountered were visually classified in general accordance with the classification system described in Figure A-1. A key to the hand auger log symbols is also presented in Figure A-1. A log of the hand auger is presented in Figure A-13.

The exploration logs are based on our interpretation of the field and laboratory data and indicate the various types of soils and groundwater conditions encountered. The logs also indicate the depths at which these soils or their characteristics change, although the change may actually be gradual.

Observations of groundwater conditions were made during the explorations. The groundwater conditions encountered during the explorations are presented on the exploration logs. Groundwater conditions observed during excavations represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site. Groundwater conditions observed during the explorations should be considered approximate.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Date Excavated	1/27/2020	Total Depth (ft)	6.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
See "Remarks" section for groundwater observed See "Remarks" section for caving observed					

Surface Elevation (ft) Vertical Datum	110 NAVD88	Easting (X) Northing (Y)	1320218 376686	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 5 inches
			1 MC		SM	Brown silty fine to medium sand with occasional gravel, small roots (loose to medium dense, moist) (fill)	31		
109	1		2 %F		SM	Brown silty fine to medium sand with gravel, small roots (loose to medium dense, moist to wet)	36	31	
			3		SM	Brown-gray silty fine to medium sand with gravel and occasional small roots (medium dense to dense, moist to wet) (weathered glacial till)			Moderate groundwater seepage observed at 20 inches, approximately 1 gpm Probe Depth = 3 to 4 inches
108	2								Probe Depth = 1 to 2 inches
107	3		4		ML	Gray brown sandy silt with gravel and occasional cobbles (very stiff, moist to wet) (glacial till)			Mild to moderate caving observed at 1½ to 2 feet Probe Depth = 1 to 2 inches
106	4		5		SM	Silty fine to coarse sand with gravel (medium dense, moist)			Probe Depth = 2 to 3 inches
105	5								
					SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist)			Probe Depth = 1 to 2 inches
104	6		6 MC				10		

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-2
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	4	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
See "Remarks" section for groundwater observed See "Remarks" section for caving observed					

Surface Elevation (ft) Vertical Datum	110 NAVD88	Easting (X) Northing (Y)	1320397 376678	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			
			1 MC		ML	Dark brown sandy silt with gravel, small roots (medium stiff to stiff, moist) (fill)	29		Probe Depth = 3 to 4 inches Probe Depth = 4 to 5 inches
109	1		2		SM	Dark brown silty fine to medium sand with occasional gravel, small roots (medium dense, moist to wet)			
108	2								Moderate groundwater seepage observed at 2 and 2½ feet, approximately 1 to 2 gpm; moderate caving observed at 2 to 2½ feet Probe Depth = 3 to 4 inches
107	3		3 %F		SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist) (glacial till)	11	30	Probe Depth = 1 to 2 inches
106	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-3
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) Vertical Datum	108 NAVD88	Easting (X) Northing (Y)	1320282 376583	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	1 to 2 inches sod			
			1 MC		ML	Dark brown sandy silt, small roots (soft to medium stiff, wet) (fill)	48		Probe Depth = 5 to 7 inches
107	1								Probe Depth = 4 to 5 inches
			2 MC		SM	Brown silty fine to medium sand with gravel, small roots (loose to medium dense, moist to wet)	26		Moderate groundwater seepage observed at 1½ to 2 feet, approximately 1 gpm; moderate caving observed at 1½ to 2 feet
106	2				SM	Gray silty fine to medium sand, moderate oxidation stains (medium dense, moist) (weathered glacial till)			Probe Depth = 2 to 4 inches
			3						
105	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-3

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-4
Sheet 1 of 1

Date Excavated 1/27/2020	Total Depth (ft) 3.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	Groundwater not observed Caving not observed
Surface Elevation (ft) 104 Vertical Datum NAVD88		Easting (X) 1320128 Northing (Y) 376487		Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 5 inches
			1		SM	Dark brown silty fine to medium sand, small roots (loose to medium dense, moist) (fill)			
103	1								Probe Depth3 to 5 inches
102	2		2 %F				41	31	Probe Depth = 2 to 3 inches
					SM	Gray silty fine to medium sand with gravel and cobbles (dense, moist) (glacial till)			
101	3		3 MC				10		Probe Depth = 1 to 2 inches; denser soil at 3 feet bgs

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-4

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-5
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) Vertical Datum	104 NAVD88	Easting (X) Northing (Y)	1320230 376484	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 4 to 5 inches
103	1		1 MC		SM	Dark brown silty fine to medium sand with occasional gravel, small roots (loose to medium dense, moist to wet) (fill)	41		Probe Depth = 3 to 4 inches; Moderate groundwater seepage observed at 1 to 2¼ feet, approximately 1 to 1½ gpm; Slight to moderate caving observed at 1 to 2¼ feet
102	2		2 MC		SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense to very dense, moist to wet) (glacial till)	26		Probe Depth = 2 to 3 inches
			3 MC				14		
101	3								Probe Depth = 1 inch

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-5

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-6
Sheet 1 of 1

Date Excavated 1/27/2020	Total Depth (ft) 3	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed
Surface Elevation (ft) 106 Vertical Datum NAVD88		Easting (X) 1320403 Northing (Y) 376508		Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
105	0		1 MC		SM	Dark brown silty fine sand with gravel and cobbles, small roots (loose to medium dense, moist) (fill)	20		Probe Depth = 4 to 5 inches
	1				ML	Brown sandy silt with occasional gravel, small roots (medium stiff to stiff, moist)			Probe Depth = 4 to 5 inches Moderate groundwater seepage observed at 1½ to 2 feet, approximately 1½ gpm; moderate caving observed at 1½ to 2 feet
104	2		2		SM	Gray silty fine to medium sand with occasional gravel (medium dense to dense, moist) (glacial till)	12		Probe Depth = 2 to 3 inches
103	3		3 MC						Probe Depth = 1 to 3 inches

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-6

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-7
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3.25	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
See "Remarks" section for groundwater observed See "Remarks" section for caving observed					
Surface Elevation (ft) Vertical Datum	103 NAVD88	Easting (X) Northing (Y)	1320505 376483	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 4 inches
			1		ML	Dark brown sandy silt with occasional gravel and cobbles, small roots (stiff, moist) (fill)			
					SM	Brown silty fine to medium sand, small roots (medium dense, moist)			
102	1								Probe Depth = 3 to 4 inches Slight to moderate groundwater seepage observed at 1 to 2½ feet, approximately 1 gpm; slight to moderate caving observed at 1 to 2½ feet
101	2		2 %F				16	14	Probe Depth = 2 to 3 inches
			3 MC		SM	Gray-brown silty fine to coarse sand with occasional gravel, moderate oxidation staining (medium dense, moist) (weathered glacial till)	14		
100	3								Probe Depth = 2 to 3 inches

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-7

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-8
Sheet 1 of 1

Date Excavated 1/27/2020	Total Depth (ft) 4	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed
Surface Elevation (ft) 101 Vertical Datum NAVD88		Easting (X) 1320095 Northing (Y) 376371	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	1 to 2 inches sod			Probe Depth = 2 to 4 inches
			1 MC		SM	Dark brown silty fine to medium sand with gravel, small roots (medium dense, moist) (fill)	22		
			2 MC		SM	Brown silty fine to medium sand with gravel, occasional small roots (medium dense to dense, moist)	21		
100	1								Probe Depth = 2 to 4 inches
99	2								Probe Depth = 1 to 3 inches Perched groundwater observed at 2 feet
98	3		3		SM	Gray silty fine to medium sand with gravel and cobbles (very dense, moist) (glacial till)			Probe Depth <1 inch
97	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-8

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-9
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3.75	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
See "Remarks" section for groundwater observed See "Remarks" section for caving observed					
Surface Elevation (ft) Vertical Datum	100 NAVD88	Easting (X) Northing (Y)	1320253 376322	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 to 3 inches sod			
			1 MC		ML	Dark brown sandy silt with occasional gravel, small roots (soft to medium stiff, moist) (fill)	49		
99	1				ML	Brown sandy silt, occasional small roots (medium stiff to stiff, wet)			
98	2		2 MC				47		Moderate groundwater seepage observed at 2 to 3 feet, approximately 2 gpm; moderate to severe caving observed at 2 to 3 feet
					SM	Gray silty fine to medium sand with occasional gravel, moderate oxidation stains (medium dense to dense, moist) (weathered glacial till)			
97	3		3 %F				16	34	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-9

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-10
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
See "Remarks" section for groundwater observed See "Remarks" section for caving observed					
Surface Elevation (ft) Vertical Datum	101 NAVD88	Easting (X) Northing (Y)	1320358 376326	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 4 inches
			1 MC		SM	Dark brown silty fine to medium sand with gravel, small roots (medium dense, moist) (fill)	18		
100	1				ML	Brown sandy silt with gravel (stiff, moist to wet)			Probe Depth = 3 to 4 inches
			2 MC				21		Moderate groundwater seepage observed at 1½ to 2½ feet, approximately 1 to 2 gpm
99	2								Probe Depth = 2 to 4 inches Moderate caving observed at 2 to 2½ feet
			3		SM	Gray silty fine to medium sand with occasional gravel (dense, moist) (glacial till)			
98	3								Probe Depth = 1 to 2 inches

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-10

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-11
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed Caving not observed
Surface Elevation (ft) Vertical Datum	100 NAVD88	Easting (X) Northing (Y)	1320494 376317	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
			1 MC		ML	Dark brown sandy silt with occasional gravel, small roots (soft to medium stiff, moist) (fill)			Probe Depth = 5 to 8 inches
					ML	Brown sandy silt with gravel, wood debris (medium stiff to stiff, moist)			
99	1		2 MC				44		Probe Depth = 3 to 5 inches Slight groundwater seepage observed at 1 foot, approximately ½ gpm
98	2				SM	Gray silty fine to medium sand with gravel (dense, moist) (glacial till)			Probe Depth = 1 to 2 inches
			3 %F				38		
97	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-11

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-12
Sheet 1 of 1

Date Excavated 1/27/2020	Total Depth (ft) 2.5	Logged By NBD Checked By YNAN	Excavator GeoEngineers Equipment Hand Auger	Groundwater not observed See "Remarks" section for caving observed
Surface Elevation (ft) 100 Vertical Datum NAVD88		Easting (X) 1320162 Northing (Y) 376341	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	1 to 2 inches sod			
					ML	Dark brown sandy silt with occasional gravel, small roots (soft, wet) (fill)			
99	1		1						
98	2		2						Caving in borehole
						Practical refusal at 2½ feet bgs			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring HA-1

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-13
Sheet 1 of 1

APPENDIX B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

Soil samples obtained from the explorations were visually classified in the field and/or in our laboratory using a system based on the Unified Soils Classification System (USCS) and ASTM International (ASTM) classification methods. ASTM test method D 2488 was used to visually classify the soil samples, while ASTM D 2487 was used to classify the soils based on laboratory tests results. These classification procedures are incorporated in the exploration logs shown in Figures A-2 through A-13.

Moisture Content Testing

Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The results of these tests are presented on the exploration logs in Appendix A at the depths at which the samples were obtained.

Percent Passing the U.S. No. 200 Sieve

Selected samples were "washed" through the U.S. No. 200 mesh sieve to determine the relative percentage of coarse- and fine-grained particles in the soil. The percent passing value represents the percentage by weight of the sample finer than the U.S. No. 200 sieve. These tests were conducted in general accordance with ASTM D 1140, and the results are shown on the exploration logs at the representative sample depths.

APPENDIX C
Report Limitations and Guidelines for Use

APPENDIX C
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for use by Sunnyside Village Cohousing, Urban Evolution, and their authorized agents. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the project, and its schedule and budget, our services have been executed in accordance with our agreement with Sunnyside Village Cohousing and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the Sunnyside Village Cohousing project in Marysville, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- Not prepared for you,
- Not prepared for your project,
- Not prepared for the specific site explored, or
- Completed before important project changes were made.

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

For example, changes that can affect the applicability of this report include those that affect:

- The function of the proposed structure;
- Elevation, configuration, location, orientation or weight of the proposed structure;
- Composition of the design team; or
- Project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

The recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring, test pit and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- Advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- Encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

This appendix provides information to help you manage your risks with respect to the use of this report.

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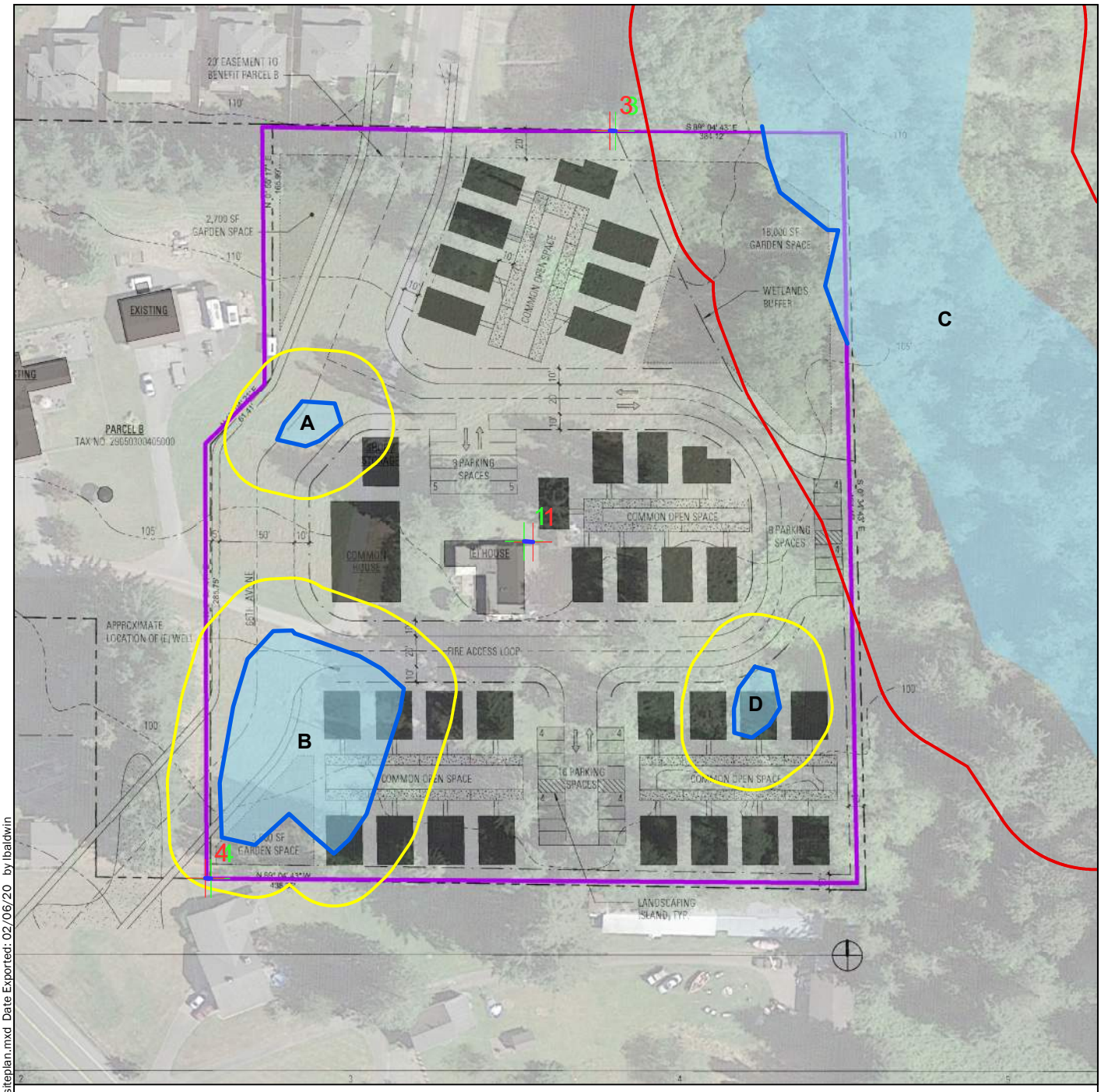
APPENDIX D

Sensitive Areas



Legend

- Assessment Area
- Wetland
- Wetland Buffer (35-ft)
- Wetland Buffer (75-ft)

N
W E
S

100 0 100

Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source:

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Site Plan

Sunnyside Village - Cottage Housing
Marysville, Washington

GeoEngineers

Figure 1

\\geoengineers.com\WAN\Projects\24\24145001\GIS\MXD\24145001_f02_siteplan.mxd Date Exported: 02/06/20 by lbaldwin

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, SEATTLE DISTRICT
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

Regulatory Branch

Mr. Dean Smith
Sunnyside Village Cohousing
3121 66th Avenue Northeast
Marysville, Washington 98270

Reference: NWS-2020-388
Sunnyside Village Cohousing
(Jurisdictional
Determination)

Dear Mr. Smith:

On July 24, 2020, we conducted a desk review of your Critical Areas Assessment Report for Sunnyside Village Cohousing Development, dated March 16, 2020, for the property at Marysville, Washington, in response to your request for verification of the jurisdictional limits of waters of the U.S. in the review area as shown on the enclosed drawings dated March 16, 2020. The U.S. Army Corps of Engineers has determined that Wetlands A, B, and D are not waters of the U.S. because they are excluded non-waters of the U.S. per 33 CFR Part 328.3 (b). As such, work that would occur within these areas does not require Department of the Army authorization under Section 404 of the Clean Water Act. This determination applies only to the review area. Other waters and wetlands that may occur on this property outside the review area are not the subject of this determination.

Other state and local regulations may still apply to these wetlands. For example, the Washington State Department of Ecology (Ecology) may regulate these wetlands. For information on how to obtain State approval for your project, you should contact Ecology's Federal Permit Coordinator at ecyrefedpermits@ecy.wa.gov or at (360) 407-6068. Information regarding State permitting requirements can also be found at the following website: https://ecology.wa.gov/Water-Shorelines/Wetlands/Regulations. We are sending a copy of this letter to Ecology and to the Environmental Protection Agency's Aquatic Resources Unit.

This approved jurisdictional determination is valid for a period of five years from the date of this letter unless new information warrants revisions of the determination. A copy of this jurisdictional determination, dated July 24, 2020, can be found on our website at www.nws.usace.army.mil select "Regulatory Branch, Permit Information" and then "Jurisdictional Determinations". If you object to this determination, you may request an administrative appeal under our regulations (33 Code of Federal Regulations, Part 331) as

described in the enclosed *Notification of Administrative Appeal Options and Process and Request for Appeal* form.

A copy of this letter with drawings will be furnished to Ms. Emily Hurn at ehurn@geoengineers.com. If you have any questions, please contact Ms. Amanda Barbieri at amanda.barbieri@usace.army.mil or at (206) 316-3156.

Sincerely,

Kristina G. Tong

Kristina G. Tong, Section Chief
Regulatory Branch

Enclosures

APPENDIX E

Operations and Maintenance Manual

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.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). 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	Top slab is free of holes and cracks. Frame is sitting 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 Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with 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, meets the design standards, and is installed and aligned with the flow path.

Table V-A.13: Maintenance Standards - Sand Filters (Above Ground/Open) (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

Table V-A.14: Maintenance Standards - Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, 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/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

Table V-A.15: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the

Table V-A.15: Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Vault			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.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	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.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1 inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, 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.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	zone/flow spreader		
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Determine why grass growth is poor and correct the offending condition. Reseed into loosened, fertile soil or compost; or, replant with plugs of grass from the upper slope.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation to not impede flow. Mow grass to a height of 6 inches.
	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix long after the storms have ceased. Typically, the 6-month, 24-hour precipitation event should drain within 48 hours. More common storms should drain within 24 hours. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.
	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.
	Flooding of Media filter drain	When media filter drain is inundated by flood water	Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards.

Table V-A.20: Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

APPENDIX F

Water Quality Treatment

WASHINGTON STATE DEPARTMENT OF ECOLOGY

March 2022

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), DISSOLVED METALS (ENHANCED), AND PHOSPHORUS TREATMENT

For

Oldcastle Infrastructure, Inc.'s The BioPod™ Biofilter (Formerly the TreePod Biofilter)

Ecology's Decision

Based on Oldcastle Infrastructure, Inc. application submissions for The BioPod™ Biofilter (BioPod), Ecology hereby issues the following use level designation:

1) General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:
   - Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.
   - Constructed with a minimum media thickness of 18-inches (1.5-feet)
2) Ecology approves the BioPod at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:
   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology- approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.7.6 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
3) For systems that have a drain down outlet, designers must increase the water quality design flow rate calculated in Item 2, above, to account for the water that will enter the initial bay but won't be treated by the engineered soil. Multiply the flow rate determined above by 1.05

to determine the required flowrate for the BioPod unit.

4) The GULD has no expiration date, but may be amended or revoked by Ecology.

Ecology's Conditions of Use

The BioPod shall comply with these conditions:

1) Applicants shall design, assemble, install, operate, and maintain the BioPod installations in accordance with Oldcastle Infrastructure Inc.'s applicable manuals and the Ecology Decision.
2) The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in Ecology Decision, Item 3, above) and the hydraulic loading rate (as identified in Ecology Decision, Item 1, above). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the hydraulic loading rate (converted to ft/sec) to obtain the required surface area (sq ft) of the BioPod unit.
3) BioPod media shall conform to the specifications submitted to and approved by Ecology.
4) The applicant tested the BioPod without plants. This GULD applies to the BioPod Stormwater Treatment System whether plants are included in the final product or not.
5) Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
    - The BioPod is designed for a target maintenance interval of 1 year. Maintenance includes replacing the mulch, assessing plant health, removal of trash, and raking the top few inches of engineered media.
    - The BioPod system initially tested at the Lake Union Ship Canal Test Facility in Seattle, WA required maintenance after 1.5 months, or 6.3% of a water year. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. Runoff from the Test Facility may be unusual and maintenance requirements of systems installed at the Test Facility may not be indicative of typical maintenance requirements. Because of this, the initial version of the GULD required Oldcastle to subsequently "conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest". Quarterly testing from a 15-month maintenance frequency assessment conducted on a BioPod system installed along a roadway in Des Moines, WA indicated the system was able to treat a full water year before requiring maintenance.
    - Test results provided to Ecology from a BioPod System evaluated in a lab following New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs have indicated the BioPod System is capable of longer maintenance intervals.
    - Owners/operators must inspect BioPod systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According

to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.

6) Install the BioPod in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.
7) Discharges from the BioPod shall not cause or contribute to water quality standard violations in receiving waters.

Approved Alternate Configurations

BioPod Internal Bypass

1) The BioPod Internal Bypass configuration may be combined with a Curb Inlet, Grated Inlet, and Piped-In Inlet. Water quality flows and peak flows are directed from the curb, overhead grate, or piped inlet to a contoured inlet rack. The inlet rack disperses water quality flows over the top surface of the biofiltration chamber. Excess flows are diverted over a curved bypass weir to the outlet area without passing through the treatment area. Both water quality flows and bypass flows are combined in the outlet area prior to being discharged out of the system.
2) To select a BioPod Internal Bypass unit, the designer must determine the size of the standard unit using the sizing guidance described above. Systems that have an internal bypass may use the off-line water quality design flow rate.
3) The internal bypass configuration has a maximum flow rate of 900 gallons per minute. Sites where the anticipated flow rate at the treatment device is larger than 900 gpm must use an external bypass, or size the treatment device for the on-line water quality design flow rate.

Applicant:	Oldcastle Infrastructure, Inc.
Applicant's Address:	7100 Longe St, Suite 100 Stockton, CA 95206

Application Documents:

BioPod™ Stormwater Filter Maintenance Frequency Assessment, Prepared for Oldcastle Infrastructure, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2022

Technical Evaluation Report TreePod™ BioFilter System Performance Certification Project, Prepared for Oldcastle, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., January 2018

Application for Pilot Use Level Designation, TreePod™ Biofilter – Stormwater Treatment System, Oldcastle Stormwater Solutions, May 2016

Emerging Stormwater Treatment Technologies Application for Certification: The TreePod™ Biofilter, Oldcastle Stormwater Solutions, April 2016

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the BioPod™ Biofilter operating at a hydraulic loading rate of 153 inches per hour is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L.
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L.
- 50% or greater total phosphorus for influent concentrations 0.1 to 0.5 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Oldcastle Infrastructure, Inc. has shown Ecology, through laboratory and field testing, that the BioPod™ Biofilter is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

- Herrera Environmental Consultants, Inc. conducted monitoring of the BioPod™ Biofilter at the Lake Union Ship Canal Test Facility in Seattle Washington between November 2016 and April 2018. Herrera collected flow-weight composite samples during 14 separate storm events and peak flow grab samples during 3 separate storm events. The system was sized at an infiltration rate of 153 inches per hour or a hydraulic loading rate of 1.6 gpm/ft^2.

- The D_{50} of the influent PSD ranged from 3 to 292 microns, with an average D_{50} of 28 microns.
- Influent TSS concentrations ranged from 17 mg/L to 666 mg/L, with a mean concentration of 98 mg/L. For all samples (influent concentrations above and below 100 mg/L) the bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean TSS reduction was 84% and the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the mean TSS effluent concentration was 8.2 mg/L.
- Dissolved copper influent concentrations from the 17 events ranged from 9.0 µg/L to 21.1 µg/L. The 21.1 µg/L data point was reduced to 20.0 µg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean dissolved copper reduction was 35%.
- Dissolved zinc influent concentrations from the 17 events ranged from 26.1 µg/L to 43.3 µg/L. A bootstrap estimate of the LCL95 of the mean dissolved zinc reduction was 71%.
- Total phosphorus influent concentrations from the 17 events ranged from 0.064 mg/L to 1.56 mg/L. All influent data greater than 0.5 mg/L were reduced to 0.5 mg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean total phosphorus reduction was 64%.
- The system experienced rapid sediment loading and needed to be maintained after 1.5 months. Monitoring personnel observed similar sediment loading issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.

- Herrera Environmental Consultants, Inc. conducted a maintenance frequency assessment of the BioPod™ installed along a roadway in Des Moines, WA between September 2020 and January 2022.
  - Herrera collected influent grab samples during 10 storm events and paired effluent samples during 5 storm events. Influent concentrations ranged from 1 mg/L to 164 mg/L, with a median concentration of 23 mg/L. Effluent concentrations ranged from 1 mg/L to 19 mg/L, with a median of 5 mg/L.
  - Herrera collected influent PSD samples during 3 storm events. The D_{50} for the samples were 42, 1306, and 57 microns. The 1306 micron value was collected during an event with an influent TSS concentration of 1 mg/L. It is assumed this sample was atypical and that it contained a few grains of very coarse sand and almost no other particles.
  - Herrera used a water truck to conduct flow testing 7 times to assess how long the system could filter at the design flow rate without bypass. Results show the system was able to treat up to a full water year before the system needed maintenance.

Laboratory Testing

- Good Harbour Laboratories (GHL) conducted laboratory testing at their site in Mississauga, Ontario in October 2017 following the New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs. The testing evaluated a 4-foot by 6-foot standard biofiltration chamber and inlet contour rack with

bypass weir. The test sediment used during the testing was custom blended by GHL using various commercially available silica sands, which had an average d_{50} of 69 µm. Based on the lab test results:

- GHL evaluated removal efficiency over 15 events at a Maximum Treatment Flow Rate (MTFR) of 37.6 gpm, which corresponds to a MTFR to effective filtration treatment area ratio of 1.80 gpm/ft^2. The system, operating at 100% of the MTFR with an average influent concentration of 201.3 mg/L, had an average removal efficiency of 99 percent.
- GHL evaluated sediment mass loading capacity over an additional 16 events using an influent SSC concentration of 400 mg/L. The first 11 runs were evaluated at 100% of the MTFR. The BioPod began to bypass, so the remaining 5 runs were evaluated at 90% of the MTFR. The total mass of the sediment captured was 245.0 lbs and the cumulative mass removal efficiency was 96.3%.

- Herrera Environmental Consultants Inc. conducted laboratory testing in September 2014 at the Seattle University Engineering Laboratory. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of twelve different media blends. Based on this testing, Oldcastle Infrastructure, Inc. selected one media blend, Mix 8, for inclusion in their TAPE evaluation of the BioPod™ Biofilter.
  - Herrera evaluated Mix 8 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column. The column contained 18-inches of Mix 8 on top of 6-inches of pea gravel. The BioPod will normally include a 3-inch mulch layer on top of the media layer; however, this was not included in the laboratory testing.
  - Mix 8 has a hydraulic conductivity of 218 inches per hour; however, evaluation of the pollutant removal ability of the media was based on an infiltration rate of 115 inches per hour. The media was tested at 75%, 100%, and 125% of the infiltration rate. Based on the lab test results:
    - The system was evaluated using natural stormwater. The dissolved copper and dissolved zinc concentrations in the natural stormwater were lower than the TAPE influent standards; therefore, the stormwater was spiked with 66.4 mL of 100 mg/L Cu solution and 113.6 mL of 1,000 mg/L Zn solution.
    - The BioPod removed an average of 81% of TSS, with a mean influent concentration of 48.4 mg/L and a mean effluent concentration of 9.8 mg/L.
    - The BioPod removed an average of 94% of dissolved copper, with a mean influent concentration of 10.6 µg/L and a mean effluent concentration of 0.6 µg/L.
    - The BioPod removed an average of 97% of dissolved zinc, with a mean influent concentration of 117 µg/L and a mean effluent concentration of 4 µg/L.
    - The BioPod removed an average of 97% of total phosphorus, with a mean influent concentration of 2.52 mg/L and a mean effluent concentration of 0.066 mg/L. When total phosphorus influent concentrations were capped at the TAPE upper limit of 0.5 mg/L, calculations showed an average removal of 87%.

Other BioPod Related Issues to be Addressed by the Company:

1. None identified at this time.

Technology Description: Download at https://oldcastleprecast.com/stormwater/bioretention-biofiltration-applications/bioretention-biofiltration-solutions/

Contact Information:

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Applicant website: https://oldcastleprecast.com/stormwater/

Ecology web link: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

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Revision History

Date	Revision
March 2018	GULD granted for Basic Treatment
March 2018	Provisional GULD granted for Enhanced and Phosphorus Treatment
June 2016	PULD Granted
April 2018	GULD for Basic and Provisional GULD for Enhanced and Phosphorus granted, changed name to BioPod from TreePod
July 2018	GULD for Enhanced and Phosphorus granted
September 2018	Changed Address for Oldcastle
December 2018	Added minimum media thickness requirement
May 2019	Changed language on who must Install and maintain the device from Oldcastle to Applicants
August 2019	Added text on sizing using infiltration rate and water quality design flow rate
October 2019	Added text describing ability to use off-line design water quality flow rate for sizing due to internal bypass
December 2021	Extended approval to installations without plants, added sizing adjustment when using facilities with a drawdown outlet
March 2022	Added results from the maintenance frequency assessment to the Ecology's Conditions of Use and the Findings of Fact sections