Belle Vista Estates

Miller Road
Sequim, WA 98382

Storm Drainage Report

April 2024

GOLDSMITH
LAND DEVELOPMENT SERVICES

Bella Vista Estates

Miller Road
Sequim, WA 98382

Prepared for:
Bella Vista Estates, LLC



April 2024

Job Number 23035

GOLDSMITH
LAND DEVELOPMENT SERVICES

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1.0 Introduction

This report provides design data and analysis for the improvements proposed for a 24-lot preliminary major subdivision. As specified by Chapter 13.104 of the Sequim Municipal Code the city has adopted the most recent Department of Ecology Stormwater *Management Manual for Western Washington (2019).* This report includes a summary of existing on-site and downstream conditions; proposed developed site conditions; and the proposed stormwater control plan. This report (Section 3) also gives specific details on how the project meets the minimum requirements specified in *Section I-3 of the Washington State Department of Ecology (DOE) 2019 Stormwater Management Manual for Western Washington*.

1.1 Project Overview - Location

The proposed Bella Vista Estates preliminary major subdivision project site is 7.8 acres in size consisting of two (2) combined tax parcels within the City of Sequim, Washington. The proposed site includes the Bella Vista Estates ownership, Clallam County tax parcel #033029240100, 7.6 acres; and a 0.2 acre portion of the adjacent tax parcel # 033029249015 as proposed under the Boundary Line Adjustment being processed concurrently with the preliminary major subdivision application. The site is in the southeast quarter, of the northwest quarter of Section 29, Township 30 North, Range 3W, W.M.

The Bella Vista Estates preliminary major subdivision project site abuts the south side of Miller Road and is accessed just west of the intersection of Miller Road with Token Lane. The south project boundary coincides with the Clallam County limits. The Emeral Highlands PUD is adjacent to the west and the Cottages PUD is located northeast along the north side of Miller Road. Single-family development is adjacent to the east boundary of the site.

See the attached Vicinity Map (Figure 1) and aerial photo (Figure 2) for the project location.

1.2 Project Description

This project will provide the necessary site improvements to serve the 24 single-family residential lots and infrastructure proposed with this preliminary major subdivision. The proposed project includes the construction of twenty-four (24) single-family residential lots; an internal public road system (Neighborhood Street classification) designed as a loop road; public water from Clallam PUD to serve the platted lots, open space and landscape areas within the public right-of-way; City of Sequim sewer utilities; an off-site sanitary sewer extension; an off-site water extension from Fox Hollow Road (Clallam PUD); a public stormwater detention vault; water quality treatment BMPs; on-site stormwater management BMPs; public roadway frontage improvements on Miller Road; site grading for proposed lots and public road; and structural walls associated with lot development, some which will require permits. There is no requirement for on-site recreation. Refer to Figure 3 for the preliminary plat design. See the Bella Vista Estates Preliminary engineering plans for roads, stormwater control, grading, water and sewer utilities, and frontage road improvements.

2.0 Existing Conditions

The project site is currently undeveloped and fronts onto the south side of Miller Road. To the south and west are existing single-family neighborhoods. To the east is a large single lot with a residence, and to the north is an undeveloped parcel. Under the existing condition, there are no impervious areas on-site.

A copy of the topographic survey submitted with the preliminary major subdivision is included in this report to show the existing site conditions (Figure 4). The site topography descends from the south to the north boundary with average slopes between 10 and 20%. The Highland irrigation ditch to the south that defines the south basin boundary. The single-family neighborhood to the west defines the west basin boundary and the east boundary is roughly coincidental with the property line as shown on the existing condition survey (Figure 4). The existing site vegetation is predominately grassed with a few trees scattered along the perimeters of the site as shown on the site aerial (Figure 2).

Based on City of Sequim mapping, the site is located in the Elwha-Dungeness Watershed - WRIA 18. The entire project is located within a single Threshold Discharge Area (TDA) with the existing surface runoff directed north toward Miller Road, and it is eventually collected by an existing ditch along the south side of the Miller Road right-of-way. See Section 2.1 below for more information on the downstream drainage system. The TDA area and the basin boundaries used for the development of the project stormwater control plan are shown in Figure 5.

The US Department of Agriculture National Resource Conservation Service (NCRS) shows the soils in the vicinity of the site as Yearly gravelly loam material (Figure 7). These are SCS Hydrologic Group C soils. Investigations by the project geotechnical engineer indicate surficial soils consist with the NCRS mapped soils. Groundwater was not encountered in the test pits, but mottled soil was observed indicating the presence of seasonal perched groundwater. A copy of the draft project geotechnical investigation is included in Appendix A.

2.1 Off-Site Analysis

Based on City of Sequim mapping, the site is located in the Elwha-Dungeness Watershed - WRIA 18. The entire project is located within a single Threshold Discharge Area (TDA) with the existing surface runoff directed north toward Miller Road, and it is eventually collected by an existing ditch along the south side of the Miller Road right-of-way. The drainage system downstream of the project is shown in Figure 6.

The following is a description of the existing stormwater flow path, See Figure 6 for more detail, references to the location identifiers are included below:

1. Runoff is discharged from the site to an existing ditch along the south side of Miller Road. **Map Location 1**
2. This ditch discharges to the inlet of an existing 12” concrete culvert. (**Map Location 2**). This culvert is located directly north of the west property boundary.
3. This culvert flows northward across Miller Road towards the existing vacant parcel to the north of the project (**Map Location 3**). The end of this culvert could not be located but is suspected to discharge into the vacant parcel to the north of the right-of-way. The culvert has been observed to be well draining therefore there are no indications that the end of the culvert is blocked or that its conveyance capacity is restricted.

3.0 Minimum Requirements

The following is a detailed description of how the project meets the requirements of *Volume I Chapter 3 of the Washington State Department of Ecology (DOE) 2019 Stormwater Management Manual for Western Washington (SWMMWW)*. This preliminary major subdivision is considered a new development as shown in the *DOE stormwater management manual Figures I-3.* (included as Figure 8). All minimum requirements apply to this project's new and replaced hard surfaces and the converted pervious surfaces. Below is a brief discussion of how these minimum requirements will be met.

Minimum Requirement #1: Preparation of Stormwater Site Plans

A description of the proposed stormwater plan is described in Section 4.0 of this report.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (CSWPP)

A detailed CSWPP will be submitted with the future engineering plans for this project.

Minimum Requirement #3: Source Control of Pollution

No additional source control BMPs are required for this permit.

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

The project does not propose to alter existing drainage systems or outfalls. Existing drainage patterns will be maintained as described in Section 2.0.

Minimum Requirement #5: On-Site Stormwater Management

On-site Stormwater Management BMPs were evaluated accordingly, and the project will utilize List Approach #2 to meet this requirement. See Section 4 of this report for more details.

Minimum Requirement #6: Runoff Treatment

As required, water quality treatment is necessary for projects with 5,000 sf or more Pollution Generating Hard Surface (PGHS) The area of PGHS proposed with this project exceeds this threshold. PGHS areas consist of both a roadway and driveways. It is currently proposed that treatment will be provided through stormwater cartridge systems sized to meet the required basic water quality treatment standard as described in Section 4.

Minimum Requirement #7: Flow Control

Infrastructure improvements will create approximately 4.03 ac of effective impervious area on and off-site and approximately 3.63 ac of landscaped pervious areas. Per the *Washington State Department of Ecology (DOE) 2019 Stormwater Management Manual for Western Washington*, flow control & on-site stormwater BMPs are required. As described in Section 4, flow control requirements will be met by a detention vault. The facility was sized using MGS Flood analysis. as detailed in Section 4 for more detail.

Minimum Requirement #8: Wetland Protection

There are no wetlands located on-site or impacted by the proposed project.

Minimum Requirement #9: Operation and Maintenance

Operation & Maintenance Requirements for the proposed storm systems will be provided during the engineering design submittal.

4.0 Stormwater Control Plan

As shown on the proposed site plan (Figure 3), the subject property will be divided into 24 lots for the construction of 24 new single-family residences. Infrastructure improvements will include the construction of frontage improvements, a public road, driveways, stormwater vault, water quality treatment BMPs, and typical utilities such as storm, water, sewer, gas, electric, telephone, and communication. Access from Miller Rd. will be provided with a public road constructed off the north property boundary providing access to the proposed plat. The following outlines how the DOE stormwater management manual requirements for flow control, water quality control, and on-site stormwater management are met.

As detailed below, this proposed drains to a single Threshold Discharge Area (TDA). The project could create approximately 4.02 acres of new plus replaced effective impervious surface. This is more than the threshold area for requiring that the project meet all DOE SWMMWW Minimum Requirements (MR 1 – MR 9). Refer to Figure 5 for the Developed Conditions Basin Plan for details on the post-development drainage basin boundaries, area, and drainage patterns.

Summary of project information for determining minimum stormwater requirements

Key	Component	Value	Notes
A	Project Site Area	7.65 ac	
B	Existing Impervious Area	0 sf	
C	Existing Impervious Coverage	0%	Calculated as B/A * 100%
D	New plus Replaced Impervious Area	4.02 ac	Effective Impervious Area
E	Converted Pervious: Native vegetation converted to lawn or landscape	0 sf	N/A
F	Converted Pervious: Native vegetation converted to pasture	0 sf	N/A
G	Total Area of Land Disturbing Activity	7.65 acres	

Further details of the assumed site impervious area are presented in the table below. The total project impervious surfaces include on-lot impervious areas, vault lid, sidewalk, and roadway surfaces. On-lot impervious areas are based on an assumed 50% lot impervious area with no reduction from on-site stormwater management BMPs. MGSFlood was used to model pre and post-development runoff.

Land Surface Coverage

Vault Sub-Basin #1

Lot	Area (sf)	Imp. Area (sf)	Perv. Area (sf)
2	9,185	4,593	4,593
3	11,402	5,701	5,701
4	11,813	5,907	5,907
5	11,182	5,591	5,591
6	7,144	3,572	3,572
7	5,590	2,795	2,795
8	5,976	2,988	2,988
9	7,782	3,891	3,891
10	7,850	3,925	3,925
11	14,054	7,027	7,027
12	19,395	9,698	9,698
13	13,557	6,779	6,779
14	9,507	4,754	4,754
15	7,919	3,960	3,960
16	8,036	4,018	4,018
17	8,173	4,087	4,087
18	9,307	4,654	4,654
19	7,740	3,870	3,870
20	10,393	5,197	5,197
21	5,822	2,911	2,911
22	7,433	3,717	3,717
23	7,735	3,868	3,868
24	8,843	4,422	4,422
Sub-Total	215,838	107,919	107,919
Side Walk	7,081	7,081	-
Road	34,297	34,297	-
Landscaping	22,373	-	22,373
Total (sf)	279,589	149,297	130,292
Total Sub- Basin (Ac.)	**6.42**	**3.43**	**2.99**

Bypass Sub-Basin

Surface	Area (sf)	Imp. Area (sf)	Perv. Area (sf)
Road	4,699	4,699	-
Side Walk	1,285	1,285	-
Landscaping	13,377	-	13,377
Total (sf)	19,361	5,984	13,377
Total Sub- Basin (Ac.)	**0.44**	**0.14**	**0.31**

Vault Sub-Basin #2

Lot	Area (sf)	Imp. Area (sf)	Perv. Area (sf)
1	9,248	4,624	4,624
Side Walk	673	673	-
Road	4,025	4,025	-
Landscaping	3,959	-	3,959
Total (sf)	17,905	9,322	8,583
Total Sub- Basin (Ac.)	**0.41**	**0.21**	**0.20**

Vault Sub-Basin #3

Vault Top	10,325	10,325	-
Landscaping	5,847	-	5,847
Total (sf)	16,172	10,325	5,847
Total Sub- Basin (Ac.)	**0.37**	**0.24**	**0.13**

Total Project

Vault Sub-Basin #1	279,589	149,297	130,292
Vault Sub-Basin #2	17,905	9,322	8,583
Vault Sub-Basin #3	16,172	10,325	5,847
Bypass Sub-Basin	19,361	5,984	13,377
Total Basin	333,027	174,928	158,099
Total Basin (Ac.)	**7.65**	**4.02**	**3.63**

MR 5: On-site Stormwater Management

Minimum Requirement 5: On-site Stormwater Management of the DOE SWMMWW requires that on-site stormwater management BMPs be utilized where feasible to infiltrate, disperse, and retain stormwater on-site to reduce the volume, peak flow rates, and the number of pollutants in stormwater runoff leaving a developed site. As shown in the *DOE stormwater management manual Figures I-3.3:Flow Chart for Determining MR#5 Requirements* (included as Figure 9) the project will utilize the List #2 approach.

For the preliminary major subdivision submittal, the geotechnical report (Appendix A) indicates that the site soil conditions are not favorable for stormwater management BMPs that rely on infiltration. These BMPs include bio-retention, drywells, trenches, or permeable pavement. Additionally, given the overall grade of the project site, the potential to utilize roof and sheet flow dispersion is limited. A final review of the potential to use dispersion BMPS will be made during the final plat engineering and building permit phase when house footprints and lot grades have been determined. The

preliminary major subdivision phase sizing of the flow control does not consider a reduction in runoff from any on-site stormwater management BMPS.

The following is an evaluation of the BMP selection Approach List #2 in MR5 of the DOE SWMMWW.

Lawn and Landscape Areas:

Compost-amended soils meeting the requirements of BMP T5.13 will be used in all disturbed pervious areas.

Roof Areas:

Full Dispersion: not feasible, the project is not able to meet either the lot coverage criteria (65% native vegetation), or the 100 ft flow path requirements.

Full Infiltration: the project geotechnical engineer has identified the site as infeasible for the use of infiltration BMPs (Appendix A).

Bio-retention: The project site has been identified as infeasible for infiltration; therefore, bio-retention BMPs are not proposed for this project.

Downspout Dispersion: Flow path length and grade requirements limit the opportunity to utilize individual lot dispersion BMPs. Further evaluation is recommended during the final plat engineering and building permit phase when house footprints and lot grades have been determined.

Perforated Stub-out Connections: The project site has been identified as infeasible for infiltration; therefore, perforated stub-out connections are not proposed for this project.

Other Hard Surfaces:

Full Dispersion: not feasible, the project is not able to meet either the lot coverage criteria (65% native vegetation) or the 100 ft flow path requirements.

Permeable Pavement: The project site has been identified as infeasible for infiltration; therefore, permeable pavement BMPs are not proposed for this project.

Bio-retention: See response under roof surfaces.

Sheet Flow Dispersion: Flow path length and grade requirements limit the opportunity to utilize sheet flow dispersion BMPs. Further evaluation is recommended during the final plat engineering and building permit phase when house footprints and lot grades have been determined.

Flow Control

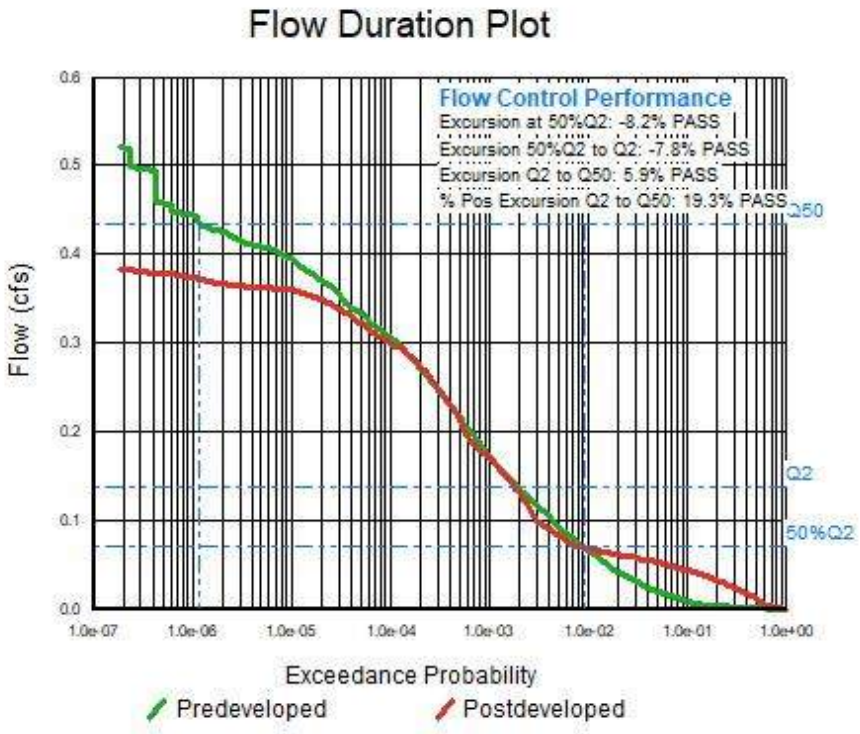
Hydrologic Analysis

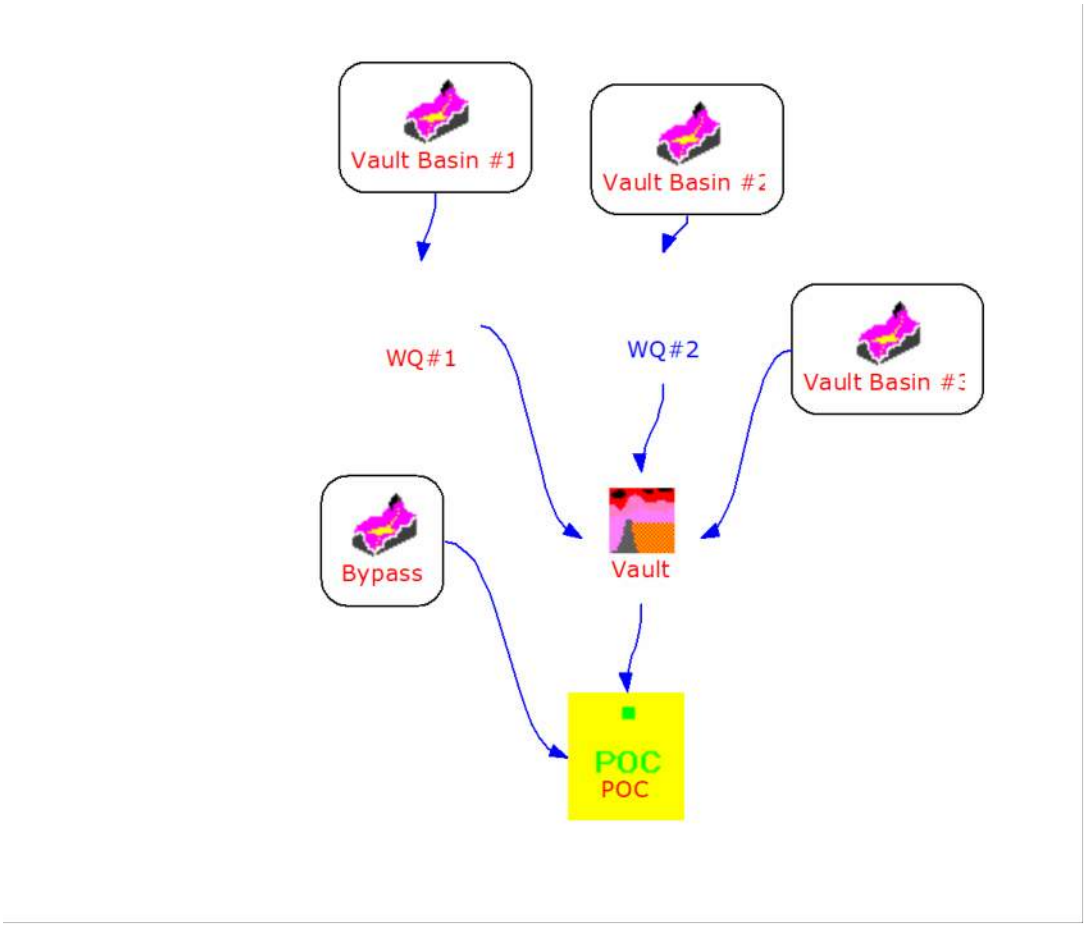
This section gives design data for the stormwater flow control vault to be constructed for the project site. The analysis herein verifies that the proposed stormwater control plan can meet the required conservation flow control standards. Verification that the required flow control standard

is met is presented first followed by the proposed vault size dimensions and control structure design and the hydrologic routing results.

Flow Duration Comparison

The following data extracted from the MGS Flood model shows a comparison of the existing and developed flow durations. Based on this analysis, Conservation flow control is provided by the proposed improvements. See the MGS Flood analysis report herein which details model input and demonstrates compliance with the discharge rate requirements.





MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.59
Program License Number: 201810008
Project Simulation Performed on: 03/29/2024 3:38 PM
Report Generation Date: 03/29/2024 3:38 PM

Input File Name: P-Plat Vault 2024-03-29.fld
Project Name: Bella Vista
Analysis Title: P. Plat. Detention
Comments: Precipitation not equal to climate region (22 in_5min)

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 1
Precipitation Station : 95003205 Puget West 32 in_5min 10/01/1939-10/01/2097

Evaporation Station : 951032 Puget West 32 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

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

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

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	7.650	7.650
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	7.650	7.650

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

---------- Subbasin : Existing ----------

	-------Area (Acres) --------
C, Forest, Mod	7.650
Subbasin Total	7.650

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 4

---------- Subbasin : Vault Basin #1 ----------

	-------Area (Acres) --------
C, Lawn, Mod	2.990
ROADS/MOD	3.430
Subbasin Total	6.420

---------- Subbasin : Bypass ----------

	-------Area (Acres) --------
C, Lawn, Mod	0.310
ROADS/MOD	0.140
Subbasin Total	0.450

---------- Subbasin : Vault Basin #2 ----------

	-------Area (Acres) --------
C, Lawn, Mod	0.200
ROADS/MOD	0.210
Subbasin Total	0.410

---------- Subbasin : Vault Basin #3 ----------
-------Area (Acres) --------
C, Lawn, Mod 0.130
ROADS/MOD 0.240

Subbasin Total 0.370

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

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

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

----------SCENARIO: POSTDEVELOPED
Number of Links: 4

Link Name: Vault
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 301.00
Riser Crest Elevation (ft) : 312.00
Max Pond Elevation (ft) : 313.00
Storage Depth (ft) : 11.00
Pond Bottom Length (ft) : 130.0
Pond Bottom Width (ft) : 74.6
Pond Side Slopes (ft/ft) : Z1= 0.00 Z2= 0.00 Z3= 0.00 Z4= 0.00
Bottom Area (sq-ft) : 9702.
Area at Riser Crest El (sq-ft) : 9,702.
(acres) : 0.223
Volume at Riser Crest (cu-ft) : 106,721.
(ac-ft) : 2.450
Area at Max Elevation (sq-ft) : 9702.
(acres) : 0.223
Vol at Max Elevation (cu-ft) : 116,423.
(ac-ft) : 2.673

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) : 0.020
Riser Crest Elevation : 312.00 ft

Hydraulic Structure Geometry

Number of Devices: 4

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 301.00
Diameter (in) : 0.95
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 308.00
Diameter (in) : 1.20
Orientation : Horizontal
Elbow : No

---Device Number 3 ---
Device Type : Circular Orifice
Control Elevation (ft) : 308.50
Diameter (in) : 1.50
Orientation : Horizontal
Elbow : Yes

---Device Number 4 ---
Device Type : Circular Orifice
Control Elevation (ft) : 309.70
Diameter (in) : 1.50
Orientation : Horizontal
Elbow : Yes

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

Link Name: WQ#1
Link Type: Copy
Downstream Link Name: Vault

Link Name: WQ#2
Link Type: Copy
Downstream Link Name: Vault

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

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

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 4
Number of Links: 4

********** Subbasin: Vault Basin #1 **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.707
5-Year	2.211
10-Year	2.619
25-Year	3.122
50-Year	4.172
100-Year	5.011
200-Year	5.421
500-Year	5.959

********** Subbasin: Bypass **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.749E-02
5-Year	0.106
10-Year	0.134
25-Year	0.178
50-Year	0.228
100-Year	0.251
200-Year	0.259
500-Year	0.269

********** Subbasin: Vault Basin #2 **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.137
10-Year	0.161
25-Year	0.192
50-Year	0.261
100-Year	0.311
200-Year	0.335
500-Year	0.367

********** Subbasin: Vault Basin #3 **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)

2-Year	0.113
5-Year	0.145
10-Year	0.176
25-Year	0.211
50-Year	0.268
100-Year	0.331
200-Year	0.364
500-Year	0.406

********** Link: Vault ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.927
5-Year	2.493
10-Year	2.962
25-Year	3.525
50-Year	4.701
100-Year	5.653
200-Year	6.120
500-Year	6.733

********** Link: Vault ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.922E-02
5-Year	0.138
10-Year	0.229
25-Year	0.282
50-Year	0.304
100-Year	0.334
200-Year	0.338
500-Year	0.344

********** Link: Vault ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	303.952
1.11-Year	304.303
1.25-Year	305.127
2.00-Year	307.047
3.33-Year	308.189
5-Year	308.877
10-Year	310.015
25-Year	310.738

50-Year	311.122
100-Year	311.664

********** Link: POC ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.119
5-Year	0.188
10-Year	0.268
25-Year	0.311
50-Year	0.366
100-Year	0.382
200-Year	0.382
500-Year	0.382

********** Link: WQ#1 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.707
5-Year	2.211
10-Year	2.619
25-Year	3.122
50-Year	4.172
100-Year	5.011
200-Year	5.421
500-Year	5.959

********** Link: WQ#1 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.707
5-Year	2.211
10-Year	2.619
25-Year	3.122
50-Year	4.172
100-Year	5.011
200-Year	5.421
500-Year	5.959

********** Link: WQ#2 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)

2-Year	0.105
5-Year	0.137
10-Year	0.161
25-Year	0.192
50-Year	0.261
100-Year	0.311
200-Year	0.335
500-Year	0.367

********** Link: WQ#2 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.137
10-Year	0.161
25-Year	0.192
50-Year	0.261
100-Year	0.311
200-Year	0.335
500-Year	0.367

*************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: Existing	1010.364
Total:	1010.364

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Vault Basin #1		299.123
Subbasin: Bypass		31.013
Subbasin: Vault Basin #2		20.008
Subbasin: Vault Basin #3		13.005
Link:	Vault	0.000
Link:	POC	0.000
Link:	WQ#1	0.000
Link:	WQ#2	0.000
Total:		363.150

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 6.395 ac-ft/year, Post Developed: 2.298 ac-ft/year

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

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

Number of Links: 0

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

Number of Links: 4

********** Link: Vault **********

Basic Wet Pond Volume (91% Exceedance): 22300. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 33449. cu-ft

2-Year Discharge Rate : 0.059 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.59 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.32 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 1809.63
Inflow Volume Including PPT-Evap (ac-ft): 1809.63
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): 1809.45
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%

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

2-Year Discharge Rate : 0.119 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): 1900.27
Inflow Volume Including PPT-Evap (ac-ft): 1900.27
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): 1900.27
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%

********** Link: WQ#1 **********

2-Year Discharge Rate : 1.707 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.52 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.28 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 1607.14
Inflow Volume Including PPT-Evap (ac-ft): 1607.14
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): 1607.14
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%

********** Link: WQ#2 **********

2-Year Discharge Rate : 0.105 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.03 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.02 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 100.67
Inflow Volume Including PPT-Evap (ac-ft): 100.67
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): 100.67
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: Existing

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	0.137	2-Year	0.119
5-Year	0.231	5-Year	0.188
10-Year	0.316	10-Year	0.268
25-Year	0.373	25-Year	0.311
50-Year	0.434	50-Year	0.366
100-Year	0.495	100-Year	0.382
200-Year	0.513	200-Year	0.382
500-Year	0.534	500-Year	0.382

** 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%):	-8.2%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-7.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	5.9%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	19.3%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

Vault Design Summary

The vault information presented below represents the vault as modeled in MGSFlood to meet the MR7 flow control and duration requirements.

The vault was modeled with a footprint of 9,702 SF (assuming a 3% FS from the proposed design footprint of 10,023 SF). The vault has a live storage depth of 11ft with a single control structure that discharges to the point of compliance. The detailed MGS Flood results are shown above.

Required Detention Volume (at riser) = 106,721 cu. ft. (2.45 ac.-ft.)
100-year Live Storage Depth = 11.00 ft.
100-year Water Surface = 311.66 ft.

Control Structure Orifice and Notch Design Table

Orifice	Diameter	Height	Elev.
1	0.95 in.	0.00 ft.	301.00 ft
2	1.20 in.	7.00 ft.	308.00 ft
3	1.50 in.	7.50 ft.	308.50 ft
4	1.50 in.	8.70 ft.	309.70 ft

Outlet IE = 301.00 (top of sediment storage)
Riser Height = 11.0 ft. (Above outlet IE)
Riser Elevation = 312.000 ft
Riser Diameter = 18 inches

Event	Predeveloped Runoff Discharge (CFS)	Developed Runoff Discharge (CFS)	Water Surface Elev.
2-year	0.137	0.119	307.05
10-year	0.316	0.268	310.02
100-year	0.495	0.382	311.667

Water Quality Control

As stated previously, the project requires both flow control and water quality treatment since the amount of effective impervious area is over the threshold. The total proposed PGHS is more than the 5,000 sf threshold. Per Minimum Requirement 6 of the DOE SWMMWW stormwater treatment is required for this project. The project proposes to mitigate runoff from PGHS by cartridge systems located upstream of the proposed vault. A cartridge system will be chosen that has received GULD designation through the Washington State DOE TAPE program for Basic Water Quality Treatment. Preliminary sizing for the preliminary major subdivision is based on the Contech stormwater cartridge system with ZPG media. The final selection will be made with the future engineering plans for the project. The proposed bypass area has 4,690 sf of road area. It is not feasible for this area to be captured and treated by a water quality treatment BMP.

Treatment will be upstream of the proposed detention vault at two separate locations as shown on the developed site plan. The following provides the water quality design flow. Per TAPE approval the number of cartridges required is based on the off-line WQ design rate using either 12” or 27” cartridges.

Water Quality Site 1: WQ#1

WQ flow rate (off-line) = 0.28 cfs (125.66 gpm)
Cartridge treatment rate = 11.3 gpm – 27” cartridge
Required Number of Cartridges = 12
Proposed Cartridge System = 96” Manhole with 14 cartridge capacity.

Water Quality Site 2: WQ#2

WQ flow rate (off-line) = 0.02 cfs (8.976 gpm)
Cartridge treatment rate = 5.0 gpm – 12” cartridge
Required Number of Cartridges = 2
Proposed Cartridge System = 48” Manhole with 3 cartridge capacity.

Figures

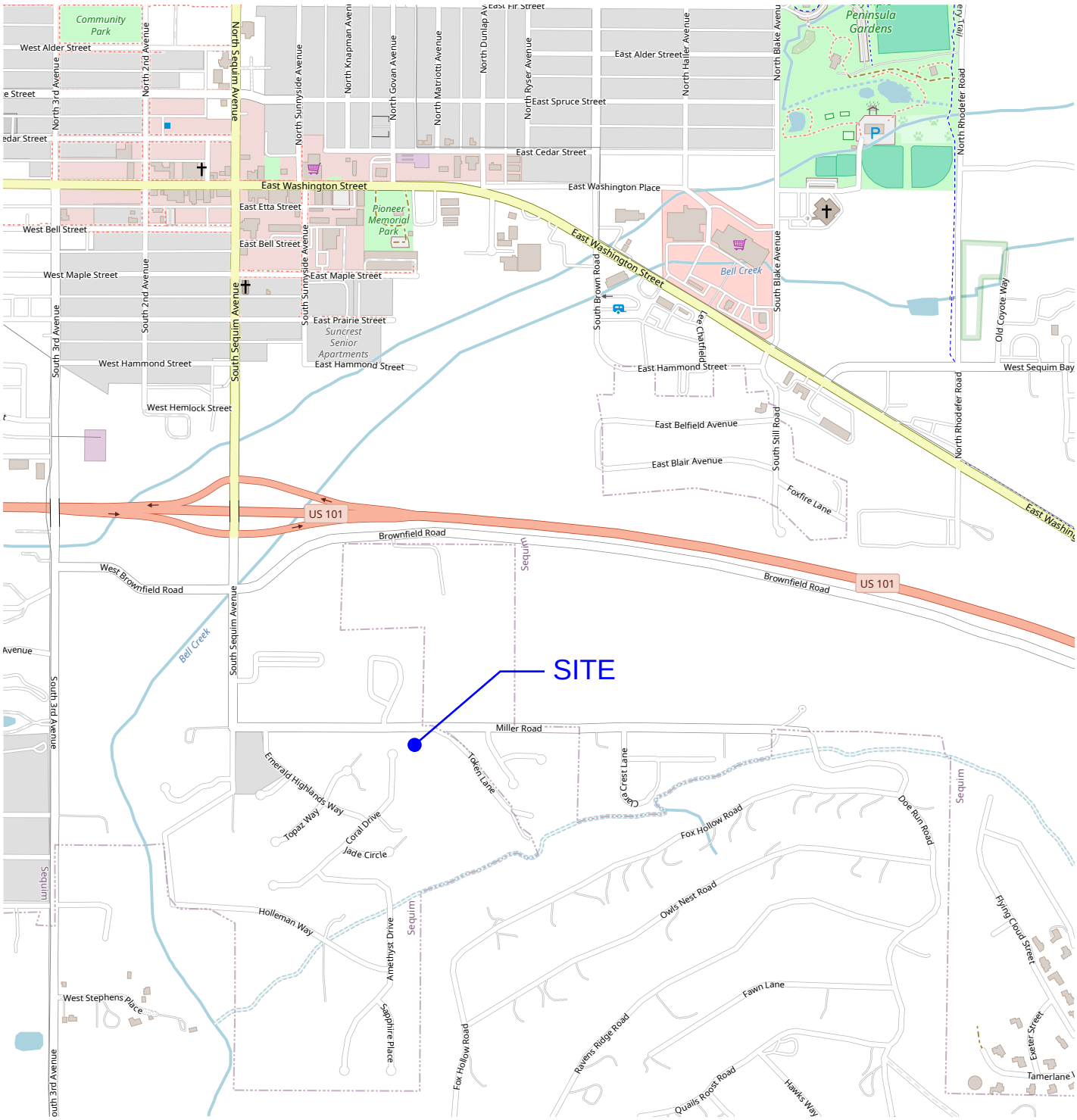


Figure 1 - Vicinity Map

NOT TO SCALE



/HJHQG

5RDG&ODVV

2WKHU URDGV

3ULYDWH URDGV

2WKHU URDGV

&LW\ /LPLWV

3DUFHOV

8UEDQ *URZWK $U

Site Aerial

FIGURE 2

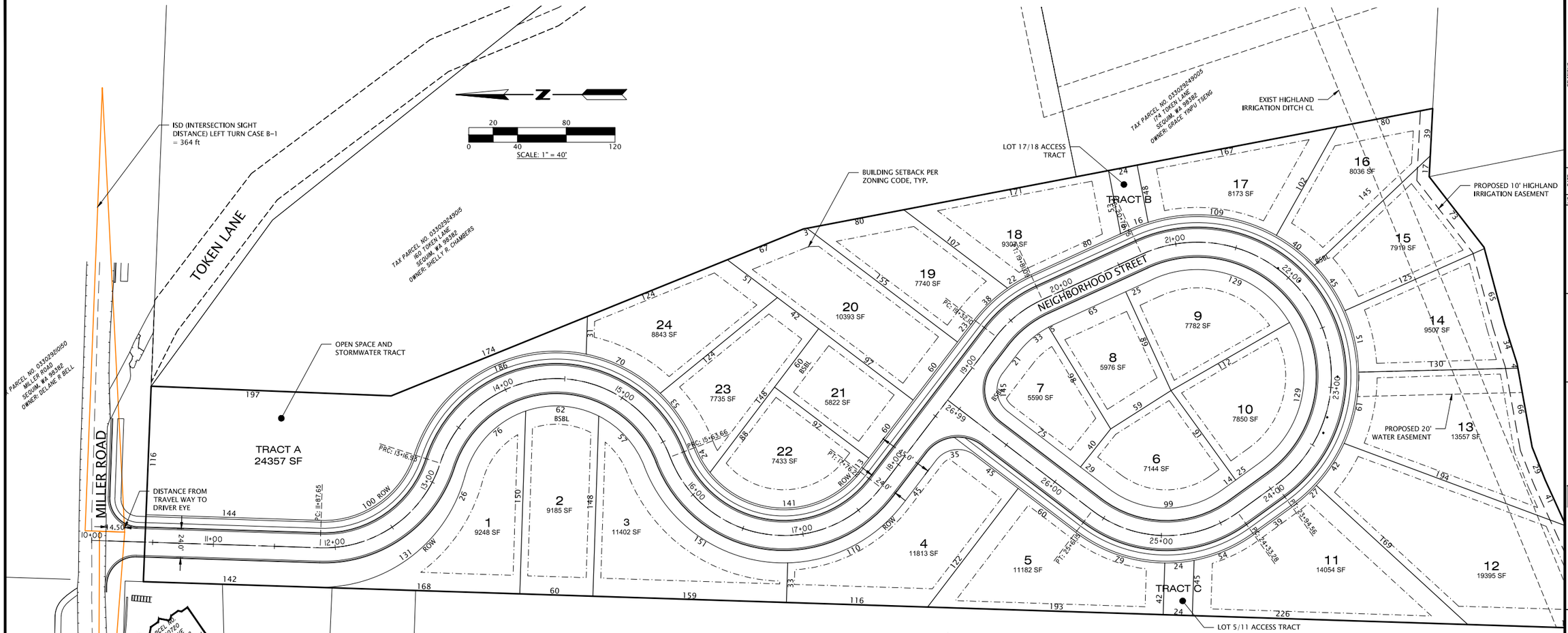
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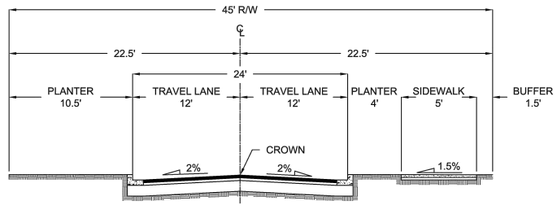
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:H DUH KDSS\ WR VKDUH RXU PDSV DQG KRS
KHOSIXO 3OHDVH EH DGYLVHG KRZHYHU W
WR VHUYH DV D JXLGH WR WKH JHQHUDO OR
DFFXUDF\ RI WKH LQGLYLGXDO OD\HUV YDUL
ZLWK RQH DQRWKHU 'HWHUPLQDWLRQ RI DI
IHDWXUHV VKRZQ RQ WKLV PDS W\SLFDOO\ U
TXDOLILHG VWDII $Q\ SHUVRQ RU HQWLW\ W
FRQWDLQHG KHUHLQ GRHV VR DW WKHLU RZ
QR ZDUUDQW\ RI WKH DFFXUDF\ RU XVHIXOQ

SE 1/4, NW 1/4 SECTION 29, TOWNSHIP 30 NORTH, RANGE 3 WEST, WILLAMETTE MERIDIAN, CITY OF SEQUIM, CLALLAM COUNTY, WASHINGTON





GENERAL NOTES:

1. SEE FIGURE 4-16 FOR TYPICAL PAVEMENT SECTION.
2. SEE FIGURE 4-15 FOR STANDARD UTILITY LOCATION.
3. ALL ROADS MUST HAVE VERTICAL CURB AND GUTTER EXCEPT AT STORMWATER LID LOCATIONS APPROVED BY THE CITY ENGINEER.
4. ALTERNATE STREET SECTION CROSS-SLOPES ARE SUBJECT TO THE CITY ENGINEERS APPROVAL.
5. SEE FIGURE 4-14 FOR STREETS ENDING IN A CUL-DE-SAC, HAMMERHEAD, OR "Y".

CITY OF SEQUIM

NEIGHBORHOOD STREET SECTION

REVISION NO.	DATE
0	1/11/2021

FIGURE 4-01

Zone Intent: The R4-8 zoning district is to provide land for residential development within the city. The R4-8 zone provides for consistency and predictability in the character of residential neighborhoods. New subdivisions must provide a minimum of four dwelling units per net acre.

Permitted Uses	Lot Size Standard	General Development Standards					
		Maximum Height	Minimum Front Yard	Minimum Side/Rear Yard	Maximum Lot Coverage	Required Parking	Site Requirements
Residences (Detached)	Min. lot size – 5,400 sf Max. lot size – 14,500 sf*	25', except 18' in central height district (see Notes below)	15'	Side: 6' each side; or 12' one side only if zero-lot-line development Rear: 15'	40% lots 10,000 sf and larger; increases by 0.4% for each 100 sf lot area less than 10,000 sf	2 spaces/residence	Site plan review per Chapter 18.22 SMC

FIGURE 3

REVISIONS: NO. | DATE | BY | CHK.

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PLOTTED: 2024/04/04 09:48 | DRAWN: #### | DESIGNED: #### | APPROVED: #### | FIELD BOOK: #### | PAGE #: #### | Ajames

BELLA VISTA ESTATES, LLC

PRELIMINARY PLAT MAJOR SUBDIVISION

SITE PLAN

BELLA VISTA ESTATES

CITY OF SEQUIM | CLALLAM COUNTY | WASHINGTON

SHEET SP

JOB NO.: 23035

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SE 1/4, NW 1/4 SECTION 29, TOWNSHIP 30 NORTH, RANGE 3 WEST, WILLAMETTE MERIDIAN, CITY OF SEQUIM, CLALLAM COUNTY, WASHINGTON

SURVEY NOTES CONTINUED FROM SHEET 1 OF 3

FOR PURPOSES OF THIS SURVEY, THE SOUTH BOUNDARIES OF PARCEL A AND PARCEL B WERE CALCULATED HOLDING THE NORTH BOUNDARIES OF (SP3) AND (SP5), UNDERSTANDING THAT THE FIELD LOCATED CENTER OF SAID DITCH, AS SHOWN HEREON, DOES NOT FOLLOW SAID REFLECTED NORTHERLY SHORT PLAT BOUNDARIES,

ALL GOLDSMITH CALCULATIONS FOR SAID SHORT PLATS HELD THE SOUTHEAST CORNER OF THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 29 AS THEIR POINTS OF BEGINNING AND THEIR BASIS OF BEARINGS AS THE NORTH-SOUTH CENTERLINE OF SAID SOUTHWEST QUARTER.

THE DISTANCE CALL ON (SP5) BETWEEN ITS SOUTHWEST CORNER AND THE BASIS OF POSITION, APPEARS TO HAVE BEEN LISTED IN ERROR, WHEN HOLDING THE DISTANCE REFERENCED IN (SP4), THE TIE BETWEEN SAID BASIS OF POSITION AND THE WESTERLY PT OF THE SOUTH LINE LINE OF LOTS 2, 3 AND 4 OF (R1) MATCHES THE DIMENSIONING ON (SP3).

THE NORTHWEST CORNER OF (SP5) DOES NOT APPEAR TO TAKE INTO ACCOUNT THE SUBDIVISION BREAK BETWEEN THE NORTHWEST AND SOUTHWEST QUARTER OF SECTION 29. THE BOUNDARY SHOWN HERON REFLECTS SAID BREAK.

9. ALL DISTANCES SHOWN HEREON ARE GROUND DISTANCES. THE COMBINATION FACTOR USED FOR THIS SITE WAS 0.99993498, WHERE GRID DISTANCE DIVIDED BY THE COMBINATION FACTOR EQUALS GROUND DISTANCE, THEREFORE, THE ONLY TRUE WASHINGTON STATE PLANE COORDINATE IS THE NORTHWEST CORNER OF SECTION 29, TOWNSHIP 30 NORTH, RANGE 3 WEST, WILLAMETTE MERIDIAN. DISTANCES ARE ALL IN U.S. SURVEY FEET.

10. THE SUBJECT PROPERTIES CONTAIN 523,023 SQUARE FEET, OR 12.01 ACRES, MORE OR LESS.

THE AREA IS DISTRIBUTED AMONG THE PARCELS AS FOLLOWS:

PARCEL A (TAX PARCEL NO. 033029240100) CONTAINS 319,485 SQUARE FEET, OR 7.33 ACRES, MORE OR LESS.
PARCEL B (TAX PARCEL NO. 033029249015) CONTAINS 203,538 SQUARE FEET, OR 4.67 ACRES, MORE OR LESS.

11. TRAVERSING AND DATA COLLECTION WERE PERFORMED USING ONE OR MORE OF THE FOLLOWING INSTRUMENTS: A 3-SECOND GT-503 TOPCON TOTAL STATION, A 3-SECOND PS-103A TOPCON TOTAL STATION, A 5-SECOND GPT-3005W TOPCON TOTAL STATION.

ADDITIONAL FIELD WORK WAS PERFORMED USING TOPCON HIPER HR GNSS POSITIONING SYSTEM, THE WASHINGTON STATE REFERENCE NETWORK, AND/OR THE NATIONAL GEODETIC SURVEYS ONLINE POSITIONING USER SERVICE (OPUS).

ALL FIELD WORK WAS PERFORMED, AND EQUIPMENT MAINTAINED, IN COMPLIANCE WITH WAC 332-130.

12. MONUMENTS SHOWN AS FOUND WERE FIELD VISITED ON OCTOBER 11, 2023. PLANIMETRIC AND TOPOGRAPHIC INFORMATION SHOWN HEREON IS A COMBINATION OF GOLDSMITH FIELD SURVEY PERFORMED IN SEPTEMBER OF 2023 AND DATA FROM OTHERS (CAD FILE), AS PROVIDED BY THE CLIENT, HOWEVER, SAID CAD FILE DID NOT DETAIL DATE OF SURVEY, WHO THE SURVEY WAS PREFORMED BY, OR DATUM INFORMATION, THEREFORE, THE DATA FROM OTHERS WAS TRANSLATED TO MATCH THE DATUM AS OUTLINED ABOVE, HOLDING THE RIM ELEVATION OF THE SANITARY SEWER MANHOLE LOCATED ADJACENT TO THE NORTHWEST CORNER OF THE SUBJECT PROPERTY.

13. UTILITY INFORMATION SHOWN HEREON IS PER A COMBINATION OF FIELD LOCATED SURFACE OBSERVABLE FEATURES AND RECORDS OF APPLICABLE UTILITY PURVEYORS, INCLUDING THE CITY OF SEQUIM AND THE CLALLAM COUNTY PUBLIC UTILITY DISTRICT. ALL UTILITIES SHOULD BE VERIFIED PRIOR TO ANY CONSTRUCTION.

LEGEND

X	FENCE LINE	CP	CARSONITE POST
	CENTERLINE OF DRAINAGE	CPP	CORRUGATED PLASTIC PIPE
W	UNDERGROUND WATER LINE	FH	FIRE HYDRANT
SS	UNDERGROUND SEWER LINE	IE	INVERT ELEVATION
SD	UNDERGROUND STORM DRAIN LINE	LP	LIGHT POLE
IR	UNDERGROUND IRRIGATION LINE	MB	MAILBOX
OHU	OVERHEAD UTILITY LINE	OTL	ELECTRIC OUTLET
	BUILDING STRUCTURE	PVC	POLYVINYL CHLORIDE PIPE
	WOOD DECK	SMH	SANITARY SEWER MANHOLE
	GRAVEL	TP	T-POST
	CONCRETE	UG	UNDERGROUND UTILITY CONNECTION
	ROCKERY	UP	UTILITY POLE
	ASPHALT / PAVEMENT	VERT	VERTICAL
BM	BENCHMARK	WM	WATER METER
CNC	CONCRETE PIPE	WP	WOOD POST
		WV	WATER VALVE

SCALE: 0 20 40 80 120, 1" = 40'

811 Know what's below. Call before you dig.

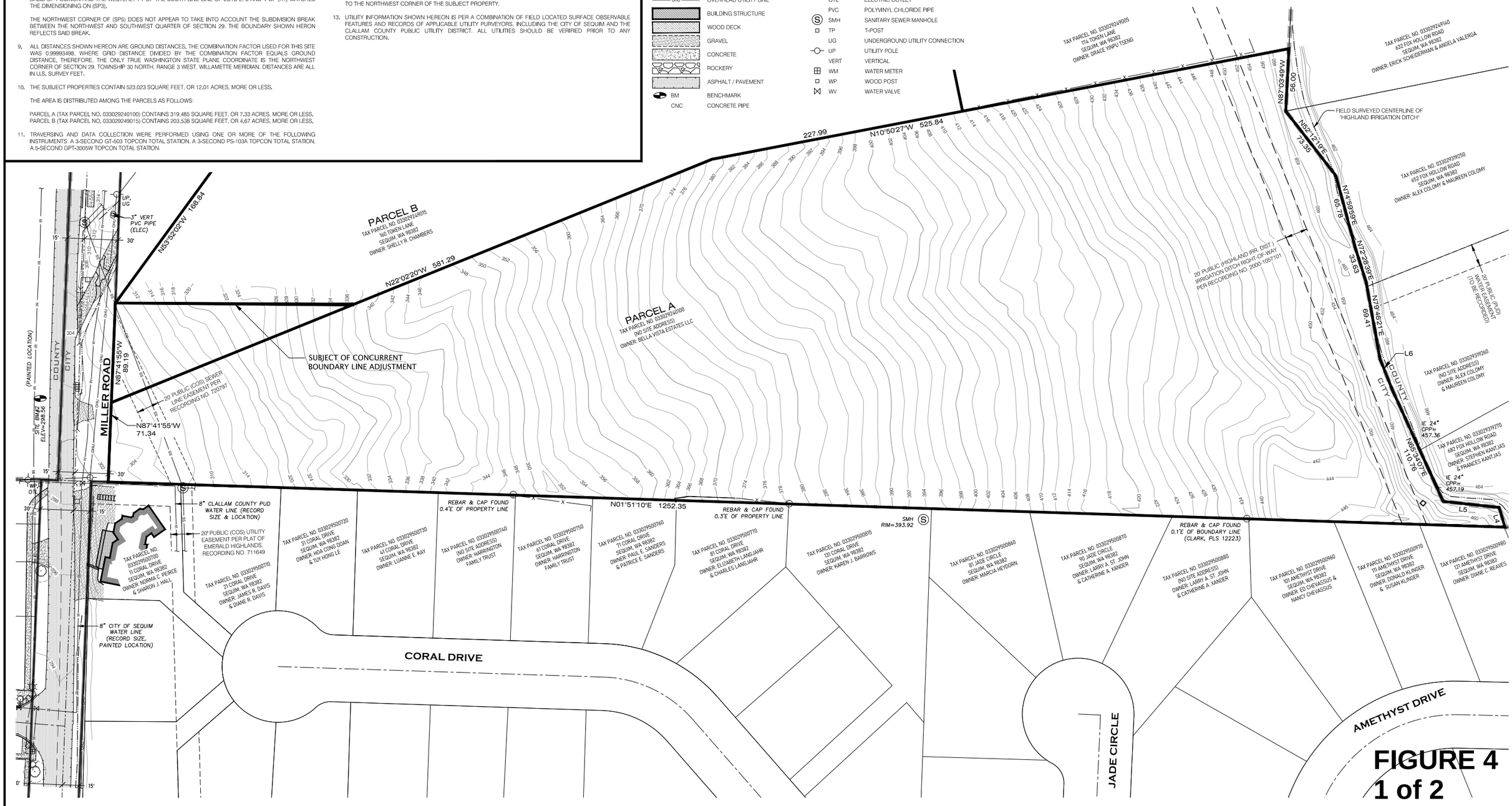


FIGURE 4
1 of 2

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REV. NO.	DATE	DESCRIPTION	MADE BY	CHECKED BY
1	11/3/2023	UPDATED LABELING FOR HIGHLAND IRRIGATION DITCH.	EMALM	LNYQUIST
2	3/12/2024	UPDATED EXISTING UNDERGROUND WATER LINE IN MILLER ROAD BASED UPON NEW PAINT. ADDED PAINTED IRRIGATION LINE IN MILLER ROAD.	EMALM	LNYQUIST

PLOTTED: 2024/03/12 15:50 EMALM
DRAWN: EMALM
PROJ. SUR.: LNYQUIST
APPROVED: LNYQUIST
FIELD BOOK: 1972
PAGE #: 68-78

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LEE D. NYQUIST — STATE OF WASHINGTON — 22894 — REGISTERED PROFESSIONAL LAND SURVEYOR
3/12/2024

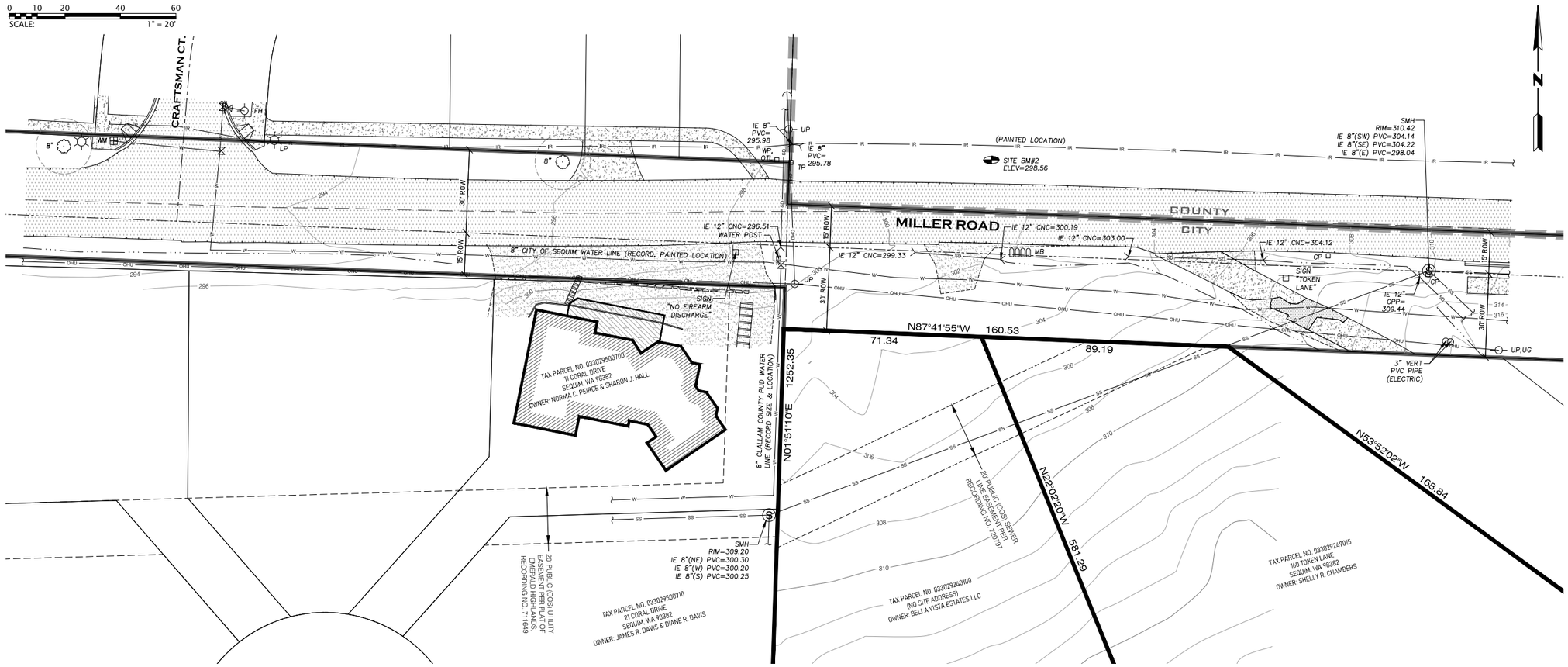
BELLA VISTA ESTATES, LLC

TOPOGRAPHIC SURVEY FOR BELLA VISTA ESTATES

CITY OF SEQUIM | CLALLAM COUNTY | WASHINGTON

JOB NO. 23035
SHEET 2/3

20 SCALE MILLER ROAD DETAIL



LEGEND

x		FENCE LINE
		CENTERLINE OF DRAINAGE
w		UNDERGROUND WATER LINE
ss		UNDERGROUND SEWER LINE
sd		UNDERGROUND STORM DRAIN LINE
ir		UNDERGROUND IRRIGATION LINE
ohu		OVERHEAD UTILITY LINE
		BUILDING STRUCTURE
		WOOD DECK
		GRAVEL
		CONCRETE
		ROCKERY
		ASPHALT / PAVEMENT
BM		BENCHMARK
	CNC	CONCRETE PIPE
CP		CARSONITE POST
	CPP	CORRUGATED PLASTIC PIPE
FH		FIRE HYDRANT
	IE	INVERT ELEVATION
LP		LIGHT POLE
MB		MAILBOX
	OTL	ELECTRIC OUTLET
	PVC	POLYVINYL CHLORIDE PIPE
S	SMH	SANITARY SEWER MANHOLE
TP		T-POST
	UG	UNDERGROUND UTILITY CONNECTION
UP		UTILITY POLE
	VERT	VERTICAL
WM		WATER METER
WP		WOOD POST
WV		WATER VALVE

811 Know what's **below.** **Call** before you dig.

FIGURE 4
2 of 2

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1	11/3/2023	UPDATED LABELING FOR HIGHLAND IRRIGATION DITCH.	EMALM	LNYQUIST
2	3/12/2024	UPDATED EXISTING UNDERGROUND WATER LINE IN MILLER ROAD BASED UPON NEW PAINT. ADDED PAINTED IRRIGATION LINE IN MILLER ROAD.	EMALM	LNYQUIST

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PAGE #: 68-78

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LEE D. NYQUIST STATE OF WASHINGTON 19994 REGISTERED PROFESSIONAL LAND SURVEYOR 4/2/2024

BELLA VISTA ESTATES, LLC

TOPOGRAPHIC SURVEY
FOR
BELLA VISTA ESTATES

CITY OF SEQUIM CLALLAM COUNTY WASHINGTON

JOB NO. 23035

SHEET
EC-3

SE 1/4, NW 1/4 SECTION 29, TOWNSHIP 30 NORTH, RANGE 3 WEST, WILLAMETTE MERIDIAN, CITY OF SEQUIM, CLALLAM COUNTY, WASHINGTON

LEGEND

- PRE-DEVELOPED CONTOURS
- POST-DEVELOPED CONTOURS
- PROPOSED RETAINING WALL
- PROJECT BOUNDARY
- FINISHED GRADE SLOPE
- BASIN BOUNDARY
- BYPASS AREA
- SIDEWALK
- ROAD
- VAULT

N

0 20 40 80 120

SCALE: 1" = 40'

EXIST. ROW

MILLER ROAD

TOKEN LANE

END FRONTAGE IMPROVEMENTS AT EXIST EP OF TOKEN LANE.

PROPOSED EP ALONG FRONTAGE IMPROVEMENTS

PROPOSED STORMWATER VAULT

SIDEWALK, TYP.

SEE VAULT EXCAVATION GRADING SHEET SD-3

TIE INTO EXISTING EP

EXIST. ROW

DRAINAGE BASIN BOUNDARY

WATER QUALITY TREATMENT BMP WQ#1

PROPOSED WATER QUALITY SUB-BASIN BOUNDARY

WATER QUALITY TREATMENT BMP WQ#2

BYPASS AREA

TRACT B

TW = 347.0 BW = 341.0 6.0'

TW = 358.0 BW = 351.0 7.0'

WALL SET 2' BACK FROM BOUNDARY PROPERTY LINE, TYP.

NO.	DATE	BY	CHK.	REVISIONS

GOLDSMITH LAND DEVELOPMENT SERVICES
11409 SE 6th St., Suite 150, Bellevue, WA 98004 | PO Box 2565, Yakima, WA 98907
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KEITH T. GOLDSMITH — STATE OF WASHINGTON — 20240405 — REGISTERED PROFESSIONAL ENGINEER

BELLA VISTA ESTATES, LLC

PRELIMINARY PLAT MAJOR SUBDIVISION
DEVELOPED CONDITIONS DRAINGE
BASIN PLAN

BELLA VISTA ESTATES

CITY OF SEQUIM CLALLAM COUNTY WASHINGTON

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SHEET 7

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FIGURE 6
DOWNSTREAM ANALYSIS MAP

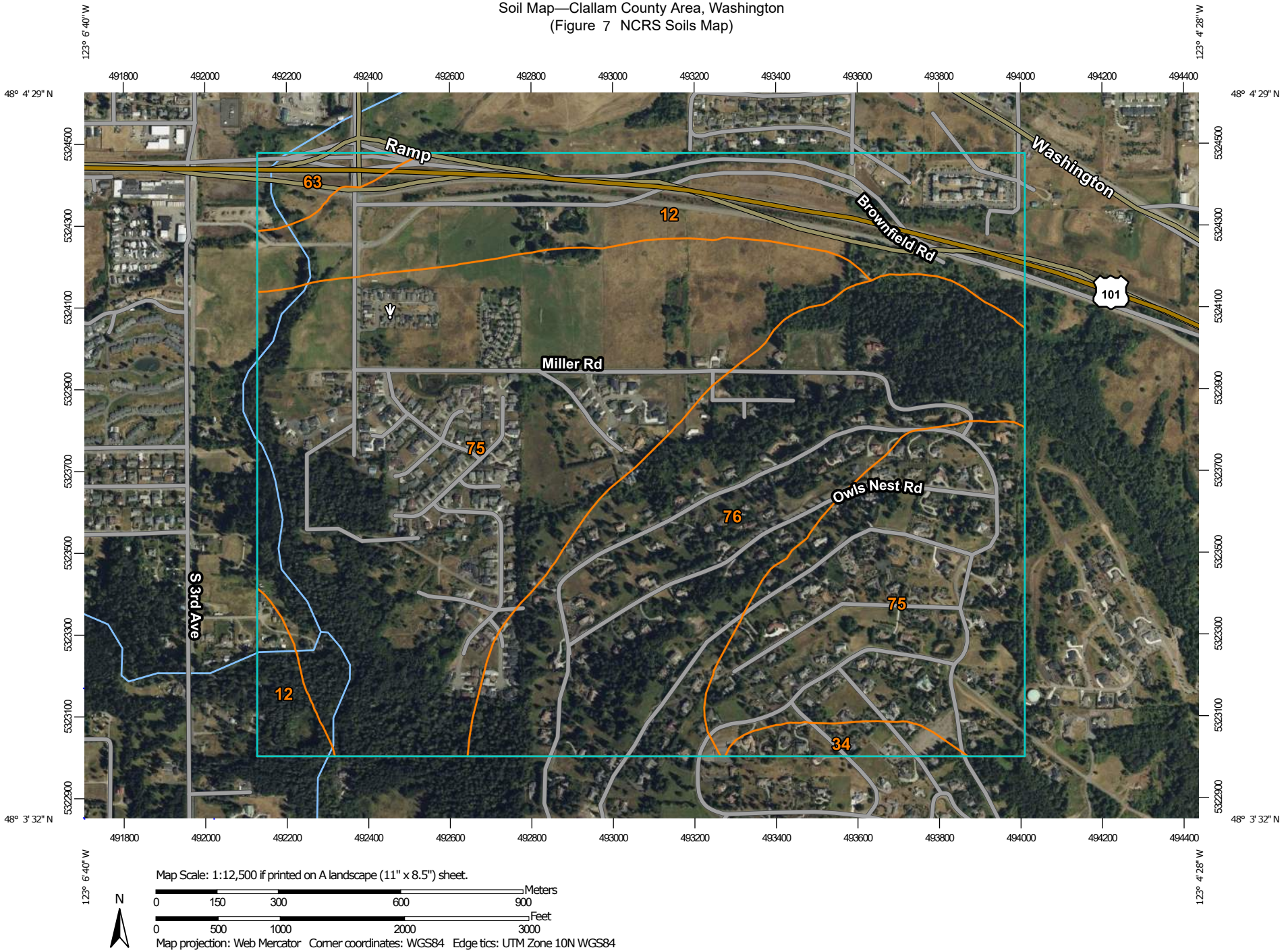
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KHOSIXO 3OHDVH EH DGYLVHG KRZHYHU W
WR VHUYH DV D JXLGH WR WKH JHQHUDO OR
DFFXUDF\ RI WKH LQGLYLGXDO OD\HUV YDUL
ZLWK RQH DQRWKHU 'HWHUPLQDWLRQ RI DI
IHDWXUHV VKRZQ RQ WKLV PDS W\SLFDOO\ U
TXDOLILHG VWDII $Q\ SHUVRQ RU HQWLW\ W
FRQWDLQHG KHUHLQ GRHV VR DW WKHLU RZ
QR ZDUUDQW\ RI WKH DFFXUDF\ RU XVHIXOQ

PL

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Soil Map—Clallam County Area, Washington
(Figure 7 NCRS Soils Map)



Map Scale: 1:12,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

Soil Survey Area: Clallam County Area, Washington
Survey Area Data: Version 21, Aug 29, 2023

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

Date(s) aerial images were photographed: Aug 8, 2022—Aug 29, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12	Clallam gravelly sandy loam, 0 to 15 percent slopes	127.5	18.5%
34	Louella gravelly loam, 10 to 30 percent slopes	10.1	1.5%
63	Sequim very gravelly sandy loam	10.6	1.5%
75	Yeary gravelly loam, 0 to 15 percent slopes	370.5	53.7%
76	Yeary gravelly loam, 15 to 35 percent slopes	170.8	24.8%
Totals for Area of Interest		**689.5**	**100.0%**

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

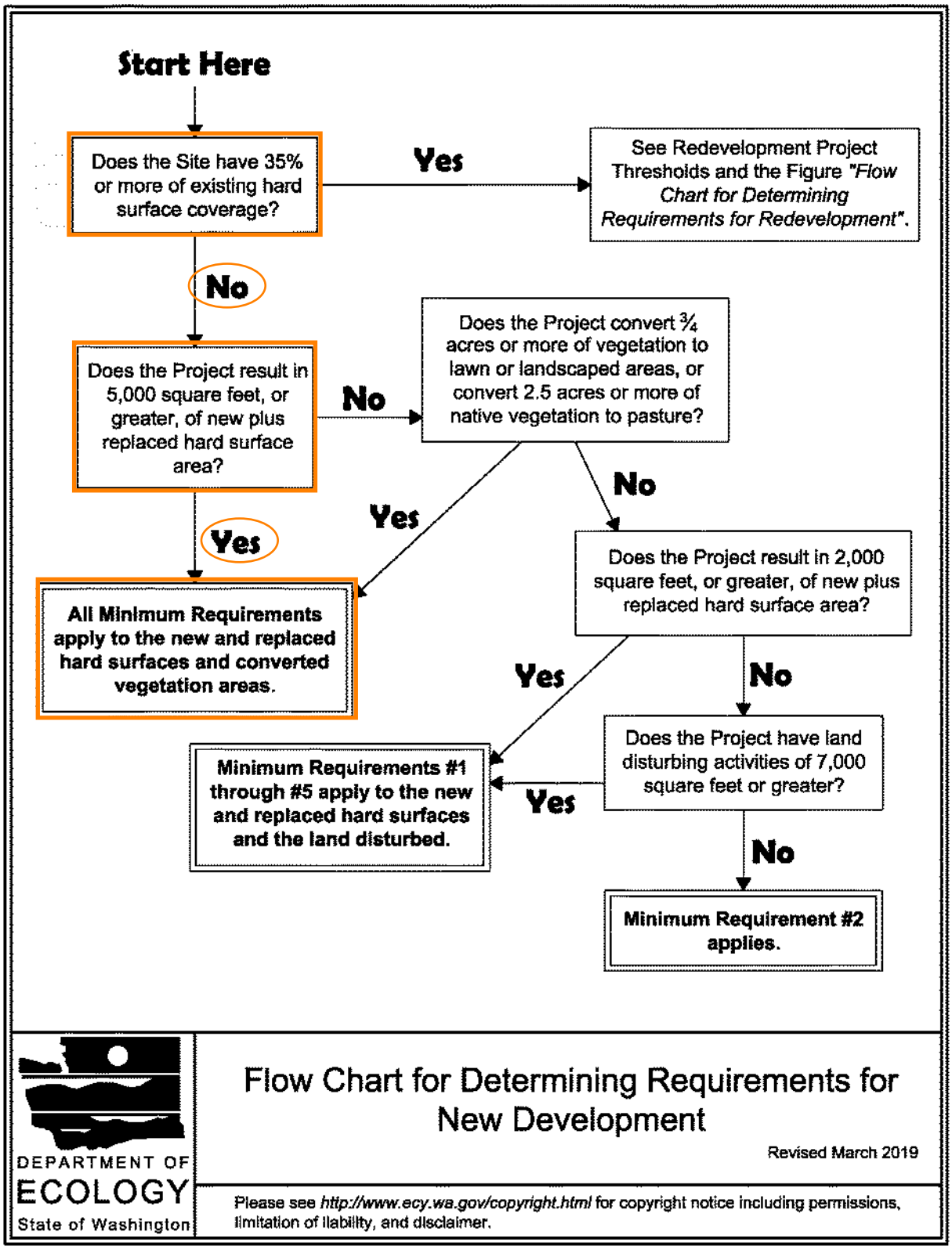


FIGURE 8

Figure I-3.3: Flow Chart for Determining MR #5 Requirements

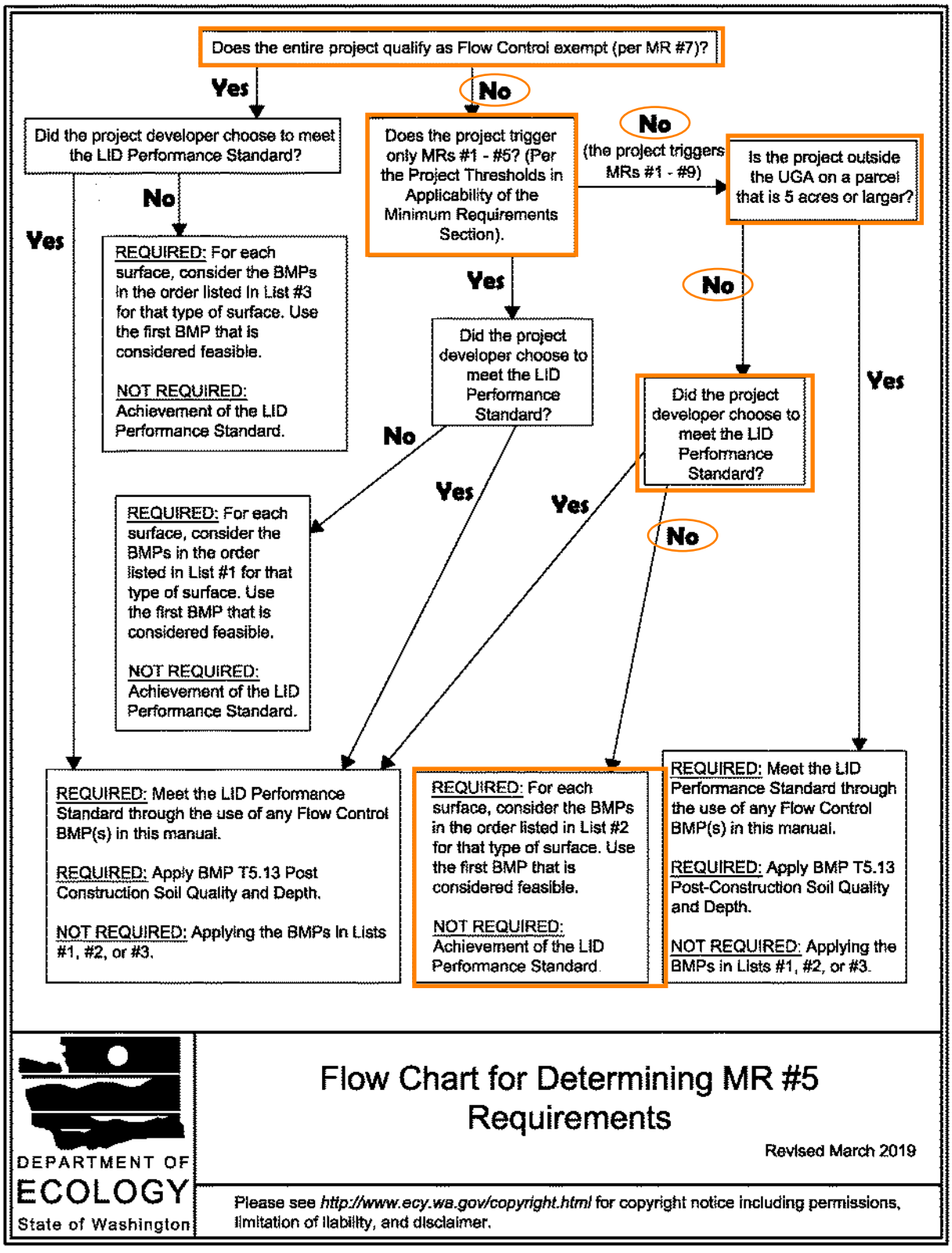


FIGURE 9

Appendix A

Geotechnical Report

GEOTECHNICAL REPORT

DRAFT

Bella Vista Estates
Miller Road and Token Lane
Sequim, Washington

Project No. T-8941

Terra Associates, Inc.

Prepared for:

Bella Vista Estates, LLC
Medina, Washington

October 12, 2023

TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

October 12, 2023
Project No. T-8941

Mr. Chris Weymouth
Bella Vista Estates, LLC
7811 Ridge Road
Medina, Washington 98038

DRAFT

Subject: Geotechnical Report
Bella Vista Estates
Miller Road and Token Lane
Sequim, Washington

Dear Mr. Weymouth:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

In general, the soil conditions at the site consist of approximately three to ten inches of organic topsoil overlying medium dense to very dense weathered and unweathered glacial till deposits to the termination of the test pits. No groundwater seepage was observed during our subsurface explorations.

In our opinion, the native soils on the site will be suitable for support of the proposed development, provided the recommendations presented in this report are incorporated into project design and construction.

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

Michael J. Xenos, E.I.T.
Staff Engineer

DRAFT

Carolyn S. Decker, P.E.
President

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Geotechnical Report
Bella Vista Estates
Miller Road and Token Lane
Sequim, Washington

1.0 PROJECT DESCRIPTION

The project consists of developing the site with 25 new residential building lots, a stormwater detention pond, along with associated access and utilities. Grading plans were not available at the time of this report. Based on existing site topography, we expect grading to be minor to moderate with cuts and fills ranging from 1 to 15 feet to achieve final building and road elevations.

We would expect that the residential structures will be two- to three-story, wood-frame buildings constructed over a crawlspace with an attached garage constructed at-grade. Foundation loads are expected to be relatively light, in the range of 4 to 8 kips per foot for bearing walls and 50 to 75 kips for isolated columns.

The recommendations in the following sections of this report are based on our understanding of the preceding design features. We should review design drawings as they become available to verify our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

We completed our work in accordance with our authorized proposal, dated August 30, 2023. Accordingly, on September 26, 2023, we observed soil and groundwater conditions in 10 soil test pits excavated with a track-mounted excavator to maximum depths of approximately 10 to 15 feet below existing grades. Using the information obtained from the subsurface exploration and laboratory testing, we performed analyses to develop geotechnical recommendations for project design and construction.

Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Geologic Hazards per the City of Sequim Municipal Code.
- Seismic Site Class per the current International Building Code (IBC).
- Site preparation and grading.
- Excavations.
- Foundation support.
- Slab-on-grade floors.
- Stormwater facilities.
- Infiltration feasibility.

- Drainage.
- Utilities.
- Pavements.

It should be noted, recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment are beyond Terra Associates, Inc.'s purview. A building envelope specialist or contactor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The site consists of a single residential tax parcel totaling about 7.26 acres located west of the intersection of Miller Road and Token Lane in Sequim, Washington. The approximate site location is shown on Figure 1.

The site is currently undeveloped and covered with brush and weeds with some mature trees in the northern and southern portions of the site. Site topography consists of a moderate slope the descends from the south to north with an overall vertical relief of approximately 160 feet.

3.2 Subsurface

In general, the soil conditions at the site consist of approximately three to ten inches of organic topsoil overlying medium dense to very dense silty sand and sandy silt deposits with varying gravel, cobble, and boulder content (weathered and unweathered glacial till) to the termination of the test pits. There were two exceptions to this general condition. In Test Pit TP-1 we observed approximately six feet of inorganic fill material composed of dense silty sand with gravel and stiff silt with sand overlying the dense till deposits. In Test Pit TP-6 we observed approximately five feet of medium dense sand with silt and gravel and gravel with silt and sand overlying the dense till deposits.

The *Geologic Map of the 7.5-Minute Quadrangle, Clallam County, Washington* by H.W. Schasse and R.L. Logan (1998) maps the site as Vashon Till (Qgt_v). The medium dense to very dense silty sand and sandy silt deposits observed in the test pits are consistent with this mapped description.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) classifies the onsite soils as Yeary gravelly loam material. A soil horizon, consisting of this material, is typically by glacial processes in the form of hillslopes, and is derived from glaciomarine or glaciolacustrine deposits over till which is consistent with our exploratory findings and knowledge of the area's geologic setting.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Pit Logs in Appendix A. The approximate location of the test pits are shown on the Exploration Location Plan, Figure 2.

3.3 Groundwater

We did not observe any groundwater seepage during our explorations. However, mottled soils were observed in all the test pits near the contact between the upper weathered till and lower unweathered till, which typically indicates the presence of seasonal perched groundwater at the site. The occurrence of shallow perched groundwater is typical for sites underlain by fine-grained soils. We expect perched groundwater levels and flow rates will fluctuate seasonally and will typically reach their highest levels during and shortly following the wet winter months (November through May). Given the time of year our field work was completed and our experience with groundwater conditions in the area, the groundwater levels observed likely represent seasonal low levels.

3.4 Geologic Hazards

Section 18.80.030.G of the City of Sequim Municipal Code (SMC) defines geologic hazards as "...areas that, because of their susceptibility to erosion, sliding, earthquake, or other geological event, are not normally suited to siting commercial, residential or industrial development consistent with public health or safety concerns." We evaluated site conditions for the presence of erosion, landslide, and seismic hazards in the discussions below.

3.4.1 Erosion Hazard Areas

Section 18.80.030.E of the SMC defines Erosion Hazard Areas as "...areas containing soils which, according to the United States Department of Agriculture Soil Conservation Service Soil Classification System, may experience severe to very severe erosion. Erosion hazard areas also include coastal erosion-prone areas and channel migration zones."

The onsite soils are classified as Yeary gravelly loam, 0 to 15 percent slopes, by the United States Department of Agriculture Natural Resources Conservation Service. (NRCS). With existing gradients, these soils are rated as moderately susceptibility to erosion. Therefore, the site would not be classified as an erosion hazard area as defined by the SMC, in our opinion.

We did not observe any indications of significant active erosion at the site; however, the potential for soil erosion will increase during construction. In our opinion, proper implementation and maintenance of Best Management Practices (BMPs) for erosion prevention and sediment control, in conjunction with appropriate site drainage, will adequately mitigate the erosion potential in the planned development area. Erosion protection measures as required by the City of Sequim will need to be in place prior to and during grading activities at the site.

3.4.2 Landslide Hazard Areas

Section 18.80.030.L of the SMC defines landslide hazard areas as "...areas at risk of mass movement due to a combination of geologic, topographic and hydrologic factors. The following areas are considered to be subject to landslide hazards:

1. Areas of historic failures or potentially unstable slopes, such as areas mapped within Soil Conservation Service Slide Hazard Area Studies; as unstable, unstable old slides, or unstable recent slides designated by the Department of Ecology Coastal Zone Atlas; and as quaternary slumps, earthflows, mudflows, lahars or landslides on maps published by the United States Geological Survey or Department of Natural Resources, Division of Geology and Earth Resources;

2. Any area with a combination of:

   a. Slopes 15 percent or steeper, and

   b. Impermeable soils (typically silt and clay) frequently interbedded with granular soils (predominantly sand and gravel), and

   c. Springs or ground water seepage;

3. Any slope of 40 percent and with a vertical relief of 10 or more feet except areas composed of consolidated rock;

4. Any slope greater than 80 percent subject to rockfall during seismic events;

5. Any area which has shown movement during the past 10,000 years or which is underlain by mass wastage debris from that period of time;

6. Any area potentially unstable as a result of rapid stream incision, stream bank erosion (e.g., ravines) or undercutting by wave action (e.g., marine bluffs);

7. Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials."

Existing site topography throughout the site generally consists of a moderate slope descending from the south to the north with little to no risk of mass movement due to geologic, topography, or hydrologic factors. Grades across the site generally range from 10 to 30 percent and are underlain by glacially consolidated till. Therefore, in our opinion none of the above criteria for classification as a landslide hazard are present at the site.

3.4.3 Seismic Hazard Areas

Section 18.80.030.E of the SMC defines Seismic Hazard Areas as "… areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement or subsidence, soil liquefaction, surface faulting, or tsunamis. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless soils of low density usually in association with a shallow ground water table. One indicator of potential for future earthquake damage is a record of earthquake damage in the past. Ground shaking is the primary cause of earthquake damage in Washington, and ground settlement may occur with shaking."

A review of a map titled *Faults and Earthquakes in Washington State*, dated 2014 by Jessica L. Czajkowski and Jeffrey D. Bowman, shows the fault nearest to the site is an unnamed fault and is located approximately 1.6 miles southwest of the site. Quaternary-age activity of the fault (rupture within the last two million years) is predicted to have occurred during the Holocene, or within the last 11,700 years. Accordingly, during a seismic event, the risk of ground rupture along a fault line at the site is low.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sands underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus eliminating the soil's strength.

The site is currently mapped on the Washington State DNR's *Natural Hazards Single-Topic Map* as having very low liquefaction potential. Based on the soil and groundwater conditions we observed, it is our opinion that the risk for soil liquefaction occurring at the site is negligible due to the relative density of the soils and amount of cohesive material that would be sufficient to resist the cyclical loading of a seismic event. Therefore, in our opinion, the site would not be considered a seismic hazard area as defined by the SMC.

3.5 Seismic Site Class

Based on soil conditions observed in the test pits, and our knowledge of the area geology, per Chapter 16 of the current International Building Code (IBC), Site Class "C" should be used in structural design.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, there are no geotechnical considerations that would preclude development of the site as currently planned. The residential buildings can be supported on conventional spread footings bearing on competent native soils, competent existing fill soils, or on structural fill placed on the competent soils observed below the organic surface horizon. Pavement and floor slabs can be similarly supported.

Most of the native and existing fill soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet. The ability to use the native and existing fill soils from site excavations as structural fill will depend upon its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import clean granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious material should be stripped and removed from the site. Surface stripping depths of approximately three to ten inches should be expected to remove the organic surface soils and vegetation. Organic topsoil will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired building grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates, Inc. to verify soil conditions are as expected and suitable for support of new fill or building elements. Our representative may request a proofroll using heavy rubber-tired equipment to determine if any isolated soft and yielding areas are present. If excessively yielding areas are observed and they cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill. If the depth of excavation to remove unstable soils is excessive, the use of geotextile fabrics, such as Mirafi 500X or an equivalent fabric can be used in conjunction with clean granular structural fill. Our experience has shown, in general, a minimum of 18 inches of a clean, granular structural fill placed and compacted over the geotextile fabric should establish a stable bearing surface.

Our study indicates that the majority of the native and existing fill soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet or too dry. The ability to use native and existing fill soils from site excavations as structural fill will depend upon its moisture content, the prevailing weather conditions at the time of construction, and the contractor's ability to compact the soils. If wet soils are encountered, the contractor will need to dry the soils by aeration during dry weather conditions. Alternatively, the use of an additive, such as Portland cement, cement kiln dust (CKD), or lime to stabilize the soil moisture can be considered. If the soil is amended, additional Best Management Practices (BMPs) addressing the potential for elevated pH levels will need to be included in the Stormwater Pollution Prevention Program (SWPPP) prepared with the Temporary Erosion and Sedimentation Control (TESC) plan. Cobbles and boulders in excess of six inches in diameter should be removed from the structural fill.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet-weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-1557 (Modified Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

4.3 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the medium dense soils would be classified as Type C soils. The dense till soils and stiff silt would be classified as Type B soils. The very dense till soils would be classified as Type A soils.

Accordingly, temporary excavations in Type C soils should have their slopes laid back at an inclination of 1.5:1 (Horizontal: Vertical) or flatter, from the toe to the crest of the slope. Side slopes in Type B soils can be laid back at a slope inclination of 1:1 or flatter. For temporary excavation slopes less than 8 feet in height in Type A soils, the lower 3.5 feet can be cut to a vertical condition, with a 0.75:1 slope graded above. For temporary excavation slopes greater than 8 feet in height up to a maximum height of 12 feet, the slope above the 3.5-foot vertical portion will need to be laid back at a minimum slope inclination of 1:1. No vertical cut with a backslope immediately above is allowed for excavation depths that exceed 12 feet. In this case, a four-foot vertical cut with an equivalent horizontal bench to the cut slope toe is required. All exposed temporary slope faces that will remain open for an extended period of time should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

Perched groundwater seepage should be anticipated within excavations during the wet winter season. We anticipate that the volume of water and rate of flow into the excavation will be relatively minor and are not expected to impact the stability of the excavations when completed, as described. Conventional sump pumping procedures, along with a system of collection trenches, if necessary, should be capable of maintaining a relative dry excavation for construction purposes.

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

4.4 Foundation Support

The residential buildings may be supported on conventional spread footing foundations bearing on competent native soils, competent existing fill soils, or on structural fill placed above the competent soils. Foundation subgrade should be prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should bear a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

The native and existing fill soils will be easily disturbed by normal construction activity particularly when wet. Care will need to be exercised during construction to avoid excessively disturbing the subgrade. If disturbed, the material should be removed and footings lowered to undisturbed material or grade restored with structural fill. During wet-weather conditions, to avoid disturbance, consideration should be given to protecting the fill foundation subgrade with a four-inch layer of crushed rock or lean mix concrete.

Foundations bearing on competent soils can be dimensioned for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With structural loading as anticipated, and this bearing stress applied, estimated total settlements are less than one- inch.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing and buried portion of the foundation stem wall can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 350 pcf. We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent reworked native soil, or backfilled with structural fill as described in Section 4.2 of this report. The values recommended include a safety factor of 1.5.

4.5 Slab-on-Grade Floors

Slab-on-grade floors may be supported on subgrade prepared as recommended in Section 4.2 of this report. Immediately below the floor slab, we recommend placing a four-inch-thick capillary break layer composed of clean, coarse sand or fine gravel that has less than five percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction and to aid in uniform curing of the concrete slab. It should be noted, if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

4.6 Lateral Earth Pressures on Below-Grade Walls

The magnitude of earth pressure development on below-grade walls will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To guard against hydrostatic pressure development, wall drainage must also be installed. A typical recommended wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be added to the 35 pcf. To account for typical traffic surcharge loading, the walls can be designed for an additional imaginary height of two feet (two-foot soil surcharge). For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall, should be applied in addition to the static lateral earth pressure. These values assume a horizontal backfill condition and that no other surcharge loading, sloping embankments, or adjacent buildings will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.

4.7 Infiltration Feasibility

The glacially consolidated soils composed of silty sand with gravel and sandy silt with gravel characteristically exhibit low permeability and would not be a suitable receptor soil for discharge of development stormwater using infiltration/retention facilities. A pocket of sand and gravel material was observed in Test Pit TP-6, however this material appears to be isolated to the vicinity of the test pit and would likely have insufficient volume to control infiltrated stormwater. Even low impact development (LID) techniques such as rain gardens, dry wells, or permeable pavement would likely fill up during rain events, overtop, and cause minor local flooding.

4.8 Stormwater Facilities

Site stormwater plans were not available at the time of this report.

Detention Vault

We expect the bottom of the excavations for the detention vaults will expose dense to very dense silty sand to sandy silt with varying gravel content. Vault foundations supported by these native soils may be designed for an allowable bearing capacity of 6,000 psf. For short-term loads, such as seismic, a one-third increase in this allowable capacity can be used.

Vault walls should be designed as below-grade retaining walls. The magnitude of earth pressure development on engineered retaining walls will partly depend upon the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To prevent overstressing the walls during backfilling, heavy construction machinery should not be operated within five feet of the wall. Wall backfill in this zone should be compacted with hand-operated equipment. To prevent hydrostatic pressure development, wall drainage must also be installed. A typical wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 pounds per square foot (psf) should be added to the 35 pcf. To account for typical traffic surcharge loading, the walls can be designed for an additional imaginary height of two feet (two-foot soil surcharge). For evaluation of below-grade walls under seismic loading, an additional uniform lateral pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall in feet, can be used. These values assume a horizontal backfill condition and that no other surcharge loading such as traffic, sloping embankments, or adjacent buildings will act on the wall. If such conditions will exist, then the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are given in Section 4.4 of this report.

If it is not possible to discharge collected water at the footing invert elevation, the invert elevation of the wall drainpipe could be set equivalent to the outfall invert. For any portion of the wall that falls below the invert elevation of the wall drain, an earth pressure equivalent to a fluid weighing 85 pcf should be used.

Stormwater Ponds

If fill berms will be constructed, the berm locations should be stripped of topsoil, duff, and soils containing organic material prior to the placement of fill. The fill berms should be constructed by placing structural fill in accordance with recommendations outlined in Section 4.2 of this report. Material used to construct pond berms should consist of predominately granular soils with a maximum size of three inches and a minimum of 20 percent fines. Terra Associates, Inc. should examine and test all onsite or imported materials proposed for use as berm fill prior to their use.

Due to the exposure to fluctuating stored water levels and wave action, soils exposed on the interior side slopes of the ponds may be subject to some risk of periodic shallow instability or sloughing. Establishing interior slopes at a 3:1 gradient will significantly reduce or eliminate this potential. Exterior berm slopes and interior slopes above the maximum water surface should be graded to a finished inclination no steeper than 2:1. Finished slope faces should be thoroughly compacted and vegetated to guard against erosion.

We should review the stormwater plans when they are completed and revise our recommendations, if required.

4.9 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a positive drainage gradient away from the building perimeter. If this gradient cannot be provided, surface water should be collected adjacent to the structures and directed to appropriate storm facilities. In addition, we recommend providing a positive drainage gradient away from the crest of the slope to prevent runoff along the face of the slope.

Subsurface

We recommend installing perimeter foundation drains adjacent to shallow foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe enveloped in washed pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

4.10 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or the local jurisdictional specifications. At a minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. As noted, most native soils excavated on the site should be suitable for use as backfill material during dry weather conditions. However, if utility construction takes place during the wet winter months, it will likely be necessary to import suitable wet-weather fill for utility trench backfilling.

4.11 Pavements

Pavement subgrades should be prepared as described in Section 4.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tired construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. For residential access, with traffic consisting mainly of light passenger vehicles with only occasional heavy traffic, and with a stable subgrade prepared as recommended, we recommend the following pavement sections:

- Two inches of Hot Mix Asphalt (HMA) over four inches of Crushed Rock Base (CRB).
- Three and one-half inches of full depth HMA.

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for half-inch class HMA and CRB.

Long-term pavement performance will depend on surface drainage. A poorly drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings and specifications in order to verify earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical service during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Bella Vista Estates project in Sequim, Washington. This report is for the exclusive use of Bella Vista Estates, LLC and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the subsurface explorations completed onsite. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

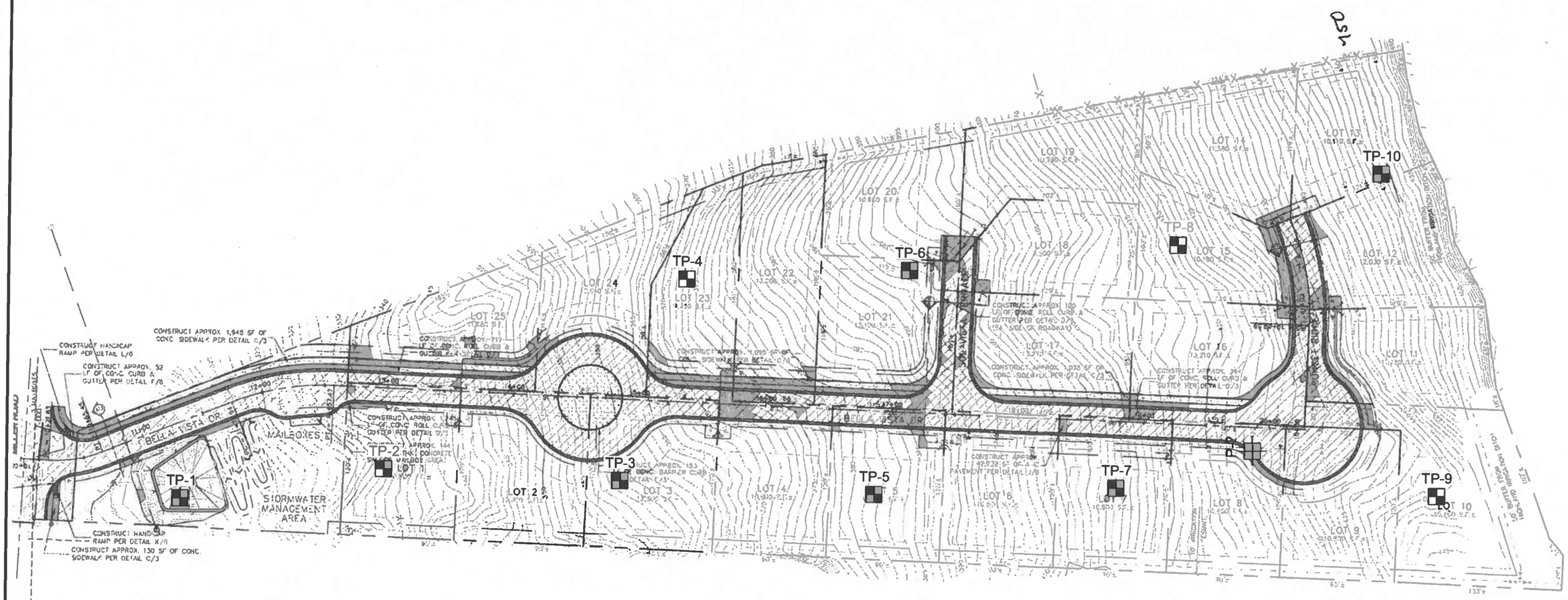


REFERENCE: https://www.bing.com/maps ACCESSED 2023

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Environmental Earth Sciences

VICINITY MAP
BELLA VISTA ESTATES
SEQUIM, WASHINGTON

Proj.No. T-8941	Date:OCT 2023	Figure 1



NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY CLIENT.

LEGEND:

APPROXIMATE TEST PIT LOCATION

0 80 160

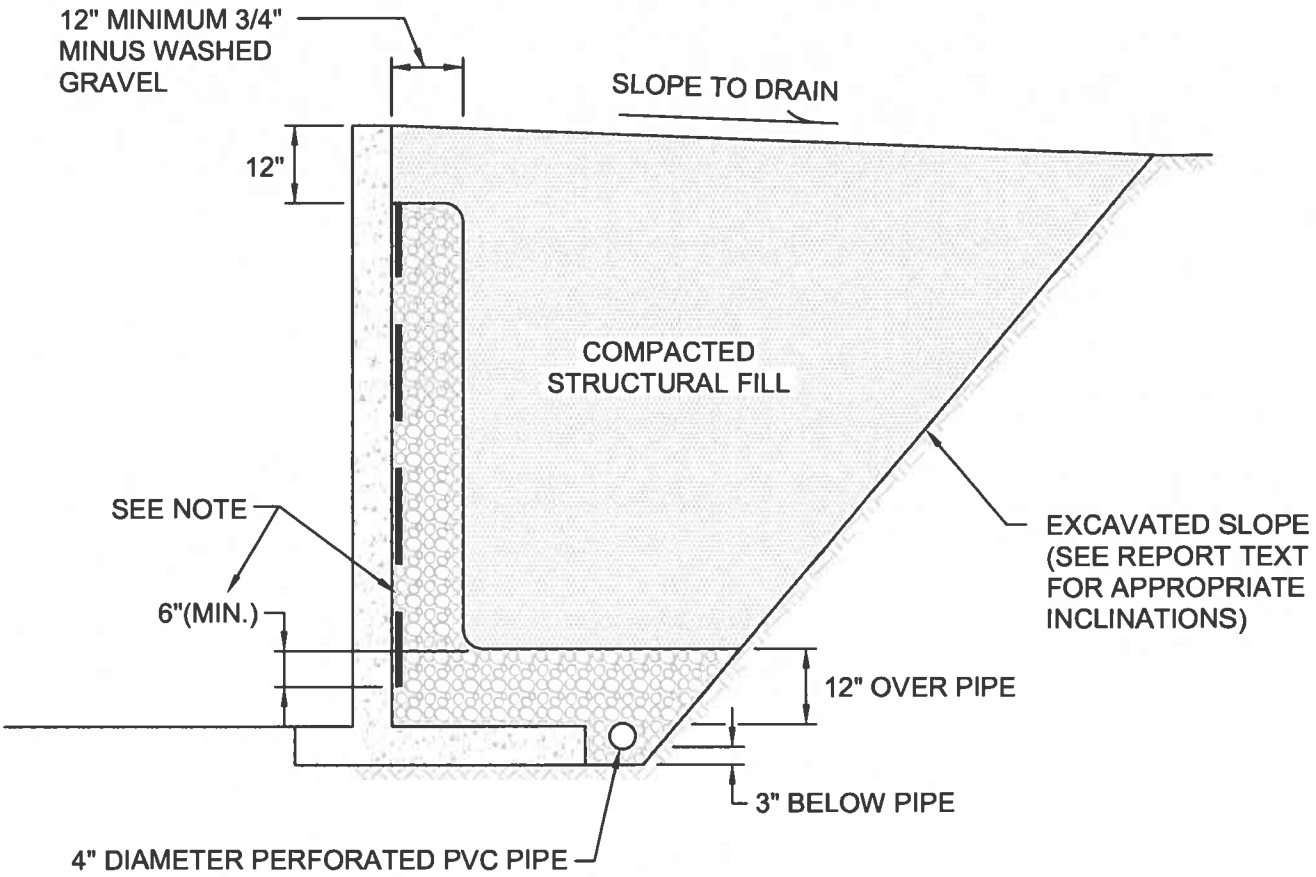
APPROXIMATE SCALE IN FEET

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EXPLORATION LOCATION PLAN
BELLA VISTA ESTATES
SEQUIM, WASHINGTON

Proj.No. T-8941	Date: OCT 2023	Figure 2



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
BELLA VISTA ESTATES
SEQUIM, WASHINGTON

Proj.No. T-8941	Date: OCT 2023	Figure 3

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Bella Vista Estates
Sequim, Washington

On September 26, 2023, we explored soil conditions at the site by excavating 10 test pits to maximum depths of approximately 10 to 15 feet below existing site grades using an excavator. The test pit locations were approximately determined in the field using GPS coordinates and by sighting and pacing from existing surface features. The approximate test pit locations are shown on Figure 2. The Test Pit Logs are presented as Figures A-2 through A-11.

A geotechnical engineer from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of the test pit, obtained representative soil samples, and recorded water levels observed during excavation. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test pits were placed in sealed plastic bags and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the Test Pit Logs. Grain size analyses were performed on select soil samples. The results are shown on Figures A-12 and A-13.

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
			SP	Poorly-graded sands, sands with gravel, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity. (Lean clay)
			OL	Organic silts and organic clays of low plasticity.
	SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
			CH	Inorganic clays of high plasticity. (Fat clay)
			OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
‖	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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Environmental Earth Sciences

UNIFIED SOIL CLASSIFICATION SYSTEM
BELLA VISTA ESTATES
SEQUIM, WASHINGTON

Proj.No. T-8941	Date:OCT 2023	Figure A-1

LOG OF TEST PIT NO.TP-1

FIGURE A-2

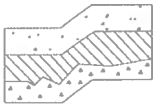
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(10-inches organic TOPSOIL) FILL: Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry, scattered cobbles, trace rootlets. (SM)	Dense	6.5
2		FILL: Bluish-gray SILT with sand, fine to medium sand, moist, trace gravel, trace small-sized organic fragments. (ML)	Stiff	23.4
3				
4				
5		*8-inch diameter PVC sewer pipe observed at approximately 5 feet*		
6		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, mottled, trace cobbles, weak to moderate cementation. (SM)	Dense	12.0
7				
8			Very Dense	
9				
10		Test Pit terminated at approximately 10 feet. No groundwater seepage observed. No caving observed.		11.5
11				
12				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-2

FIGURE A-3

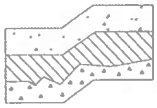
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(3-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, trace cobbles, occasional boulder, occasional rootlet, occasional silt layer, occasional sand seam, weak to moderate cementation. (SM)		6.0
3				
4			Dense	10.7
5				
6				
7				
8				10.1
9				
10				
11			Very Dense	
12				
13				
14				
15				12.7
16		Test Pit terminated at approximately 15 feet. No groundwater seepage observed. No caving observed.		
17				
18				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-3

FIGURE A-4

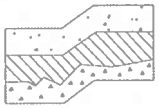
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(3-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, scattered cobbles, occasional boulder, occasional rootlet, weak to moderate cementation. (SM)		5.4
3				
4				9.3
5			Dense	
6				
7				
8				8.3
9		*3-inch sand layer observed*		
10				
11				
12			Very Dense	
13				
14				
15				12.3
16		Test Pit terminated at approximately 15 feet. No groundwater seepage observed. No caving observed.		
17				
18				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-4

FIGURE A-5

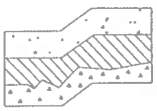
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(3-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, trace cobbles, occasional boulder, occasional rootlet, weak to moderate cementation. (SM)		4.7
3				
4			Dense	13.3
5				
6				
7				
8		*2-inch sand layer observed*		18.6
9				
10		Gray sandy SILT, fine to coarse sand, moist, trace cobbles, trace fine gravel, occasional boulder, weak to moderate cementation. (ML)	Very Dense	
11				
12				20.0
13		Test Pit terminated at approximately 12 feet. No groundwater seepage observed. No caving observed.		
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-5

FIGURE A-6

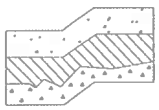
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(5-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, trace cobbles, occasional boulder, occasional rootlet, weak to moderate cementation. (SM)		5.1
3				
4			Dense	10.4
5				
6				
7				
8				
9				
10				11.0
11			Very Dense	
12				
13				
14				
15				9.1
16		Test Pit terminated at approximately 15 feet. No groundwater seepage observed. No caving observed.		
17				
18				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-6

FIGURE A-7

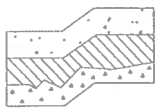
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(4-inches organic TOPSOIL) Gray GRAVEL with silt and sand, fine to coarse sand, fine to coarse gravel, dry, scattered cobbles, occasional boulder, occasional rootlet. (GP-GM)	Medium Dense	2.6
4		Gray SAND with silt and gravel, fine to coarse sand, fine to coarse gravel, dry, scattered cobbles. (SP-SM)		4.3
6		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, trace cobbles, occasional boulder, weak to moderate cementation. (SM)	Dense	12.7
10				10.1
12		Test Pit terminated at approximately 12 feet. No groundwater seepage observed. No caving observed.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-7

FIGURE A-8

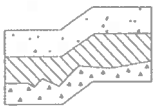
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(5-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, trace cobbles, occasional boulder, occasional rootlet, weak to moderate cementation. (SM)		6.7
3				
4			Dense	11.0
5				
6				
7				
8				
9				
10				11.7
11			Very Dense	
12				
13				
14		*Trace sand seams observed*		
15				9.4
16		Test Pit terminated at approximately 15 feet. No groundwater seepage observed. No caving observed.		
17				
18				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-8

FIGURE A-9

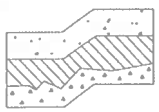
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1–2–3		Brownish-gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry, scattered cobbles, scattered boulders, occasional rootlet. (SM)	Medium Dense to Dense	5.7
4				16.9
5–6–7		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, mottled, trace cobbles, trace boulders, trace sandy silt layers, weak to moderate cementation. (SM)	Dense	
8				11.9
9–10–11			Very Dense	
12				10.1
13–14		Test Pit terminated at approximately 12 feet. No groundwater seepage observed. No caving observed.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-9

FIGURE A-10

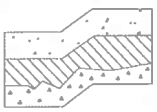
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Blackberries **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(6-inches organic TOPSOIL)		
2		Brownish-gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, occasional cobble, occasional rootlet, (SM)	Medium Dense	11.5
3		Gray silty SAND to silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, mottled, trace cobbles, occasional boulder, weak to moderate cementation. (SM)		
4				14.0
5				
6			Dense	
7				22.4
8		*Highly weathered sandstone(?) inclusion observed*		
9				
10				11.7
11				
12			Very Dense	
13				
14				
15				10.6
16		Test Pit terminated at approximately 15 feet. No groundwater seepage observed. No caving observed.		
17				
18				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO.TP-10

FIGURE A-11

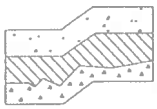
PROJECT NAME: Bella Vista Estates **PROJ. NO:** T-8941 **LOGGED BY:** MJX

LOCATION: Sequim, Washington **SURFACE CONDITIONS:** Tall Grass **APPROX. ELEV:** NA

DATE LOGGED: September 26, 2023 **DEPTH TO GROUNDWATER:** NA **DEPTH TO CAVING:** NA

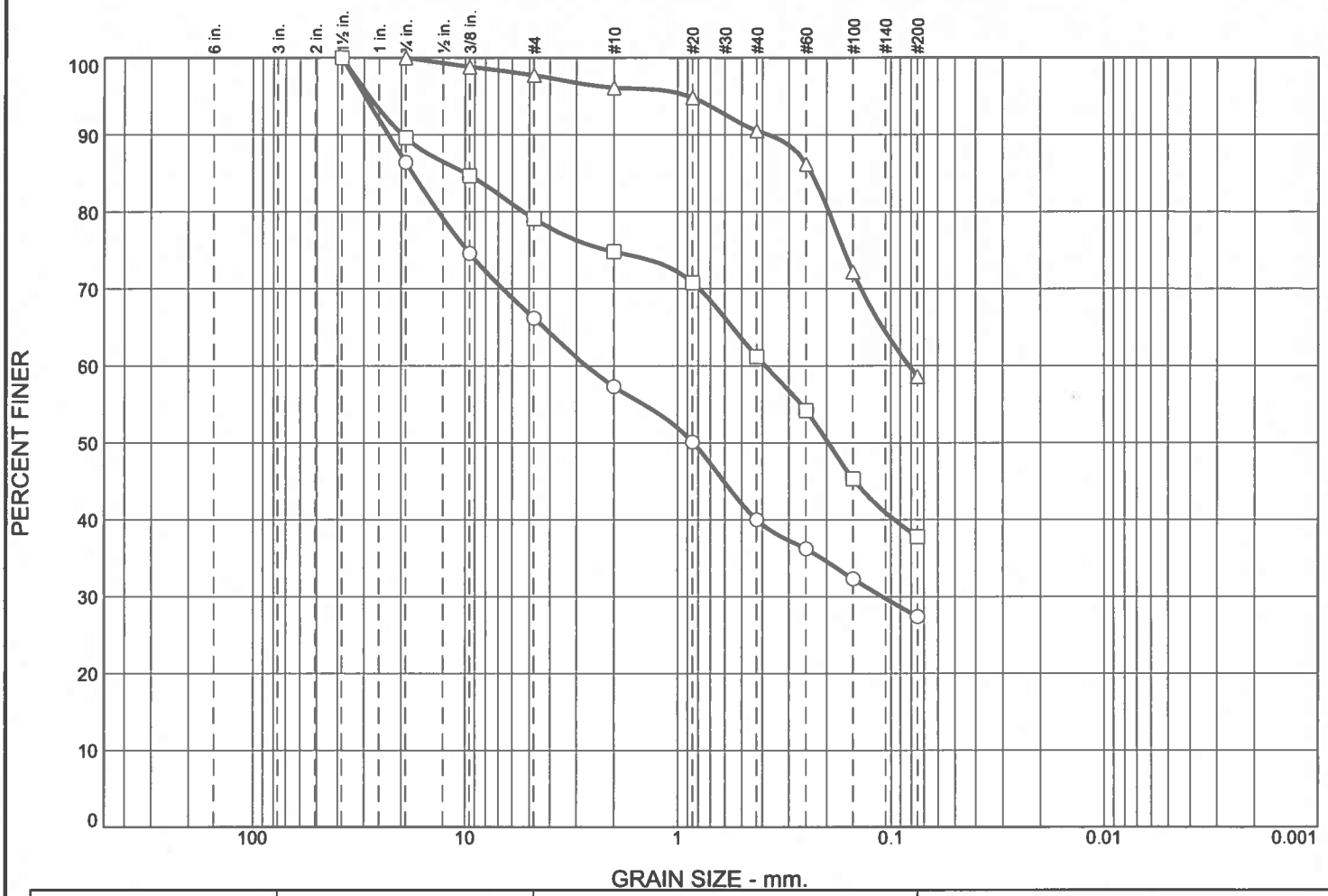
Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(4-inches organic TOPSOIL)		
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, mottled, trace cobbles, occasional boulder, occasional rootlet, weak to moderate cementation. (SM)		4.4
3				
4				11.0
5			Dense	
6				
7				
8				
9				
10			Very Dense	
11				
12				11.2
13		Test Pit terminated at approximately 12 feet. No groundwater seepage observed. No caving observed.		
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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Environmental Earth Sciences

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	13.6	20.2	8.9	17.3	12.6	27.4	
□	0.0	10.4	10.5	4.3	13.6	23.4	37.8	
△	0.0	0.0	2.3	1.6	5.6	31.9	58.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			17.6822	2.6907	0.8435	0.1099				
□			9.9649	0.3877	0.1964					
△			0.2359	0.0820						

Material Description	USCS	AASHTO
○ silty SAND with gravel	SM	
□ silty SAND with gravel	SM	
△ sandy SILT	ML	

Project No. T-8941 **Client:** Bella Vista Estates, LLC

Project: Bella Vista Estates

○ **Location:** Test Pit TP-1 **Depth:** -6 feet **Sample Number:** 3

□ **Location:** Test Pit TP-4 **Depth:** -1.5 feet **Sample Number:** 1

△ **Location:** Test Pit TP-4 **Depth:** -12 feet **Sample Number:** 4

Terra Associates, Inc.

Kirkland, WA

Remarks:

○ Tested on October 4, 2023

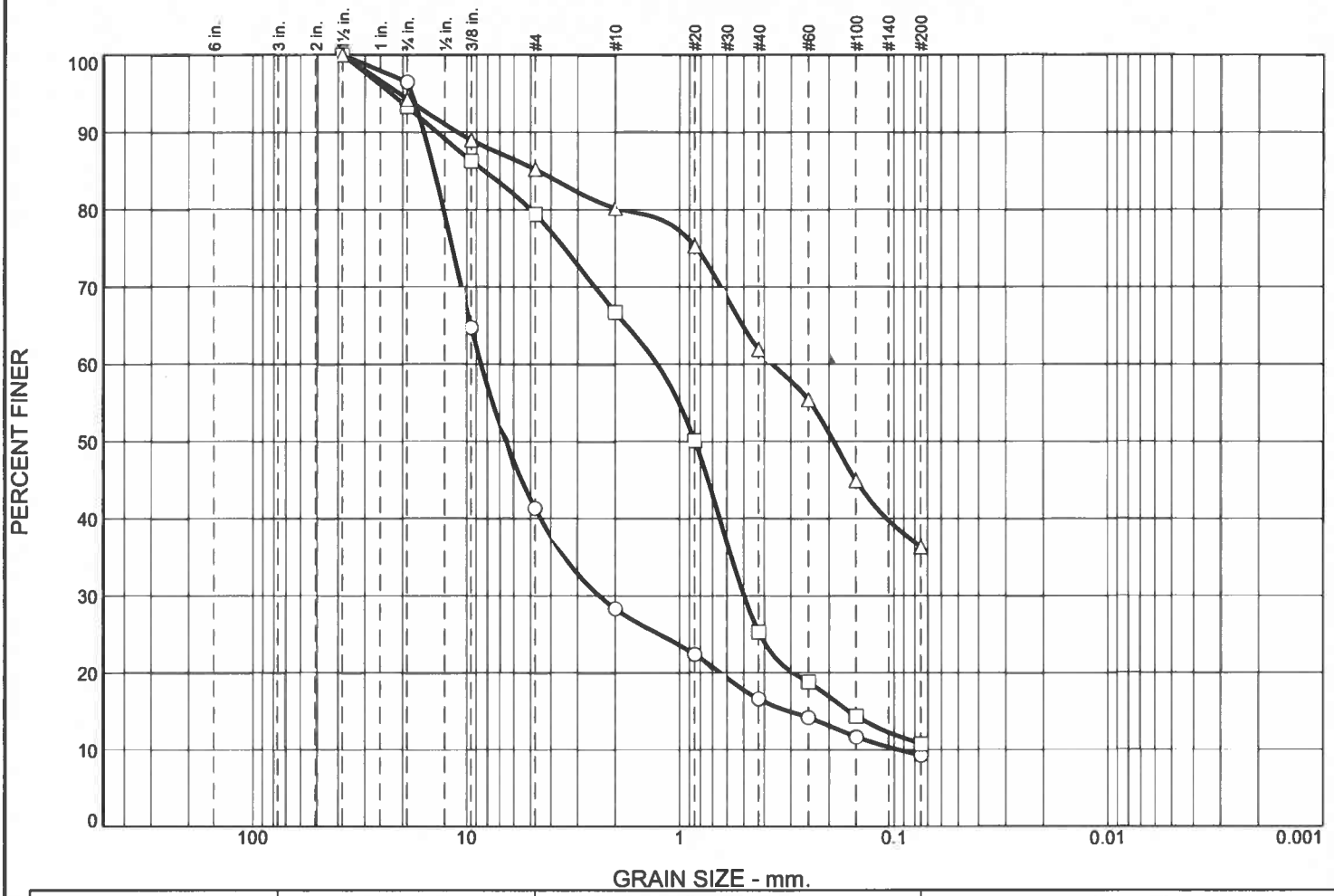
□ Tested on October 3, 2023

△ October 3, 2023

Figure A-12

Tested By: KJ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.5	55.2	13.0	11.7	7.3	9.3	
□	0.0	6.7	13.9	12.7	41.4	14.5	10.8	
△	0.0	5.7	9.1	5.0	18.3	25.6	36.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			14.2521	8.5703	6.5358	2.3832	0.3049	0.0949	6.98	90.33
□			8.2727	1.2767	0.8474	0.4982	0.1616			
△			4.5938	0.3673	0.1907					

Material Description	USCS	AASHTO
○ GRAVEL with silt and sand	GP-GM	
□ SAND with silt and gravel	SP-SM	
△ silty SAND	SM	

Project No. T-8941 **Client:** Bella Vista Estates, LLC

Project: Bella Vista Estates

○ **Location:** Test Pit TP-6 **Depth:** -1.5 feet **Sample Number:** 1

□ **Location:** Test Pit TP-6 **Depth:** -4 feet **Sample Number:** 2

△ **Location:** Test Pit TP-9 **Depth:** -15 feet **Sample Number:** 5

Terra Associates, Inc.

Kirkland, WA

Remarks:

○ Tested on October 3, 2023

□ Tested on October 3, 2023

△ Tested on October 3, 2023

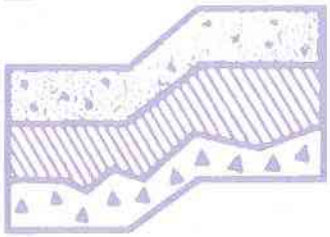
Figure A-13

Tested By: KJ

GEOTECHNICAL REPORT

Arborwood Phase 2
Kingston, Washington

Project No. T-8502-4



Terra Associates, Inc.

Prepared for:

Pulte Homes of Washington, Inc.
Bellevue, Washington

March 28, 2022
Revised March 26, 2024

Geotechnical Report
Arborwood Phase 2
Kingston, Washington

1.0 PROJECT DESCRIPTION

Early C&G SDAP dated 3-01-2024 had been provided for reference

The project consists of developing Phase 2 of the Arborwood Development. Phase 2 consists of developing the site with ~~110~~ 98 residential building lots, recreational areas, and associated utilities, stormwater facilities, and access. Grading and development plans were not available at the time of this report. Based on the existing topography, we expect grading, to achieve building lot and roadway elevations, will consist of approximately 5 to 20 feet of cut and fill across the site.

The recommendations contained in the following sections of this report are based on our understanding of the conceptual design features discussed above. We should review design drawings as they become available to verify our recommendations have been properly interpreted and incorporated into project design, and to amend or supplement our recommendations, if required.

2.0 SCOPE OF WORK

Our work was completed in accordance with our authorized proposal dated January 3, 2022. Accordingly, on January 12 and 13, 2022, we investigated subsurface conditions at the site by observing soil conditions in 40 test pits excavated to maximum depths of about 12 feet below current site grades. Using the results of our subsurface exploration and laboratory testing, along with existing soils data, analyses were undertaken to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Geologic Hazards per the Kitsap County Code.
- Seismic Criteria per the current International Building Code (IBC).
- Site preparation and grading.
- Excavations.
- Foundations.
- Slab-on-grade floors.
- Lateral earth pressures for wall design.
- Stormwater facilities.
- Infiltration feasibility.
- Drainage.
- Utilities.
- Pavements.

It should be noted, recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structural environment are beyond Terra Associates, Inc.'s purview. A building envelope specialist or contactor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

(# 5707-000-068-0004)

25 acres

The project site consists of a single tax parcel totaling approximately 38 acres located approximately one-half mile north of the intersection of South Kingston Road Northeast and Mahoney Lane Northeast in Kingston, Washington. The approximate location of the site is shown on Figure 1.

The site is currently undeveloped and covered with a light to moderate forest and associated understory. Site topography consists of a slope that descends from the approximate north-center of the site with an overall relief of approximately 30 feet.

3.2 Subsurface

In general, soil conditions at the site consisted of 4 to 12 inches of topsoil over medium dense to very dense silty sand with various amounts of gravel to the termination of the test pits.

The *Preliminary Geomorphic Map of the Kitsap Peninsula, Washington,* by Ralph A. Haugerud (2009) shows site soils mapped as a late Pleistocene Pockmarked glaciated surface (gp). The soils observed in the test pits are generally consistent with this geologic mapping.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Pit Logs in Appendix A. The approximate locations of the test pits are shown on Figure 2.

3.3 Groundwater

Groundwater seepage was observed in the majority of the test pits between two and eight feet below current site grades. The exception to this was observed in Test Pits TP-13, TP-15 and TP-33 where no groundwater was observed. The groundwater appeared to be perched on top of the underlying dense till and till-like soil deposits. Additionally, some mottling was observed within some test pits above the dense till soil. Mottling of the upper layer indicates slow fluctuating seepage flows.

This occurs as a result of rainfall that infiltrates through the upper weathered soil zone and becomes perched on the underlying dense till and till-like soils. The till and till-like soils have relatively low permeability that impedes the continued downward migration of the infiltrated rainfall. As a result, groundwater seepage will develop and tend to flow laterally along the contact. Locally, such seepage is referred to as interflow.

The occurrence of interflow will fluctuate seasonally with the highest seepage levels occurring during the normally wet winter to late spring months (November to June).

With wall backfill placed and compacted as recommended, and drainage properly installed, we recommend designing unrestrained walls that support level grades for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). We recommend designing unrestrained walls that support a 2:1 (Horizontal:Vertical) backslope for an active earth pressure equivalent to a fluid weighing 50 pcf. For restrained walls, an additional uniform load of 100 psf should be added to the above values. For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall, should be applied in addition to the static lateral earth pressure.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.

4.7 Stormwater Detention Facility

Early C&G SDAP dated 3-01-2024 had been provided for reference

Site stormwater will be collected and directed to stormwater facilities located in the western, northeastern, and southeastern portions of the site. Specific stormwater plans were not available at the time of this report.

Detention Vault

If development stormwater will be collected and routed to a detention vault, we expect that the bottom of the excavation for the vault would expose native, dense silty sand soils. Vault foundations supported by these native soils may be designed for an allowable bearing capacity of 2,500 psf, the bearing capacity can be increased to 5,000 psf provided the foundation for the detention vault is greater than 7 feet below current site grades.

The magnitude of earth pressures developing on below-grade walls will depend on the quality and compaction of the wall backfill. We recommend placing and compacting wall backfill as structural fill, as described in Section 4.2 of this report. To prevent overstressing the walls during backfilling, heavy construction machinery should not be operated within five feet of the back of the wall. Wall backfill in this zone should be compacted with hand-operated equipment. To prevent hydrostatic pressure development, wall drainage must also be installed. A typical wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be added to the 35 pcf. To account for typical traffic surcharge loading, the walls can be designed for an additional imaginary height of two feet (two-foot soil surcharge). For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall, should be applied in addition to the static lateral earth pressure. These values assume a horizontal backfill condition and that no other surcharge loading, sloping embankments, or adjacent buildings will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.