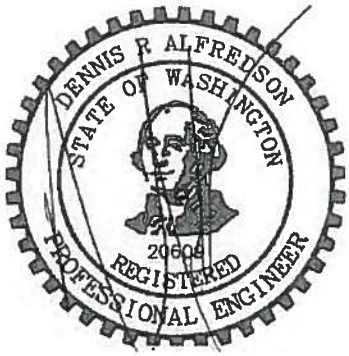
STORMWATER CONTROL PLAN

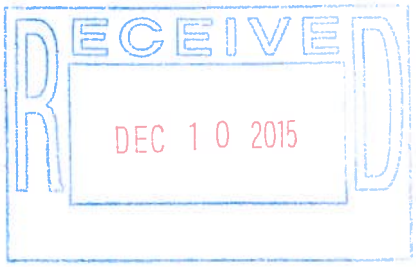
Prepared in accordance with BMC 14.30.052 and WSDOE SWMM, Vol. 1

Grading and Paving Parcel 566500 0256

For: *WS Contractors*
P. O. Box 2300
Buckley, WA 98321

City of Buckley
Parcel Number 566500 0256
278XX SR 410E





Prepared by:

PSED PLAT & SITE CIVIL DESIGN, LLC
Dennis Alfredson, P.E.
37702 280th Pl SE
Enumclaw, WA 98022-6828

December 8, 2015

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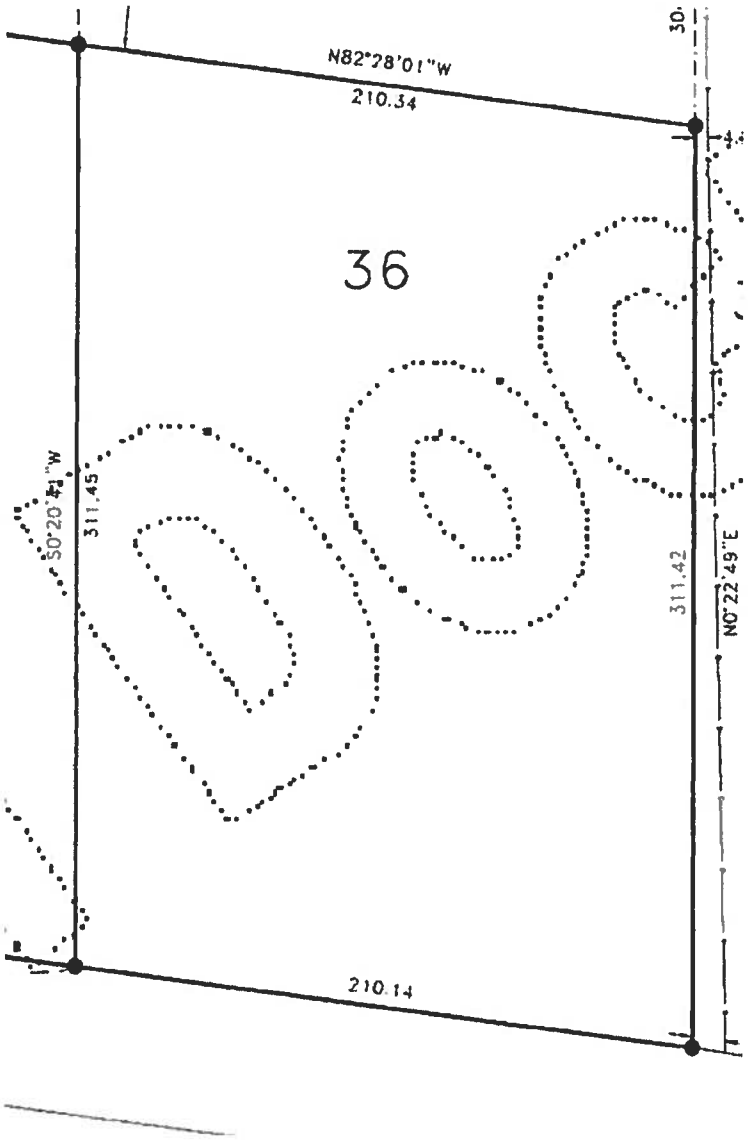
SECTION A: PROJECT OVERVIEW

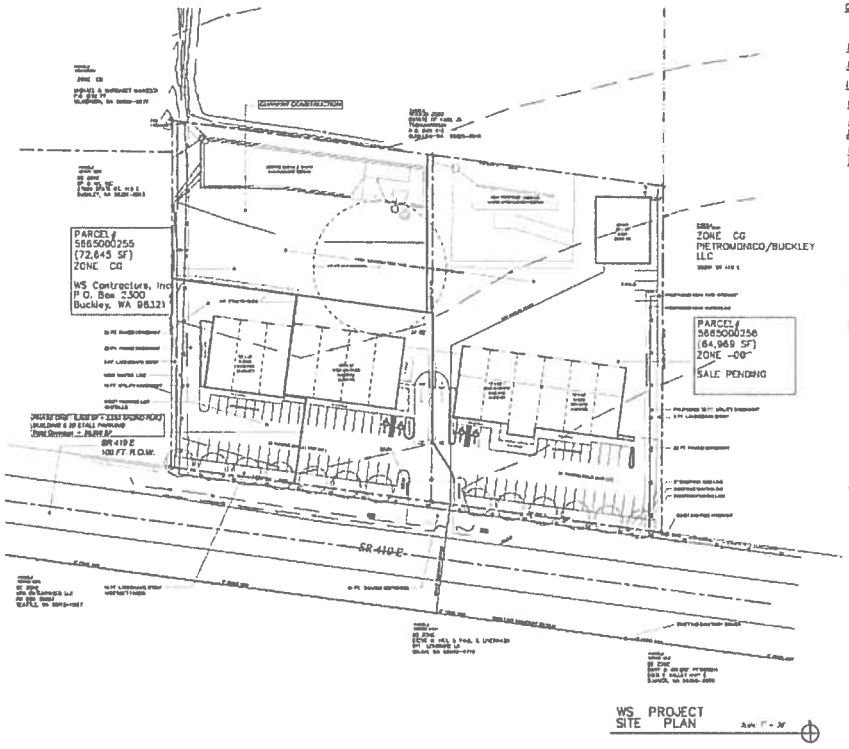
- Pave a portion of a 1.49A parcel. Construct a stormwater detention pond.



- No new street is required. Access is off SR 410E. A shared driveway will be constructed to serve also the parcel to the west.
- Water and sewer services to two future buildings are a part.
- Parcel is zoned GC.

- Design standards are taken from the Washington State Department of Ecology 2005 Stormwater Management Manual.
- New impervious area = 51286 sf (1.177 A)
- New type of pervious area = 13679 sf (0.314 A)
- Water quality is provided by a stormwater wetland.
- Required detention volume = 0.549 A-ft, = 25,043 cf

Earthwork Quantities:
Cut – 10 cy (moved to other onsite areas)
Fill - 2,000 cy



OWNER: WS CONTRACTORS INC.
P.O. BOX 2300
BUCKLEY, WA 98321

SITE ADDRESS: 27Nw SR 410 E

TAX PARCEL #: 5665000255 & 5665000256

LOT SIZE: 72,645 SF & 64,969 SF = 137,614 SF

LOT COVERAGE: 79 %

TOTAL IMPERVIOUS AREA: 108,180 SF

ZONING: GC

PROJECT DESCRIPTION: LIGHT INDUSTRIAL - BUSINESS

BUILDING SIZE: WEST BUILDING: 11,180 SF (MAIN LEVEL)
5,500 SF(SECOND LEVEL)

EAST BUILDING: 9,750 SF (MAIN LEVEL)
4,875 SF(SECOND LEVEL)

SHOP BUILDING: 3,000 SF

BUILDING HT: 2 STORY

USE ANALYSIS & PARKING REQUIREMENTS:

WEST BUILDING - MAIN FLR. 11,180 SF + SECOND FLR. 5,500 SF

USES: CONTRACTORS SHOP AREA= 10,980 SF
REQUIRED PARKING: 1 STALL PER 900 SF = 12 STALLS

GENERAL OFFICE AREA = 5,500 SF
REQUIRED PARKING: 1 STALL PER 400 SF
+ 1 STALL PER EMPLOYEE = 14 STALLS
& EMPLOYEES STALLS

AUTO REPAIR AREA W/ONE BAY = 1,620 SF
REQUIRED PARKING: 4 STALLS PER BAY = 4 STALLS

WEST BUILDING REQUIRED PARKING = 30 STALLS

EAST BUILDING - MAIN FLR. 9,750 SF + SECOND FLR. 4,875 SF

USES: CONTRACTORS SHOP AREA= 6,500 SF
REQUIRED PARKING: 1 STALL PER 900 SF = 7 STALLS

GENERAL OFFICE AREA = 4,875 SF
REQUIRED PARKING: 1 STALL PER 400 SF
+ 1 STALL PER EMPLOYEE = 13 STALLS
& EMPLOYEES STALLS

AUTO REPAIR AREA W/TWO BAY = 3,250 SF
REQUIRED PARKING: 4 STALLS PER BAY = 8 STALLS

EAST BUILDING REQUIRED PARKING = 32 STALLS

SHOP BUILDING - 3,000 SF

USES: CONTRACTORS SHOP AREA= 3,000 SF
REQUIRED PARKING: 1 STALL PER 900 SF = 3 STALLS

PARKING: REQUIRED PARKING - 73 STALLS - 79 STALL PROVIDED
(INCLUDES 4 ADA SPACES)

Project: WS CONTRACTORS SR 410 PROJECT

Sheet No. A1.0

SECTION B: EXISTING CONDITIONS SUMMARY

- Currently parcel is cleared but undeveloped.
- No known sensitive areas are found on site.
- The parcel Is low sloped toward the northwest. Runoff flows overland the northwest corner, thence west in a new ditch across the adjacent parcel, to a poorly maintained ditch running due north to the White River roughly 1.2 miles to the north.
- Soils are mapped by the Soil Conservation Service as 8A Buckley gravelly silt loam. Prior to construction, the Applicant shall provide documentation to the City from a geotechnical engineer confirming the stated soil conditions.

SECTION C: OFF-SITE ANALYSIS

System Description

The downstream conveyance consists of four distinct features:

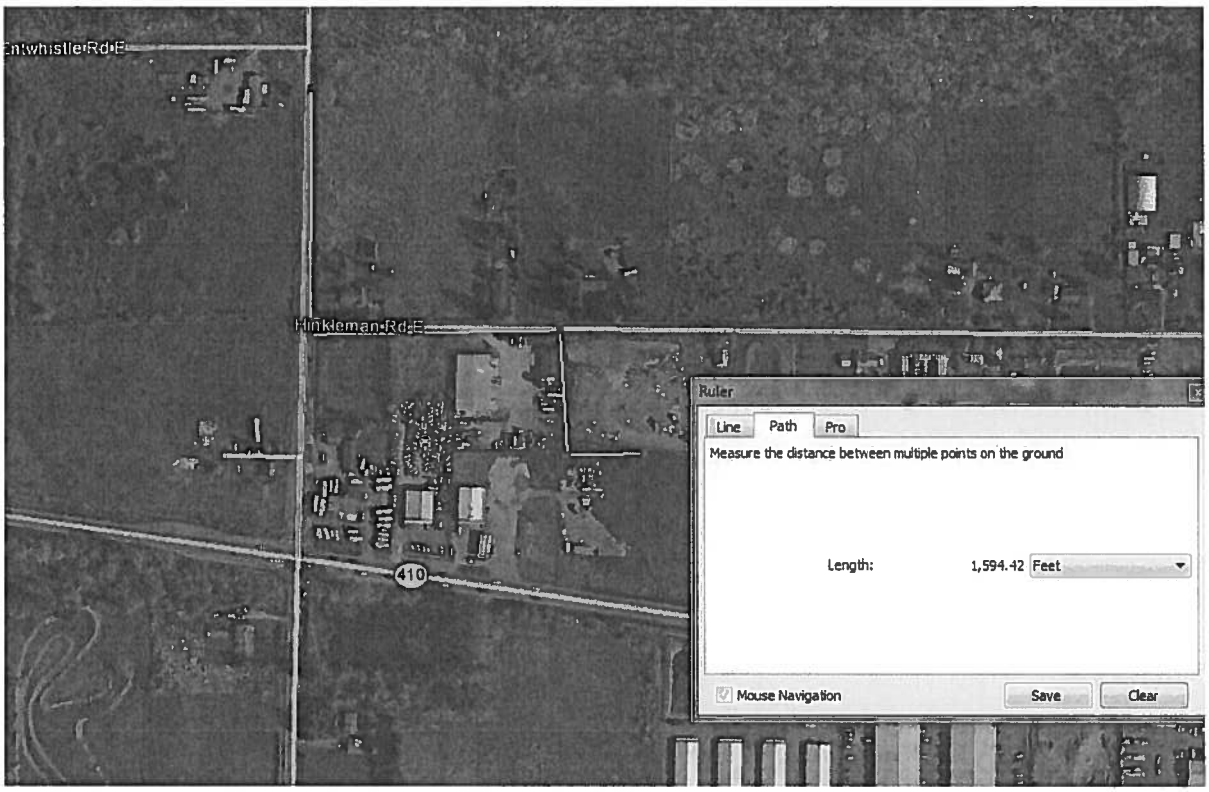
1. Runoff off the northwest corner is to be routed through a new ditch to be constructed on the north side of the existing detention pond on the adjacent parcel.

2. Runoff then flows north into a ditch between parcels running north to Hinkleman Road. Approximately 90 ft north of the site, this ditch becomes undefined, with the west side and bottom levelling off to flush with the adjacent ground.

3. This ditch then empties into a road ditch adjacent to Hinkleman, running west from there to east ditch adjacent to Mundy Loss Road.

4. This ditch runs north on the east side of Mundy Loss, crossing several driveways in culverts, until reaching the 1/4 mile point.

Beyond this flow eventually enters a 30" culvert under a driveway ~100 yards south of Sumner-Buckley Hwy. The water disappears at that point. The opposite (north) end of the culvert is not apparent, and water does not appear to emerge. The White River flume is on the north side of Sumner-Buckley Hwy, so apparently the water discharges into the flume. A discharge was not apparent on the date of inspection.


ntwhistler Rd E
Hinkleman Rd E
410
Ruler
Line
Path
Pro
Measure the distance between multiple points on the ground
Length:
1,594.42
Feet
Mouse Navigation
Save
Clear

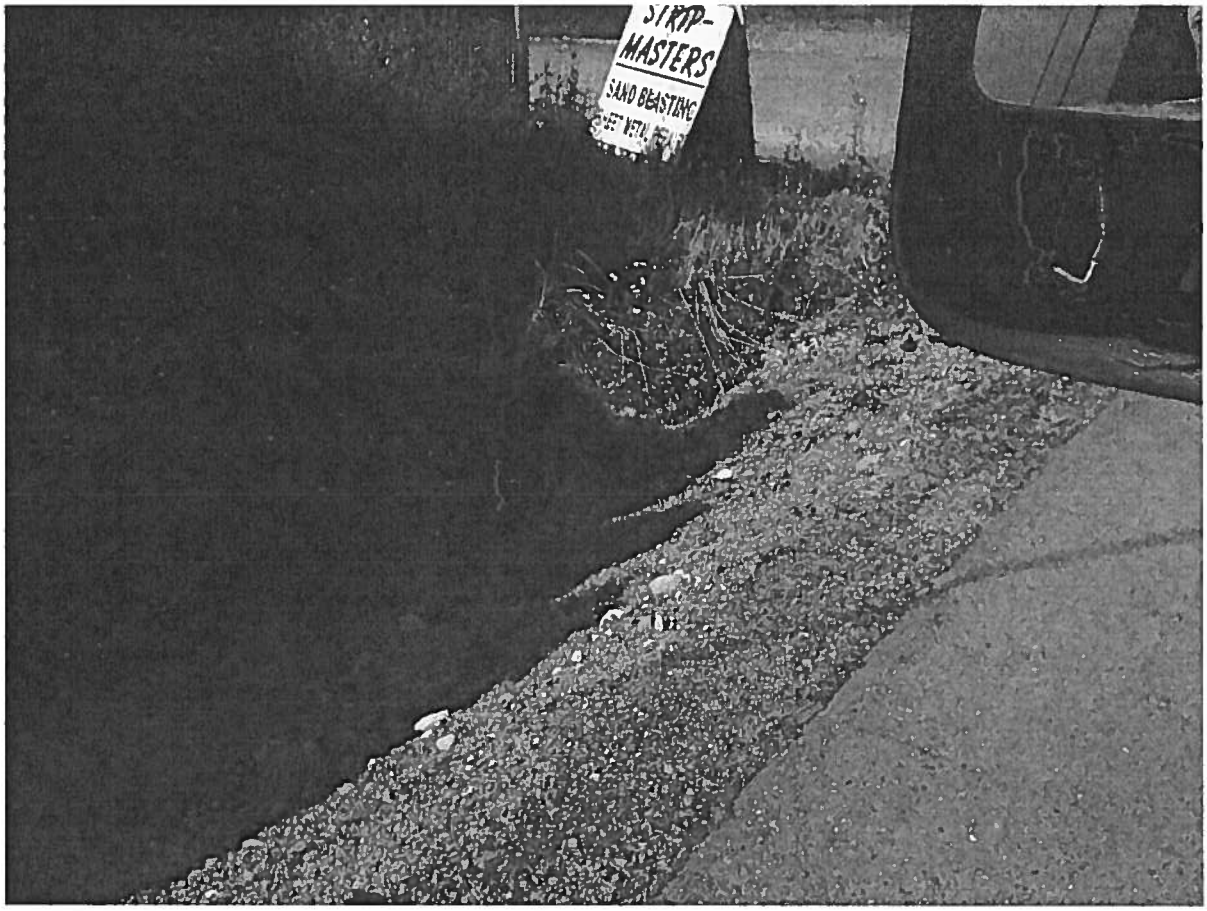
Photos

Site is covered with grass.

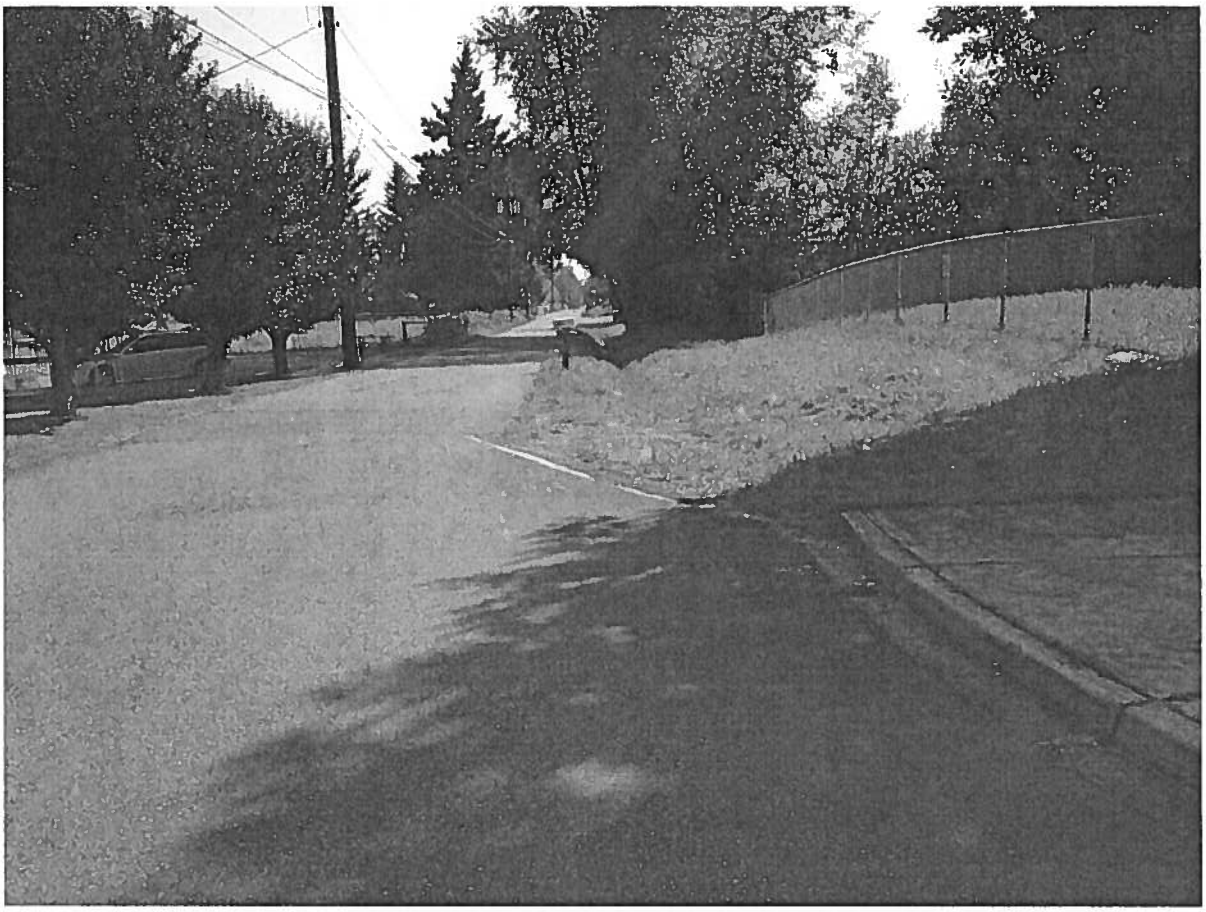
At the northwest corner looking north into the ditch/swale that drains away.

From Hinkleman Rd looking south back at the ditch/swale approaching the roadditch. Off in the distance, beyond the blue car, the ditch becomes undefined, with the bottom and west bank becoming flush with the ground adjacent.

The roadditch on Hinkleman flowing westerly.



At the intersection of Hinkleman and Mundy Loss looking back to the east to the approaching road ditch. A crossing exists under the intersection, releasing water to the roadditch on the east side of Mundy Loss, flowing north.



North on Mundy Loss, 1/4 mile from site

CONCLUSION OF DOWNSTREAM ANALYSIS

No problems were observed, or are expected to be created or aggravated by this project due to its design in accordance with WSDOE requirements.

SECTION D: CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

ELEMENT 1 – Preserve Vegetation/Mark Clearing Limits

Clearing limits are required to be marked.

ELEMENT 2 – Establish Construction Access

A rock construction entrance in accordance with standard detail is to be constructed on the access

ELEMENT 3 – Control Flow Rates

The developed flow rate will be restricted to predeveloped conditions by the stormwater detention pond/flow control structure.

ELEMENT 4 – Install Sediment Controls

Silt fence is to be installed on all sides to which slope falls.

ELEMENT 5 – Stabilize Soils

From October 1 – April 30, no native erosion prone soils are to remain exposed and unworked for more than two days. From May 1 – Sept 30, no native erodible soils are to remain exposed and unworked for more than seven days.

ELEMENT 6 – Protect Slopes

Cut and fill slopes are to be constructed in a manner that will minimize erosion.

ELEMENT 7 – Protect Drain Inlets

All catch basins and drain inlets, both existing and new, shall be provided with inlet protection as shown on the detail.

ELEMENT 8 – Stabilize Channels and Outlets

A note requires stabilization of channels and outlets with 4-inch quarry spalls.

ELEMENT 9 – Control Pollutants

All pollutants, including waste materials, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.

Protection from vandalism shall be provided for all chemicals and non-inert wastes on site. Equipment maintenance involving oil changes, hydraulic system drain-downs, cleaning operations, fuel tank draining, and the like shall be conducted using spill prevention measures such as drip pans. Contaminated ground surface shall be cleaned immediately. Equipment repairs shall be performed using temporary plastic placed beneath and, if raining, over the equipment.

ELEMENT 10 – Control Dewatering

No dewatering is proposed or contemplated.

ELEMENT 11 – Maintain BMPs.

All erosion control measures shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

Silt fence shall be inspected weekly during the dry season, daily during the wet season, and/or after a runoff-producing rainfall.

Erosion control features shall be removed within 30 days of site stabilization. Trapped sediment shall be removed or stabilized on site.

ELEMENT 12 – Manage the Project

The project shall be phased in order to minimize the transport of sediment.

CONSTRUCTION SEQUENCE AND PROCEDURE

1. Pre-construction meeting with inspector.
2. Install the rock construction entrance.
3. Fence perimeter with orange silt fence.
4. Cover all areas that will remain unworked for more than seven days during the dry season and two days during the wet season with straw, wood fiber mulch, compost, plastic sheeting, or equivalent.
5. Inspection of the installed silt fence shall be performed as specified under Element 11.
6. Inspection of the installed rock construction entrance shall be done upon completion as well as monthly thereafter.
7. Regrade site.
8. Replace gravel where necessary.
9. Construct storm drainage system and other site improvements.
10. Remove erosion control measures.

SECTION E: STORMWATER CONTROL PLAN

MINIMUM REQUIREMENTS OF THE STORMWATER MANUAL

According to Figure 2.3 of the 2005 WSDOE Stormwater Management Manual for Western Washington, because this project proposes perhaps more than 5000 sf of new impervious surface, it must conform to all 10 Minimum Requirements as listed starting on page 2-15.

1. PREPARATION OF STORMWATER SITE PLANS

This document plus the drawing set of the same title constitute conformance.

2. CONSTRUCTION STORMWATER POLLUTION PREVENTION

The applicable section(s) of this document plus the applicable drawing in the plan set constitute conformance.

3. SOURCE CONTROL OF POLLUTION

The standard erosion control and pollution prevention procedures documented herein and in the plan set are expected to suffice to meet this requirement.

4. PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

No change to the downstream conveyance of stormwater is proposed.

5. ON-SITE STORMWATER MANAGEMENT

Stormwater runoff from on-site will be routed to a detention pond. See Paragraph 7.

6. RUNOFF TREATMENT

Storm runoff will be treated by a stormwater wetland, BMT T10.30, in accordance with Vol V, p 10-26.

7. FLOW CONTROL

A flow control structure is provided to control release from the detention pond to pre-developed rates to the 100-yr storm.

AREAS FOR WWHM12

hma + buildings	51286	sf		
		sf		
total impervious	51286	=	**1.18**	**A**
total new-type pervious			0.31	A
		sf		
total parcel area	64966	=	1.49	A

WWHM2012
PROJECT REPORT

Project Name: default[3]
Site Name: WS
Site Address:
City :
Report Date: 12/9/2015
Gage :
Data Start : 10/01/1901
Data End : 09/30/2059
Precip Scale: 1.00
Version : 2015/03/18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	1.49
Pervious Total	1.49

Impervious Land Use	Acres
Impervious Total	0
Basin Total	1.49

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	.31
Pervious Total	0.31

Impervious Land Use	Acres
ROADS FLAT	1.18
Impervious Total	1.18
Basin Total	1.49

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Name : Trapezoidal Pond 1
Bottom Length: 60.53 ft.
Bottom Width: 60.53 ft.
Depth: 6 ft.
Volume at riser head: 0.5749 acre-ft.
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 5 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.012 ft.
Notch Height: 1.344 ft.
Orifice 1 Diameter: 0.558 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.084	0.000	0.000	0.000
0.0667	0.084	0.005	0.002	0.000
0.1333	0.085	0.011	0.003	0.000
0.2000	0.086	0.017	0.003	0.000
0.2667	0.087	0.022	0.004	0.000
0.3333	0.087	0.028	0.004	0.000
0.4000	0.088	0.034	0.005	0.000
0.4667	0.089	0.040	0.005	0.000
0.5333	0.090	0.046	0.006	0.000
0.6000	0.090	0.052	0.006	0.000
0.6667	0.091	0.058	0.006	0.000
0.7333	0.092	0.064	0.007	0.000
0.8000	0.093	0.070	0.007	0.000
0.8667	0.094	0.077	0.007	0.000
0.9333	0.094	0.083	0.007	0.000
1.0000	0.095	0.089	0.008	0.000
1.0667	0.096	0.096	0.008	0.000
1.1333	0.097	0.102	0.008	0.000
1.2000	0.098	0.109	0.009	0.000
1.2667	0.098	0.115	0.009	0.000
1.3333	0.099	0.122	0.009	0.000
1.4000	0.100	0.129	0.009	0.000
1.4667	0.101	0.135	0.009	0.000
1.5333	0.102	0.142	0.010	0.000
1.6000	0.102	0.149	0.010	0.000
1.6667	0.103	0.156	0.010	0.000
1.7333	0.104	0.163	0.010	0.000
1.8000	0.105	0.170	0.011	0.000
1.8667	0.106	0.177	0.011	0.000
1.9333	0.107	0.184	0.011	0.000
2.0000	0.107	0.191	0.011	0.000
2.0667	0.108	0.198	0.011	0.000
2.1333	0.109	0.205	0.011	0.000
2.2000	0.110	0.213	0.012	0.000
2.2667	0.111	0.220	0.012	0.000
2.3333	0.112	0.228	0.012	0.000
2.4000	0.112	0.235	0.012	0.000
2.4667	0.113	0.243	0.012	0.000
2.5333	0.114	0.250	0.013	0.000
2.6000	0.115	0.258	0.013	0.000
2.6667	0.116	0.266	0.013	0.000
2.7333	0.117	0.274	0.013	0.000
2.8000	0.118	0.281	0.013	0.000
2.8667	0.119	0.289	0.013	0.000
2.9333	0.119	0.297	0.014	0.000
3.0000	0.120	0.305	0.014	0.000
3.0667	0.121	0.313	0.014	0.000
3.1333	0.122	0.321	0.014	0.000
3.2000	0.123	0.330	0.014	0.000
3.2667	0.124	0.338	0.014	0.000
3.3333	0.125	0.346	0.014	0.000
3.4000	0.126	0.355	0.015	0.000
3.4667	0.127	0.363	0.015	0.000
3.5333	0.128	0.372	0.015	0.000
3.6000	0.128	0.380	0.015	0.000

3.6667	0.129	0.389	0.015	0.000
3.7333	0.130	0.397	0.016	0.000
3.8000	0.131	0.406	0.018	0.000
3.8667	0.132	0.415	0.019	0.000
3.9333	0.133	0.424	0.021	0.000
4.0000	0.134	0.433	0.023	0.000
4.0667	0.135	0.442	0.026	0.000
4.1333	0.136	0.451	0.028	0.000
4.2000	0.137	0.460	0.031	0.000
4.2667	0.138	0.469	0.033	0.000
4.3333	0.139	0.478	0.036	0.000
4.4000	0.140	0.488	0.039	0.000
4.4667	0.141	0.497	0.041	0.000
4.5333	0.142	0.507	0.044	0.000
4.6000	0.143	0.516	0.047	0.000
4.6667	0.144	0.526	0.050	0.000
4.7333	0.145	0.535	0.053	0.000
4.8000	0.145	0.545	0.057	0.000
4.8667	0.146	0.555	0.061	0.000
4.9333	0.147	0.565	0.064	0.000
5.0000	0.148	0.574	0.068	0.000
5.0667	0.149	0.584	0.320	0.000
5.1333	0.150	0.594	0.780	0.000
5.2000	0.151	0.604	1.375	0.000
5.2667	0.152	0.615	2.080	0.000
5.3333	0.153	0.625	2.880	0.000
5.4000	0.154	0.635	3.764	0.000
5.4667	0.155	0.646	4.726	0.000
5.5333	0.156	0.656	5.759	0.000
5.6000	0.157	0.666	6.859	0.000
5.6667	0.158	0.677	8.021	0.000
5.7333	0.159	0.688	9.243	0.000
5.8000	0.161	0.698	10.52	0.000
5.8667	0.162	0.709	11.85	0.000
5.9333	0.163	0.720	13.24	0.000
6.0000	0.164	0.731	14.67	0.000
6.0667	0.165	0.742	16.16	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.49
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.31
Total Impervious Area:1.18

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)

2 year	0.031398
5 year	0.048847
10 year	0.058327
25 year	0.067977
50 year	0.073713
100 year	0.078429

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.01885
5 year	0.035991
10 year	0.054183
25 year	0.088702
50 year	0.125936
100 year	0.176446

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.023	0.015
1903	0.019	0.012
1904	0.031	0.014
1905	0.015	0.026
1906	0.007	0.011
1907	0.048	0.015
1908	0.036	0.013
1909	0.035	0.015
1910	0.049	0.015
1911	0.032	0.015
1912	0.105	0.022
1913	0.050	0.039
1914	0.012	0.011
1915	0.020	0.028
1916	0.031	0.014
1917	0.010	0.013
1918	0.034	0.047
1919	0.025	0.014
1920	0.032	0.015
1921	0.036	0.026
1922	0.036	0.015
1923	0.029	0.031
1924	0.013	0.014
1925	0.016	0.013
1926	0.030	0.014
1927	0.020	0.015
1928	0.024	0.016
1929	0.050	0.027
1930	0.032	0.015
1931	0.030	0.015
1932	0.023	0.024
1933	0.022	0.015
1934	0.066	0.091
1935	0.031	0.044
1936	0.027	0.016
1937	0.042	0.014
1938	0.026	0.015
1939	0.002	0.012
1940	0.029	0.027

1941	0.014	0.011
1942	0.043	0.068
1943	0.022	0.015
1944	0.041	0.038
1945	0.036	0.015
1946	0.019	0.012
1947	0.012	0.013
1948	0.068	0.015
1949	0.058	0.046
1950	0.016	0.014
1951	0.020	0.013
1952	0.088	0.050
1953	0.079	0.199
1954	0.029	0.020
1955	0.023	0.012
1956	0.011	0.012
1957	0.041	0.032
1958	0.085	0.254
1959	0.053	0.116
1960	0.014	0.011
1961	0.053	0.092
1962	0.028	0.018
1963	0.014	0.011
1964	0.015	0.013
1965	0.059	0.058
1966	0.017	0.014
1967	0.025	0.013
1968	0.026	0.019
1969	0.026	0.015
1970	0.040	0.016
1971	0.064	0.056
1972	0.041	0.016
1973	0.053	0.036
1974	0.029	0.015
1975	0.067	0.255
1976	0.035	0.015
1977	0.012	0.011
1978	0.060	0.056
1979	0.016	0.014
1980	0.034	0.014
1981	0.032	0.016
1982	0.013	0.012
1983	0.053	0.029
1984	0.022	0.014
1985	0.035	0.014
1986	0.031	0.021
1987	0.060	0.050
1988	0.038	0.036
1989	0.034	0.014
1990	0.039	0.015
1991	0.030	0.016
1992	0.043	0.044
1993	0.042	0.015
1994	0.063	0.016
1995	0.012	0.015
1996	0.069	0.063
1997	0.026	0.013
1998	0.031	0.015
1999	0.003	0.013
2000	0.024	0.022

2001	0.012	0.011
2002	0.044	0.015
2003	0.038	0.016
2004	0.035	0.015
2005	0.065	0.020
2006	0.020	0.014
2007	0.020	0.015
2008	0.033	0.015
2009	0.023	0.014
2010	0.019	0.032
2011	0.016	0.013
2012	0.023	0.014
2013	0.018	0.011
2014	0.013	0.012
2015	0.025	0.014
2016	0.010	0.013
2017	0.048	0.042
2018	0.088	0.302
2019	0.082	0.063
2020	0.027	0.013
2021	0.044	0.038
2022	0.018	0.013
2023	0.037	0.018
2024	0.069	0.015
2025	0.032	0.015
2026	0.053	0.033
2027	0.019	0.014
2028	0.016	0.012
2029	0.036	0.039
2030	0.066	0.032
2031	0.022	0.012
2032	0.012	0.012
2033	0.019	0.012
2034	0.019	0.014
2035	0.075	0.320
2036	0.039	0.022
2037	0.009	0.013
2038	0.031	0.035
2039	0.003	0.010
2040	0.017	0.014
2041	0.023	0.013
2042	0.073	0.068
2043	0.035	0.039
2044	0.047	0.033
2045	0.032	0.030
2046	0.038	0.051
2047	0.028	0.023
2048	0.036	0.015
2049	0.032	0.015
2050	0.023	0.014
2051	0.034	0.015
2052	0.019	0.015
2053	0.035	0.058
2054	0.044	0.043
2055	0.014	0.012
2056	0.015	0.013
2057	0.024	0.017
2058	0.030	0.027
2059	0.053	0.030

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1045	0.3204
2	0.0881	0.3024
3	0.0880	0.2547
4	0.0850	0.2536
5	0.0821	0.1991
6	0.0794	0.1157
7	0.0749	0.0919
8	0.0729	0.0909
9	0.0690	0.0685
10	0.0689	0.0683
11	0.0675	0.0633
12	0.0669	0.0632
13	0.0664	0.0583
14	0.0657	0.0577
15	0.0645	0.0560
16	0.0638	0.0557
17	0.0630	0.0515
18	0.0599	0.0505
19	0.0596	0.0497
20	0.0591	0.0475
21	0.0579	0.0458
22	0.0531	0.0444
23	0.0528	0.0436
24	0.0528	0.0430
25	0.0528	0.0424
26	0.0527	0.0394
27	0.0525	0.0394
28	0.0501	0.0386
29	0.0499	0.0380
30	0.0487	0.0377
31	0.0484	0.0364
32	0.0482	0.0361
33	0.0475	0.0355
34	0.0440	0.0333
35	0.0438	0.0327
36	0.0436	0.0324
37	0.0433	0.0324
38	0.0431	0.0319
39	0.0424	0.0310
40	0.0420	0.0301
41	0.0413	0.0297
42	0.0407	0.0288
43	0.0406	0.0278
44	0.0405	0.0273
45	0.0389	0.0273
46	0.0387	0.0266
47	0.0381	0.0260
48	0.0380	0.0256
49	0.0379	0.0243
50	0.0366	0.0233
51	0.0361	0.0222
52	0.0359	0.0219
53	0.0358	0.0216
54	0.0358	0.0210
55	0.0357	0.0199
56	0.0357	0.0199

57	0.0354	0.0192
58	0.0353	0.0183
59	0.0352	0.0178
60	0.0351	0.0170
61	0.0350	0.0165
62	0.0346	0.0164
63	0.0342	0.0163
64	0.0337	0.0162
65	0.0336	0.0162
66	0.0335	0.0161
67	0.0333	0.0161
68	0.0324	0.0158
69	0.0323	0.0154
70	0.0323	0.0154
71	0.0323	0.0154
72	0.0320	0.0154
73	0.0319	0.0154
74	0.0317	0.0154
75	0.0315	0.0153
76	0.0314	0.0153
77	0.0313	0.0153
78	0.0313	0.0153
79	0.0310	0.0151
80	0.0305	0.0151
81	0.0304	0.0150
82	0.0303	0.0150
83	0.0301	0.0150
84	0.0296	0.0150
85	0.0288	0.0150
86	0.0287	0.0150
87	0.0286	0.0150
88	0.0285	0.0149
89	0.0284	0.0149
90	0.0279	0.0149
91	0.0268	0.0149
92	0.0265	0.0148
93	0.0265	0.0148
94	0.0259	0.0148
95	0.0259	0.0147
96	0.0258	0.0147
97	0.0254	0.0146
98	0.0254	0.0146
99	0.0248	0.0146
100	0.0243	0.0145
101	0.0240	0.0145
102	0.0238	0.0145
103	0.0234	0.0144
104	0.0232	0.0143
105	0.0232	0.0143
106	0.0232	0.0143
107	0.0230	0.0142
108	0.0229	0.0142
109	0.0228	0.0142
110	0.0224	0.0141
111	0.0222	0.0141
112	0.0219	0.0141
113	0.0215	0.0140
114	0.0202	0.0140
115	0.0202	0.0139
116	0.0197	0.0138

117	0.0196	0.0138
118	0.0195	0.0138
119	0.0195	0.0137
120	0.0194	0.0135
121	0.0193	0.0135
122	0.0192	0.0135
123	0.0192	0.0134
124	0.0190	0.0134
125	0.0189	0.0133
126	0.0180	0.0133
127	0.0178	0.0133
128	0.0172	0.0132
129	0.0166	0.0132
130	0.0164	0.0132
131	0.0164	0.0129
132	0.0163	0.0129
133	0.0163	0.0127
134	0.0157	0.0127
135	0.0153	0.0127
136	0.0151	0.0127
137	0.0150	0.0125
138	0.0140	0.0124
139	0.0136	0.0124
140	0.0136	0.0124
141	0.0136	0.0123
142	0.0133	0.0123
143	0.0132	0.0122
144	0.0132	0.0121
145	0.0123	0.0120
146	0.0123	0.0118
147	0.0122	0.0118
148	0.0121	0.0117
149	0.0119	0.0117
150	0.0119	0.0114
151	0.0115	0.0114
152	0.0105	0.0113
153	0.0101	0.0113
154	0.0093	0.0112
155	0.0067	0.0111
156	0.0031	0.0110
157	0.0025	0.0109
158	0.0016	0.0102

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0157	54365	47307	87	Pass
0.0163	50187	41972	83	Pass
0.0169	46570	38387	82	Pass
0.0175	43357	35905	82	Pass
0.0180	40271	33379	82	Pass
0.0186	37501	31440	83	Pass
0.0192	34936	29473	84	Pass
0.0198	32559	27545	84	Pass

0.0204	30343	26044	85	Pass
0.0210	28265	24565	86	Pass
0.0216	26443	23196	87	Pass
0.0221	24797	21989	88	Pass
0.0227	23285	20864	89	Pass
0.0233	21939	19750	90	Pass
0.0239	20637	18670	90	Pass
0.0245	19435	17568	90	Pass
0.0251	18288	16498	90	Pass
0.0257	17219	15540	90	Pass
0.0262	16166	14598	90	Pass
0.0268	15141	13773	90	Pass
0.0274	14282	13019	91	Pass
0.0280	13451	12354	91	Pass
0.0286	12659	11712	92	Pass
0.0292	11944	11136	93	Pass
0.0298	11241	10570	94	Pass
0.0303	10570	10061	95	Pass
0.0309	9972	9551	95	Pass
0.0315	9374	9113	97	Pass
0.0321	8853	8692	98	Pass
0.0327	8332	8266	99	Pass
0.0333	7861	7878	100	Pass
0.0339	7462	7507	100	Pass
0.0345	7025	7147	101	Pass
0.0350	6615	6798	102	Pass
0.0356	6271	6465	103	Pass
0.0362	5978	6149	102	Pass
0.0368	5701	5867	102	Pass
0.0374	5437	5618	103	Pass
0.0380	5198	5376	103	Pass
0.0386	4942	5148	104	Pass
0.0391	4706	4906	104	Pass
0.0397	4513	4677	103	Pass
0.0403	4333	4474	103	Pass
0.0409	4159	4294	103	Pass
0.0415	3957	4079	103	Pass
0.0421	3770	3855	102	Pass
0.0427	3578	3662	102	Pass
0.0432	3411	3501	102	Pass
0.0438	3265	3357	102	Pass
0.0444	3134	3227	102	Pass
0.0450	3027	3093	102	Pass
0.0456	2927	2952	100	Pass
0.0462	2813	2805	99	Pass
0.0468	2682	2687	100	Pass
0.0473	2555	2557	100	Pass
0.0479	2451	2450	99	Pass
0.0485	2359	2358	99	Pass
0.0491	2255	2244	99	Pass
0.0497	2141	2140	99	Pass
0.0503	2038	2034	99	Pass
0.0509	1952	1949	99	Pass
0.0514	1860	1867	100	Pass
0.0520	1777	1788	100	Pass
0.0526	1690	1717	101	Pass
0.0532	1619	1647	101	Pass
0.0538	1561	1583	101	Pass
0.0544	1482	1499	101	Pass
0.0550	1407	1413	100	Pass

0.0555	1339	1340	100	Pass
0.0561	1270	1249	98	Pass
0.0567	1218	1183	97	Pass
0.0573	1163	1123	96	Pass
0.0579	1103	1050	95	Pass
0.0585	1055	983	93	Pass
0.0591	1006	930	92	Pass
0.0596	964	872	90	Pass
0.0602	919	790	85	Pass
0.0608	872	693	79	Pass
0.0614	815	633	77	Pass
0.0620	772	576	74	Pass
0.0626	738	521	70	Pass
0.0632	694	476	68	Pass
0.0638	636	440	69	Pass
0.0643	601	409	68	Pass
0.0649	553	379	68	Pass
0.0655	517	355	68	Pass
0.0661	478	327	68	Pass
0.0667	433	295	68	Pass
0.0673	394	259	65	Pass
0.0679	363	218	60	Pass
0.0684	339	159	46	Pass
0.0690	310	149	48	Pass
0.0696	295	148	50	Pass
0.0702	273	146	53	Pass
0.0708	252	145	57	Pass
0.0714	237	142	59	Pass
0.0720	223	140	62	Pass
0.0725	206	138	66	Pass
0.0731	194	136	70	Pass
0.0737	180	135	75	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for Water Quality Treatment?	Total Volumn Needs Treatment (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft)	Cumulative Volumn Infiltration Credit	Percent Comment
Trapezoidal Pond 1 POC	N	480.13			N	
0.00						
Total Volume Infiltrated		480.13	0.00	0.00		
0.00 0.00	0%	No Treat. Credit				

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

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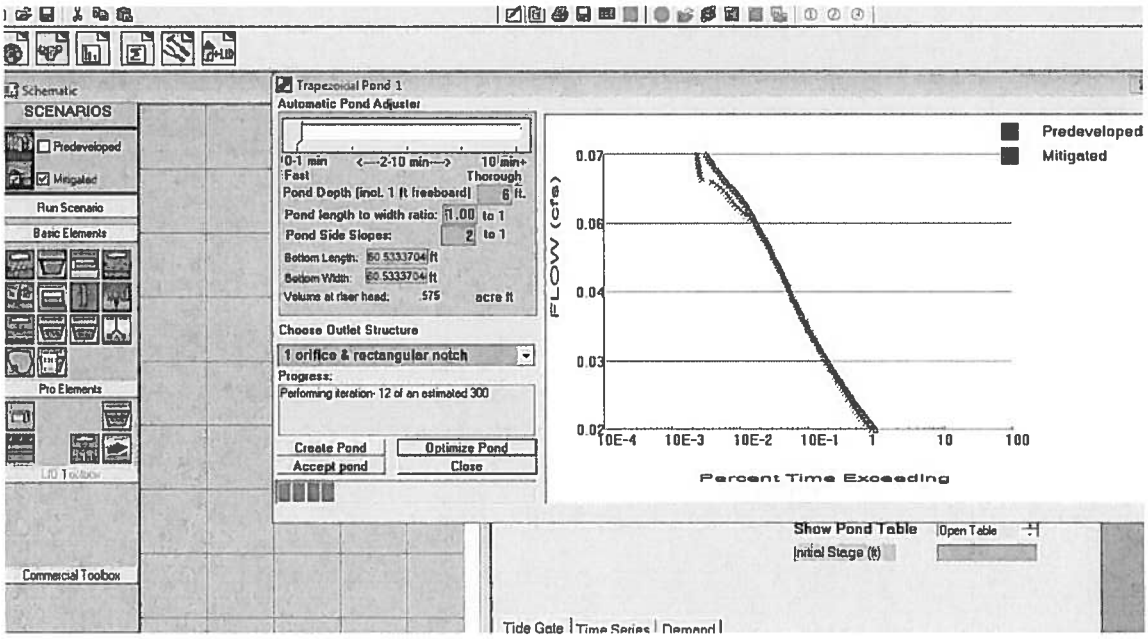
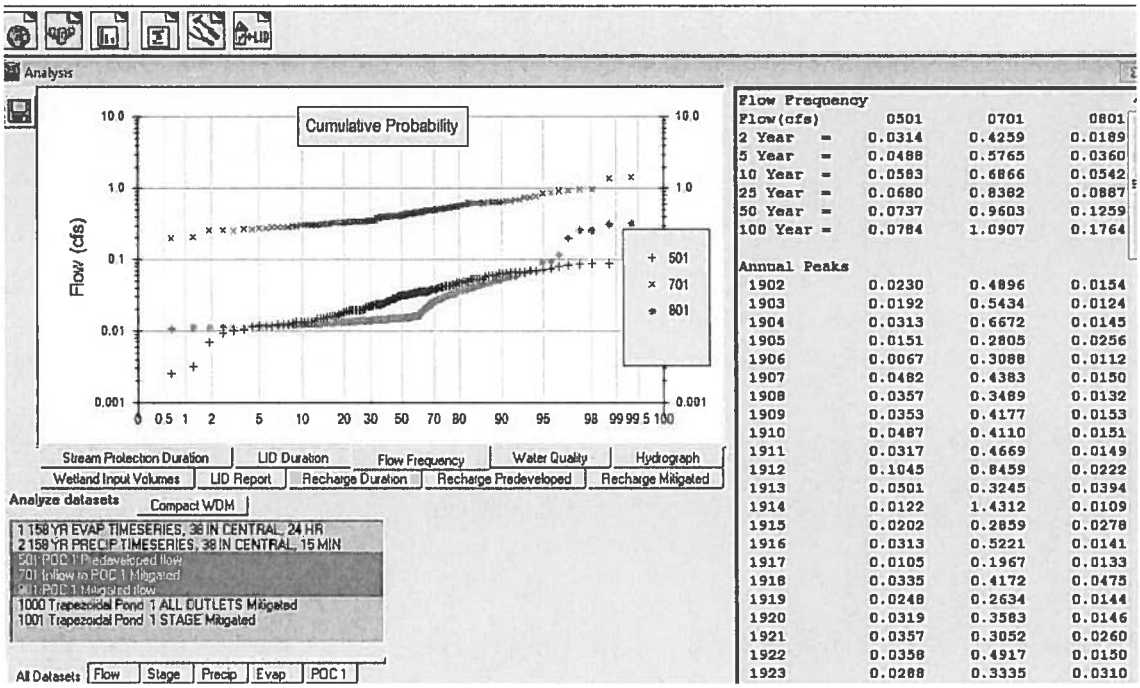




Flow Frequency

Flow(cfs)	0501	0701	0801
2 Year =	0.0314	0.4259	0.0189
5 Year =	0.0488	0.5765	0.0360
10 Year =	0.0583	0.6866	0.0542
25 Year =	0.0680	0.8382	0.0887
50 Year =	0.0737	0.9603	0.1259
100 Year =	0.0784	1.0907	0.1764
Annual Peaks			
1902	0.0230	0.4896	0.0154
1903	0.0192	0.5434	0.0124
1904	0.0313	0.6672	0.0145
1905	0.0151	0.2805	0.0256
1906	0.0067	0.3088	0.0112
1907	0.0482	0.4383	0.0150
1908	0.0357	0.3489	0.0132
1909	0.0353	0.4177	0.0153
1910	0.0487	0.4110	0.0151
1911	0.0317	0.4669	0.0149
1912	0.1045	0.8459	0.0222
1913	0.0501	0.3245	0.0394
1914	0.0122	1.4312	0.0109
1915	0.0202	0.2859	0.0278
1916	0.0313	0.5221	0.0141
1917	0.0105	0.1967	0.0133
1918	0.0335	0.4172	0.0475
1919	0.0248	0.2634	0.0144
1920	0.0319	0.3583	0.0146
1921	0.0357	0.3052	0.0260
1922	0.0358	0.4917	0.0150
1923	0.0288	0.3335	0.0310

PLAT & SITE CIVIL DESIGN, LLC

12/9/2015

Emergency Overflow Weir Width

Q100	=	1.070	cfs, from KCRTS run
		1.090	
C	=	7	given
g	=	32.2	ft/sec^2, given
height of water H	=	0.20	minimum, given
tan (angle side slopes)	=	3.00	given
rearranged, length of weir L	=	((Q100/(3.2*H^1.5))-2.4*H	
		3.2	ft
		6	FT PROVIDED - OKAY

8. WETLANDS PROTECTION

No wetlands exist on site.

9. BASIN/WATERSHED PLANNING

No basin/watershed plan that contains more stringent requirements than are found in the Manual exists.

10. OPERATION AND MAINTENANCE MANUAL

In Section H.

SECTION F: SPECIAL REPORT AND STUDIES

No geotech report has been done for this site. However, a report was done for the adjacent parcel to the west. See next page.

GEOTECHNICAL ENGINEERING STUDY

For

GENISIS PROPERTY

27971 SR 410 E HWY
BUCKLEY, PIERCE COUNTY, WASHINGTON

Prepared For

W. S. CONTRACTORS, LLC.
28702, 210TH AVENUE SE, KENT, WA 98042

Prepared By

PGE Pacific Geo Engineering
Geotechnical Engineering, Consulting & Inspection
P.O. BOX 1419, ISSAQUAH, WASHINGTON 98027

PGE PROJECT NUMBER 14-445

November 30, 2014

PGE Pacific Geo Engineering

Geotechnical Engineering, Consulting & Inspection

November 30, 2014

W.S. Contractors
28707, 210th Ave SE
Kent, WA 98042

Attn.: Mr. Jared Stevenson

Re: Genisis Property
27971, SR 410 Highway
Buckley, Pierce County, Washington
Parcel No. 566000255
PGE Project No. 13-423

Ref.: 'Genisis Property - Grading And Paving' Site Plan - Sheet No. 1 of 3, prepared by Plat & Site Design, LLC.

Dear Mr. Stevenson:

As per your request, Pacific Geo Engineering, LLC (PGE) has completed a geotechnical engineering study for the proposed development, which will include construction of a warehouse building, associated parking and driveways, and a storm pond for stormwater management.

This study was accomplished in general accordance with our proposal No. 14-11-418, dated November 20, 2014, and was granted to proceed by written authorization by you on the next day, November 21, 2014.

This report presents the results of our subsurface explorations, laboratory soil testing results, and the conclusions and recommendations pertinent to the bearing capacity of the soil and the infiltration potential of the naive soils in this site.

1.0 Site Location

The proposed development is located on the north side of the SR 410 E in Buckley, Pierce County, Washington. The project site is bounded by a gas station at its west, an industrial storage area at its north, an open land at its north, and SR 410 E at its west. The general location of the site is shown on the Vicinity Map, Figure 1.

2.0 Site Description

The project site is located within a region dominated by mix use of pasturelands, scattered residences with farm lands, and industrial facilities. The subject site is used as a storage area, covered with pasture grasses, bushes, and recently placed gravels. The parcel will have access from the SR 410 E via the gas station. The proposed development areas in the site are shown on the Site & Exploration Plan, Figure 2.

The site is relatively level with its overall grades lower than the SR 410 E road. The topography of the site is shown in Figure 3, and the site photo is shown in Appendix A, Site Photo.

3.0 Field Investigation

The subsurface conditions of the project site were explored on November 18, 2014, with a total of six (6) test pits (TP 1 to 6) excavated to depths of about 6 to 10 feet below the existing grades. The general vicinity of the exploration areas with the individual test pit locations are shown on the Site & Exploration Plan, Figure 2.

The test pits were completed using a backhoe provided by the client. Test pits were backfilled with loosely compacted excavated soils. The specific number, location, and depth of the test pit was selected in relation to the existing and proposed site features, accessibility, underground utility conflicts, purpose of evaluation, and budget considerations. The locations of the test pits were decided on-site by a PGE representative, and should be considered accurate only to the degree implied by the measuring methods. The approximate test pit locations are shown in Site & Exploration Plan, Figure 2.

A professional geotechnical engineer from our firm observed the excavation works, continually logged the subsurface conditions in the test pits, collected representative bulk samples from different soil layers of the soil test pits, visually-manually classified the soil samples in the field according to the methods presented in ASTM D-2488-93 (based on the soil samples' density/consistency, moisture condition, grain size, and plasticity estimations), and the 'Key to Exploration Logs' Figure in Appendix A. and observed pertinent site features. Samples were designated according to the test pit number and depth, stored in watertight plastic containers, and later on transported to our laboratory for further visual examination.

Results of the field investigation are presented on the test pit logs, which are presented in Appendix A. The final exploration log for the test pits was prepared with our observation and interpretation of the excavation, visual examination of the samples in the field and later on in the laboratory, and the subsequent laboratory test results. The soils were classified according to the methods presented on the Figure 'Key to Exploration Logs' in Appendix A. This figure also provides a legend explaining the symbols and abbreviations used in the soil exploration logs. The soil logs indicate the depth where the soils change. It should be noted that the indicated stratification lines on the logs represent the approximate boundaries between soil types. The actual transitions of varying soil strata may be more gradual in the field.

4.0 Laboratory Testing

Laboratory tests were conducted on several selected representative soil samples collected from the soil test pits excavated during our field investigation to evaluate the general physical properties and engineering characteristics of the soils encountered. The samples were visually-manually classified in the laboratory following the procedure described in ASTM D-2488-93 (based on the soil samples' density/consistency, moisture condition, grain size, and plasticity estimations), and later on the soil samples' classifications were supplemented by laboratory tests data in accordance with the procedure described in ASTM D-2487-98. Moisture content tests were conducted on selected samples in accordance with ASTM D-2216 procedures. The results of the moisture content tests are presented on the test pit log in Appendix A. A total of three (3) percentage passing #200 sieve tests were performed in accordance with ASTM D-1140 procedure on selected samples in accordance with ASTM D-422 and D-2487 procedures. The results of the percentage passing #200 sieve test results are presented on the Soil Test Pit Logs in Appendix A.

5.0 Engineering Evaluation

The results from the field and laboratory tests were evaluated and engineering analyses were performed to develop the design information and the geotechnical engineering recommendations for the following items of the proposed development:

- Descriptions of the soil and groundwater conditions encountered in the site.
- Infiltration Potential Evaluation and field percolation rates of the native soils in accordance with the guidelines provided in the Pierce County Stormwater Management and Site Development Manual and the Pierce County Soil Conservation Survey Map.

- Foundation type and allowable bearing capacity for supporting the proposed warehouse.
- Estimated settlement for the recommended bearing capacity and observed soil conditions.
- Frictional and passive values for the resistance of lateral forces.
- Footing subgrade preparation.
- Fill placement and compaction requirements.

6.0 Subsurface Features

6.1 Local & Site Geology

As per the WA State Department of Natural Resources' Geologic Map of WA State by J. Eric Schuster, 2005, the subject site is underlain by the geologic unit 'Qvt', which is described as the '*Quaternary fragmental volcanic deposits that includes the lahars.* A 'lahar' is a debris avalanche that originates from the flanks of a volcano (the Indonesian word for a mudflow). The geologic map is attached in Geological Unit Map, Figure 4.

The largest post-glacial 'lahar' to deposit in the vicinity of the subject site close to the White River was the massive Osceola Mudflow from Mt. Rainier that occurred about 5,700 years ago in the Holocene period. Osceola deposits cover an area of about 550 km^2 (212 mi^2) in the Puget Sound lowland, extending at least as far as the Seattle suburb of Kent, and to Commencement Bay, now the site of the Port of Tacoma. The communities of Orting, Buckley, Sumner, Puyallup, Enumclaw, and Auburn are wholly or partly located on top of deposits of the Osceola Mudflow and, in some cases, of more recent lahars as well.

6.2 Soil Conservation Survey Soil Descriptions

According to the United States Department of Agriculture (USDA) Soil Conservation Survey (SCS) for Pierce County, Washington, the proposed development areas are underlain by the soil unit 'Buckley Loam (8A)' described below. The site with respect to the horizontal boundary of this soil unit is shown in Figure 5, Soil Conservation Survey (SCS) Map.

Buckley Loam (8A)

According to the SCS manual, Buckley loam is nearly level soil and poorly drained. It formed in the Osceola mudflow. In a typical profile the surface layer is very dark brown medium

acid loam about 10 inches thick. The upper part of the subsoil is brown, medium acid, prominently mottled sandy loam and gravelly sandy loam about 28 inches thick. The lower part of the subsoil, to a depth of more than 60 inches, is grayish brown, slightly acid gravelly sandy clay loam. According to this manual, the permeability is slow. Surface runoff is very slow, and there is no erosion hazard. The high water table remains close to the surface throughout the rainy season, and the primary limitation for development is the high water table in winter and spring. Community sewerage systems must be used because septic tank drainage fields do not function properly during the rainy season. A typical soil profile for this category is as follows:

Buckley Loam (8A)		
Depth, Inch	USDA Texture	USCS Soil Definition
0 – 10	Loam	ML, MH, OL
10 – 60	Gravelly sandy loam, loam, gravelly sandy clay loam	SM, GM

In general, the above mapped stratigraphy and its USCS classification as per the manual correlate well with the soil profile that was observed during our exploration, and also with the USCS soil descriptions determined from the subsequent laboratory grain size analyses performed on the representative samples. However, the mapped unit may contain inclusions of other soil types or may contain entirely different soil types in areas away from the test pits. The permeability values and the infiltration potential of this unit provided in the SCS Manual are discussed later on in section 7.3 of this report.

6.3 Soil & Groundwater Conditions

Visual Soil Descriptions

The average thickness of the topsoil in the test pits are about 12 inches, which is composed of very moist, soft, dark brown and black SILT with roots and organics. The topsoil is underlain by very moist, soft, yellowish-brown sandy SILT with gravels and some cobbles (USCS: ML) to depths of about 1 to 3 feet below the existing grades. This material is known as 'Buckley Loam (8A)', as per the Pierce County Soil Conservation Map. This deposit contains significant amount of fines (approximately 51.3% of fines, Appendix A, Test Pit 1, Sample No. S-1 @ 2 feet depth below grade). This deposit is then underlain by moist, dense to very dense, very low permeable, olive-orange-grayish silty SAND with gravels, cobbles, and occasional boulders (SM, GM), geologically known as 'Osceola Mudflow'. The Osceola Mudflow extends upto almost 6

feet below the grades. The Osceola Mudflow contains fines of approximately 26.4% (Appendix A, Test Pit 1, Sample No. S-2 @ 4 feet below grade). The Osceola Mudflow is underlain by light gray, slightly moist, very dense glacial till, consisted of partly cemented silty SAND with gravels and cobbles (USCS; SM). The till contains fines of approximately 20.5% (Appendix A, Test Pit 1, Sample No. S-3 @ 7 feet below grade). Glacial till is characterized as a mixture of silt, sand, and gravel, glacially consolidated, and therefore dense, strong, and relatively incompressible. It was very difficult to dig through the till deposit due to their compactness under the glaciers.

Groundwater Conditions

Minor perched water seepage was encountered in the test pits at approximately 2 to 3 feet below the grades above the dense Osceola Mudflow. Minor caving and sloughing was noticed within the seepage zone.

Signs of major mottling were noticed in the test pits between 1 to 3 feet below the existing grades above the mudflow deposit. The mottling signs became lesser as the depth increases below 3 feet depth. We believe that the mottling indicates the evidence of the accumulation of the perched water, which percolated through the upper more permeable loamy soils and retained by the very low permeable mudflow deposit underneath. This is normally occurs in the Puget Sound area during the wet winter periods. Due to the very dense and cemented, and low permeable characteristics of the mudflow deposit, perched water does not flow through this deposit, rather flows laterally across the top of this deposit, causing mottling at the transition between the upper loamy soils and the lower mudflow deposit.

As it was evident by mottling, fluctuations in the groundwater level and the presence of perched water in the permeable sandy gravelly soils may be expected due to seasonal variations in the amount of rainfall, surface runoff, and other factors not apparent at the time of our exploration. Typically, the groundwater levels rise higher and the flow rates increase during the wet winter months. The possibility of groundwater level fluctuations and the presence of perched water should be considered when designing and developing the construction plans for the project.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The test pit logs included in Appendix A should be reviewed for specific information at individual test pit locations. These logs include soil descriptions, stratification, and location of the samples and laboratory test data. The stratification shown on the logs represents the conditions only at the test pit locations.

Variations may occur and should be expected between test pit locations and elsewhere on the site, which may not be evident until the time of construction. The stratification represents the approximate boundary between subsurface materials and the actual transition may be gradual. Therefore, the soil and the groundwater described in this report should be verified on-site by the on-site geotechnical engineer during the actual construction of the project.

7.0 Conclusions And Recommendations

The following sections of this report present detailed recommendations on the pertinent geotechnical issues that are anticipated for the design and construction of the proposed development. These recommendations should be incorporated into the project design, drawings, and specifications.

7.1 Footing Subgrade Preparation

7.1.1 Clearing and Grubbing

Initial site preparation for construction of the proposed structures such as the warehouse, roadways and driveways and any other structure, the storm pond, and placing new fills on the native grades should include stripping of vegetation and topsoil from the construction areas. Based on the topsoil thickness encountered at our test pit locations, we anticipate topsoil stripping depths of about 12 inches, however, thicker layers of topsoil may be present in unexplored portions of the site. It should be realized that if the stripping operation takes place during wet winter months, it is typical a greater stripping depth might be necessary to remove the near-surface moisture-sensitive silty soils disturbed during the stripping; therefore, stripping is best performed during dry weather period. Stripped vegetation debris should be removed from the site. Stripped organic topsoils will not be suitable for use as structural fill but may be used for future landscaping purposes.

7.2.2 Subgrade Preparation

After the site clearing and site stripping, cut and fill operations can be initiated to establish desired grades for the proposed structures and any new fills to be placed on the native grades. Any exposed subgrades that are intended to provide direct support for new construction and/or require new fills should be adequately proofrolled to evaluate their conditions and to identify the presence of any isolated soft and yielding areas and to verify that stable subgrades are achieved to support the proposed structures, and any new fills. Proofrolling should be done

with a loaded dump truck or a front-end loader or a big vibratory roller under the supervision of the on-site geotechnical engineer. If it is found by the on-site geotechnical engineer that the soil is too wet near the subgrade to be proofrolled or it not feasible to proofroll the subgrade, then an alternative method (i,e., visual evaluation and probing with a 1/2-inch diameter steel T-probe) can be used by the geotechnical engineer to identify the presence of any isolated soft and yielding areas and to verify that stable subgrades are achieved to support the proposed structures and any new fills.

If any subgrade area are found in soft and moist conditions, ruts and pumps excessively, and cannot be stabilized in place by compaction the affected soils should be over-excavated completely to firm and unyielding suitable bearing materials, and to be replaced with new structural fills to desired final subgrade levels. If the depth of overexcavation to remove unstable soils becomes excessive, a geotextile fabric, such as Mirafi 500X or equivalent in conjunction with structural fills may be considered to achieve a firm bearing subgrades to support the proposed structures and any new fills.

If needed to stabilize the soft/wet base of an overexcavated area, we recommend to consider a 6 to 12-inch layer of ballast rock or quarry spalls should be placed to form a base on which the structural fill needs to be placed and compacted to achieve the final grade. Ballast rock should meet the requirements for Class B Foundation Material in Section 9-03.17 and quarry spalls should meet the requirements in Section 9-13.6 of the 2008 WSDOT Standard Specifications. The ballast rock or quarry spalls should be pushed into the subgrade with the back of a backhoe bucket or with the use of a large-vibratory steel drummed roller without the use of vibration. Such decision should be made the on-site geotechnical engineer during the actual construction of the project.

The loosely backfilled soils in the areas of exploratory test pits should be overexcavated completely to the firm native soils and backfilled with adequately compacted new structural fills to the final grades. Tree stumps and large root balls should be removed completely and backfilled with new structural fills to the desired subgrade levels.

7.2.3 Fill Placement and Compaction Requirements

Generally, quarry spalls, controlled density fills (CDF), lean mix concrete (LMC) do not require special placement and compaction procedures. In contrast, clean sand, crushed rock, soil mixtures and recycled materials should be placed under special placement and compaction procedures and specifications described here. Such structural fills under structural elements

should be placed in uniform loose lifts not exceeding 12 inches in thickness for heavy compactors and 4 inches for hand held compaction equipment. Each lift should be compacted to a minimum of 95 percent of the soil's laboratory maximum dry density as determined by ASTM Test Designation D-1557 (Modified Proctor) method, or to the applicable minimum City or County standard, whichever is the more conservative. The fill should be moisture conditioned such that its final moisture content at the time of compaction should be at or near (typically within about 2 percent) of its optimum moisture content, as determined by the ASTM method. If the fill materials are on the wet side of optimum, they can be dried by periodic windrowing and aeration or by intermixing lime or cement powder to absorb excess moisture.

7.3 Infiltration Potential Evaluation

As a part of the scope of this geotechnical study the permeability characteristics of the native soils in this site was evaluated to consider an underground infiltration system in this site for managing the stormwater runoff from the proposed development. The suitability of using such system in this site are evaluated in this section by utilizing the guidelines and the information provided in the Pierce County Stromwater Management and Site Development Manual, and the Pierce County Soil Conservation Survey (SCS) Map.

According to the Pierce County Soil Conservation Survey (SCS) Map, the subject site is underlain by the soil unit 'Buckley loam (8A)', which is categorized as Soil Hydrologic Group 'D' in this manual. This soil unit is described as 'soils having a very slow infiltration rate when thoroughly wet' and that 'this unit is not considered suitable for installing underground infiltration system because septic tank drainage fields do not function properly in this soil unit during the rainy season'. The permeability values of different layers of this soil unit for the upper 5 feet (60 inches) depth given in the manual ranges from 0.6"/hr to 2"/hr, which is considered to be very low permeability rates. In addition to this, applying a minimum FS value of 2 on the above permeability values would further lower the infiltration rates. Based on the low permeability value of these soils, it is our opinion that the underground infiltration system may not be an appropriate option in this site for managing the storm and surface water runoff. Furthermore, other geological factors such as high fines content in the native soils (51.3% to 20.5%), shallow mottling depth (@ 1 to 3 feet below grades), presence of very dense Osceola Mudflow and till at shallow depths in this site will restrict the depth of the underground infiltration system, and will also pose problems against the proper functioning of the system.

Therefore, we suggest that a stormwater facility with surface storage capability (e.g., detention pond) should be considered for managing the stormwater runoff of the proposed development.

7.4 Building Foundation Recommendations

Spread Footing

Based on the subsurface conditions encountered in the test pits, it is our opinion that the proposed warehouse can be supported on conventional shallow spread footings. The footings should be supported on the 'competent' native soil, or on new fills to be placed above the 'competent' native subgrade. The 'competent' native subgrade is described as the native subgrade that must be compacted and proofrolled adequately (as the procedures described earlier in Section 7.2.2, 'Subgrade Preparation' of this report) to firm and unyielding conditions prior to placing footings or new fills above the native subgrades. For the design of shallow footing foundation supported on the 'competent' native soils or properly compacted structural fills (as described earlier in Section 7.2.3, 'Fill Placement and Compaction Requirements' of this report), we recommend using a maximum net allowable bearing capacity of 1,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity can be used. We recommend that continuous footings have a minimum width of 18 inches and individual column footings a minimum width of 24 inches. All exterior footings should bear at least 18 inches below the final adjacent finish grade to provide adequate confinement of the bearing materials and frost protection.

Based on our settlement potential evaluation in this site, we anticipate that properly designed and constructed foundations supported on the recommended materials should experience total and differential settlements of less than 1 inch and 1/2 inch, respectively. The majority of these settlements are expected to occur during construction. This estimation was done without the aid of any laboratory consolidation test data, but on the basis of our experience with similar types of structures and subsoil conditions.

Lateral foundation loads can be resisted by friction between the foundation base and the supporting soil, and by passive earth pressure acting on the face of the embedded portion of the foundation. For frictional resistance, a coefficient of 0.35 can be used. For passive earth pressure, the available resistance can be computed using an equivalent fluid pressure of 320 pcf, which includes a factor of safety of 1.5. This value assumes the foundation must be poured "neat"

against the undisturbed native soils or structural fill placed and compacted as described earlier in Section 7.2.3, 'Fill Placement and Compaction Requirements' of this report.

Variations in the quality and strength of the potential bearing soils can occur with depth and distance between the test pits. Therefore, careful evaluation of these bearing materials is recommended at the time of construction to verify their suitability to support the above recommended bearing pressure. We recommend that PGE representatives examine the bearing materials prior to placing forms or rebar.

8.0 Construction-Time Testing & Monitoring Services

As the geotechnical engineer of record for the proposed development, PGE should be retained to perform a review of the project plans and specifications to verify that the geotechnical recommendations of this report have been properly interpreted and incorporated into the project design and specifications. Problems associated with earthwork and construction can be avoided or corrected during the progress of the construction activities if proper inspection and testing services are provided. Therefore, it is recommended that site preparation including but not limited to stripping, cut and filling, final footing subgrade preparation for foundation and pavement be monitored by an experienced and qualified geotechnical engineer and inspector of PGE. PGE should also be retained to provide geotechnical consultation, material testing, and construction monitoring services during the construction of the project. These services are important for the project to confirm that the earthwork and the general site development are in compliance with the general intent of design concepts, specifications, and the geotechnical recommendations presented in this report. Also, participation of PGE during the construction will help PGE engineers to make on-site engineering decisions in the event that any variations in subsurface conditions are encountered or any revisions in design and plan are made.

9.0 Report Limitations

The evaluation and recommendations presented in this report are based upon the information available from our subsurface explorations, and the project details furnished by the client. The study was performed using a mutually agreed-upon scope of work, which is presented in this report.

It should be noted that PGE cannot take the responsibility regarding the accuracy of the information available from other consultant. If any of the information considered during this study is not correct or if there are any revisions to the plans for this project, PGE should be

notified immediately of such information and the revisions so that necessary amendment of our geotechnical recommendations can be made. If such information and revisions are not notified to PGE, no responsibility should be implied on PGE for the impact of such information and the revisions on the project.

Variations in soil and groundwater conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and the extent of variations in soil and groundwater conditions may not be evident until construction occurs. If any soil and groundwater conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations if there are any changes in the project scope.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or others factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PGE should be notified if the project is delayed by more than 24 months from the date of this report so that we may review to determine that the conclusions and recommendations of this report remain applicable to the changed conditions.

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' method, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances.

This report including its evaluation, conclusions, specifications, recommendations, or professional advice has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted professional geotechnical engineering practices in the local areas at the time this report was written. No warranty, express or implied, is made.

This report is the property of our client, and has been prepared for the exclusive use of our client and its authorized representatives for the specific application to the proposed development at the subject site in Buckley, Washington.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PGE of such intended use and for permission to copy this report. Based on the intended use of the report, PGE may require that additional work be performed and that and updated report be reissued. Noncompliance with any of these requirements will release PGE from any liability resulting from the use of this report.

If there is a substantial lapse of time between the submission of this report and the start of the proposed construction work, or if the present conditions of the site changes during the lapsed time due to natural causes or construction activity at or adjacent to the site, it is recommended that this report be reviewed to determine that the conclusions and recommendations of this report remain applicable to the changed conditions.

10.0 Closure

We trust the information presented in this report is sufficient for your current needs. We appreciate the opportunity to provide the geotechnical services at this phase of the project and look forward to continued participation during the design and construction phase of this project. Should you have any questions or concerns, which have not been addressed, or if we may be of additional assistance, please do not hesitate to call us at 425-218-9316 or 425-643-2616 at your convenience.

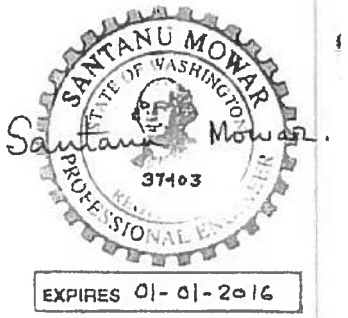
Respectfully submitted,

Santanu Mowar.

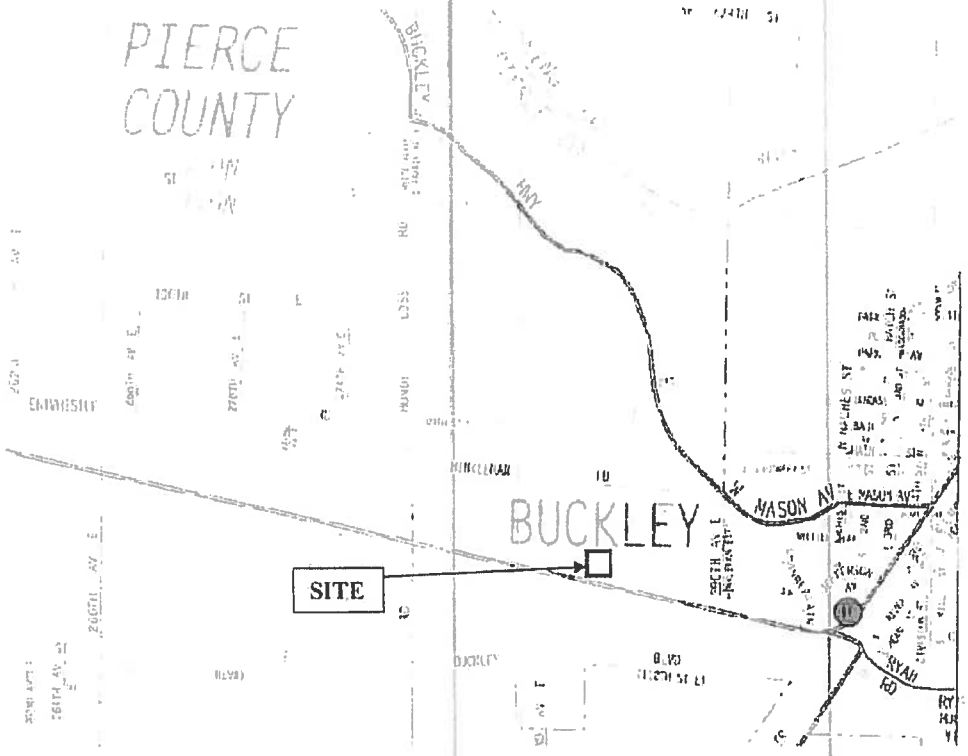
Santanu Mowar, MSCE, P.E.

PGE Pacific Geo Engineering

D:\Geotechnical\2014-proj\14-445



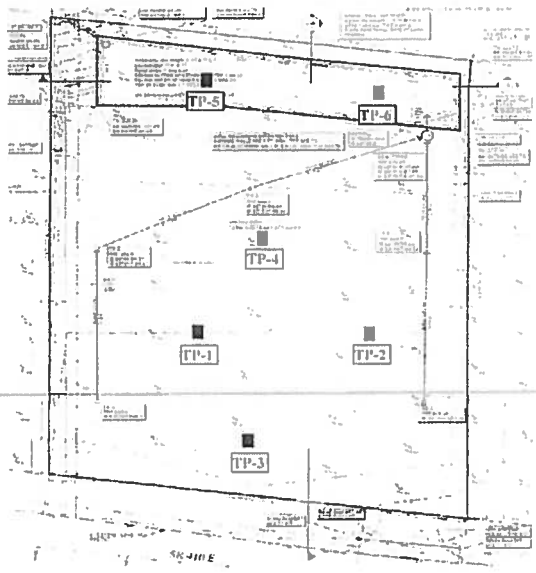
Attachments: Appendix A: Soil Test Pit Log



Source: Thomas Guide

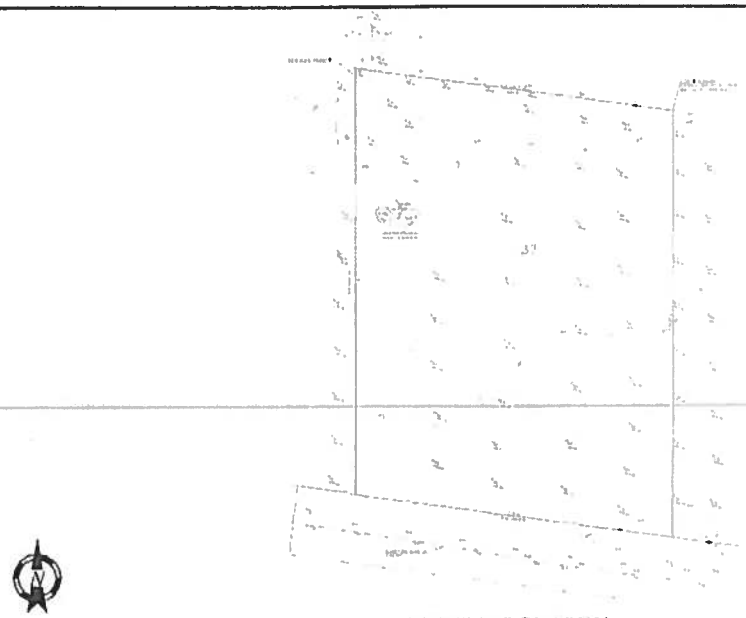
VICINITY MAP
Not to Scale

Project No: 14-445	PROJECT	PGE Pacific Geo Engineering Geotechnical Engineering, Consulting & Inspection
Date: November 30, 2014		
Drawn by:	Genisis Property 27971, SR 410 E Hwy Buckley, Pierce County, WA	Figure 1
Client: W. S. Contractors		



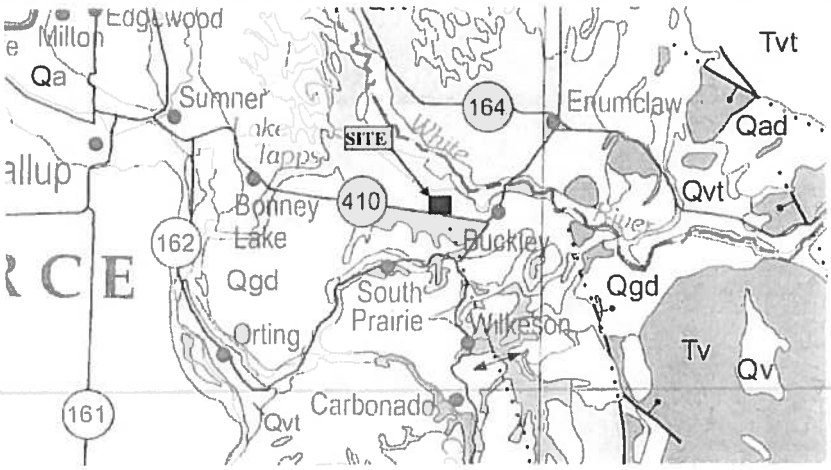
SITE & EXPLORATION PLAN
Not to Scale

LEGEND: ■ Approximate Test Pit Location	Project No.: 14-445 Date: November 30, 2014 Drawn By: Client: W. S. Contractors	PROJECT Genisis Property 27971, SR 410 E Hwy Buckley, Pierce County, WA	PGE Pacific Geo Engineering Figure 2



SITE TOPOGRAPHY
Not to Scale

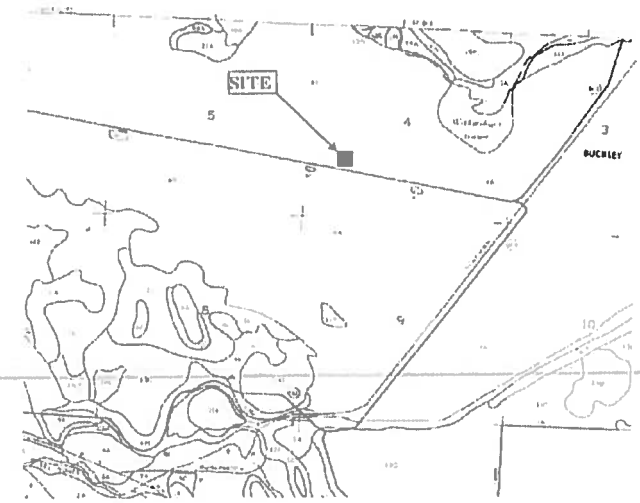
Project No.: 14-445 Date: November 30, 2014 Drawn By: Client: W. S. Contractors	PROJECT Genisis Property 27971, SR 410 E Hwy Buckley, Pierce County, WA	PGE Pacific Geo Engineering Figure 3



Source - WA State Dept. Natural Resources
Geologic Map of WA State By J. Eric Schuster, 2005
Qvt - Quaternary fragmental volcanic deposit includes lahars

GEOLOGICAL UNIT MAP
Not to Scale

Project No.: 14-445 Date: November 30, 2014 Drawn By: Client: W. S. Contractors	**PROJECT** Genisis Property 27971, SR 410 E Hwy Buckley, Pierce County, WA	PGE Pacific Geo Engineering Figure 4



Source: Pierce County SCS Map - P 31
Soil Unit - Buckley Loam 8A

N

SOIL CONSERVATION SURVEY MAP
Not to Scale

Project No.: 14-445 Date: November 30, 2014 Drawn By: Client: W. S. Constructors	**PROJECT** Genisis Property 27971, SR 410 E Hwy Buckley, Pierce County, WA	PGE Pacific Geo Engineering Figure 5

Appendix A

Soil Test Pit Log, Site Photo, Test Pit Photo

PGE Pacific Geo Engineering

Geotechnical Engineering, Consulting & Inspection

KEY TO EXPLORATION LOGS

Sample Descriptions:

Classification of soils in this report is based on visual field and laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual classification methods in accordance with ASTM D-2488 were used as an identification guide. Where laboratory data available, soil classifications are in general accordance with ASTM D2487. Soil density/consistency in borings is related primarily to the Standard Penetration Resistance values. Soil density/consistency in test pits is estimated based on visual observations of excavations. Undrained shear strength = ½ unconfined compression strength.

RELATIVE DENSITY OR CONSITENCY VS. SPT N-VALUE					
COARSE GRAINED SOILS: SAND OR GRAVEL			FINE GRAINED SOILS: SILT OR CLAY		
Density	N (Blows/ft)	Approx Relative Density (%)	Consistency	N (Blows/ft.)	Approx. Undrained Shear Strength (psf)
Very Loose	0 – 4	0- 15	Very Soft	0 – 2	<250
Loose	4 – 10	15 – 35	Soft	2 – 4	250 –500
Medium Dense	10 – 30	35 – 65	Medium Stiff	4 – 8	500 – 1000
Dense	30 – 50	65 – 85	Stiff	8 – 15	1000 – 2000
Very Dense	>50	85 – 100	Very Stiff Hard	15 – 30 > 50	2000 – 4000 > 4000

MOISTURE CONTENT DEFINITIONS	
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

DESCRIPTIONS FOR SOIL STRATA AND STRUCTURE					
General Thickness or Spacing		Structure		General Attitude	
Parting	< 1/16 in	Pocket	Erratic, discontinuous deposit of limited extent	Near Horizontal	0 - 10 deg
Seam	1/16 - 1/2 in	Lens	Lenticular deposit	Low Angle	10 - 45 deg
Layer	½ - 12 in	Varved	Alternating seams of silt and clay	High Angle	45 - 80 deg
Stratum	> 12 in	Laminated	Alternating seams	Near Vertical	80 - 90 deg
Scattered	< 1 per ft	Interbedded	Alternating Layers		
Numerous	> 1 per ft	Fractured	Breaks easily along definite fractured planes		
		Slickensided	Polished, glossy, fractured planes		
		Blocky, Diced	Breaks easily into small angular lumps		
		Sheared	Disturbed texture, mix of strengths		
		Homogeneous	Same color and appearance throughout		

SOIL TEST PIT LOG

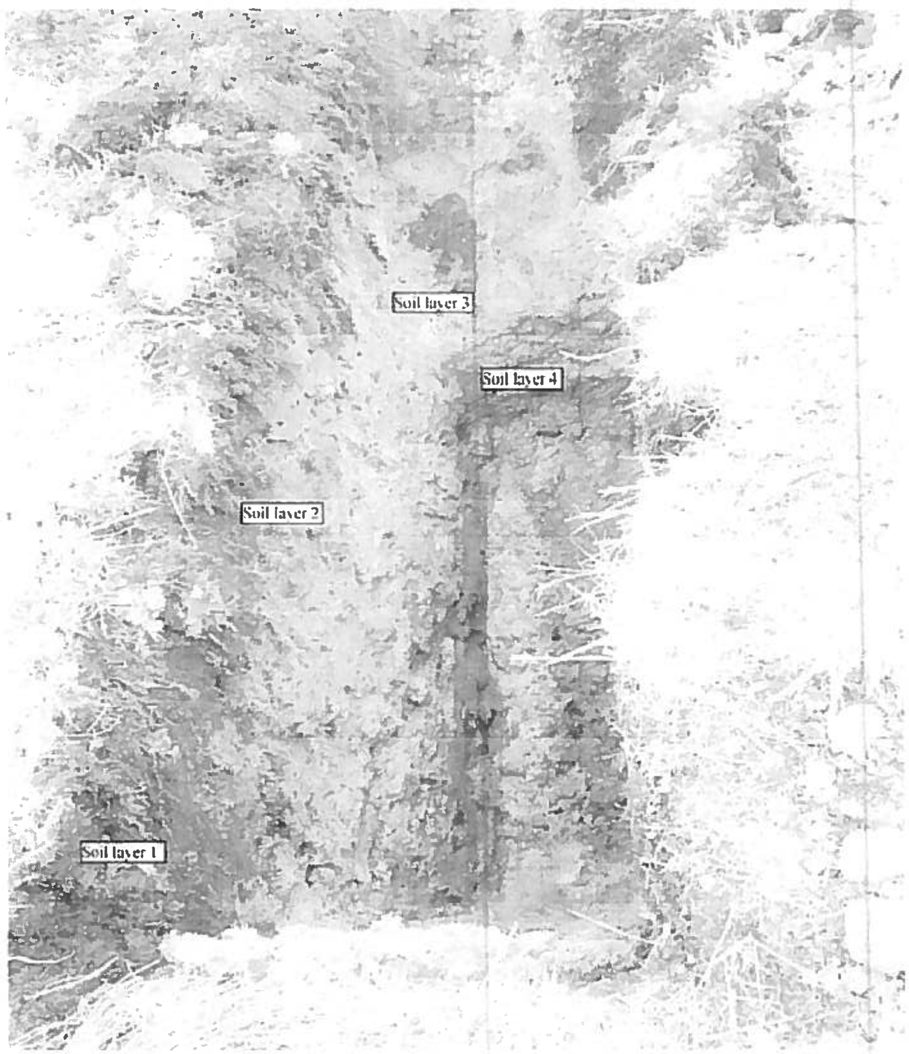
TEST PIT – 1 through 6

Date of Excavation: 11/21/14

Depth, Ft.	USCS	Soil Descriptions	Sample No./ Depth, Ft.	Moisture Content %	- #200 % (Fines content)
0 - 1	-	Topsoil: 12" thick Drk. Brn./Blk. Silt w/roots & organics, and small size gravels V. Moist, Soft	-	-	-
1 –3	ML	Mottled, Yellowish Brn. Sandy SILT w/Gravel and some Cobbles (Buckley Loam, 8A as per Pierce County SCS Map) V. Moist, Soft	S-1	21.1	51.3
3 – 6	SM, GM	Lightly Mottled, Olive-Orange-Grayish Silty SAND w/ Gravels and Boulders (Osceola Mudflow) Moist, Med. Dense from 3 to 5 ft depths and Dense from 5 to 6 ft depths.	S-2	15.8	26.4
6 - 7	SM	Lt. Gray, Partly Cemented, Silty SAND w/ Gravels and Boulders (Glacial Till) Sl. Moist, V. Dense (V. difficult digging)	S-3	7.6	20.5

Note: Test pits were terminated at 7 feet below grade. TP-5 was terminated @ approximately 10 feet below grade. Minor perched water seepage was encountered at approximately 2 to 3 feet below grade above the dense Osceola Mudflow.
Mottling was noticed above Osceola Mudflow between 1 to 3 feet below grade, which became lesser below 3 feet depth.
No caving was noticed throughout the exploration depth, except with some minor caving and sloughing within the perched water seepage zone.

Site - Looking North from Hwy 410



Test Pit Soil Logs:-

Soil Layer 1 -Topsoil
Soil Layer 2 - Buckley Loam (8a)
Soil Layer 3 - Osceola Mudflow
Soil Layer 4 - Glacial Till
Seepage water accumulated at the bottom

SECTION G: OTHER PERMITS

PERMITS REQUIRED

SEPA

Required

CITY-ISSUED CONSTRUCTION PERMIT

Required.

RIGHT-OF-WAY USE

A Right-of-Way use from the WSDOT is necessary to construct the driveway.

NPDES STORMWATER PERMIT

An NPDES permit from the State DOE is required because construction is over one acre.

PERMITS NOT REQUIRED

The threshold triggering a requirement for each of the following permits has not been met.

FOREST PRACTICES PERMIT, Department of Natural Resources

Project does not meet the threshold of 5,000 board feet of merchantable timber that triggers the requirement for a Forest Practices Permit.

SECTION 10, 401 and 404 PERMIT, Army Corps of Engineers

No discharge of dredge material or fill into waters of the U.S., including wetlands, is contemplated.

WATER QUALITY CERTIFICATION (401), Department of Ecology

The need for a 401 permit is automatically triggered by application for Federal license or permits, such as Section 404. It is certification by the State that the permitted activity complies with:

- the stormwater discharge requirements of federal law
- the aquatic protection requirements of State law.

Application for Federal license or permit is not required.

HYDRAULIC PROJECT APPROVAL, Department of Fish and Wildlife

(For work that will use, divert, obstruct, or change the natural flow or bed of State waters. The Department is also responsible for implementing State guidelines for wetland protection.)

No work is to be done in State waters.

TEMPORARY MODIFICATION OF WATER QUALITY CRITERIA, DOE

(For activities in or near water that will temporarily cause violation of state water quality standards; in particular, the standard for turbidity)

No work will be done in or near State waters.

SHORELINE DEVELOPMENT PERMIT

The project is not within a shoreline.

FLOOD PLAIN REGULATORY PERMIT

The Federal Emergency Management Agency (FEMA) has not determined that floodplains exist within the Project site.

SECTION H: OPERATION AND MAINTENANCE MANUAL

Maintenance of the stormwater facilities will be the specific responsibility of Jarred Stevenson, or his successor(s) in job title or equivalent function, for so long as the parcel is owned by WS Contractors or another entity with Jarred Stevenson as executive or director. Upon transfer of parcel title, maintenance responsibility will transfer to the new owner or designee of the new owner.

MAINTENANCE REQUIREMENTS FOR FLOW CONTROL, CONVEYANCE, AND WQ FACILITIES

NO. 1 – DETENTION PONDS			
Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Poisonous Vegetation or Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to County personnel or the public.	No danger of poisonous vegetation where County personnel or the public might normally be. Coordination with Seattle-King County Health Department
	Contaminants and Pollution	Oil, gasoline, or other contaminants of one gallon or more, or any amount found that could: 1) cause damage to plant, animal, or marine life; 2) constitute a fire hazard; or 3) be flushed downstream during rain storms.	No contaminants present other than a surface film. (Coordination with Seattle/King County Health Department)
	Unmowed Grass/Ground Cover	If facility is located in private residential area, mowing is needed when grass exceeds 18 inches in height. In other areas, the general policy is to make the pond site match adjacent ground cover and terrain as long as there is no interference with the function of the facility.	When mowing is needed, grass/ground cover should be mowed to 2 inches in height. Mowing of selected higher use areas rather than the entire slope may be acceptable for some situations.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes or other causes.	Rodents destroyed and dam or berm repaired. (Coordination with Seattle/King County Health Department)
	Insects	When insects such as wasps and hornets interfere with maintenance activities. Mosquito complaints accompanied by presence of high mosquito larvae concentrations (aquatic phase).	Insects destroyed or removed from site. Mosquito control: Swallow nesting boxes or approved larvicide applied.
	Tree Growth	Tree growth threatens integrity of berms acting as dams, does not allow maintenance access, or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are a threat to berm integrity or not interfering with access, leave trees alone.	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash and Debris (Includes Sediment)	Distance between debris build-up and bottom of orifice plate is less than 1.5 feet.	All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes–other than designed holes—in the structure.	Structure has no holes other than designed holes
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See "Detention Tanks and Vaults"	See "Detention Tanks and Vaults" Table No. 3	See "Detention Tanks and Vaults" Table No. 3

NO. 8 – FENCING

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Missing or Broken Parts	Any defect in the fence that permits easy entry to a facility.	Parts in place to provide adequate security.
	Erosion	Erosion more than 4 inches high and 12-18 inches wide permitting an opening under a fence.	No opening under the fence that exceeds 4 inches in height.
Wire Fences	Damaged Parts	Post out of plumb more than 6 inches.	Post plumb to within 1½ inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
		Missing or loose barbed wire that is sagging more than 2½ inches between posts.	Barbed wire in place with less than ½ inch sag between post.
		Extension arm missing, broken, or bent out of shape more than 1½ inches.	Extension arm in place with no bends larger than ½ inch.
	Deteriorated Paint or Protective Coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in Fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	No openings in fabric.

NO. 9 – GATES

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Damaged or Missing Members	Missing gate or locking devices.	Gates and Locking devices in place.
		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
		Missing stretcher bar, stretcher bands, and ties.	Stretcher bar, bands, and ties in place.
	Openings in Fabric	See "Fencing" Table No. 8	See "Fencing" Table No. 8

SECTION I: BOND QUANTITIES WORKSHEET

The driveway is the only item that requires a bond. It is in State right-of-way. Bonding will fall under authority of the State.