STORMWATER CONTROL PLAN

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

Grading and Paving Parcel 566500 0361

For: *Albert Kuehn*
8501 240th Ave E
Buckley, WA 98321-7494

City of Buckley
Parcel Number 566500 0361
28238 SR 410E

DENNIS R ALFREDSON
STATE OF WASHINGTON
20609
REGISTERED
PROFESSIONAL ENGINEER

RECEIVED
APR 25 2016

Prepared by:

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September 10, 2015
Revised February 25, 2016

TABLE OF CONTENTS

SECTION A: PROJECT OVERVIEW 4

SECTION B: EXISTING CONDITIONS SUMMARY 7

SECTION C: OFF-SITE ANALYSIS 8

System Description 8
Basin Map, from Google Earth 8
Photos 9

Conclusion of Downstream Analysis 14

SECTION D: CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN 15

Construction Sequence and Procedure 16

SECTION E: STORMWATER CONTROL PLAN 17

MINIMUM REQUIREMENTS OF THE STORMWATER MANUAL 17

1. preparation of stormwater site plans 17

2. construction stormwater pollution prevention 17

3. source control of pollution 17

4. preservation of natural drainage systems and outfalls 17

5. on-site stormwater management 17

6. runoff treatment 31

7. flow control 32

8. wetlands protection 32

9. Basin/watershed planning 32

10. Operation and Maintenance Manual 33

SECTION F: SPECIAL REPORT AND STUDIES 34

SECTION G: OTHER PERMITS 74

Permits required 74

Permits not required 74

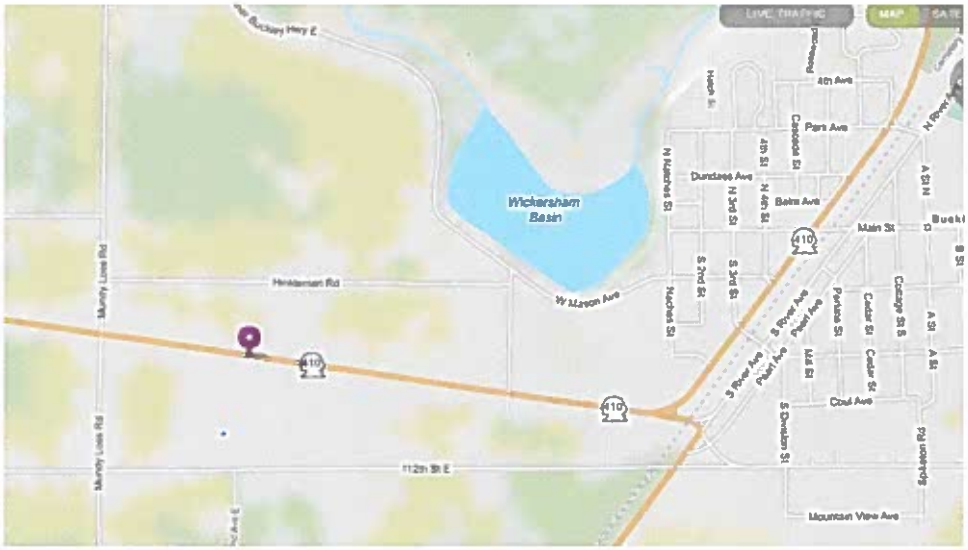
SECTION H: OPERATION AND MAINTENANCE MANUAL 76

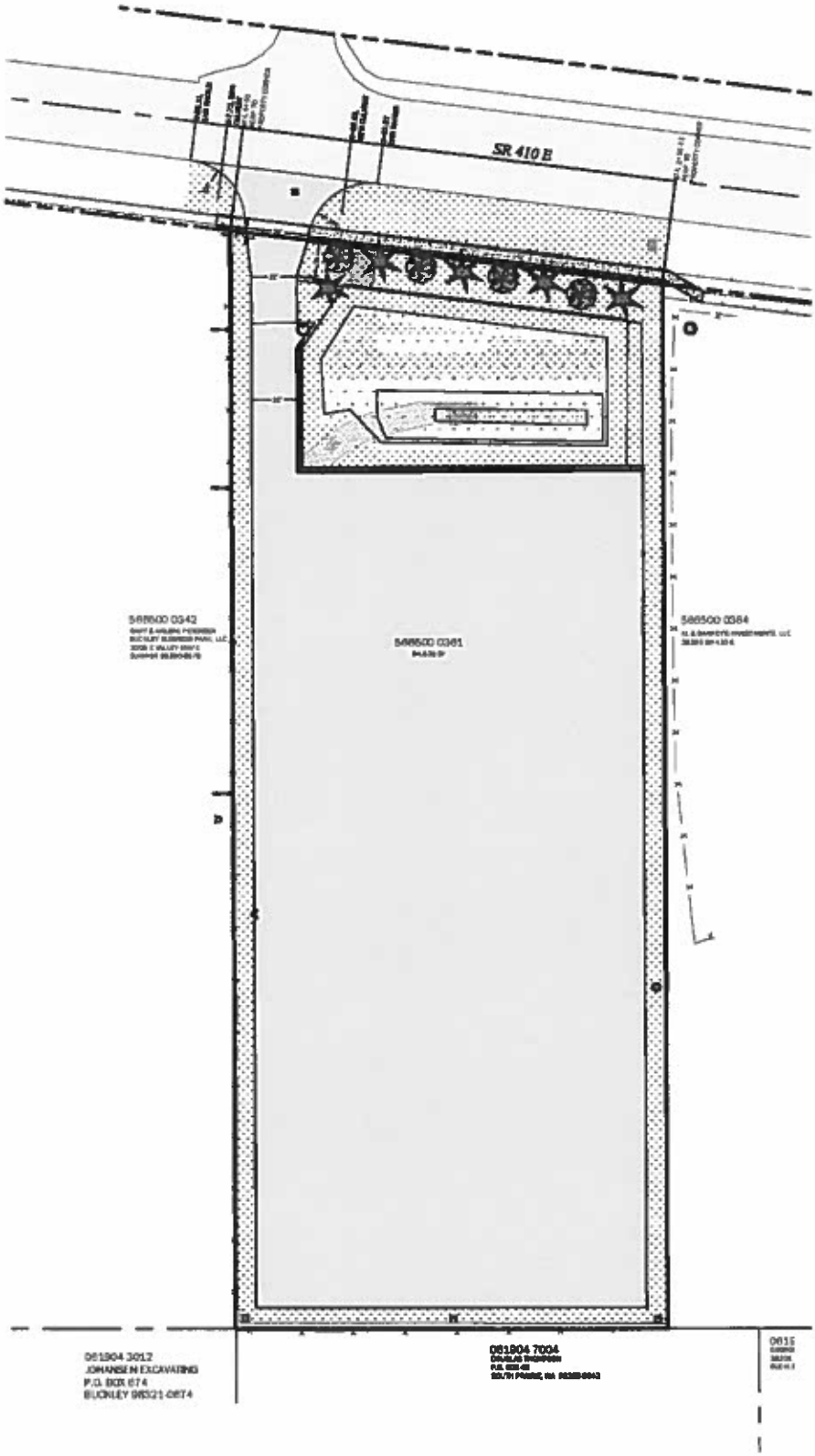
SECTION I: BOND QUANTITIES WORKSHEET 80

SECTION A: PROJECT OVERVIEW

- Pave a portion of a 2.47A parcel for use as a construction equipment yard. Construct a stormwater detention pond.
- Currently parcel is cleared and mostly filled. The fill work was done under a previous permit. The owner has decided to have the previously-permitted work redesigned.
- No new street is required, only a driveway. Access is off SR 410E.
- A new water crossing with hydrant is proposed. Also proposed is the placement of a pressure sewer line for possible future use. This line is also needed by a neighboring parcel, so an easement will be granted to that neighbor.
- Parcel is zoned GC.
- Design standards are taken from the Washington State Department of Ecology 2005 Stormwater Management Manual.
- New paved area on-site = 78,674 sf
- New pond area to be modeled as impervious pursuant to the DOE SWMM - 12,371 sf
- New type of pervious area = 15,366 sf
- Water quality is provided by a constructed stormwater wetland.

Earthwork Quantities:
Cut – 1994 cy
Fill - 2490 cy
Net - fill required of 496 cy

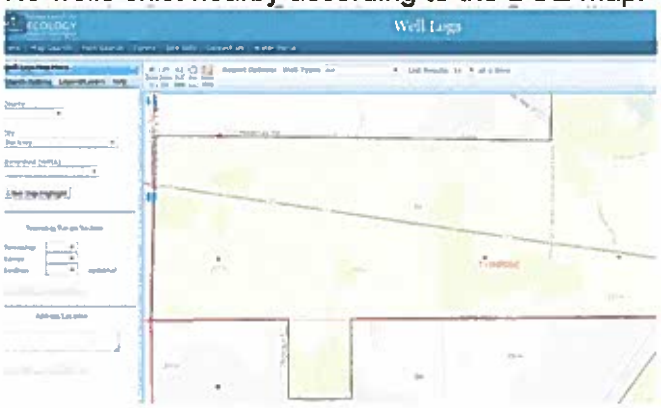

LIVE TRAFFIC
MAP
Wickersham Basin
Hinkleman Rd
W Mason Ave
Munly Lose Rd
112th St E
Dundass Ave
Park Ave
Main St
Coal Ave
Mountain View Ave
Spliston Rd
410


SR 410 E
586500 0342
586500 0381
586500 0384
061904 3012
JOHANSEN EXCAVATING
P.O. BOX 674
BUCKLEY 98321-0674
061904 7004

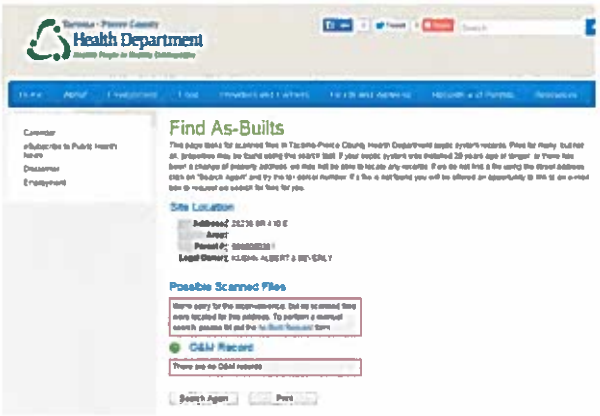
SECTION B: EXISTING CONDITIONS SUMMARY

- Currently parcel is cleared and mostly filled. The fill work was done under a previous permit. The owner has opted to have the site work redesigned.
- No known sensitive areas are found on site.
- The parcels are low sloped toward the north. Runoff flows overland to a maintained ditch on SR 410E.
- Soils are mapped by the Soil Conservation Service as 8A Buckley gravelly silt loam.

No wells exist nearby according to the DOE map.



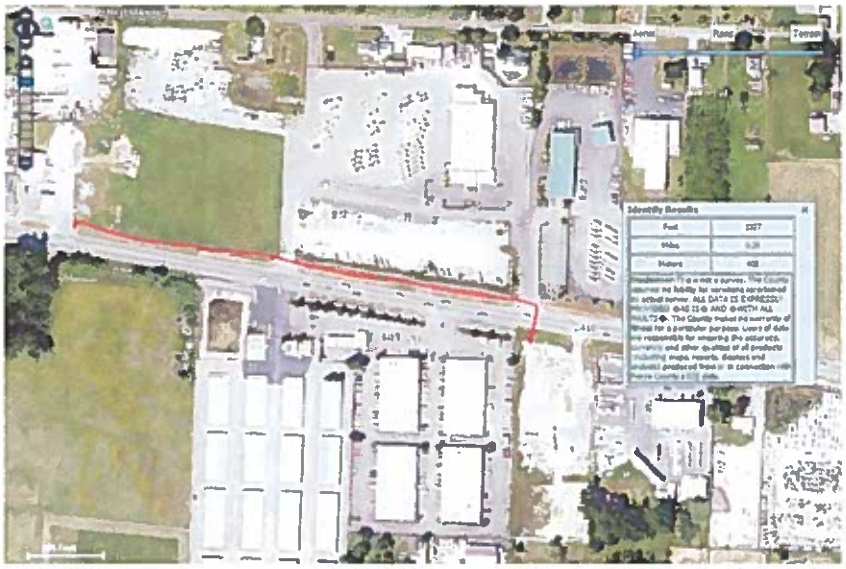
No septic systems are on record according to the Pierce Co Health Dept.



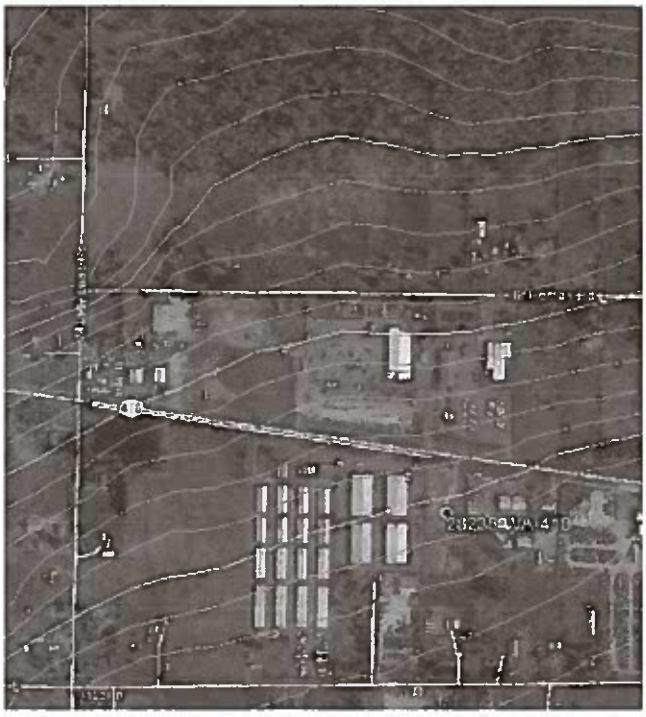
SECTION C: OFF-SITE ANALYSIS

System Description

Runoff is to be collected and routed north through an existing 18" culvert under SR 410 E. On the north side of the highway is an existing catch basin. Runoff turns here and continues to the west dumping into a wide, deep, well-maintained road ditch adjacent to the highway SR 410 E.



Basin Map, from Google Earth



Photos

1. Immediately offsite runoff flows into a pipe crossing SR 410 E (flowing north).

In the ditch south side of SR 410, looking at the inlet to the pipe flowing north under SR 410. This inlet is below the sight line of the photo above.

Looking back (south) from across SR 410 over the top of the culvert, inlet of which is shown above. Note: The new driveway will be built here.

Photo is taken standing on the catch basin that is shown in the photo following.

Looking at the catch basin on the north side of SR 410 to which the culvert flows.

Looking west from the catch basin shown in the photo above at the ditch to which the drainage discharges.

Continuing to the west. The 1/4 mile point is at the end of this ditch.

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 erodible 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 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 control will be achieved with a detention pond/flow control structure.

WWHM2012
PROJECT REPORT

Project Name: KUEHN2
Site Name: Kuehn2
Site Address:
City : Buckley
Report Date: 7/16/2015
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	2.505
Pervious Total	2.505

Impervious Land Use	Acres
Impervious Total	0
Basin Total	2.505

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres

C, Lawn, Mod	.401
Pervious Total	**0.401**

Impervious Land Use	Acres
PARKING FLAT	2.104
Impervious Total	**2.104**
Basin Total	**2.505**

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Name : Trapezoidal Pond 1
Bottom Length: 89.12 ft.
Bottom Width: 89.12 ft.
Depth: 6 ft.
Volume at riser head: 1.1316 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: 0.024 ft.
Notch Height: 1.423 ft.
Orifice 1 Diameter: 0.728 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	0.182	0.000	0.000	0.000
0.0667	0.183	0.012	0.003	0.000
0.1333	0.184	0.024	0.005	0.000
0.2000	0.185	0.036	0.006	0.000
0.2667	0.186	0.049	0.007	0.000
0.3333	0.187	0.061	0.008	0.000
0.4000	0.189	0.074	0.008	0.000
0.4667	0.190	0.086	0.009	0.000
0.5333	0.191	0.099	0.010	0.000
0.6000	0.192	0.112	0.010	0.000
0.6667	0.193	0.125	0.011	0.000
0.7333	0.194	0.138	0.011	0.000

0.8000	0.195	0.151	0.012	0.000
0.8667	0.196	0.164	0.013	0.000
0.9333	0.197	0.177	0.013	0.000
1.0000	0.199	0.190	0.013	0.000
1.0667	0.200	0.204	0.014	0.000
1.1333	0.201	0.217	0.014	0.000
1.2000	0.202	0.230	0.015	0.000
1.2667	0.203	0.244	0.015	0.000
1.3333	0.204	0.258	0.016	0.000
1.4000	0.206	0.271	0.016	0.000
1.4667	0.207	0.285	0.016	0.000
1.5333	0.208	0.299	0.017	0.000
1.6000	0.209	0.313	0.017	0.000
1.6667	0.210	0.327	0.018	0.000
1.7333	0.211	0.341	0.018	0.000
1.8000	0.213	0.355	0.018	0.000
1.8667	0.214	0.369	0.019	0.000
1.9333	0.215	0.384	0.019	0.000
2.0000	0.216	0.398	0.019	0.000
2.0667	0.217	0.412	0.020	0.000
2.1333	0.218	0.427	0.020	0.000
2.2000	0.220	0.442	0.020	0.000
2.2667	0.221	0.456	0.021	0.000
2.3333	0.222	0.471	0.021	0.000
2.4000	0.223	0.486	0.021	0.000
2.4667	0.225	0.501	0.021	0.000
2.5333	0.226	0.516	0.022	0.000
2.6000	0.227	0.531	0.022	0.000
2.6667	0.228	0.546	0.022	0.000
2.7333	0.229	0.562	0.023	0.000
2.8000	0.231	0.577	0.023	0.000
2.8667	0.232	0.592	0.023	0.000
2.9333	0.233	0.608	0.023	0.000
3.0000	0.234	0.624	0.024	0.000
3.0667	0.236	0.639	0.024	0.000
3.1333	0.237	0.655	0.024	0.000
3.2000	0.238	0.671	0.024	0.000
3.2667	0.239	0.687	0.025	0.000
3.3333	0.241	0.703	0.025	0.000
3.4000	0.242	0.719	0.025	0.000
3.4667	0.243	0.735	0.025	0.000
3.5333	0.244	0.751	0.026	0.000
3.6000	0.246	0.768	0.026	0.000
3.6667	0.247	0.784	0.028	0.000
3.7333	0.248	0.801	0.031	0.000
3.8000	0.249	0.817	0.035	0.000
3.8667	0.251	0.834	0.038	0.000
3.9333	0.252	0.851	0.043	0.000
4.0000	0.253	0.868	0.047	0.000
4.0667	0.255	0.885	0.052	0.000
4.1333	0.256	0.902	0.057	0.000
4.2000	0.257	0.919	0.062	0.000
4.2667	0.258	0.936	0.067	0.000
4.3333	0.260	0.953	0.072	0.000
4.4000	0.261	0.971	0.078	0.000
4.4667	0.262	0.988	0.083	0.000
4.5333	0.264	1.006	0.089	0.000
4.6000	0.265	1.023	0.094	0.000
4.6667	0.266	1.041	0.101	0.000
4.7333	0.268	1.059	0.108	0.000

4.8000	0.269	1.077	0.115	0.000
4.8667	0.270	1.095	0.122	0.000
4.9333	0.272	1.113	0.130	0.000
5.0000	0.273	1.131	0.167	0.000
5.0667	0.274	1.149	0.419	0.000
5.1333	0.276	1.168	0.879	0.000
5.2000	0.277	1.186	1.474	0.000
5.2667	0.278	1.205	2.179	0.000
5.3333	0.280	1.223	2.979	0.000
5.4000	0.281	1.242	3.864	0.000
5.4667	0.282	1.261	4.825	0.000
5.5333	0.284	1.280	5.858	0.000
5.6000	0.285	1.299	6.958	0.000
5.6667	0.286	1.318	8.121	0.000
5.7333	0.288	1.337	9.343	0.000
5.8000	0.289	1.356	10.62	0.000
5.8667	0.291	1.376	11.95	0.000
5.9333	0.292	1.395	13.34	0.000
6.0000	0.293	1.415	14.77	0.000
6.0667	0.295	1.434	16.26	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:2.505
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.401
Total Impervious Area:2.104

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.052787
5 year	0.082122
10 year	0.098061
25 year	0.114284
50 year	0.123926
100 year	0.131855

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.029983
5 year	0.052072
10 year	0.073378
25 year	0.110461
50 year	0.14743
100 year	0.194372

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

Year	Predeveloped	Mitigated
1902	0.039	0.025
1903	0.032	0.020
1904	0.053	0.024
1905	0.025	0.037
1906	0.011	0.018
1907	0.081	0.024
1908	0.060	0.022
1909	0.059	0.025
1910	0.082	0.025
1911	0.053	0.024
1912	0.176	0.035
1913	0.084	0.064
1914	0.021	0.018
1915	0.034	0.046
1916	0.053	0.023
1917	0.018	0.022
1918	0.056	0.082
1919	0.042	0.023
1920	0.054	0.024
1921	0.060	0.037
1922	0.060	0.024
1923	0.048	0.043
1924	0.022	0.022
1925	0.027	0.022
1926	0.051	0.023
1927	0.033	0.024
1928	0.041	0.026
1929	0.084	0.043
1930	0.054	0.024
1931	0.050	0.025
1932	0.039	0.032
1933	0.038	0.025
1934	0.111	0.121
1935	0.051	0.072
1936	0.045	0.027
1937	0.071	0.023
1938	0.043	0.025
1939	0.003	0.019
1940	0.048	0.037
1941	0.023	0.018
1942	0.072	0.114
1943	0.037	0.025
1944	0.068	0.054
1945	0.060	0.025
1946	0.033	0.021
1947	0.021	0.022
1948	0.114	0.025
1949	0.097	0.069
1950	0.028	0.023
1951	0.034	0.021
1952	0.148	0.072
1953	0.134	0.128
1954	0.048	0.026
1955	0.039	0.020
1956	0.019	0.020
1957	0.068	0.049

1958	0.143	0.225
1959	0.088	0.120
1960	0.024	0.018
1961	0.089	0.114
1962	0.048	0.027
1963	0.023	0.018
1964	0.025	0.021
1965	0.099	0.100
1966	0.028	0.023
1967	0.043	0.021
1968	0.044	0.028
1969	0.043	0.025
1970	0.068	0.026
1971	0.107	0.088
1972	0.070	0.026
1973	0.089	0.056
1974	0.048	0.024
1975	0.113	0.160
1976	0.060	0.025
1977	0.020	0.018
1978	0.100	0.098
1979	0.027	0.023
1980	0.057	0.024
1981	0.054	0.026
1982	0.022	0.019
1983	0.089	0.039
1984	0.036	0.023
1985	0.059	0.023
1986	0.053	0.028
1987	0.101	0.082
1988	0.064	0.055
1989	0.057	0.023
1990	0.065	0.024
1991	0.051	0.027
1992	0.073	0.076
1993	0.071	0.024
1994	0.106	0.026
1995	0.020	0.024
1996	0.116	0.106
1997	0.045	0.021
1998	0.053	0.024
1999	0.004	0.022
2000	0.040	0.031
2001	0.021	0.018
2002	0.074	0.024
2003	0.064	0.026
2004	0.059	0.025
2005	0.109	0.028
2006	0.033	0.023
2007	0.033	0.025
2008	0.056	0.024
2009	0.038	0.023
2010	0.033	0.046
2011	0.026	0.022
2012	0.038	0.023
2013	0.030	0.018
2014	0.022	0.019
2015	0.043	0.022
2016	0.017	0.022
2017	0.081	0.060

2018	0.148	0.163
2019	0.138	0.110
2020	0.045	0.022
2021	0.073	0.065
2022	0.030	0.022
2023	0.062	0.027
2024	0.116	0.024
2025	0.054	0.025
2026	0.089	0.050
2027	0.032	0.022
2028	0.028	0.019
2029	0.060	0.060
2030	0.112	0.047
2031	0.037	0.020
2032	0.020	0.020
2033	0.032	0.020
2034	0.032	0.022
2035	0.126	0.329
2036	0.065	0.031
2037	0.016	0.021
2038	0.052	0.055
2039	0.005	0.016
2040	0.029	0.023
2041	0.039	0.021
2042	0.123	0.106
2043	0.059	0.059
2044	0.080	0.052
2045	0.054	0.041
2046	0.064	0.090
2047	0.047	0.036
2048	0.061	0.024
2049	0.054	0.025
2050	0.039	0.024
2051	0.057	0.025
2052	0.033	0.025
2053	0.058	0.100
2054	0.074	0.066
2055	0.023	0.019
2056	0.026	0.021
2057	0.040	0.027
2058	0.051	0.044
2059	0.089	0.050

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

Rank	Predeveloped	Mitigated
1	0.1757	0.3291
2	0.1481	0.2248
3	0.1479	0.1630
4	0.1429	0.1599
5	0.1380	0.1278
6	0.1336	0.1215
7	0.1259	0.1196
8	0.1225	0.1142
9	0.1160	0.1137
10	0.1158	0.1099
11	0.1136	0.1065
12	0.1125	0.1056
13	0.1116	0.0998

14	0.1105	0.0996
15	0.1085	0.0982
16	0.1072	0.0901
17	0.1059	0.0878
18	0.1008	0.0824
19	0.1002	0.0819
20	0.0994	0.0765
21	0.0973	0.0723
22	0.0893	0.0722
23	0.0888	0.0694
24	0.0888	0.0663
25	0.0888	0.0650
26	0.0886	0.0643
27	0.0883	0.0601
28	0.0842	0.0598
29	0.0838	0.0590
30	0.0818	0.0559
31	0.0813	0.0551
32	0.0810	0.0546
33	0.0798	0.0537
34	0.0739	0.0521
35	0.0736	0.0502
36	0.0733	0.0500
37	0.0728	0.0490
38	0.0724	0.0472
39	0.0712	0.0464
40	0.0706	0.0462
41	0.0695	0.0440
42	0.0684	0.0429
43	0.0683	0.0429
44	0.0681	0.0412
45	0.0654	0.0392
46	0.0650	0.0373
47	0.0641	0.0373
48	0.0639	0.0368
49	0.0637	0.0360
50	0.0616	0.0345
51	0.0607	0.0324
52	0.0603	0.0310
53	0.0602	0.0310
54	0.0602	0.0279
55	0.0600	0.0277
56	0.0600	0.0275
57	0.0596	0.0275
58	0.0593	0.0273
59	0.0592	0.0270
60	0.0589	0.0265
61	0.0589	0.0265
62	0.0582	0.0262
63	0.0574	0.0260
64	0.0567	0.0259
65	0.0565	0.0258
66	0.0564	0.0258
67	0.0561	0.0257
68	0.0544	0.0256
69	0.0544	0.0254
70	0.0543	0.0253
71	0.0542	0.0252
72	0.0539	0.0252
73	0.0537	0.0252

74	0.0533	0.0252
75	0.0529	0.0251
76	0.0528	0.0251
77	0.0527	0.0251
78	0.0527	0.0250
79	0.0522	0.0250
80	0.0513	0.0249
81	0.0511	0.0248
82	0.0509	0.0248
83	0.0506	0.0246
84	0.0498	0.0245
85	0.0484	0.0245
86	0.0482	0.0244
87	0.0481	0.0243
88	0.0480	0.0243
89	0.0477	0.0243
90	0.0469	0.0242
91	0.0450	0.0242
92	0.0446	0.0242
93	0.0445	0.0242
94	0.0436	0.0242
95	0.0435	0.0242
96	0.0434	0.0240
97	0.0428	0.0240
98	0.0427	0.0240
99	0.0417	0.0240
100	0.0409	0.0239
101	0.0403	0.0239
102	0.0399	0.0238
103	0.0394	0.0236
104	0.0391	0.0235
105	0.0390	0.0234
106	0.0389	0.0233
107	0.0387	0.0233
108	0.0385	0.0233
109	0.0384	0.0233
110	0.0376	0.0233
111	0.0373	0.0231
112	0.0369	0.0230
113	0.0362	0.0230
114	0.0339	0.0229
115	0.0339	0.0228
116	0.0332	0.0228
117	0.0329	0.0226
118	0.0328	0.0223
119	0.0327	0.0223
120	0.0326	0.0222
121	0.0325	0.0220
122	0.0323	0.0220
123	0.0322	0.0220
124	0.0319	0.0219
125	0.0318	0.0219
126	0.0303	0.0218
127	0.0300	0.0217
128	0.0290	0.0217
129	0.0279	0.0216
130	0.0277	0.0215
131	0.0276	0.0213
132	0.0275	0.0213
133	0.0274	0.0212

134	0.0265	0.0209
135	0.0257	0.0208
136	0.0253	0.0206
137	0.0251	0.0206
138	0.0235	0.0205
139	0.0229	0.0204
140	0.0229	0.0202
141	0.0229	0.0201
142	0.0223	0.0200
143	0.0222	0.0198
144	0.0221	0.0196
145	0.0206	0.0193
146	0.0206	0.0193
147	0.0206	0.0191
148	0.0203	0.0189
149	0.0201	0.0188
150	0.0201	0.0185
151	0.0193	0.0184
152	0.0176	0.0182
153	0.0170	0.0182
154	0.0156	0.0181
155	0.0113	0.0181
156	0.0052	0.0180
157	0.0043	0.0180
158	0.0027	0.0163

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0264	54298	0	0	Pass
0.0274	50187	0	0	Pass
0.0284	46581	0	0	Pass
0.0293	43340	0	0	Pass
0.0303	40265	0	0	Pass
0.0313	37473	0	0	Pass
0.0323	34925	0	0	Pass
0.0333	32581	0	0	Pass
0.0343	30326	0	0	Pass
0.0353	28260	0	0	Pass
0.0362	26432	0	0	Pass
0.0372	24786	0	0	Pass
0.0382	23290	0	0	Pass
0.0392	21922	0	0	Pass
0.0402	20637	0	0	Pass
0.0412	19412	0	0	Pass
0.0422	18288	0	0	Pass
0.0431	17219	0	0	Pass
0.0441	16160	0	0	Pass
0.0451	15141	0	0	Pass
0.0461	14271	0	0	Pass
0.0471	13446	0	0	Pass
0.0481	12665	0	0	Pass
0.0491	11933	0	0	Pass
0.0500	11246	0	0	Pass

0.0510	10559	0	0	Pass
0.0520	9972	0	0	Pass
0.0530	9374	0	0	Pass
0.0540	8847	0	0	Pass
0.0550	8332	0	0	Pass
0.0559	7861	0	0	Pass
0.0569	7462	0	0	Pass
0.0579	7030	0	0	Pass
0.0589	6609	0	0	Pass
0.0599	6277	0	0	Pass
0.0609	5978	0	0	Pass
0.0619	5701	0	0	Pass
0.0628	5437	0	0	Pass
0.0638	5197	0	0	Pass
0.0648	4942	0	0	Pass
0.0658	4702	0	0	Pass
0.0668	4512	0	0	Pass
0.0678	4333	0	0	Pass
0.0688	4156	0	0	Pass
0.0697	3956	0	0	Pass
0.0707	3764	0	0	Pass
0.0717	3577	0	0	Pass
0.0727	3413	0	0	Pass
0.0737	3259	0	0	Pass
0.0747	3134	0	0	Pass
0.0757	3026	0	0	Pass
0.0766	2927	0	0	Pass
0.0776	2813	0	0	Pass
0.0786	2682	0	0	Pass
0.0796	2555	0	0	Pass
0.0806	2451	0	0	Pass
0.0816	2359	0	0	Pass
0.0825	2256	0	0	Pass
0.0835	2140	0	0	Pass
0.0845	2038	0	0	Pass
0.0855	1952	0	0	Pass
0.0865	1860	0	0	Pass
0.0875	1778	0	0	Pass
0.0885	1689	0	0	Pass
0.0894	1619	0	0	Pass
0.0904	1561	0	0	Pass
0.0914	1482	0	0	Pass
0.0924	1407	0	0	Pass
0.0934	1338	0	0	Pass
0.0944	1270	0	0	Pass
0.0954	1217	0	0	Pass
0.0963	1162	0	0	Pass
0.0973	1103	0	0	Pass
0.0983	1055	0	0	Pass
0.0993	1006	0	0	Pass
0.1003	966	0	0	Pass
0.1013	922	0	0	Pass
0.1023	874	0	0	Pass
0.1032	815	0	0	Pass
0.1042	775	0	0	Pass
0.1052	737	0	0	Pass
0.1062	695	0	0	Pass
0.1072	641	0	0	Pass
0.1082	602	0	0	Pass
0.1091	558	0	0	Pass

0.1101	517	0	0	Pass
0.1111	478	0	0	Pass
0.1121	433	0	0	Pass
0.1131	396	0	0	Pass
0.1141	364	0	0	Pass
0.1151	341	0	0	Pass
0.1160	311	0	0	Pass
0.1170	297	0	0	Pass
0.1180	273	0	0	Pass
0.1190	252	0	0	Pass
0.1200	237	0	0	Pass
0.1210	224	0	0	Pass
0.1220	207	0	0	Pass
0.1229	195	0	0	Pass
0.1239	180	0	0	Pass

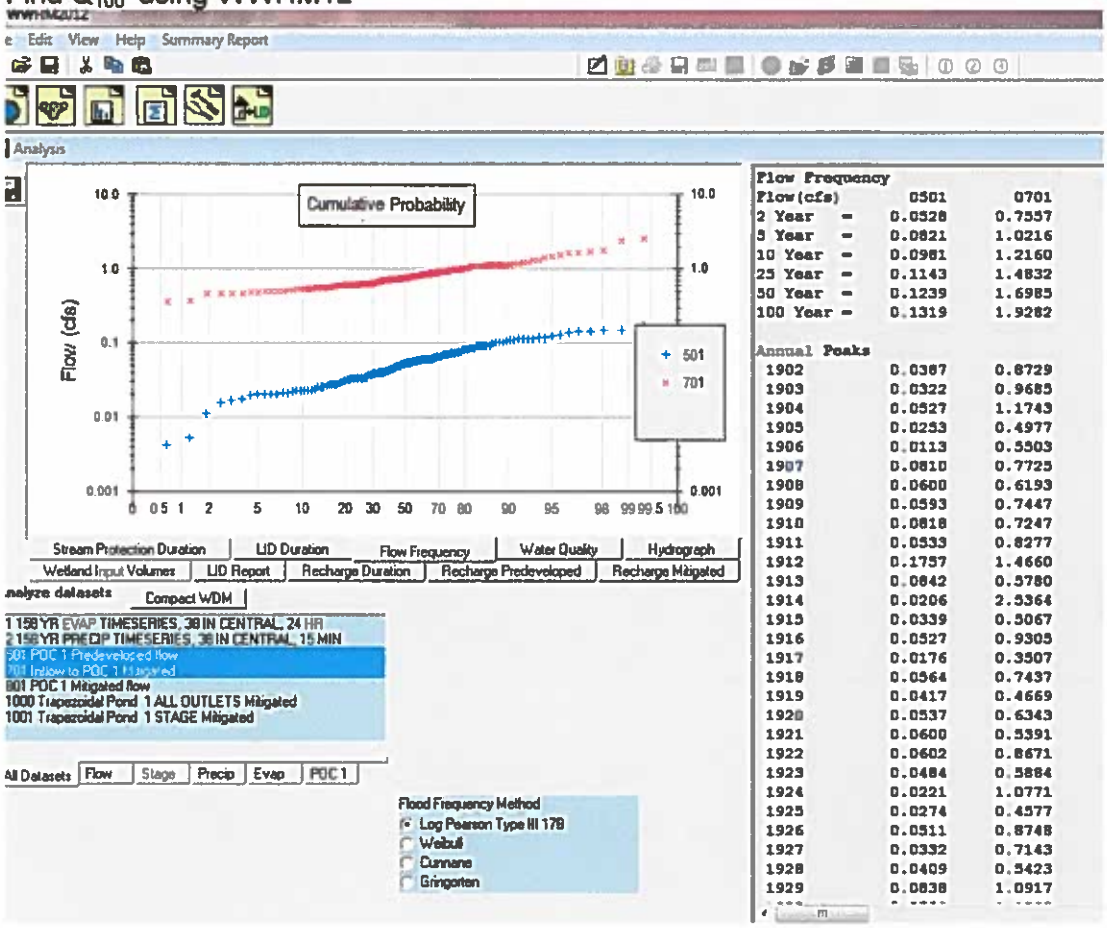
Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Percent Treatment?	Total Volumn Needs Treatment (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft)	Cumulative Volumn Infiltration Credit	Percent Water Quality Volumn Infiltrated	Comment Treated

REQUIRED WIDTH OF POND OVERFLOW WEIR

Find Q_{100} using WWHM12



Q_{100} = 1.93 cfs

PSCD PLAT & SITE CIVIL DESIGN, LLC

9/10/2015

Emergency Overflow Weir Width

		1.93	
Q_{100}	=	0	cfs, from WWHM12 run
C	=	1	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	
		6.2	ft
		10	FT PROVIDED - OKAY

6. RUNOFF TREATMENT

Runoff will be treated by a stormwater wetland constructed below the bottom level of the detained stormwater.

PSCD PLAT & SITE CIVIL DESIGN, LLC

Albert Kuehn
Stormwater Wetland Design
DOE SWMM p. 10-5

STEP 1 Identify required wetpool volume

Identify 6-month 24 hour rainfall

2-yr rainfall	=	2.3	inches from isopluvial
6-month 24-hr= 1/2 2-yr		1.15	inches
Area Tributary	=	2.1	acres, all impervious

Volume of wetpool/wetpond req'd

area * rainfall =	0.201	acre/ft
	8,766	cf

STEP 2 Determine volume provided

V	=	.333 * h * (Ab + At + (At*Ab)^0.5			
where					
h	=	height			
Ab	=	Area of bottom			
At	=	Area of top			
h	=	4	ft		
Ab	=	836	sf		
At (elev 702)	=	7,680	sf		
V	=	14,733	cf =	546	cy
14,733	>	8,766	OKAY		

THE SIZE OF THE STORMWATER WETLAND IS >> REQUIRED BY VIRTUE OF WETPOOL REQUIREMENTS ALONE. THE POND IS SIZED TO FIT UNDERNEATH
THE STORMWATER DETENTION, THUS THE SIZE IS DETERMINED BY THAT.

Proof of relative volume of settling cell vs. total wetpool volume

Volume of settling cell:

V	=	.333 * h * (Ab + At + (At*Ab)^0.5			
where					
h	=	height			
Ab	=	Area of bottom			
At	=	Area of top			
h	=	5	ft		
Ab(elev 697)	=	478	sf		
At (elev 702)	=	3,431	sf		
V	=	8,649	cf =	320	cy
8,649	=	0.5871	of total volume, okay		

Volume of cell 2:

V	=	.333 * h * (Ab + At + (At*Ab)^0.5			
where					
h	=	height			
Ab	=	Area of bottom			
At	=	Area of top			
h	=	1.5	ft		
Ab(elev 700.5))	=	2,943	sf		
At (elev 702)	=	4,201	sf		
V	=	5,330	cf =	197	cy

Settling Cell has larger volume than cell 2 because it needs to be wide in order to accommodate the side slope + the access road.

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. See **Paragraph 5** for 2012 WWHM computer calcs in accordance with 2005 Ecology Manual.

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

A manual is found in Section H.

SECTION F: SPECIAL REPORT AND STUDIES

A geotech report was prepared for this site as part of a project that is superseded by this project, following.

PGE Pacific Geo Engineering
Geotechnical Engineering, Consulting & Inspection

March 31, 2014

Albert Kuehn
8501, 240th Avenue East
Buckley, WA 98321

Attn.: Mr. Al Kuehn

Re: **Kuehn Property - Retaining Wall Recommendations**
28238, SR 410 Highway
Buckley, Pierce County, Washington
PGE Project No. 13-423

Ref.: 'Kuehn Property - Pond Plan & Cover Sheet', Drawing No. 8128BASE, Sheet No. 1 of 8 and Sheet No. 4 of 8, dated 03-03-2014, prepared by Larson & Associates.

Dear Mr. Kuehn:

As per the request of Mr. Jeff Cederholm of Larson and Associates, Pacific Geo Engineering, LLC (PGE) has provided the design parameters for the design of a continuous, outside, concrete retaining wall for the proposed below grade detention pond, the details of a free-standing baffle wall (ecology block wall) within the detention pond, the design and details of two above grade ecology block walls at the perimeter of the property, and the pertinent geotechnical engineering recommendations for the construction and inspection of these walls.

Our scope of work is performed in general accordance with our proposal No. 13-07-392, dated July 31, 2013, which was authorized by Mr. Al Kuehn on September 18, 2013.

We understand that the subject site is currently vacant, and will be developed for using it as a commercial site. As per the site plan the site has been raised to the current grades in the past years by placing fills on the original grade. Our subsurface explorations in the pond site reveals that the amount of fills is estimated to be of approximately 4 feet thick. The current development plan includes the construction of a below grade detention pond in the site to manage the stormwater runoff. The pond's sides will be supported by a continuous concrete retaining wall with varying heights, ranging from 8 feet to 11.5 feet. The east and the south concrete walls will be approximately 11.5 feet tall and the west wall will be approximately 8 feet tall. These heights include a minimum embedment depth of 2 feet below the pond bottom elevation. The pond will have two chambers separated by a free-standing ecology block baffle wall of approximately 6.5