STORMWATER DRAINAGE REPORT

PACIFIC SEAFOOD

MUKILTEO, WA

9/16/2016

September 15, 2016 *Initial: November 30, 2015*	**Prepared for:** City of Mukilteo	**Reviewed by:** Joe Taflin, P.E., LEED Principal joe@navixeng.com

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PROJECT OVERVIEW

PROPOSED IMPROVEMENTS

The proposed development consists of the construction of a single commercial building with parking for trucks and cars, an access roadway, stormwater management facilities, utilities, and on-site landscaping on a 4.98-acre site in Mukilteo, Washington. The property is currently zoned as planned industrial.

DESIGN CRITERIA

The City of Mukilteo utilizes the 2012 Washington State Department of Ecology Stormwater Management Manual for Western Washington (DOE Manual) drainage requirements. Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The pre-developed condition to be matched shall be a pastured land cover. Additionally, the site is tributary to an existing wetland and shall meet the Wetland Protection Guidelines Criterion 1 and 2.

JURISDICTIONAL REQUIREMENTS

Table 1 below summarizes City of Mukilteo stormwater requirements.

TABLE 1

Jurisdictional Requirements	
Duration Analysis:	
2-year:	Reduce to ½ pre-developed duration
50-year:	Match pre-developed
Downstream Wetland Protection:	Criteria 1: ±20% of daily volume Criteria 2: ±15% of monthly volume
Water Quality Volume:	n/a
Water Quality Flow Rate:	0.45 CFS
Downstream Analysis:	
Level 1:	¼ mile downstream

SUBBASINS, AND SITE CHARACTERISTICS:

SUBBASIN

The site is located within a single basin with upstream property tributary via sheet flow. The proposed drainage system consists of a system of catch basins and underground storm drainage pipes that will convey the stormwater runoff from the paved and roof surfaces to a bioswales(s) and a detention vault located in the northwest portion of the site. Runoff will receive water quality treatment and be controlled released to an existing type II structure 80th Street SW (vacated right-of-way), which eventually discharges to the Puget Sound.

SOILS

Per the Geotechnical Investigation Report by Redmond Geotechnical Services, dated April 24, 2015, the site is underlain by glacial till consisting of non-sorted mixture of clay, silt, sandy pebbles and cobbles. The Soil Conservation Service has mapped the site as Alderwood-Urban land complex, 2-8% slope, classified as Type B soils for stormwater runoff but will be modeled as C type soils per site and geotechnical recommendation. Infiltration of stormwater is limited to 0.30"/hr per letter dated July 29, 2016. Groundwater was not encountered within depths of 20 feet on the site.

PROJECT LOCATION

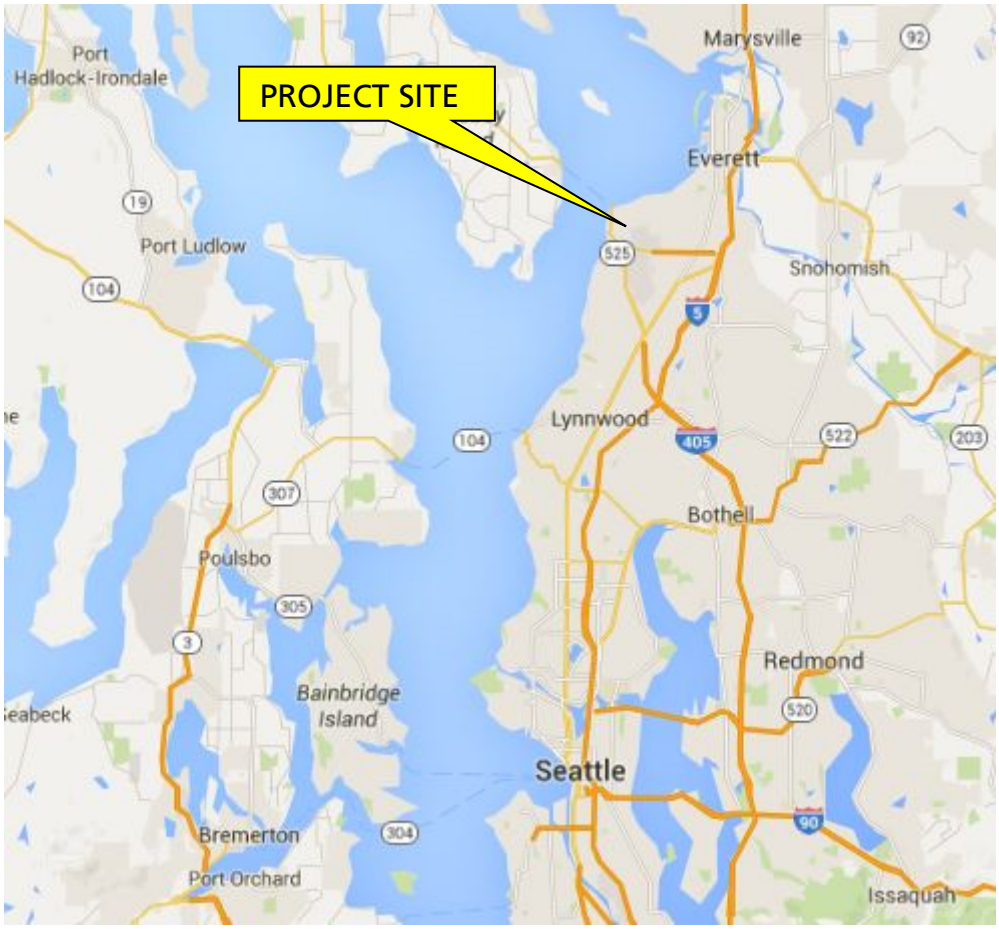


Figure 1: Vicinity Map

Location: 8007 44th Avenue West Mukilteo, WA, 98274

Section, Township, Range: SW 1/4, SW 1/4 OF SEC 10, T 28N, R 4E, W.M.

Tax Account Number: 0061160000980, 00611600009701, 28041000301800, 28041000303000 & 28041000301700.

Size: 217,099 SF (4.98 AC) – 10' ROW Dedication = 212,562 (4.88 AC)

City, County, State: Mukilteo, Snohomish County, Washington State

Governing Agency: City of Mukilteo

Design Criteria: 2012 Washington State Department of Ecology Stormwater Management Manual for Western Washington

Zoning: PI (Planned Industrial)

MINIMUM REQUIREMENTS

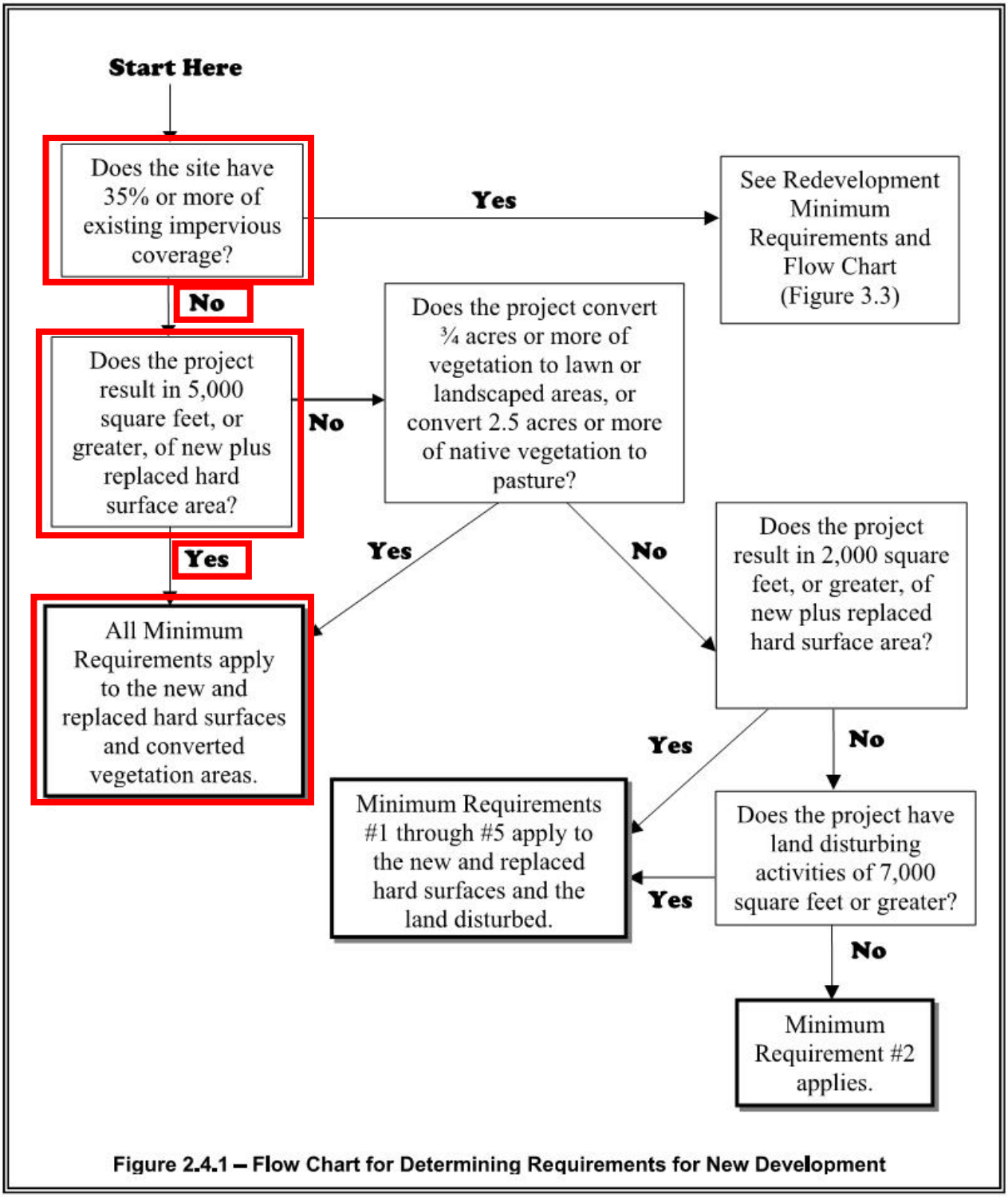


Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

Minimum Requirement #1: Preparation of Stormwater Site Plans
All projects meeting the thresholds in Section 2.4 shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible.

> **Response:** *A stormwater site plan has been prepared for the development in the form of this report. The stormwater site plan includes the existing and proposed stormwater conditions, WWHM output report, supporting reports, and the SWPPP.*

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)
All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters.
Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Stormwater Site Plan (see Section 2.5.1). Projects that result in less than 2,000 square feet of new plus replaced hard surface area, or disturb less than 7,000 square feet of land are not required to prepare a Construction SWPPP, but must consider all of the 13 Elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

> **Response:** *The 13 elements of a SWPPP are addressed in the Construction SWPPP section of this report. A full Construction SWPPP and NPDES permit have been prepared for the site.*

Minimum Requirement #3: Source Control of Pollution
All known, available and reasonable source control BMPs shall be applied to all projects. Source control BMPs shall be selected, designed, and maintained according to the manual.

> **Response:** *All available and reasonable source control BMPs have applied to this project. These include, but are not limited to, Dust Control at Disturbed Land Areas, Landscaping and Lawn/Vegetation Management and Maintenance of Stormwater Drainage and Treatment Systems.*

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

> **Response:** *Runoff from the proposed project will discharge to a new on-site conveyance system that will connect downstream at an existing structure in vacated 80th Street SW. From there, stormwater is conveyed north until it discharges to the existing man-made wetland, the existing point of discharge. The right-of-way stormwater system is designed to keep the right-of-way stormwater runoff separate from the onsite system. An existing roadside ditch along the sites right-of-way will be conveyed in a closed pipe and catch basin system.*

Minimum Requirement #5: On-site Stormwater Management
Projects shall employ On-site Stormwater Management BMPs in accordance with the following projects thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible without causing flooding or erosion impacts. Projects qualifying as flow control exempt in accordance with Section 2.5.7 of this chapter do not have to achieve the LID performance standard, nor consider bioretention, rain gardens, permeable pavement, and full

dispersion if using List #1 or List #2. However, those projects must implement BMP T5.13; BMPs T5.10A, B, or C; and BMP T5.11or T5.12, if feasible.

Project Thresholds:
Projects triggering only Minimum Requirements #1 through #5 shall either:

a. Use On-site Stormwater Management BMPs from List #1 for all surfaces within each type of surface in List #1; or
b. Demonstrate compliance with the LID Performance Standard. Projects selecting this option cannot use Rain Gardens. They may choose to use Bioretention BMPs as described in Chapter 7 of Volume V to achieve the LID Performance Standard.

Projects triggering Minimum Requirements #1 through #9, must meet the requirements in Table 2.5.1.

Response: *On-site stormwater runoff will be collected and transported via a system of catch basins and underground storm pipes to an onsite biofiltration facility, then routed to a stormwater vault. A portion of the site (passenger car parking area) will be routed to supplemental biofiltration facilities (parking area planter strips). The detained stormwater will flow from the vault at the historical discharge rate to the existing downstream collection point. Low-impact-development (LID) infiltration is limited due to the low infiltration rate through-out the site. The long term infiltration rate onsite is 0.30" per hour as specified by the project geotechnical engineer.*

Minimum Requirement #6: Runoff Treatment
Thresholds
When assessing a project against the following thresholds, only consider those hard and pervious surfaces that are subject to this minimum requirement as determined in Section 2.4 of this chapter. The following require construction of stormwater treatment facilities:

- Projects in which the total of, pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements – is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.

Response: *Stormwater will be treated with the use of a bioretention swale per BMP T9.10.*

Minimum Requirement #7: Flow Control
Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody. Flow Control is not required for projects that discharge directly to, or indirectly to a water listed in Appendix I-E.

Response: *The proposed stormwater system includes a detention vault that is sized for the entire project area, using the WWHM3 program.*

Minimum Requirement #8: Wetlands Protection
The requirements below apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system.
Thresholds:
The thresholds identified in Minimum Requirement #6 – Runoff Treatment, and Minimum Requirement #7 – Flow Control shall also be applied to determine the applicability of this requirement to discharges to wetlands.
Standard Requirement:

Projects shall comply with Guide Sheets #1 through #3 in Appendix I-D. They hydrologic analysis shall use the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

> **Response:** *The stormwater vault is sized to meet the guide sheets to the maximum extent feasible as described in more detail below*

Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual that is consistent with the provisions in Volume V of this manual shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.

> **Response:** *Operations and Maintenance checklists for the proposed storm drainage system facilities have been included in Appendix E.*

EXISTING CONDITIONS

The project site is located at 8007 44th Avenue West Mukilteo, WA, 98274. The site is approximately 217,099 SF (4.98 acres) and is currently occupied by a mobile home with two detached service garages. There is approximately 25,688 SF (0.59 acres) of existing impervious area, and the remainder of the site consists of pasture.

Per the Geotechnical Engineering Report by Redmond Geotechnical Services, dated May 1st, 2015, the site is underlain with 2'-4' of gray to gray-brown, dense, clayey, silty sand with gravel and cobbles and/or glacial till deposits.

The site is bordered to the east by an empty field, to the west by 44th Avenue West, to the north by an existing commercial development, and to the south by another commercial development. The majority of the project site is generally sloping to the northeast corner of the site at an average of 2%. A portion of the property to the south is tributary to the site with approximately 1.03 acres (0.93ac impervious and 0.10ac lawn). This upstream area currently sheet flows onsite and will continue to in the developed conditions.

SOILS CONDITIONS

Per the Geotechnical Engineering Report by Redmond Geotechnical Services, dated May 1st, 2015, the site is underlain at a depth of between two to four feet beneath the existing site and/or surface grades by gray to gray-brown, dense, clayey, silty sand with gravel and cobbles and/or glacial till deposits.

DEVELOPED CONDITIONS

The proposed development consists of the construction of a single commercial building totaling approximately 62,166± SF (1.43 acres) with parking stalls, stormwater management facilities, utilities and on-site landscaping on a 4.98-acre site in Mukilteo, Washington. The property is currently zoned as planned industrial.

The upstream area (1.03 acres) will be collected in a proposed ditch along the southern property line, where the runoff will be collected and conveyed in the proposed conveyance system.

On-site and the upstream stormwater runoff will be collected and transported via a system of catch basins and storm pipes to a biofiltration swale and underground detention vault. A portion of the site (passenger car parking area) will be routed to supplemental biofiltration facilities (parking area planter strips) for increased site infiltration only. Low-impact-development (LID) infiltration is limited due to the low infiltration rate through-out the site of 0.30" per hour as specified by the project geotechnical engineer.

The released stormwater will flow in a conveyance system to an existing catch basin northeast of the project site. See the Permanent Stormwater Control Plan section for further information about the conveyance system.

PERMANENT STORMWATER CONTROL PLAN

EXISTING SITE HYDROLOGY

The project site is approximately 217,099 SF (4.98 acres) – 10' ROW Dedication = 212,562 (4.88 AC) and is currently occupied by a mobile home with two detached service garages. There is approximately 25,688 SF (0.59 acres) of existing impervious area, and the remainder of the site consists of overgrown fields. See table 2 and 3 below, for existing conditions of the onsite and upstream basin. The upstream existing tributary basin consists of 0.93 acres of impervious and 0.10 acres of lawn for a total of 1.03 acres.

Table 2 – Onsite Existing Basin

Basin Area (AC)	Description	Grade
0.59	Impervious (buildings and parking/drive)	Flat
0.41	Lawn (area around mobile home)	Flat
1.94	Pasture (1/2 cleared site)	Moderate
1.94	Forest (1/2 cleared site)	Moderate
4.88	**Total Onsite**	
+1.03	Upstream Basin	
5.91	Total to downstream connection point	

Table 3 – ROW Existing Basin

Basin Area (AC)	Description	Grade
0.02	Impervious (pavement)	Flat
0.29	Lawn (ditch and shoulder)	Flat
0.10	Pasture (dedicated area)	Flat
0.42	**Total**	

DEVELOPED SITE HYDROLOGY

The proposed on-site development will consist of paved parking and drive aisles, concrete walkways, a building, and landscaping/pervious surface. The right-of-way improvements consist of ½ street widening and curb, gutter, and sidewalk along the sites frontage (323'). See Table 4 and 5 for proposed conditions.

Table 4 - Onsite Developed Basin

Basin Area (AC)	Description	Grade
2.73	Impervious (parking/drive and walkways)	Flat
1.43	Impervious (building)	Flat
0.72	Lawn (not covered with impervious)	Flat
4.88	**Total**	
+1.03	Upstream Basin	
5.91	Total to downstream connection point	

Table 5 – ROW Developed Basin

Basin Area (AC)	Description	Grade
0.32	Impervious (pavement and sidewalk)	Flat
0.10	Lawn (planter strip)	Flat
0.42	**Total**	

HYDROLOGIC MODELING

The hydrologic analysis for the project was performed using the computer-modeling program, Western Washington Hydrology Model (WWMH2012), based on matching flow durations and wetland protection volumes. The program effectively models predeveloped and post-developed runoff conditions using basins for a given area. An infiltration rate of 0.30" per hour has been used at the parking lot and site swales and 0.15" per hour at the vault (bottomless) to enhance the natural stormwater release. The WWHM2012 model for the project site states that current stormwater conveyance system meets 2012 Department of Ecology Stormwater Management Manual standards and City of Mukilteo development standards. See Appendix C for the WWHM report.

FLOW CONTROL SYSTEM

In the developed condition, onsite stormwater runoff will be drained in several areas.

- The building (1.43 acres) will be directly connected to the vault.
- The northwest parking area (1.35 acres) drains to one of five swales located in the center island parking area. These swales are connected to the onsite conveyance system via a catch basin at the low point of the swale. Each ditch has a bottom width of 4' and a length of 65'. The swales are for groundwater recharge only and are not considered for water quality.
- The upstream area (1.03 acres) is tributary to the site via a proposed ditch along the southern boundary. The ditch is connected to the onsite conveyance system that is tributary to the biofiltration swale and vault.
- The onsite conveyance system (4.48 acres) is tributary to the water quality biofiltration swale in the northeast portion of the site. The swale is connected to the site vault. The swale is 30' (three sections each 10') wide and 100' long with a slope of 1.6%
- The entire site (biofiltration swale and building roof) is tributary to the underground vault (4.48 acres + 1.43 acres = 5.91 acres) that discharges stormwater east of the property. The vault has a live storage volume of 50,400 cubic feet (40' wide x 120' long x 10.5' tall).

Existing Site Basin including Upstream Area

Name : Ext Basin

Pervious Land Use	acre
C, Forest, Mod	1.94
C, Pasture, Mod	1.94
C, Lawn, Flat	.51
Pervious Total	4.39

Impervious Land Use	acre
ROADS FLAT	0.59
DRIVEWAYS FLAT	0.93
Impervious Total	1.52
Basin Total	5.91

Developed Site Basin including Upstream area

Name : Parking

Pervious Land Use	acre
C, Lawn, Flat	.08
Pervious Total	0.08
Impervious Land Use	**acre**
ROADS FLAT	1.27
Impervious Total	1.27
Basin Total	1.35

Name : BUILDING

Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	**acre**
ROOF TOPS FLAT	1.43
Impervious Total	1.43
Basin Total	1.43

Name : Dev Site

Pervious Land Use	acre
C, Lawn, Flat	.74
Pervious Total	0.74
Impervious Land Use	**acre**
ROADS FLAT	1.46
DRIVEWAYS FLAT	0.93
Impervious Total	2.39
Basin Total	3.13

Water Quality Swale

Name : Biofiltration Swale
Bottom Length: 100.00 ft.
Bottom Width: 30.00 ft.
Manning's n: 0.24
Channel bottom slope 1: 0.016 To 1
Channel Left side slope 0: 3 To 1
Channel right side slope 2: 3 To 1
Infiltration On
Infiltration rate: 0.3
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 107.018
Total Volume Through Riser (ac-ft.): 324.122
Total Volume Through Facility (ac-ft.): 431.14
Percent Infiltrated: 24.82
Total Precip Applied to Facility: 0
Total Evap From Facility: 0

Stormwater Vault

Name : Vault 1
Width : 40 ft.
Length : 120 ft.
Depth: 11 ft.
Infiltration On
Infiltration rate: 0.3
Infiltration safety factor: 2
Total Volume Infiltrated (ac-ft.): 383.527
Total Volume Through Riser (ac-ft.): 109.45
Total Volume Through Facility (ac-ft.): 492.977
Percent Infiltrated: 77.8
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 10.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 2 in. **Elevation:** 0.5 ft.
Orifice 2 Diameter: 0.75 in. **Elevation:** 4.5 ft.
Orifice 3 Diameter: 6 in. **Elevation:** 9.7 ft.

Point of Compliance (outlet of vault)

Groundwater element is not part of matching flow durations and has been removed in this analysis to show compliance with requirements.

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.52135
5 year	0.721503
10 year	0.87044
25 year	1.078179
50 year	1.247715
100 year	1.430424

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.157733
5 year	0.193959
10 year	0.219547
25 year	0.253712
50 year	0.280521
100 year	0.308525

Stream Protection Duration
POC #2
The Facility PASSED

The Facility PASSED.

Point of Compliance (wetland)

Per Guide Sheet 3B of the 2014 SMMWW, the following criteria need to also be met;

- Criteria 1: Total volume of water into a wetland during a single precipitation event should not be more than 20% higher or lower than the pre-project volumes.
- Criteria 2: Total volume of water into a wetland on a monthly basis should not be more than 15% higher or lower than the pre-project volumes.

Using the same vault and orifice control structure as described above, we applied the Guide Sheet 3B criteria, which requires groundwater flow (in addition to the traditional surface flow and interflow) to be accounted for in pervious surface areas in the pre-project and post-project conditions.

Infiltration is the means by which groundwater flow to the mitigated wetland is simulated. Per the geotechnical engineer, the site is underlain by glacial till soils, which provides very limited infiltration in the order of 0.30"/hour. As the tributary area from Sterling Business Park is over 800' away from the mitigated wetland area, groundwater flow from this area to the mitigated wetland will be minimal to none. Therefore, no groundwater flow was assigned to the upstream Sterling Business Park tributary area. Groundwater flow was assigned, however, to the on-site pervious surface areas in the pre- and post-project conditions. In the pre-project conditions, all on-site landscaped areas (lawn, pasture and forest) are assigned groundwater flow through infiltration. In the post-project condition, there are several means by which infiltration, and therefore groundwater flow, is accounted for:

- All landscaped areas allow for infiltration
- The proposed detention vault is bottomless and, therefore, allows for infiltration (0.15"/hr)
- The proposed bio-infiltration swale is the primary source of water quality treatment and allows for infiltration (0.30"/hr)
- The proposed bio-infiltration swales in the main parking lot for infiltration (0.30"/hr)

Using the pre-project and post-project conditions described above, we ran the WWHM model using the 40' wide x 120' long x 11' deep bottomless vault with a 3-orifice control structure, the westerly bio-infiltration swale, and the bio-infiltration swales in the main parking lot. The results, shown below, show that we are able to meet the Criteria 1 monthly volumes 5 out of the 12 months. No other combination of elements that we have tried has yielded a better result, so we conclude that we have met this criterion to the maximum extent feasible.

Criterion #1:

Day	Predevel	Mitigated	Percent	Pass/Fail					
1Jan	1.9782	2.5853	130.7	Fail	15	1.6377	1.4233	86.9	Pass
2	1.716	1.8668	108.8	Pass	16	1.7101	1.8102	105.9	Pass
3	1.6232	1.7095	105.3	Pass	17	1.7719	1.5448	87.2	Pass
4	2.1245	2.1535	101.4	Pass	18	1.6268	1.5478	95.1	Pass
5	1.8222	2.0618	113.1	Pass	19	1.5036	1.0703	71.2	Fail
6	1.933	2.0236	104.7	Pass	20	1.7494	1.4704	84	Pass
7	2.1764	2.6171	120.3	Fail	21	1.5416	1.493	96.9	Pass
8	1.926	2.0399	105.9	Pass	22	1.4971	1.1565	77.2	Fail
9	1.7305	1.7285	99.9	Pass	23	1.8842	1.7301	91.8	Pass
10	1.5137	1.3027	86.1	Pass	24	1.7972	1.7585	97.8	Pass
11	1.5196	1.3844	91.1	Pass	25	1.6311	1.3162	80.7	Pass
12	1.6149	1.5174	94	Pass	26	1.4906	1.1399	76.5	Fail
13	2.0566	2.2375	108.8	Pass	27	1.6154	1.324	82	Pass
14	1.8869	2.1409	113.5	Pass	28	1.5404	1.0455	67.9	Fail
15	1.9455	1.8261	93.9	Pass	29	1.6683	1.5424	92.5	Pass
16	1.8824	2.0304	107.9	Pass	1-	1.6271	1.3832	85	Pass
17	2.2085	2.0372	92.2	Pass	2	1.6414	1.4239	86.7	Pass
18	1.9664	2.0307	103.3	Pass	3	1.5747	1.439	91.4	Pass
19	1.7437	1.6745	96	Pass	4	1.4288	0.9304	65.1	Fail
20	1.6716	1.4734	88.1	Pass	5	1.096	0.6434	58.7	Fail
21	1.7161	1.5457	90.1	Pass	6	1.3852	1.15	83	Pass
22	1.9029	1.9673	103.4	Pass	7	1.3308	1.0721	80.6	Pass
23	2.0901	2.2292	106.7	Pass	8	1.6908	1.8599	110	Pass
24	1.5867	1.5119	95.3	Pass	9	1.4622	1.2087	82.7	Pass
25	1.5649	1.1898	76	Fail	10	1.5657	1.3635	87.1	Pass
26	1.4173	1.032	72.8	Fail	11	1.5039	1.1883	79	Fail
27	1.6644	1.5293	91.9	Pass	12	1.3699	1.0742	78.4	Fail
28	1.9381	2.0415	105.3	Pass	13	1.3149	0.9927	75.5	Fail
29	1.9183	1.8908	98.6	Pass	14	1.3938	1.091	78.3	Fail
30	1.7715	1.5951	90	Pass	15	1.3622	1.1319	83.1	Pass
31	1.6572	1.5439	93.2	Pass	16	1.3616	1.0685	78.5	Fail
1-	1.522	1.2601	82.8	Pass	17	1.4021	1.0998	78.4	Fail
2	1.3563	0.857	63.2	Fail	18	1.343	1.0839	80.7	Pass
3	1.6034	1.3957	87	Pass	19	1.3348	1.1695	87.6	Pass
4	1.6012	1.3289	83	Pass	20	1.1088	0.691	62.3	Fail
5	1.5962	1.4823	92.9	Pass	21	1.4436	1.303	90.3	Pass
6	1.48	1.1564	78.1	Fail	22	1.4471	1.4916	103.1	Pass
7	1.7728	1.5818	89.2	Pass	23	1.3452	1.114	82.8	Pass
8	1.3628	1.0955	80.4	Pass	24	1.3011	1.0367	79.7	Fail
9	1.2882	0.9047	70.2	Fail	25	1.4295	1.2491	87.4	Pass
10	1.3454	1.0132	75.3	Fail	26	1.1827	0.8766	74.1	Fail
11	1.6352	1.4706	89.9	Pass	27	1.2975	1.038	80	Pass
12	1.5978	1.5884	99.4	Pass	28	1.2045	0.917	76.1	Fail
13	1.5119	1.2754	84.4	Pass	29	1.0961	0.843	76.9	Fail
14	1.5308	1.3814	90.2	Pass	30	1.161	0.9155	78.9	Fail
					31	1.1768	0.96	81.6	Pass

1-Apr	1.1266	0.8624	76.5	Fail	17	0.5905	0.3372	57.1	Fail
2	1.1652	0.9893	84.9	Pass	18	0.6747	0.5667	84	Pass
3	1.2569	1.1611	92.4	Pass	19	0.6726	0.7922	117.8	Pass
4	1.203	1.0569	87.9	Pass	20	0.6009	0.5545	92.3	Pass
5	1.132	0.8982	79.3	Fail	21	0.5118	0.2765	54	Fail
6	0.9781	0.5796	59.3	Fail	22	0.5521	0.348	63	Fail
7	1.2129	1.1714	96.6	Pass	23	0.6277	0.653	104	Pass
8	1.0168	0.7585	74.6	Fail	24	0.5658	0.5044	89.2	Pass
9	1.0173	0.6783	66.7	Fail	25	0.6339	0.5734	90.5	Pass
10	1.1631	1.0285	88.4	Pass	26	0.745	0.869	116.7	Pass
11	1.2036	1.0933	90.8	Pass	27	0.6389	0.7772	121.7	Fail
12	1.0768	0.9378	87.1	Pass	28	0.6941	0.6066	87.4	Pass
13	0.8895	0.6308	70.9	Fail	29	0.6155	0.8576	139.3	Fail
14	1.0108	0.7506	74.3	Fail	30	0.9174	1.0462	114	Pass
15	1.1889	1.1631	97.8	Pass	31	0.5785	0.7892	136.4	Fail
16	0.9933	0.835	84.1	Pass	1-Jun	0.6827	0.5969	87.4	Pass
17	0.9022	0.4969	55.1	Fail	2	0.7757	0.8746	112.8	Pass
18	1.1593	1.0426	89.9	Pass	3	0.6161	0.7268	118	Pass
19	0.9603	0.9417	98.1	Pass	4	0.5898	0.4841	82.1	Pass
20	0.6908	0.1727	25	Fail	5	0.5918	0.4095	69.2	Fail
21	0.7669	0.3221	42	Fail	6	0.6946	0.6331	91.1	Pass
22	1.0888	0.7617	70	Fail	7	0.6059	0.5752	94.9	Pass
23	0.9889	1.0984	111.1	Pass	8	0.5883	0.5392	91.7	Pass
24	0.8244	0.5659	68.6	Fail	9	0.8894	0.9622	108.2	Pass
25	0.7249	0.3378	46.6	Fail	10	0.6644	1.0203	153.6	Fail
26	0.9329	0.7332	78.6	Fail	11	0.6683	0.7108	106.4	Pass
27	0.9407	0.9716	103.3	Pass	12	0.5455	0.5085	93.2	Pass
28	0.8963	0.6503	72.6	Fail	13	0.4078	0.147	36	Fail
29	0.8744	0.8719	99.7	Pass	14	0.4771	0.2642	55.4	Fail
30	0.7288	0.4561	62.6	Fail	15	0.5873	0.4977	84.7	Pass
1-May	0.7546	0.4671	61.9	Fail	16	0.6802	0.7863	115.6	Pass
2	0.7743	0.6217	80.3	Pass	17	0.6273	0.64	102	Pass
3	0.7025	0.4901	69.8	Fail	18	0.5934	0.6019	101.4	Pass
4	0.8055	0.7796	96.8	Pass	19	0.4478	0.2175	48.6	Fail
5	0.6912	0.5325	77	Fail	20	0.488	0.3457	70.8	Fail
6	0.5209	0.2184	41.9	Fail	21	0.5561	0.3655	65.7	Fail
7	0.6116	0.3145	51.4	Fail	22	0.5455	0.571	104.7	Pass
8	0.6096	0.3781	62	Fail	23	0.6931	0.7849	113.2	Pass
9	0.8547	0.8215	96.1	Pass	24	0.6075	0.7599	125.1	Fail
10	0.8765	1.0674	121.8	Fail	25	0.5109	0.588	115.1	Pass
11	0.6398	0.4475	69.9	Fail	26	0.505	0.3549	70.3	Fail
12	0.7114	0.6282	88.3	Pass	27	0.4318	0.3013	69.8	Fail
13	0.7351	0.5496	74.8	Fail	28	0.5893	0.5572	94.5	Pass
14	0.6097	0.6694	109.8	Pass	29	0.4836	0.3885	80.3	Pass
15	0.6855	0.6618	96.6	Pass	30	0.5921	0.5032	85	Pass
16	0.5044	0.2567	50.9	Fail					

1-Jul	0.6001	0.8988	149.8	Fail	16	0.33	0.3097	93.8	Pass
2	0.5327	0.4727	88.7	Pass	17	0.4177	0.4709	112.7	Pass
3	0.4076	0.2073	50.9	Fail	18	0.4886	0.5415	110.8	Pass
4	0.4887	0.4577	93.7	Pass	19	0.3194	0.4966	155.5	Fail
5	0.3621	0.2469	68.2	Fail	20	0.2698	0.0683	25.3	Fail
6	0.3725	0.1016	27.3	Fail	21	0.5135	0.6768	131.8	Fail
7	0.4654	0.4883	104.9	Pass	22	0.6051	0.7434	122.9	Fail
8	0.5043	0.402	79.7	Fail	23	0.4358	0.8405	192.9	Fail
9	0.3555	0.244	68.6	Fail	24	0.3706	0.4663	125.8	Fail
10	0.4152	0.1548	37.3	Fail	25	0.5236	0.5862	112	Pass
11	0.3541	0.2568	72.5	Fail	26	0.4795	0.8577	178.9	Fail
12	0.4492	0.333	74.1	Fail	27	0.3784	0.5217	137.9	Fail
13	0.3759	0.3253	86.6	Pass	28	0.3323	0.2284	68.7	Fail
14	0.327	0.1118	34.2	Fail	29	0.3406	0.2645	77.7	Fail
15	0.5722	0.5856	102.4	Pass	30	0.398	0.5124	128.7	Fail
16	0.3816	0.4257	111.6	Pass	31	0.4931	0.4911	99.6	Pass
17	0.2993	0.0892	29.8	Fail	1-Sep	0.3468	0.5669	163.5	Fail
18	0.4258	0.3521	82.7	Pass	2	0.3362	0.3366	100.1	Pass
19	0.3733	0.2713	72.7	Fail	3	0.3363	0.3382	100.6	Pass
20	0.2826	0.066	23.4	Fail	4	0.3319	0.2612	78.7	Fail
21	0.3603	0.1895	52.6	Fail	5	0.5186	0.6448	124.3	Fail
22	0.2921	0.0913	31.3	Fail	6	0.3542	0.501	141.4	Fail
23	0.2863	0.0332	11.6	Fail	7	0.4199	0.5233	124.6	Fail
24	0.328	0.1273	38.8	Fail	8	0.4808	0.7553	157.1	Fail
25	0.4295	0.3962	92.2	Pass	9	0.549	0.8937	162.8	Fail
26	0.3211	0.2459	76.6	Fail	10	0.5032	1.0573	210.1	Fail
27	0.3496	0.1687	48.3	Fail	11	0.2419	0.1837	76	Fail
28	0.3181	0.2082	65.5	Fail	12	0.3576	0.292	81.7	Pass
29	0.2616	0.0191	7.3	Fail	13	0.442	0.5395	122.1	Fail
30	0.264	0.0085	3.2	Fail	14	0.4075	0.688	168.9	Fail
31	0.2702	0.0473	17.5	Fail	15	0.5039	0.6655	132.1	Fail
1-Aug	0.2712	0.0418	15.4	Fail	16	0.6775	1.1858	175	Fail
2	0.2906	0.0817	28.1	Fail	17	0.3168	0.596	188.1	Fail
3	0.3019	0.1039	34.4	Fail	18	0.4168	0.4503	108.1	Pass
4	0.302	0.1742	57.7	Fail	19	0.462	0.6245	135.2	Fail
5	0.4677	0.3782	80.9	Pass	20	0.3376	0.5	148.1	Fail
6	0.4518	0.5712	126.4	Fail	21	0.5663	0.6629	117	Pass
7	0.2608	0.2932	112.4	Pass	22	0.5044	0.9215	182.7	Fail
8	0.3001	0.1484	49.5	Fail	23	0.425	0.688	161.9	Fail
9	0.2543	0.0333	13.1	Fail	24	0.3621	0.4706	130	Fail
10	0.2704	0.0886	32.7	Fail	25	0.4116	0.5594	135.9	Fail
11	0.298	0.1062	35.6	Fail	26	0.3855	0.4549	118	Pass
12	0.4106	0.3577	87.1	Pass	27	0.3846	0.5909	153.6	Fail
13	0.3281	0.3723	113.5	Pass	28	0.3813	0.4244	111.3	Pass
14	0.4761	0.4282	89.9	Pass	29	0.4824	0.6768	140.3	Fail
15	0.3753	0.5355	142.7	Fail	30	0.4979	0.653	131.1	Fail

1-Oct	0.3979	0.6158	154.7	Fail	16	1.1922	2.1126	177.2	Fail
2	0.4762	0.7558	158.7	Fail	17	1.1849	1.9086	161.1	Fail
3	0.6001	0.8231	137.2	Fail	18	1.6504	2.6875	162.8	Fail
4	0.5165	0.9445	182.9	Fail	19	1.7801	3.1522	177.1	Fail
5	0.6813	1.2191	178.9	Fail	20	1.387	2.6484	190.9	Fail
6	0.5105	1.0566	207	Fail	21	1.1321	1.5417	136.2	Fail
7	0.6891	1.1247	163.2	Fail	22	1.3844	1.7519	126.5	Fail
8	0.5783	1.0993	190.1	Fail	23	1.9232	2.988	155.4	Fail
9	0.5514	0.8892	161.3	Fail	24	1.9656	3.3653	171.2	Fail
10	0.5223	0.9492	181.7	Fail	25	1.2571	1.9285	153.4	Fail
11	0.4475	0.6876	153.6	Fail	26	1.4747	2.0306	137.7	Fail
12	0.5019	0.7315	145.7	Fail	27	1.207	1.6833	139.5	Fail
13	0.5206	0.7452	143.1	Fail	28	1.5176	2.1075	138.9	Fail
14	0.4468	0.6925	155	Fail	29	1.7183	2.4133	140.4	Fail
15	0.592	1.0698	180.7	Fail	30	1.7292	2.6915	155.6	Fail
16	0.7535	1.256	166.7	Fail	1-Dec	1.5718	2.3128	147.1	Fail
17	0.5522	1.2197	220.9	Fail	2	2.0133	2.582	128.3	Fail
18	0.8081	1.4337	177.4	Fail	3	1.8153	2.9111	160.4	Fail
19	0.937	1.866	199.1	Fail	4	1.8676	2.6418	141.5	Fail
20	0.7431	1.5061	202.7	Fail	5	1.7074	2.4976	146.3	Fail
21	0.7087	1.4439	203.7	Fail	6	1.3769	1.7687	128.5	Fail
22	0.7033	1.192	169.5	Fail	7	1.4069	1.7525	124.6	Fail
23	0.7941	1.3828	174.1	Fail	8	1.5356	1.8632	121.3	Fail
24	0.7392	1.5243	206.2	Fail	9	1.6581	2.1996	132.7	Fail
25	0.9448	1.6433	173.9	Fail	10	1.7436	2.2695	130.2	Fail
26	0.8303	1.678	202.1	Fail	11	1.9318	2.504	129.6	Fail
27	0.8849	1.8765	212.1	Fail	12	1.611	2.069	128.4	Fail
28	0.596	0.946	158.7	Fail	13	1.844	1.8878	102.4	Pass
29	0.7017	1.1253	160.4	Fail	14	2.2765	3.1499	138.4	Fail
30	0.6126	1.096	178.9	Fail	15	1.895	2.5318	133.6	Fail
31	0.8242	1.2911	156.6	Fail	16	1.6108	2.0125	124.9	Fail
1-Nov	0.7308	1.4609	199.9	Fail	17	1.4738	1.6191	109.9	Pass
2	0.9597	1.4493	151	Fail	18	1.7	1.6618	97.8	Pass
3	1.1244	2.4429	217.3	Fail	19	1.7991	2.2423	124.6	Fail
4	0.813	1.5969	196.4	Fail	20	1.769	2.1099	119.3	Pass
5	0.7926	1.5279	192.8	Fail	21	1.5774	1.8611	118	Pass
6	0.8247	1.404	170.2	Fail	22	1.6832	1.8589	110.4	Pass
7	0.817	1.3515	165.4	Fail	23	1.7936	2.122	118.3	Pass
8	0.9562	1.7315	181.1	Fail	24	1.7823	1.858	104.2	Pass
9	1.1175	2.1172	189.5	Fail	25	1.7357	2.0261	116.7	Pass
10	1.1805	2.2245	188.4	Fail	26	1.8739	2.1868	116.7	Pass
11	1.3997	2.7101	193.6	Fail	27	1.5018	1.604	106.8	Pass
12	1.3032	2.4794	190.3	Fail	28	1.745	1.8038	103.4	Pass
13	1.0721	2.0524	191.4	Fail	29	1.6144	1.9079	118.2	Pass
14	1.1512	1.7479	151.8	Fail	30	1.6168	1.3343	82.5	Pass
15	1.1693	2.0642	176.5	Fail	31	2.1521	2.2722	105.6	Pass

Passing 154/366 days

Criterion #2:

Wetlands Fluctuation for POC 2

Average Annual Volume (acft)				
Month	Predevel	Mitigated	Percent	Pass/Fail
Jan	56.7626	57.2357	100.8	Pass
Feb	44.7226	38.3868	85.8	Pass
Mar	42.8724	35.3850	82.5	Fail
Apr	30.5624	24.5171	80.2	Fail
May	20.8575	18.1198	86.9	Pass
Jun	17.7223	16.9998	95.9	Pass
Jul	12.1480	8.4821	69.8	Fail
Aug	11.5317	11.3460	98.4	Pass
Sep	12.7366	17.5419	137.7	Fail
Oct	19.8396	35.2393	177.6	Fail
Nov	37.0098	61.9618	167.4	Fail
Dec	53.2630	65.8296	123.6	Fail

Passing 5/12 months

WATER QUALITY SYSTEM

Onsite stormwater will be routed through a water quality biofiltration swale. The swale is sized per BMP T9.10. The following equations size the swale using given the WWHM2012 inflow:

Water quality flowrate at POC 1 (inlet to bioswale)

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.3032 **acre-feet**
On-line facility target flow: 0.4518 **cfs.**
Adjusted for 15 min: 0.4518 **cfs.**
Off-line facility target flow: 0.2566 **cfs.**
Adjusted for 15 min: 0.2566 **cfs.**

Step A – Compute the Flow Velocity

$V = K \times Q/A$

Where: V = Flow velocity into swale (fs)
K = Ratio of the peak volumetric flow rate for on-line facility
Q = Water quality flow rate for on-line facility (cfs)
A = Cross sectional area of trapezoidal channel (sf)

V = 1.5 x 0.45 / (30 x 0.25) = feet per second
= 0.09 feet per second $V \leq 1.0$ OK

Step B – Compute Length

L = V x T (60 sec/min)

Where: L = Length of swale (cf)
V = Flow velocity of swale (fs)
T = Time (T=9 minutes)

L = 0.09 x 9 x 60 = feet (required length)
= 49 feet Actual length is 100 feet, OK

Step C – Calculate Flow Capacity at Greatest Resistance

$Q = 1.49AR^{0.67} S^{0.5} / n$

Where: Q = Flowrate (cfs)
A = Cross sectional area of trapezoidal channel (sf)
R = Hydraulic radius (f)
S = Slope of swale (f)
n = Manning's number

$Q = 1.49\ (15)\ 32^{0.67}\ 0.016^{0.5} / 0.24$ = cubic feet per second
= 120 cubic feet per second $Q \geq$ actual100-year flow, OK

The proposed biofiltration swale is 30' wide and 100' long at a slope of 1.6%.

CONVEYANCE SYSTEM ANALYSIS AND DESIGN

A full conveyance system analysis and design will be provided with the final land use and site development permit submittal.

DOWNSTREAM ANALYSIS

A formal downstream analysis was completed on October 16, 2015. Figure C in Appendix A shows the downstream analysis path from the project site to ¼ mile downstream. As discussed previously, the site slopes towards the northeast, and is conveyed offsite to the north via a system of pipes and culverts. Runoff ultimately discharges to Puget Sound.

Stormwater leaves the site from an existing Type-II 48-inch catch basin located in the northeast portion of the site. From this catch basin stormwater is conveyed in a 12" piped system to a man-made wetland and detention pond on the Mukilteo Public Works site. Stormwater leaves site crossing 78th Street SW where it combines with stormwater from the 44th Avenue West right-of-way basin and continues in a northerly direction. The combined flow travels in a swale past the ¼ point where the analysis was terminated.

100-YEAR FLOOD/OVERFLOW CONDITION

The stormwater conveyance system for this project has been designed to address storm events in accordance with common industry practices. In the event of a larger storm, the system may fail. In this case, the runoff from larger events will overflow the control structure in the proposed detention vault, and flow to the intended discharge point, the existing catch basin to the northeast.

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

All erosion and sediment control measures shall be governed by the requirements of the City of Mukilteo. A temporary erosion and sedimentation control plan has been prepared to assist the contractor in complying with these requirements. The Erosion and Sediment Control (ESC) plan is included with the construction plans.

Element 1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practicable.

Element 2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMP's, to minimize tracking of sediment onto public roads.
- Locate wheel wash or tire baths on site, if stabilized construction entrance is not effective in preventing tracking sediment onto public roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of the say, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.
- Control street wash wastewater by pumping back on-site, or otherwise prevent it from discharging into systems tributary to waters of the State.

Element 3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct stormwater retention or detention facilities s one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

Element 4: Install Sediment Controls

- Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an

infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard in Element #3, bullet #1.

- Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Element 5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base early on areas to be paved, and dust control.
- Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:
    - During the dry season (May 1 - Sept. 30): 7 days
    - During the wet season (October 1 - April 30): 2 days
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Element 6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
    - Temporary pipe slope drains must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year and 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates.

If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped" area.

- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within constructed channels that are cut down a slope.

Element 7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Element 8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:
    - Channels must handle the peak 10-minute velocity of flow from a Type 1A, 10- year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches at the outlets of all conveyance systems.

Element 9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest take within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.

- Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of water quality standards.
- Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.
- Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.

Element 10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.
- Other treatment or disposal options may include: 1. Infiltration, 2. Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 3. Ecology-approved on-site chemical treatment or other suitable treatment technologies, 4. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option, and 5. Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Element 11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

Element 12: Manage the Project

- Phase development projects to the maximum degree practicable and take into account seasonal work limitations.
- Inspection and monitoring – Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit must conduct site inspections and monitoring in accordance with Special Condition S4 of the Construction Stormwater General Permit.
- Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.

- Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present on-site or on-call at all times.
- The CESCL or inspector (project sites less than one acre) must have the skills to assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

  Based on the results of the inspection, construction site operators must correct the problems identified by:
    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
    - Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems not later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension within the initial 10-day response period.
    - Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).
- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporary stabilized, inactive sites to once every calendar month.

ESC ANALYSIS AND DESIGN

Trapping Sediment

Structural control measures will be used to reduce erosion and retain sediment on the construction site. The control measures will be selected to fit specific site and seasonal conditions.

The following structural items will be used to control erosion and sedimentation processes:

- Stabilized construction entrances
- Filter fabric fences
- Catch Basin Inlet Sediment Protection
- Proper Cover measures
- Temporary swales
- Sediment pond/vault
- Rock check dam

Weekly inspection of the erosion control measures will be required during construction. Any sediment buildup shall be removed and disposed of off-site.

Vehicle tracking of mud off-site shall be avoided. Installation of a stabilized construction entrance will be installed at a location to enter the site. The entrances are a minimum requirement and may be supplemented if tracking of mud onto public streets becomes excessive. In the event that mud is tracked off site, it shall be swept up and disposed of off-site on a daily basis. Depending on the amount of tracked mud, a vehicle road sweeper may be required.

Because vegetative cover is the most important form of erosion control, construction practices must adhere to stringent cover requirements. More specifically, the contractor will not be allowed to leave soils open for more than 14 days and, in some cases, immediate seeding will be required season dependent.

Sediment Pond/Vault:

A temporary sediment pond and vault are proposed during construction to collect, contain and control release of any site runoff during construction. The pond will be constructed prior to construction of the permanent vault. The entire 5.91 acre site is tributary to the temporary pond. The sediment structure is sized according to design specifications per Section BMPC241: Temporary Sediment Pond of the DOE Manual. Using WWHM2012, the 10-year, flow based on the post development cleared conditions (lawn) and existing upstream. Below are the results:

TESC Pond Tributary Area: 5.91 acres

```
Flow Frequency
Flow(cfs)  0501
2 Year   =    0.4654
5 Year   =    0.7564
10 Year  =    1.0013
25 Year  =    1.3787
50 Year  =    1.7149
100 Year =    2.1035
```

The required surface area was calculated using the following equation:
SA = 2 x Q_{10} / 0.00096
= 2 x 1.00 / 0.00096
= 2083 sf

This equation results in a surface area of 2,083 SF. The pond was designed with a surface area of 2,200 SF at the top of the sediment storage, which exceeds the minimum requirements for the 2-year flow. The required area of the orifice was calculated using the following equation:

$A_o = A_s(2h)^{0.5} / 0.6 \times 3600Tg^{0.5}$
=2,083 x $(2(3.5))^{0.5}$ / [0.6 x 3600 x 24 x $32.2^{0.5}$]
= 0.0187 sf
Converted to the required diameter using the following calculation:

$D = 13.54 \times Ao^{0.5}$
= 13.54 x $0.0187^{0.5}$
= 1.85" □1 – 3/4"

The sediment pond will have a 3.5' minimum depth from top of riser to bottom of live pond along with 1' of free board and 1.5' of sediment storage for a total depth of 6.0'.

SPECIAL REPORTS AND STUDIES OTHER PERMITS

Geotechnical Engineering Report by Redmond Geotechnical Services dated April 24th, 2015 is included in Appendix B. Also included is the pilot infiltration test results dated July 29th, 2016.

OTHER PERMITS

Dry utility and building permits will be applied for at a later date.

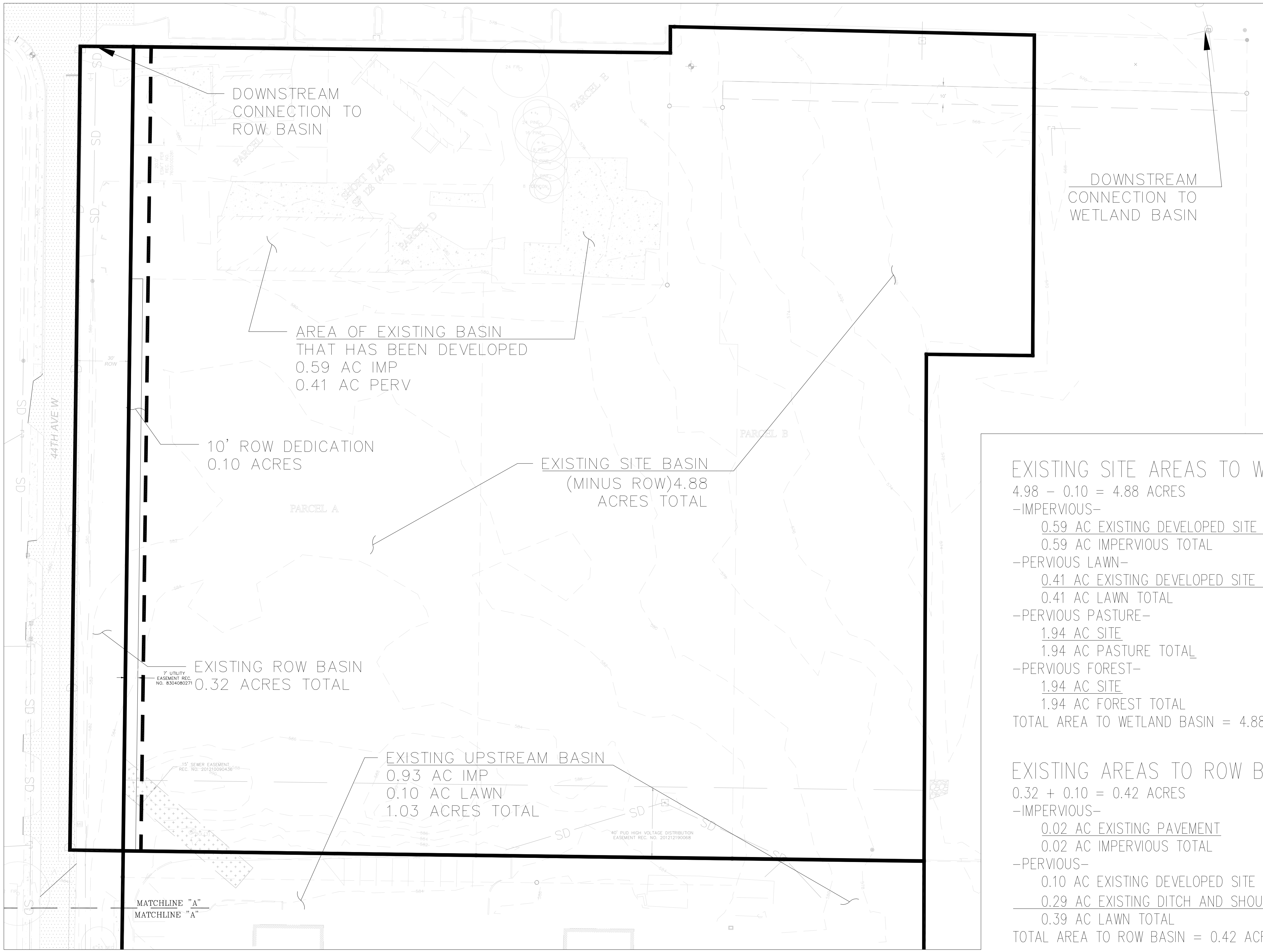
OPERATION AND MAINTENANCE

The owner or operator of the project shall be responsible for maintaining the stormwater facilities in accordance with local requirements. Proper maintenance is important for adequate functioning of the stormwater facilities. Operations and maintenance guidelines have been provided in Appendix E.

APPENDIX A

FIGURES

Figure A – Existing Conditions Exhibit
Figure B – Developed Conditions Exhibit
Figure C – Downstream Conditions Exhibit
Figure D – Drainage Plan, reduced sheet C-2.0
Figure E – Detention Vault Details, reduced sheet C-2.3



EXISTING SITE AREAS TO WETLAND BASIN

4.98 – 0.10 = 4.88 ACRES

–IMPERVIOUS–

0.59 AC EXISTING DEVELOPED SITE AREA

0.59 AC IMPERVIOUS TOTAL

–PERVIOUS LAWN–

0.41 AC EXISTING DEVELOPED SITE AREA

0.41 AC LAWN TOTAL

–PERVIOUS PASTURE–

1.94 AC SITE

1.94 AC PASTURE TOTAL

–PERVIOUS FOREST–

1.94 AC SITE

1.94 AC FOREST TOTAL

TOTAL AREA TO WETLAND BASIN = 4.88 ACRES

EXISTING AREAS TO ROW BASIN

0.32 + 0.10 = 0.42 ACRES

–IMPERVIOUS–

0.02 AC EXISTING PAVEMENT

0.02 AC IMPERVIOUS TOTAL

–PERVIOUS–

0.10 AC EXISTING DEVELOPED SITE AREA

0.29 AC EXISTING DITCH AND SHOULDER (LAWN)

0.39 AC LAWN TOTAL

TOTAL AREA TO ROW BASIN = 0.42 ACRES

EXHIBIT A

8/17/2016

SCALE: 1" = 60'

PACIFIC SEAFOOD

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EXISTING CONDITIONS

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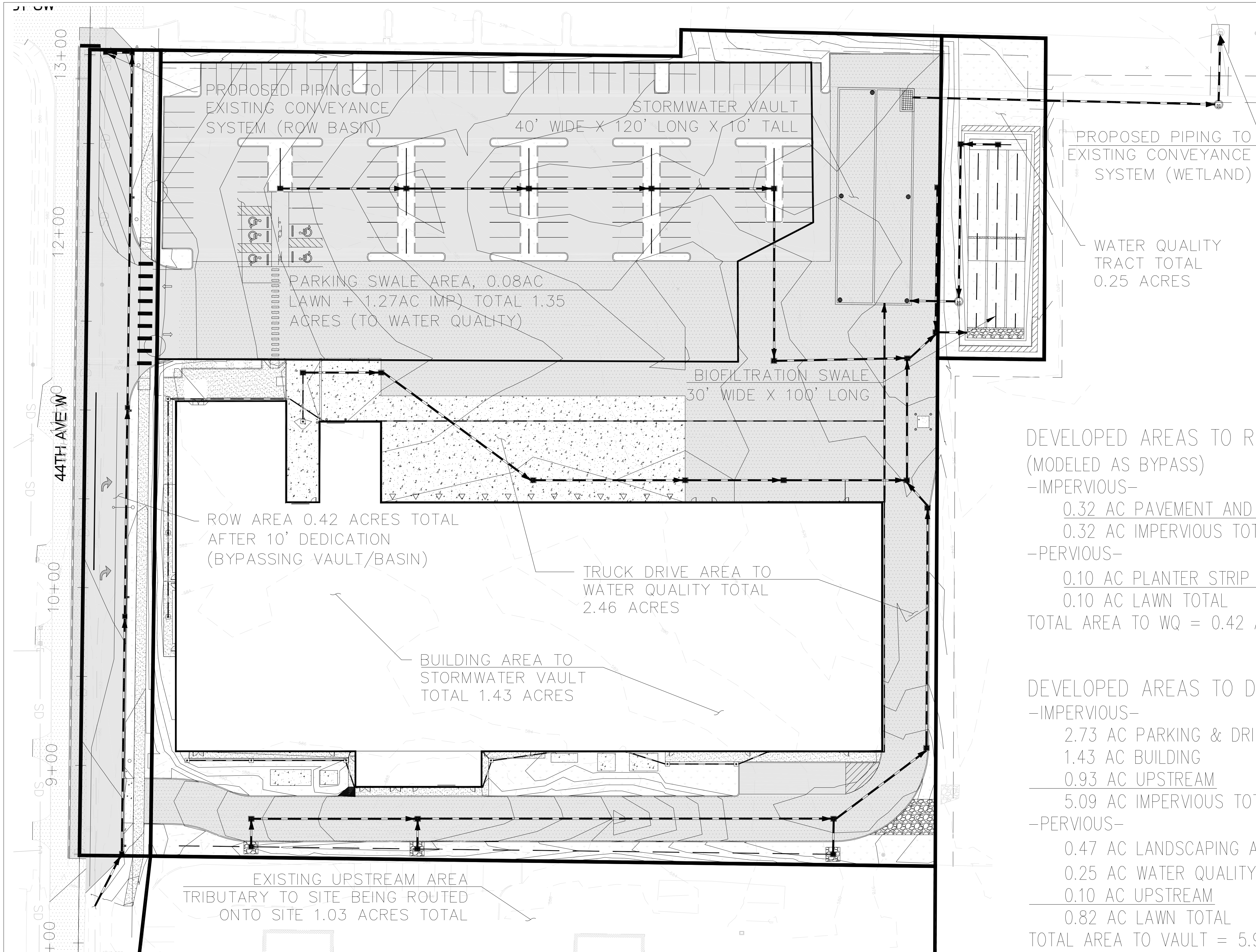

DEVELOPED AREAS TO ROW BASIN
(MODELED AS BYPASS)
-IMPERVIOUS-
0.32 AC PAVEMENT AND SIDEWALK
0.32 AC IMPERVIOUS TOTAL
-PERVIOUS-
0.10 AC PLANTER STRIP (LAWN)
0.10 AC LAWN TOTAL
TOTAL AREA TO WQ = 0.42 ACRES

DEVELOPED AREAS TO DETENTION VAULT
-IMPERVIOUS-
2.73 AC PARKING & DRIVE AREAS
1.43 AC BUILDING
0.93 AC UPSTREAM
5.09 AC IMPERVIOUS TOTAL
-PERVIOUS-
0.47 AC LANDSCAPING AREAS (LAWN)
0.25 AC WATER QUALITY TRACT (LAWN)
0.10 AC UPSTREAM
0.82 AC LAWN TOTAL
TOTAL AREA TO VAULT = 5.91 ACRES

EXHIBIT B
9/16/2016
SCALE: 1" = 60'

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DEVELOPED CONDITIONS

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PACIFIC SEAFOOD
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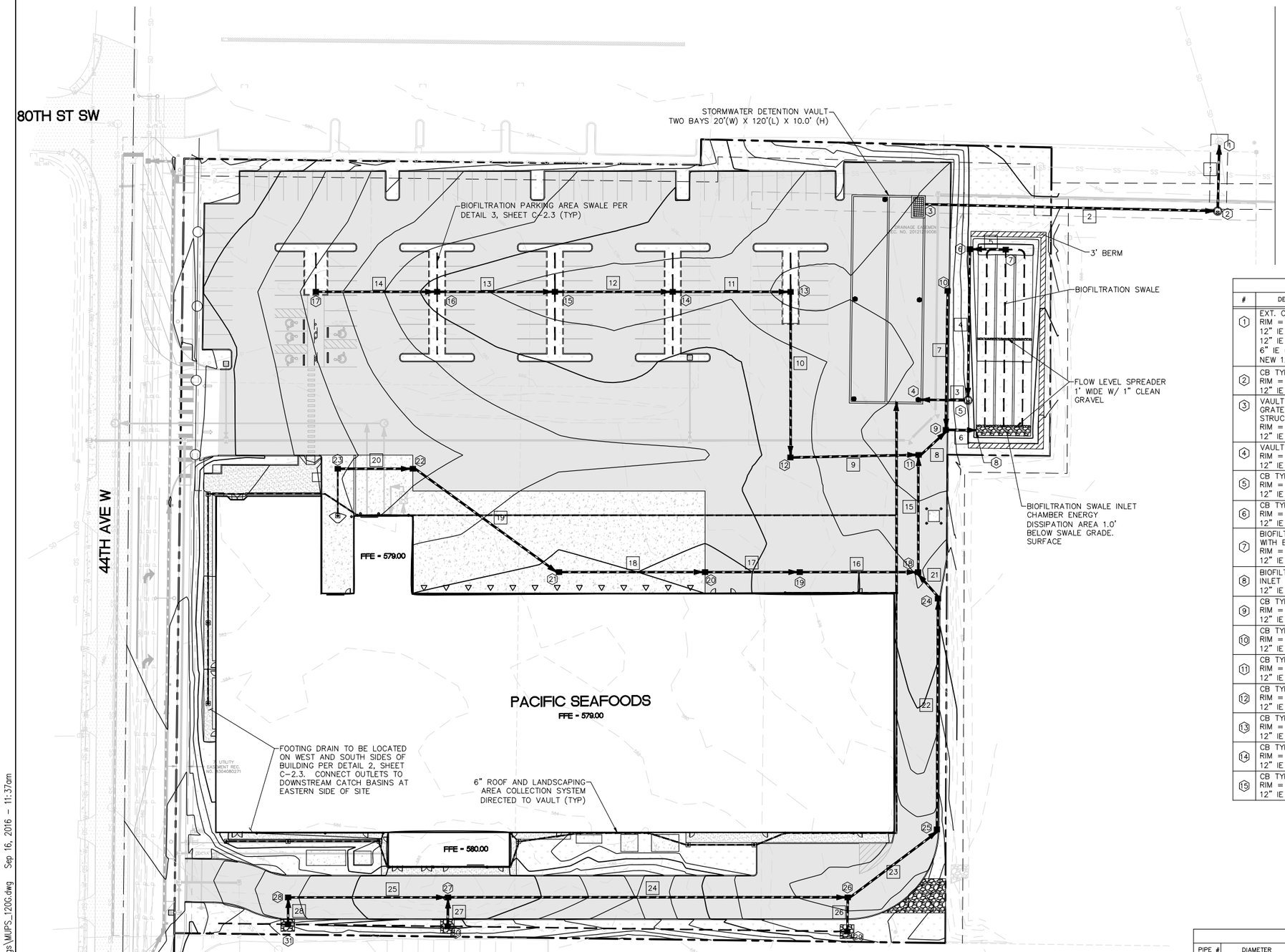
DOWNSTREAM CONDITIONS

EXHIBIT C

8/22/2016

SCALE: 1" = 200'

SW 1/4 OF SECTION 10, TOWNSHIP 28 NORTH, RANGE 4 EAST, W.M.



0 15 30 60

SCALE: 1 INCH = 30 FEET

LEGEND:

- PROPERTY BOUNDARY
- STORM PIPE
- BIOFILTRATION SWALE (5/C2.2)
- TYPE I CATCH BASIN
- TYPE II CATCH BASIN (1/C2.2)
- AREA DRAIN (1/C2.2)
- PRECAST DETENTION VAULT

STRUCTURE SCHEDULE

#	DESCRIPTION	#	DESCRIPTION
1	EXT. CB TYPE 2 RIM = 568.77 12" IE = 555.67 (N) 12" IE = 555.77 (S) 6" IE = 564.57 (W,E) NEW 12" IE 555.77 (S)	16	CB TYPE 1 RIM = 574.52 12" IE = 571.41
2	CB TYPE 2-48" RIM = 569.75 12" IE = 555.97	17	CB TYPE 1 RIM = 577.63 12" IE = 574.25
3	VAULT 5.83' X 11' ACCESS GRATE AND OUTLET STRUCTURE (1/C2.4) RIM = 572.90 12" IE = 557.00	18	CB TYPE 1 RIM = 573.92 4" IE = 571.36 12" IE = 570.69
4	VAULT INLET AND ACCESS LID RIM = 572.69 12" IE = 557.90	19	CB TYPE 1 RIM = 574.75 12" IE = 571.04
5	CB TYPE 2-48" RIM = 571.00 12" IE = 563.50	20	CB TYPE 1 RIM = 574.75 12" IE = 571.32
6	CB TYPE 1 RIM = 569.61 12" IE = 565.50	21	CB TYPE 1 RIM = 574.75 12" IE = 571.75
7	BIOFILTRATION SWALE OUTLET CB WITH BEEHIVE GRATE (5/C2.3) RIM = 568.00 12" IE = 566.00	22	CB TYPE 1 RIM = 577.20 12" IE = 573.92
8	BIOFILTRATION SWALE INLET (4/C2.3) 12" IE = 568.60	23	CB TYPE 1 RIM = 578.26 6" IE = 575.30 12" IE = 574.80
9	CB TYPE 1 RIM = 572.00 12" IE = 568.69	24	CB TYPE 1 RIM = 574.17 12" IE = 571.17
10	CB TYPE 1 RIM = 572.00 12" IE = 569.50	25	CB TYPE 1 RIM = 577.42 12" IE = 572.79
11	CB TYPE 1 RIM = 572.56 12" IE = 568.80	26	CB TYPE 1 RIM = 577.45 12" IE = 573.12
12	CB TYPE 1 RIM = 574.44 12" IE = 569.18	27	CB TYPE 1 RIM = 578.97 12" IE = 575.46
13	CB TYPE 1 RIM = 572.55 12" IE = 569.67	28	CB TYPE 1 RIM = 581.20 12" IE = 576.40
14	CB TYPE 1 RIM = 573.34 12" IE = 570.02	29	CB TYPE 1 RIM = 577.98 12" IE = 575.48
15	CB TYPE 1 RIM = 573.34 12" IE = 570.37	30	CB TYPE 1 RIM = 579.63 12" IE = 575.63
		31	CB TYPE 1 RIM = 580.91 12" IE = 577.91

PIPE SCHEDULE

PIPE #	DIAMETER	LENGTH (FT.)	SLOPE (FT./FT.)	PIPE #	DIAMETER	LENGTH	SLOPE (FT./FT.)
1	12" CPEP	40	.0050	15	12" CPEP	69	.0274
2	12" CPEP	172	.0072	16	12" CPEP	69	.0050
3	12" CPEP	28	.0238	17	12" CPEP	55	.0050
4	12" CPEP	88	.0227	18	12" CPEP	85	.0050
5	12" CPEP	21	.2000	19	12" CPEP	105	.0207
6	12" CPEP	18	.0050	20	12" CPEP	44	.0200
7	12" CPEP	88	.0100	21	12" CPEP	20	.0240
8	12" CPEP	16	.0050	22	12" CPEP	135	.0120
9	12" CPEP	75	.0050	23	12" CPEP	65	.0051
10	12" CPEP	97	.0050	24	12" CPEP	232	.0100
11	12" CPEP	69	.0050	25	12" CPEP	92	.0102
12	12" CPEP	69	.0050	26	12" CPEP	20	.1180
13	12" CPEP	69	.0150	27	12" CPEP	17	.0100
14	12" CPEP	71	.0400	28	12" CPEP	16	.0944

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

No.	Revision Description	Date	By

Issue Date: 09/16/2016 PERMIT
Designed By: JWT/SNG/TVW
Drawn By: SNG/TVW
Checked By: JJV
Project No. 50530001

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DRAINAGE PLAN

C-2.0

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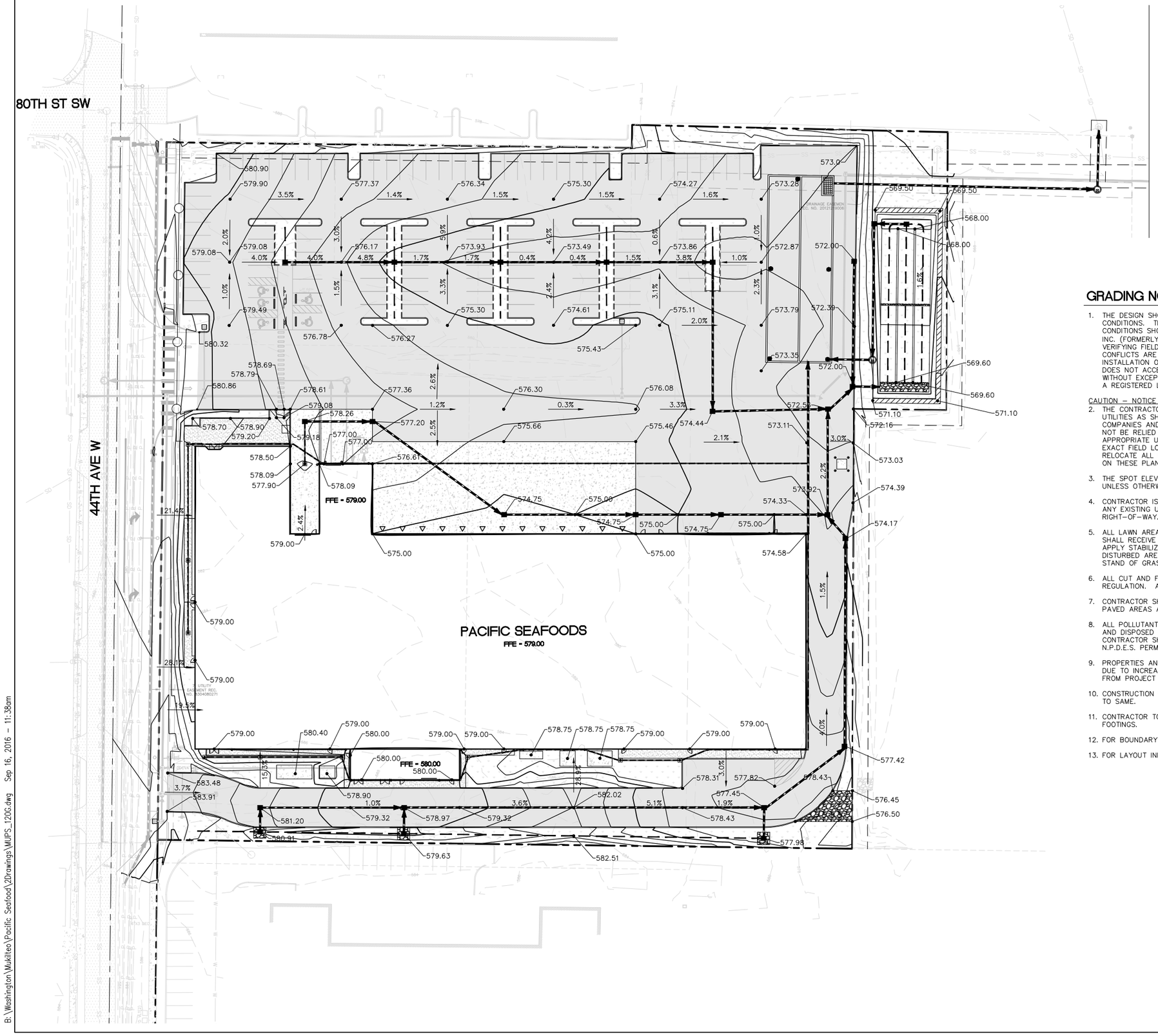
SW 1/4 OF SECTION 10, TOWNSHIP 28 NORTH, RANGE 4 EAST, W.M.



0 15 30 60

SCALE: 1 INCH = 30 FEET

LEGEND:

- PROPERTY BOUNDARY
- BIOFILTRATION SWALE
- TYPE I CATCH BASIN
- TYPE II CATCH BASIN
- AREA DRAIN
- PRECAST DETENTION VAULT
- 2.0% SLOPE
- 573.54 SPOT ELEVATION: HP = HIGH POINT LP = LOW POINT

GRADING NOTES: (NAVIX)

1. THE DESIGN SHOWN IS BASED UPON THE ENGINEER'S UNDERSTANDING OF THE EXISTING CONDITIONS. THE PLAN DOES NOT REPRESENT A DETAILED FIELD SURVEY. THE EXISTING CONDITIONS SHOWN ON THIS PLAN SHEET ARE BASED UPON THE SURVEY PREPARED BY TERRANE, INC. (FORMERLY GEODIMENSIONS INC.), DATED 02/12/16. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING FIELD CONDITIONS PRIOR TO BIDDING THE PROPOSED SITEWORK IMPROVEMENTS. IF CONFLICTS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE OWNER PRIOR TO INSTALLATION OF ANY PORTION OF THE SITEWORK WHICH WOULD BE AFFECTED. IF CONTRACTOR DOES NOT ACCEPT EXISTING SURVEY, INCLUDING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, HE SHALL HAVE MADE, AT HIS OWN EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR AND SUBMIT IT TO THE OWNER FOR REVIEW.

CAUTION – NOTICE TO CONTRACTOR

2. THE CONTRACTOR IS SPECIFICALLY CAUTIONED AT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE APPROPRIATE UTILITY COMPANY AT LEAST 48 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATION OF UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THESE PLANS.

3. THE SPOT ELEVATIONS INDICATED ON THIS PLAN REPRESENT THE DESIGN TOP OF PAVEMENT, UNLESS OTHERWISE NOTED.

4. CONTRACTOR IS RESPONSIBLE FOR DEMOLITION OF EXISTING STRUCTURES INCLUDING REMOVAL OF ANY EXISTING UTILITIES SERVING THE STRUCTURE. UTILITIES ARE TO BE REMOVED TO THE RIGHT–OF–WAY.

5. ALL LAWN AREAS SHALL RECEIVE 4 INCHES OF TOPSOIL AND ALL OTHER LANDSCAPED AREAS SHALL RECEIVE 6 INCHES OF TOPSOIL PER LANDSCAPING SPECIFICATIONS. CONTRACTOR SHALL APPLY STABILIZATION FABRIC TO ALL SLOPES 3H:1V OR STEEPER. CONTRACTOR SHALL STABILIZE DISTURBED AREAS WITH GRASS IN ACCORDANCE WITH LOCAL SPECIFICATION UNTIL A HEALTHY STAND OF GRASS IS OBTAINED.

6. ALL CUT AND FILL SLOPES SHALL BE CONSTRUCTED PER THE UBC CODE AND APPLICABLE LOCAL REGULATION. ALL CUT AND FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED.

7. CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE AWAY FROM BUILDINGS FOR ALL NATURAL AND PAVED AREAS AND SHALL GRADE ALL AREAS TO PRECLUDE PONDING OF WATER.

8. ALL POLLUTANTS OTHER THAN SEDIMENT ON–SITE DURING CONSTRUCTION SHALL BE HANDLED AND DISPOSED OF IN A MANNER THAT DOES NOT CAUSE CONTAMINATION OF STORMWATER. THE CONTRACTOR SHALL ADHERE TO ALL TERMS AND CONDITIONS AS OUTLINED IN THE GENERAL N.P.D.E.S. PERMIT FOR STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES.

9. PROPERTIES AND WATERWAYS DOWNSTREAM OF THE SITE SHALL BE PROTECTED FROM EROSION DUE TO INCREASES IN THE VOLUME, VELOCITY AND PEAK FLOW RATE OF STORMWATER RUNOFF FROM PROJECT SITE.

10. CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE GOVERNING CODES AND BE CONSTRUCTED TO SAME.

11. CONTRACTOR TO REMOVE UNSUITABLE SOILS LOCATED WITHIN THE BUILDINGS SPLAY LINE OF THE FOOTINGS.

12. FOR BOUNDARY AND TOPOGRAPHIC INFORMATION REFER TO PROJECT SURVEY.

13. FOR LAYOUT INFORMATION REFER TO THE SITE PLAN.

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

No.	Revision Description	Date	By

Issue Date: 09/16/2016 PERMIT
Project No. 50530001
Designed By: JWT/SNG/TVW
Drawn By: SNG/TVW
Checked By: JJV

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FINISHED GRADING PLAN

C-2.1

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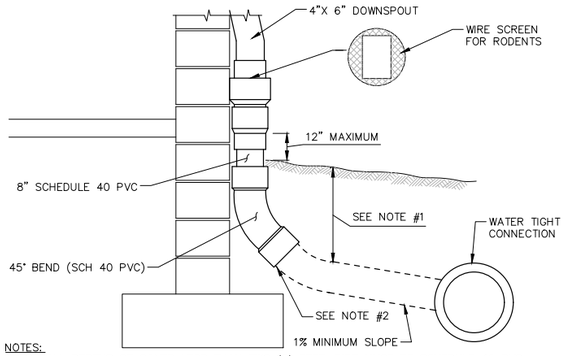
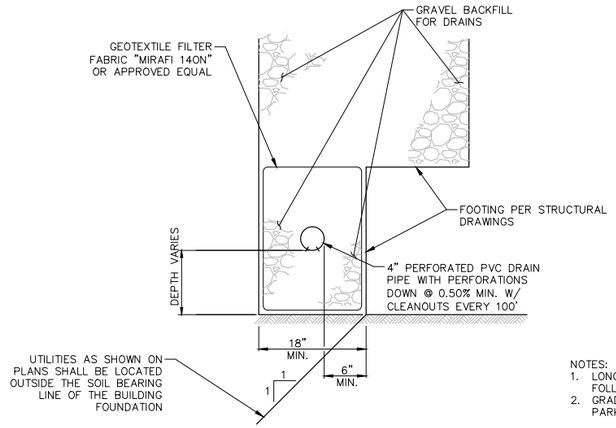
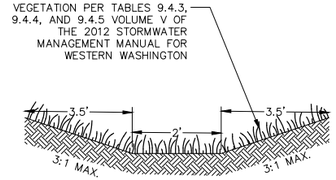


NOTES:
1. FOR ALL DEPTHS OF COVER LESS THAN TWO (2) FEET, PIPE MUST BE SCHEDULE 40 PVC. FOR DEPTHS OF COVER GREATER THAN TWO (2) FEET, FLEXIBLE PIPE MAY BE USED. REFER TO SPECIFICATIONS FOR ALLOWABLE PIPE TYPES.
2. A WATERTIGHT CONNECTION SHALL BE MAINTAINED WITH ANY TRANSITION FROM SCHEDULE 40 PVC PIPE TO ANY OTHER PIPE TYPE.
3. THE DOWNSPOUT COLLECTOR DRAIN SHALL BE INSTALLED BEFORE THE DOWNSPOUTS ARE INSTALLED ON THE BUILDING. SITEWORK CONTRACTOR SHALL BE RESPONSIBLE FOR ALL WORK TO AND INCLUDING THE RODENT SCREEN. BUILDING CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONNECTION AT THE POINT OF THE RODENT SCREEN.

DOWNSPOUT COLLECTOR DETAIL — NTS — 1

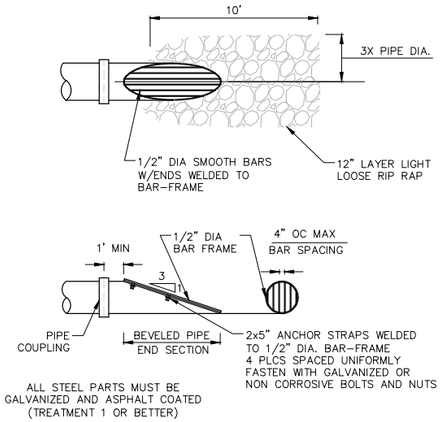


FOOTING DRAINAGE — NTS — 2

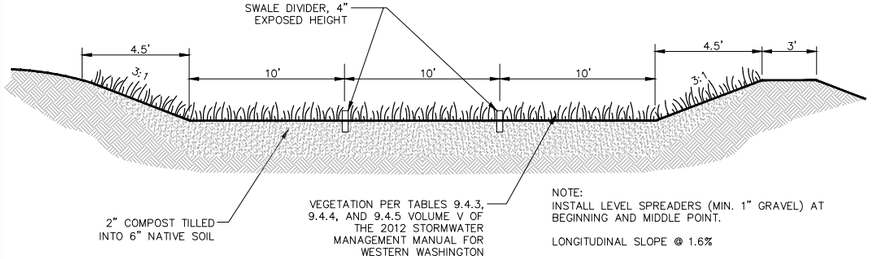


NOTES:
1. LONGITUDINAL BOTTOM SLOPE OF PARKING SWALE SHALL FOLLOW ROADWAY OR 1.5% WHICH EVER IS GREATER.
2. GRADE SWALE TO LOW POINT AT CATCH BASIN IN CENTER OF PARKING ISLE.

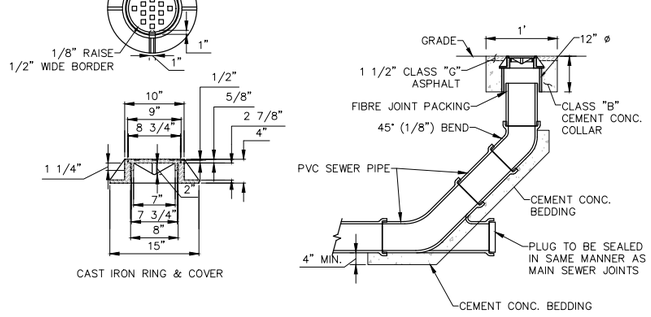
BIOFILTRATION PARKING AREA SWALE — NTS — 3



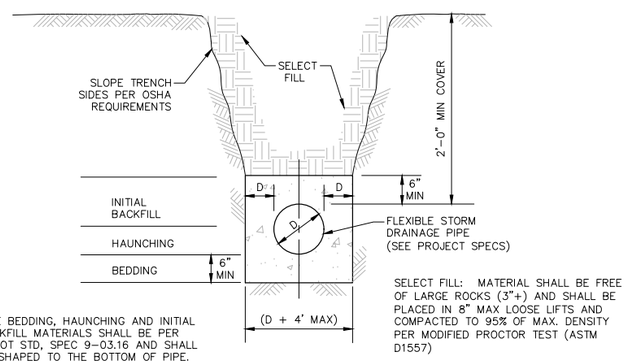
OUTFALL PROTECTION — NTS — 4



BIOFILTRATION SWALE SECTION — NTS — 5



STORM DRAIN CLEANOUT — NTS — 6



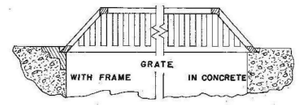
TYPICAL DRAINAGE TRENCH AND BEDDING — NTS — 7

NEENAH FOUNDRY

R-4345 to R-4347 Series

Square Beehive Drainage Grate, Frame

Light Duty



- For off-roadway construction.

These castings are suitable for use at low points of large graded areas and will drain a substantial volume of surface water from all sides.

Catalog Number	Grate Type	Sq. Feet Open	Weir Perimeter Lineal Feet
R-4345	Beehive	2.4	8.6
R-4346	Beehive	2.4	8.6
R-4347	Beehive	2.4	8.6

Catalog Number	Grate Overall	Grate Top Size	Frame Overall	Height Grate	Height Frame
R-4345	26x26	12x12	-	6-1/4	-
R-4346	26x26	12x12	30x30	6-1/4	4
R-4347	27-5/8x27-5/8	12x12	-	6-1/4	-

* OR APPROVED EQUAL

BEEHIVE GRATE — NTS — 8

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

No.	Date	By	Revision Description

Issue Date:	09/16/2016		PERMIT	Project No.	50530001
Designed By:	JWT/SNG/TVW	Drawn By:	SNG/TVW	Checked By:	JJV

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PACIFIC SEAFOOD
PROCESSING FACILITY
8007 44TH AVE W
MUKILTEO, WA 98274

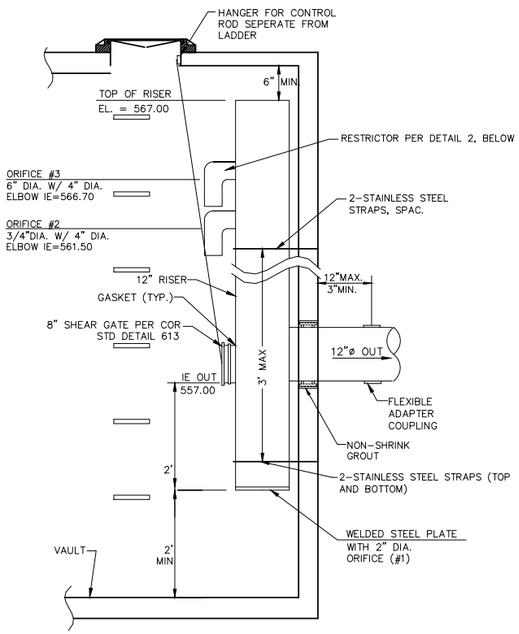
DRAINAGE NOTES AND DETAILS

C-2.3

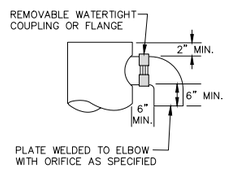
B:\Washington\Mukilteo\Pacific Seafood\2Drawings\MUPS_1200.dwg Sep 16, 2016 - 11:38am

STORM DRAINAGE NOTES: (NAVIX)

1. THE DESIGN SHOWN IS BASED UPON THE ENGINEER'S UNDERSTANDING OF THE EXISTING CONDITIONS. THE PLAN DOES NOT REPRESENT A DETAILED FIELD SURVEY. THE EXISTING CONDITIONS SHOWN ON THIS PLAN SHEET ARE BASED UPON THE SURVEY PREPARED BY TERRANE, INC. (FORMERLY GEODIMENSIONS INC.), DATED 02/12/16. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING FIELD CONDITIONS PRIOR TO BIDDING THE PROPOSED SITEWORK IMPROVEMENTS. IF CONFLICTS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE OWNER PRIOR TO INSTALLATION OF ANY PORTION OF THE SITEWORK WHICH WOULD BE AFFECTED. IF CONTRACTOR DOES NOT ACCEPT EXISTING SURVEY, INCLUDING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, HE SHALL HAVE MADE, AT HIS OWN EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR AND SUBMIT IT TO THE OWNER FOR REVIEW.
2. CAUTION – NOTICE TO CONTRACTOR
   THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE APPROPRIATE UTILITY COMPANY AT LEAST 48 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATION OF UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THESE PLANS.
3. ALL WORKMANSHIP AND MATERIALS SHALL CONFORM TO THE MOST CURRENT APPLICABLE LOCAL, STATE, AND FEDERAL STANDARDS.
4. EXISTING DRAINAGE STRUCTURES TO BE INSPECTED AND REPAIRED AS NEEDED, AND EXISTING PIPES TO BE CLEANED OUT TO REMOVE ALL SILT AND DEBRIS.
5. IF ANY EXISTING STRUCTURES TO REMAIN ARE DAMAGED DURING CONSTRUCTION IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPAIR AND/OR REPLACE THE EXISTING STRUCTURE AS NECESSARY TO RETURN IT TO EXISTING CONDITIONS OR BETTER.
6. STORM DRAINAGE PIPE WITH LESS THAN 2'–0" COVER SHALL BE CLASS IV REINFORCED CONCRETE PIPE, OR APPROVED EQUAL TO SUSTAIN H–20 LOADING.
7. ALL ONSITE STORM DRAINAGE PIPE SHALL BE SMOOTH WALLED INTERIOR, MANUFACTURER'S VERIFICATION OF MANNING'S ROUGHNESS COEFFICIENT N=0.012 OR LESS.
8. PRECAST STRUCTURES MAY BE USED AT CONTRACTOR'S OPTION.
9. ALL CATCH BASINS AND AREA DRAINS ARE TO BE SITUATED SUCH THAT THE OUTSIDE EDGE OF GRATE FRAME IS AT TOE OF CURB OR FLOW LINE OF GUTTER (WHERE APPLICABLE).
10. CATCH BASIN INLET PROTECTION / EROSION CONTROL TO BE USED FOR ALL NEW INLETS.
11. ALL STORM PIPE ENTERING STRUCTURES SHALL BE GROUTED TO ASSURE CONNECTION AT STRUCTURE IS WATERTIGHT.
12. ALL STORM SEWER MANHOLES IN PAVED AREAS SHALL BE FLUSH WITH PAVEMENT, AND SHALL HAVE TRAFFIC BEARING RING AND COVERS. MANHOLES IN UNPAVED AREAS SHALL BE 6" ABOVE FINISH GRADE. LIDS SHALL BE LABELED "STORM SEWER".
11. ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED MORTAR INVERT FROM INVERT IN TO INVERT OUT, UNLESS OTHERWISE SHOWN IN THE CATCH BASIN DETAIL.
12. CONTRACTOR SHALL CONNECT ROOF DRAIN LEADERS TO PROPOSED STORM DRAINS AS SHOWN.



VAULT CONTROL STRUCTURE (1)
NTS



ELBOW RESTRICTOR DETAIL (2)
NTS

No.	Date	By	Revision Description

Issue Date:	Project No.
09/16/2016	50530001
PERMIT	

Designed By:	Drawn By:	Checked By:
JWT/SNG/TVW	SNG/TVW	JJV

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DRAINAGE NOTES AND DETAILS

C–2.4

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

APPENDIX B

GEOTECHNICAL ENGINEERING INVESTIGATION REPORTS

Report 1 – Geotechnical Investigation Services – April 24, 2015
Report 2 – Infiltration Rate Letter – July 29, 2016

April 24, 2015

Mr. Dave Franklin
FFE Architecture and Engineering, Inc.
201 East Lincoln Avenue, Suite 200
Yakima, Washington 98901

Dear Mr. Franklin:

Re: Geotechnical Investigation Services, Proposed Pacific Seafood Greenfield Processing/Distribution Facility Site, 8007 44th Avenue West, Mukilteo (Snohomish County), Washington

Submitted herewith is our report entitled "Geotechnical Investigation Services, Proposed Pacific Seafood Greenfield Processing/Distribution Facility Site, 8007 44th Avenue West, Mukilteo (Snohomish County), Washington". The scope of our services was outlined in our formal proposal to Mr. Bill Marczewski of C.D. Pacific Seafood Group dated February 17, 2015. Written authorization of our services was provided by Mr. Bill Marczewski of Pacific Seafood Group on March 5, 2015.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

cc: Mr. Bill Marczewski, P.E.
Pacific Seafood Group

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Table of Contents (continued)

GEOTECHNICAL INVESTIGATION SERVICES
PROPOSED PACIFIC SEAFOOD GREENFIELD PROCESSING/DISTRIBUTION FACILITY SITE
8007 44TH AVENUE WEST
MUKILTEO (SNOHOMISH COUNTY), WASHINGTON

INTRODUCTION

Redmond Geotechnical Services, LLC is please to submit to you the results of our Geotechnical Investigation at the site of the proposed Pacific Seafood Greenfield Processing/Distribution Facility located to the southeast of the intersection of 44th Avenue West and 80th Street SW in Mukilteo (Snohomish County), Washington. The general location of the subject site is shown on the Site Vicinity Map, Figure No. 1. The purpose of our geotechnical investigation services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to develop and/or provide appropriate geotechnical design and construction recommendations for the proposed new processing and/or distribution facility project.

PROJECT DESCRIPTION

Based on a review of the proposed site development plan, we understand that present plans for the project will consist of the construction of one (1) new processing and/or distribution facility building. Although the processing and/or distribution facility project is still in the final planning and design stage, we understand that the project will result in the construction of an approximate 63,777 square feet concrete tilt-up structure with steel framing which will house multi-temperature rooms ranging from +32 degrees F storage rooms to a -10 degrees F freezer room as well as other warehouse dry storage, office and employee areas. Additionally, we understand that the new processing and distribution building will be designed to have a common finish floor elevation which will be a dock high facility that will allow for Over the Road (OTR) trucks and trailers to back against the Cool loading dock. Further, we understand that the processing and distribution building height will be approximately 35 feet at the roof peak with an additional 10 feet for mechanical equipment.

Support of the new processing and distribution facility structure is anticipated to include both conventional shallow individual (column) footings and strip (continuous) footings. Structural loading information, although unavailable at this time, is anticipated to be fairly typical for this type of concrete tilt-up and/or warehouse structure and is expected to result in maximum dead plus live continuous (strip) and individual (column) footing loads on the order of about 5.0 to 6.0 kips per lineal foot (klf) and 100 to 120 kips, respectively.

Earthwork and grading operations associated with bringing the subject property to finish design grades are unknown at this time. However, based on the existing sloping site grades, we anticipated that some cuts and/or fills on the order of approximately two (2) to four (4) feet will likely be required in order to lower the higher westerly portion of the site and raise the lower easterly portion of the site.

Other associated site improvements for the project will include new underground utility services, concrete curbs and sidewalks, and landscaping as well as new paved (concrete and/or asphalt) parking and drive areas for automobiles as well as both 18 kip single axle and 34 kip tandem axle trucks and trailers.

SCOPE OF WORK

The purpose of our geotechnical studies was to evaluate the overall site subsurface soil and/or groundwater conditions underlying the site with regard to the proposed new processing and distribution facility construction at the site and any associated impacts or concerns with respect to the processing and distribution center as well as provide appropriate geotechnical design and construction recommendations for the project. Specifically, our geotechnical investigation included the following scope of work items:

1. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of seventeen (17) exploratory test borings. The exploratory test borings were drilled to depths ranging from about five (9) to fifteen (15) feet beneath existing site grades with track mounted auger drilling equipment at the approximate locations as shown on the Site Exploration Map, Figure No. 2. Additionally, representative samples of the subsurface soils encountered at the site were collected and returned to our laboratory for further examination and testing.

2. Laboratory testing to evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, maximum dry density and optimum moisture content, gradational characteristics, and Atterberg Limits as well as direct shear strength, consolidation and “R”-value testing.

3. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.

4. Engineering analyses utilizing the field and laboratory data as a basis for furnishing recommendations for foundation support of the proposed new processing and distribution facility structure. Recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance, and foundation subgrade preparation. Additionally, construction and/or permanent subsurface water drainage considerations have also been prepared. Further, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation, pavement and/or floor slab subgrades.

5. Development of various flexible and rigid pavement design sections for both automobile and heavy truck access drive and parking areas.

SITE CONDITIONS

Site Geology

Much of the Puget Sound region was affected by past intrusion of continental glaciation. The last period of glaciation, the Vashon Stade, ended approximately 10,000 to 11,000 years ago. Many of the geomorphic features seen today are a result of scouring and overriding by glacial ice. During the Vashon Stade, the Puget Sound region was overridden by over 3,000 feet of ice. Soil layers overridden by the ice sheet were compacted to a much greater extent than those that were not. A typical sequence includes recessional outwash sand, overlying glacial till or drift, underlain by advance outwash.

Available geologic mapping of the area and/or subject site as shown on the Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington by James P. Minard (1982) indicates that the near surface soils consist of glacial till (Qvt). The glacial till unit is described as a non-sorted mixture of clay, silt, sandy, pebbles, and cobbles.

Surface Conditions

The subject property is generally irregular in shape and encompassing a total area of approximately 5.07 acres. The subject property is roughly bounded to the west 44th Avenue West and to the north, south and east by existing and/or developed commercial and/or industrial properties.

The northwesterly portion of the subject site is presently improved which includes two (2) existing commercial and/or shop structures and a mobile home structure as well as paved and/or graveled vehicle parking. Additionally, the northwesterly portion of the site contains an existing concrete slab believed to be associated with a prior structure. Further, the remainder of the easterly and southerly portions of the site are presently unimproved.

Surface vegetation across the unimproved portion of the site generally consists of a moderate growth of grass and weeds as well as some brush while the area around the existing structures also contains some trees.

Topographically, the site is characterized as gently sloping terrain (5 to 10 percent) descending downward towards the northeast with overall topographic relief estimated at about fourteen (14) feet and is estimated to lie between a low of about Elevation 570 feet near the northeasterly corner of the site to a high of about Elevation 586 feet near the southwesterly portion of the site. However, the southwesterly portion of the site has been elevated above its natural site grades with stockpiles which lie at about Elevation 590 feet.

Subsurface Soil Conditions

Our understanding of the subsurface soil conditions underlying the site was developed by means of seventeen (17) exploratory test borings drilled to depths ranging from about five (5) to fifteen (15) feet beneath existing site grades on April 10, 2015 with track mounted auger drilling equipment. The location of the exploratory test borings were located in the field by marking off distances from existing and/or known site features and are shown in relation to the existing and/or proposed site improvements on the Site Exploration Map, Figure No. 2. Detailed logs of the test boring explorations, presenting conditions encountered at each location explored, are presented in the Appendix, Figure No's. A-5 through A-21.

The exploratory test boring excavations performed during this study were observed by staff from Redmond Geotechnical Services, LLC who logged each of the test boring explorations and obtained representative samples of the subsurface soils encountered across the site. Additionally, the elevation of the exploratory test boring excavations were referenced from a Boundary & Topographic Survey prepared by GeoDimensions dated March 24, 2015 and should be considered as approximate. All subsurface soils encountered at the site and/or within the exploratory test boring excavations were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-4.

The test boring explorations revealed that the subject site is generally underlain by native soil deposits comprised of glacial drift and/or till deposits of Pleistocene age. However, localized fill soils were also encountered at the site. Specifically, the subsurface soils underlying the project area generally consists of a surficial layer of topsoil materials comprised of about 8 to 18 inches of dark brown, very moist to saturated, very soft to soft, organic to highly organic, sandy, clayey silt. These surficial topsoil materials were inturn underlain by native residual soils composed of an upper layer of medium to orangish-brown, very moist to saturated, loose to medium dense, clayey, silty sand with occasional gravel and roots subgrade soils to depths ranging from about 2 to 3 feet beneath the existing site and/or surface grades. This upper layer of residual soils is considered to be highly weathered glacial drift and is best characterized by relatively low strength and moderately to high compressibility. This upper layer of glacial drift was inturn underlain by gray to gray-brown, very moist, medium dense to dense, clayey, silty sand with gravel and cobbles to the maximum depth explored of about fifteen (15) feet beneath existing site and/or surface grades.

This underlying unit represents the glacial till bedrock deposits and are best characterized by relatively high strength and low compressibility. However, areas of fill soil and/or surface improvements were also found to be present at the site. Specifically, the northwesterly portion of the site contains various gravel base rock and concrete pavements/slabs of approximately 6 inches in depth and/or thickness. Additionally, the central, southerly and easterly portions of the site contain a 6 to 24 inch layer of bark chips. Further, the southwesterly portion of the site contains two (2) large spoil piles which contain approximately 6 to 8 feet of uncompacted silty sand soils. In addition to the above, other evidence of fill placement was observed at the site and to the east of the existing site improvements and/or concrete slab which was observed to consist of a mixture of soil with miscellaneous wood and construction debris.

Groundwater

Groundwater was generally not encountered within any of the exploratory test boring explorations (B-#1 through B-#17) at the time of drilling to depths of at least fifteen (15) feet beneath existing site grades. However, several of the test borings drilled across the central and/or easterly portion of the site encountered seepage. Based on a review of available water wells in the area, the apparent depth to seasonal high groundwater in the area of the subject site is greater than 20 feet. However, groundwater elevations at and/or below the subject site may fluctuate seasonally in accordance with rainfall conditions as well as changes in site utilization. Additionally, due to the presence of relatively low permeability within the underlying medium dense to dense, clayey, silty sand with gravel and cobble glacial till bedrock deposits, surface water was observed to be perch near to and/or at the ground surface at the time of our field work and/or during periods of peak and/or prolonged rainfall.

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from various test boring explorations and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics. The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, gradation analyses and Atterberg Limits as well as direct shear strength, consolidation and “R”-value tests. Results of the various laboratory tests are presented in the Appendix, Figure No’s. A-22 through A-29.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the northwest Washington as well as the Seattle and/or Everett areas, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A recent study by Geomatrix (1995) suggests that the maximum earthquake associated with the CSZ is moment magnitude (M_W) 8 to 9. This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An M_W 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ, and is considered unlikely. For the purpose of this study an earthquake of M_W 8.5 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking within the Seattle/Everett and northwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which lose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the ground water table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

Our review of the subsurface soil test boring logs from our exploratory field explorations (B-#1 through B-#17) and laboratory test results indicates that the site is generally underlain by medium dense to dense, clayey, silty sand glacial till deposits to depths of at least 15.0 feet beneath existing site grades.

As such, due to the medium dense to dense characteristics of the underlying clayey, silty sand glacial till bedrock deposits beneath the site, it is our opinion that the soil deposits located beneath the subject site do not have the potential for liquefaction during the design earthquake motions previously described. A more detailed liquefaction assessment was not part of the scope of work for this Geotechnical Investigation.

Landslides

No ancient and/or active landslides were observed or are known to be present on the subject site. Additionally, due to the relatively flat-lying to gently sloping nature of the subject site, the risk of seismic induced slope instability at the site resulting in landslides and/or lateral earth movements does not appear to present a potential geologic hazard.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. As such, the risk of surface rupture due to faulting is considered negligible.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Snohomish County and Mukilteo. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new auto dealership structure and any associated site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Snohomish County requirements for the 100-year flood levels of any nearby creeks and/or streams.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field explorations, laboratory testing, and engineering analyses, it is our opinion that the site is suitable for the proposed new Pacific Seafood Greenfield Processing and Distribution facility and its associated site improvements provided that the recommendations contained within this report are properly incorporated into the design and construction of the project.

The primary features of concern at the site are 1) the presence of the existing site and/or surface improvements across the northwesterly portion of the site, 2) the presence of existing fill materials at the site, 3) the presence of the extensive layer of topsoil materials across the site, 4) the presence of the upper layer of medium to orangish-brown, loose, clayey, silty sand subgrade soils, 5) the presence of perched and/or surface water, and 6) the relatively dense glacial till bedrock deposits beneath the site.

In regards to the presence of the existing site and/or surface improvements within the northwesterly portion of the site, we are generally of the opinion that carefully monitoring of the site grading and earthwork activities will be required by the Geotechnical Engineer to ensure that all of the old foundation remnants, surface improvements and/or old utility services are properly removed and/or abandoned prior to the placement of any new structural fills and/or site improvements.

With regard to the presence of existing fill materials at the site, we are of the opinion that the fill materials are likely undocumented. Additionally, much of the surficial fill consists of bark chips. Further, the fill materials appear to be poorly compacted and are generally unsuitable for support of the proposed new site improvements. As such, we are generally of the opinion that all of the existing fill soil materials be removed in their entirety down to an approved native subgrade. Additionally, if during the upcoming site grading and earthwork operations it is determined that the existing fill materials contain deleterious materials and/or significant organics, the existing fill materials would be considered unsuitable for use/reuse as structural fill and/or support of the planned new site improvements. However, existing fill materials which are generally free of organics and/or deleterious materials, such as the large stockpiles located in the southwesterly portion of the site, may be used/re-used as structural fill if approved by the Geotechnical Engineer.

In regards to the presence of the extensive layer of topsoil materials across the site, we are generally of the opinion that stripping depths of about 1.0 to 1.5 feet will likely be required during the clearing and site preparation work for the project. However, additional stripping and clearing will be required in areas where the topsoil materials are covered by surficial fill materials.

With regard to the presence of the upper layer of medium to orangish-brown, loose, clayey, silty sand subgrade soils, these soil deposits are believed to represent highly weathered glacial drift. Additionally, these clayey, silty sand soil deposits are presently loose and contain pockets of medium to large sized roots. Further, in their present condition, these loose clayey, silty sand subgrade soils possess low strength and high compressibility characteristics. As such, we are of the opinion that these upper clayey, silty sand subgrade soils should be removed in their entirety down to the surface of the medium dense to dense, clayey, silty sand glacial till bedrock deposits. However, use/re-use of the upper glacial drift soil deposits as structural fill soil may be considered acceptable and approved by the Geotechnical Engineer if the roots and/or organic matter is suitably removed.

In regards to the presence of perched and/or surface water at the site, we are generally of the opinion that all site grading and earthwork operations for the project be performed during the drier summer months which is typically June through September.

With regard to the relatively dense glacial till bedrock deposits beneath the site, we are of the opinion that these glacial till bedrock deposits will provide suitable support of foundations and/or site improvements. However, hard and/or difficult excavation conditions should be anticipated for site excavations which extend into the glacial till deposits.

The following sections of this report provide specific recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new Pacific Seafood Greenfield Processing and Distribution Facility project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new processing and distribution facility building area(s) and its associated structural and/or site improvement area(s) be stripped and cleared of all existing improvements, any existing unsuitable and/or undocumented fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing surface improvements and/or topsoil materials as well as undocumented fill materials will generally be about 6 to 24 inches. However, localized areas requiring deeper removals, such as old foundation remnants as well as the stockpiled undocumented fill materials, will be encountered and should be evaluated at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be generally be disposed of as they are generally considered organic and unsuitable for use/reuse as structural fill materials. Additionally and as previously noted, following the site clearing and stripping,

Following the completion of the site stripping and clearing work and prior to the placement of any required structural fill materials and/or structural improvements, the upper medium to orangish-brown and loose, clayey, silty sandand/or highly weathered glacial drift subgrade soils should be removed in their entirety down to the surface of the medium dense to dense glacial till bedrock deposits.

The on-site native clayey, silty sand subgrade soil materials are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of the on-site native soil materials which contain significant silt and clay sized particles will be difficult at best. In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of the existing undocumented fill materials as well as the topsoil materials and/or underlying loose highly weathered glacial drift subgrade soils be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated. Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils may also be required during wet weather grading and construction. Further, we recommend that areas in which construction equipment will be traveling over moisture sensitive subgrade soils be protected by covering the exposed subgrade soils with a geotextile fabric such as Mirafi 600nx followed by at least 12 inches or more of crushed aggregate base rock. The geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

All structural fill materials placed within the new processing and distribution facility building and/or pavement areas should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 8 inches. Additionally, all fill materials placed within five (5) lineal feet of the perimeter (limits) of the proposed new processing and distribution facility structure and/or pavements should be considered structural fill. All aspects of the site grading should be monitored and approved by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new processing and distribution facility is suitable for support of the concrete tilt-up and steel framed structure provided that the following foundation design recommendations are followed. The following sections of this report present specific foundation design and construction recommendations for the planned new processing and distribution facility structure.

Shallow Foundations

In general, conventional shallow continuous (strip) footings and individual (spread) column footings may be supported by properly placed and approved structural fill soils based on an allowable contact bearing pressure of about 2,500 pounds per square foot (psf). However, where higher allowable contact bearing pressures are desired and/or required, an allowable contact bearing pressure of 3,000 psf may be used for design where foundations are supported by the existing medium dense to dense, clayey, silty sand glacial till bedrock deposits. These recommended allowable contact bearing pressures are intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads. In general, continuous strip footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual column footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches.

Total and differential settlements of foundations constructed as recommended above and supported by approved structural fill materials and/or native medium dense to dense, clayey, silty sand glacial till bedrock deposits are expected to be well within the tolerable limits for this type of concrete tilt-up and steel framed structure and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.35 and 0.50 for native structural fill materials or the medium dense to dense, clayey, silty sand glacial till bedrock deposits, respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured “neat” against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 300 pounds per cubic foot (pcf). This recommended value includes a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

In order to provide uniform subgrade reaction beneath concrete slab-on-grade floors, we recommend that the floor slab area be underlain by a minimum of 6 inches of free-draining (less than 5 percent passing the No. 200 sieve), well-graded, crushed rock. The crushed rock should help provide a capillary break to prevent migration of moisture through the slab. Additional moisture protection, where needed, can be provided by using a 15-mil polyolefin geo-membrane sheeting such as StegoWrap.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Where floor slab subgrade materials are undisturbed, firm and stable and where the underslab aggregate base rock section has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction of 250 pci be used for design.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	45	35
3H:1V	65	60
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid overcompaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Pavements

Flexible (AC) and rigid (PCC) pavement design for the project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to laboratory subgrade soil strength ("R"-value) characteristics. Based on a laboratory subgrade "R"-value of 32 (Resilient Modulus = 5,000 to 10,000) and utilizing the Asphalt Institute Flexible Pavement Design Procedures and/or the American Association of State Highway and Transportation Officials (AASHTO) 1993 "Design of Pavement Structures" manual, we recommend that the flexible asphaltic concrete (AC) and/or rigid Portland Cement Concrete (PCC) pavement section(s) for the automobile and truck drive and/or parking areas at the site consist of the following:

	Asphaltic Concrete Thickness (inches)	**Crushed Base Rock Thickness (inches)**
Automobile Drive & Parking Areas	3.0	9.0
Heavy Truck traffic Areas	5.0	12.0

	Portland Cement Concrete Thickness (inches)	**Crushed Base Rock Thickness (inches)**
Automobile Parking & Drive Areas	5.0	4.0
Heavy Truck Traffic Areas	7.5	6.0

Note: For wet weather construction, we recommend a minimum gravel base rock thickness of at least 12 inches. Additionally, the above recommended flexible and rigid pavement section(s) assumes a design life of 20 and 40 years, respectively. Further, the rigid PCC pavement design assumes a minimum Modulus of Rupture (M.R.) of 3rd point loading of 650 psi and minimum 28 day concrete strength of 4,000 psi.

Pavement Subgrade, Base Course & Asphalt Materials

The above recommended pavement section(s) were based on the design assumptions listed herein and on the assumption that construction of the pavement section(s) will be completed during an extended period of reasonably dry weather. All thicknesses given are intended to be the minimum acceptable. Increased base rock sections and the use of geotextile fabric may be required during wet and/or inclement weather conditions and/or in order to adequately support construction traffic and protect the subgrade during construction. Additionally, the above recommended pavement section(s) assume that the subgrade will be prepared as recommended herein, that the exposed subgrade soils will be properly protected from rain and construction traffic, and that the subgrade is firm and unyielding at the time of paving. Further, it assumes that the subgrade is graded to prevent any ponding of water which may tend to accumulate in the base course.

Pavement base course materials should consist of well-graded 1-1/4 inch and/or 5/8-inch minus crushed base rock having less than 5 percent fine materials passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirements set forth in the latest edition of the Washington Department of Transportation, Standard Specifications for Highway Construction. The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. The asphaltic concrete paving materials should be compacted to at least 92 percent of the theoretical maximum density as determined by the ASTM D-2041 (Rice Gravity) test method.

Excavation/Slopes

Temporary excavations of up to about four (4) feet in depth may be constructed with near vertical inclinations. Temporary excavations greater than about four (4) feet but less than eight (8) feet should be excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about eight (8) feet, this office should be consulted. All shoring systems and/or temporary excavation bracing for the project should be the responsibility of the excavation contractor. Permanent cut and/or fill slopes should be constructed no steeper than 2H:1V.

Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Ground Water

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from the building and landscaping areas as well as adjacent properties or buildings are directed away from the new processing and distribution facility structure foundations and/or floor slabs. All roof drainage should be directed into conduits that carry runoff water away from the processing and distribution facility to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the building.

Groundwater was generally not encountered at the site in any of the exploratory test borings (B-#1 through B-#17) at the time of drilling to depths of at least 15.0 feet beneath existing site grades. However, surface ponding was present at the time of our field work. Additionally, groundwater elevations in the area and/or beneath the subject site may fluctuate seasonally and may temporarily pond/perch near the ground surface during periods of prolonged rainfall.

As such, based on our current understand of the site grading required to bring the subject site to finish design grades, we are of the opinion that an underslab drainage system is not required for the proposed new processing and distribution facility structure. However, due to the presence of clayey, silty sand subgrade soils within the foundation bearing level of the proposed new processing and distribution facility structure, we are generally of the opinion that a footing/foundation drainage system should be utilized around the perimeter of the proposed processing and distribution facility structure. Additionally, a foundation drain is recommended for any below grade footing and/or retaining walls. A typical recommended perimeter footing and/or retaining wall drain detail is shown on Figure No. 3.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition of the State of Washington Structural Specialty Code and/or Amendments to the 2012 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Washington Structural Specialty Code and/or Figures 1613 (1) and 1613 (2) of the 2009 National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class "C" be used for design per Table 1613.5.2.

Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from Tables 1613.5.3 (1) and 1613.5.3 (2) of the 2012 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 1. IBC Seismic Design Parameters

Site Class	S_S	S_1	F_a	F_v	S_{MS}	S_{M1}	S_{DS}	S_{D1}
C	1.450	0.564	1.000	1.300	1.450	0.733	0.967	0.489

Notes: 1. S_S and S_1 were established based on the USGS 2012 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. Fa and Fv were established based on IBC 2012 tables 1613.5.3 (1) and 1613.5.3 (2) using the selected S_S and S_1 values.

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new processing and distribution facility project. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to grading to help establish a plan that will minimize costly overexcavation and site preparation work. Of primary importance will be observations made during site preparation, structural fill placement, footing excavations and construction as well as any retaining wall backfill.

CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new processing and distribution facility structure and its associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site inspections and construction monitoring services associated with the site grading and earthwork operations as well as all foundation excavation and preparation work for this project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection and/or testing services performed by others.

It is the owners/developers responsibility for insuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

REFERENCES

Adams, John, 1984, Active Deformation of the Pacific Northwest Continental Margin: Tectonics, v.3, no. 4, p. 449-472.

Applied Technology Council, ATC-13, 1985, Earthquake Damage Evaluation Data for Cailifornia.

Atwater, B.F., 1992, Geologic evidence for earthquakes during the past 2000 years along the Copalis River, southern coastal Washington: Journal of Geophysical Research, v. 97, p. 1901-1919.

Atwater, B.F., 1987a, A periodic Holocene recurrence of widespread, probably coseismic Subsidence in southwestern Washington: EOS, v. 68, no. 44.

Atwater, B.F., 1987b, Evidence for great Holocene earthquakes along the outer coast of Washington State: Science, v. 236, no. 4804, pp. 942-944.

Campbell, K.W., 1990, Empirical prediction of near-surface soil and soft-rock ground motion for the Diablo Canyon Power Plant site, San Luis Obispo County, California: Dames & Moore report to Lawrence Livermore National Laboratory.

Carver, G.A., and Burke, R.M., 1987, Late Holocene paleoseismicity of the southern end of the Cascadia Subduction zone [abs.]: EOS, v. 68, no. 44, p. 1240.

Chase, R.L., Tiffin, D.L., Murray, J.W., 1975, The western Canadian continental margin: In Yorath, C.J., Parker, E.R., Glass, D.J., editors, Canada's continental margins and offshore petroleum exploration: Canadian Society of Petroleum Geologists Memoir 4, p. 701-721.

Crouse, C.B., 1991a, Ground motion attenuation equations for earthquakes on the Cascadia Subduction Zone: Earthquake Spectra, v. 7, no. 2, pp. 201-236.

Crouse, C.B., 1991b, Errata to Crouse (1991a), Earthquake Spectra, v. 7, no. 3, p. 506.

Darienzo, M.E., and Peterson, C.D., 1987, Episodic tectonic subsidence recorded in late Holocene salt marshes, northern Oregon central Cascadia margin: Tectonics, v. 9, p. 1-22.

Darienzo, M.E., and Peterson, C.D., 1987, Episodic tectonic subsidence recorded in late Holocene salt marshes northwest Oregon [abs]: EOS, v. 68, no. 44, p. 1469.

EERI (Earthquake Engineering Research Institute), 1993, The March 25, 1993, Scotts Mill Earthquake, Western Oregon's Wake-Up Call: EERI Newsletter, Vol. 27, No. 5, May.

Geomatrix, 1995 Seismic Design Mapping, State of Oregon: Final Report to Oregon Department of Transportation, January.

Geologic Map Series (GMS-49), Map of Oregon Seismicity, 1841-1986 dated 1986.

Geologic Map Series (GMS-97), Geologic Map of the Coos Bay Quadrangle, Coos County, Oregon dated 1995.

Grant, W.C., and McLaren, D.D., 1987, Evidence for Holocene Subduction earthquakes along the northern Oregon coast [abs]: EOS v. 68, no. 44, p. 1239.

Grant, W.C., Atwater, B.F., Carver, G.A., Darienzo, M.E., Nelson, A.R., Peterson, C.D., and Vick, G.S., 1989, Radiocarbon dating of late Holocene coastal subsidence above the Cascadia Subduction zone-compilation for Washington, Oregon, and northern California, [abs]: EOS Transactions of the American Geophysical Union, v. 70, p. 1331.

International Conference of Building Officials (ICBO), 1994, Uniform Building Code: 1994 Edition, Whittier, CA. 1994.

Joyner, W.B., and Boore, D.M., 1998, Measurement, characterization and prediction of strong ground motion: Earthquake Engineering and Soil Dynamics II – Recent Advances in Ground Motion Evaluation, ASCE Geotech. Special Publ. No. 20, p. 43-102.

Riddihough, R.P., 1984, Recent movements of the Juan de Fuca plate system: Journal of Geophysical Research, v. 89, no. B8, p. 6980-6994.

Youngs, R.R., Day, S.M., and Stevens, J.L., 1998, Near field ground motions on rock for large Subduction earthquakes: Earthquake Engineering and Soil Dynamics II – Recent Advances in Ground Motion Evaluation, ASCE Geotech. Special Publ. No. 20, p. 445-462.

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site were explored by drilling seventeen (17) exploratory test borings on April 10, 2015. The approximate location of the test boring explorations are shown in relation to the existing and/or proposed new site improvements on the Site Exploration Map, Figure No. 2.

The test borings were drilled using track mounted auger drilling equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test borings were drilled to depths ranging from about 5.0 to 15.0 feet beneath existing site grades. Detailed logs of the test borings are presented on the Boring Logs, Figure No's. A-5 through A-21. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-4.

The exploration program was coordinated by a field engineer who monitored the drilling and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was generally not encountered within any of the exploratory test borings (B-#1 through B-#17) at the time of drilling at depths of between five (5) to fifteen (15) feet beneath existing site grades. However, perched surface water was present at the site at the time of our field work.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, Atterberg Limits and gradational characteristics as well as direct shear strength, consolidation and "R"-value tests.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test boring explorations in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the test boring logs at the appropriate sample depths.

Maximum Dry Density

One (1) maximum dry density test was performed on representative sample of the upper clayey, silty sand subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557-78. The test was conducted to facilitate classification of the soils and for correlation purposes. Test results appear on Figure No. A-22.

Atterberg Limits

Liquid Limit (LL) and Plastic Limit (PL) tests were performed on a representative sample of the clayey, silty sand subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. The test results were conducted to help facilitate the classification of the subgrade soils and for correlation purposes. The test results are shown graphically on Figure No. A-23.

Gradation Analysis

Gradation analyses were performed on representative samples of the clayey, silty sand subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No. A-24.

Direct Shear Strength Test

Two (2) Direct Shear Strength tests were performed on remolded samples at a continuous rate of shearing deflection (0.02 inches per minute) in accordance with ASTM Vol. 4.08 Part D-3080-79. The test results were used to determine engineering strength properties and are shown graphically on Figure No's. A-25 and A-26.

Consolidation Tests

One (1) Consolidation test was performed on an undisturbed sample of the upper clayey, silty sand subgrade soils to help assess the compressibility characteristics of the near surface subgrade soils in general conformance with ASTM Vol. 4.08 Part D-2435-80.

Conventional loading increments of 100, 200, 400, … 12,800 psf were applied after the 100 percent time of primary consolidation was identified and defined foe each loading increment. The sample was unloaded and allowed to rebound after the completion of the loading sequence. Deflection versus time readings were recorded for all load increments from 100 through 12,800 psf. The deflection corresponding to 100 percent primary consolidation was plotted on the consolidation strain versus consolidation pressure curve, which is presented on Figure No. A-27.

“R”-Value Tests

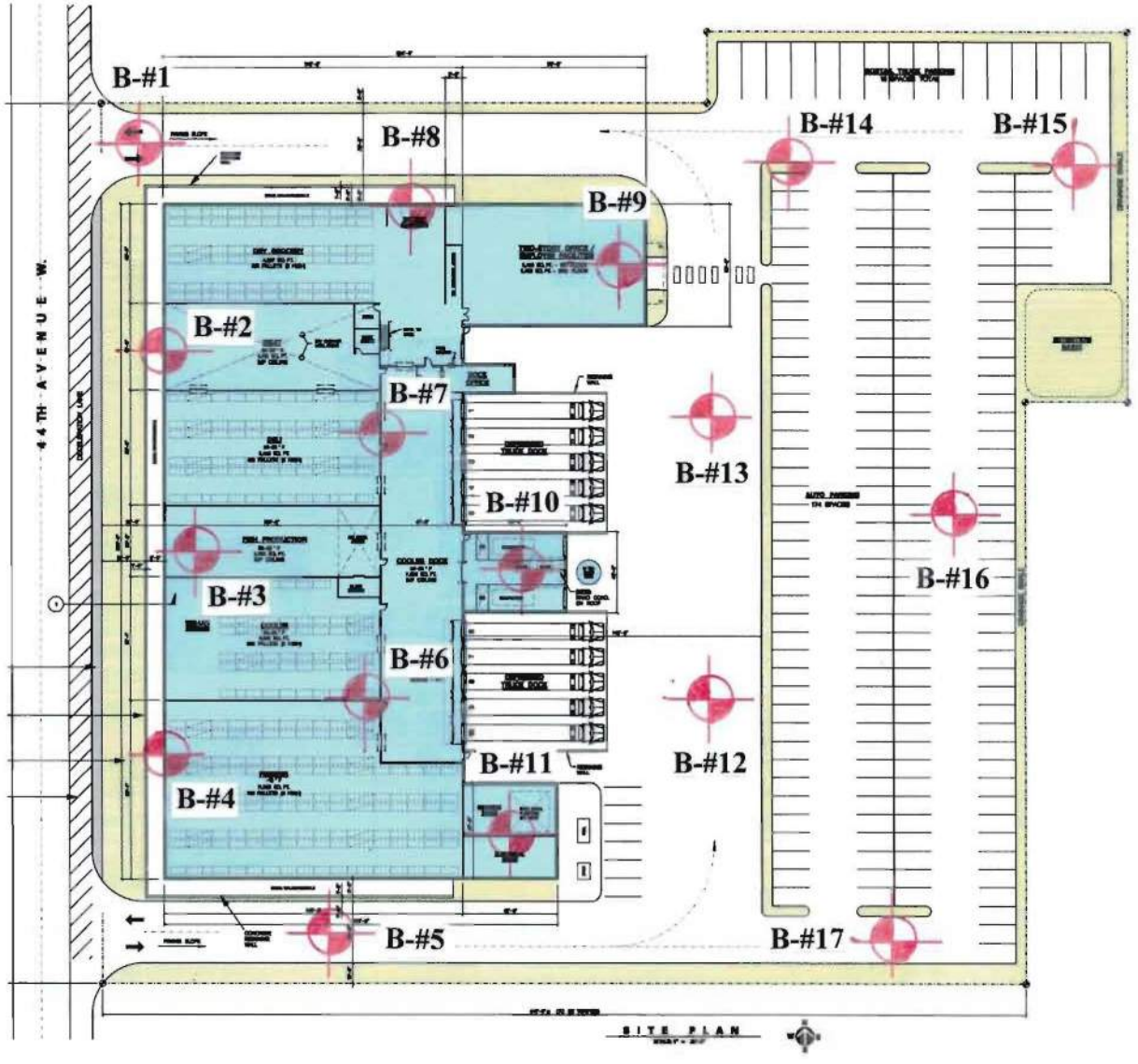
One (1) “R”-value test was performed on a representative sample of the near surface clayey, silty sand subgrade soils in general conformance with ASTM Vol. 4.08 Part D-2844. The test results were used to help evaluate the subgrade soil supporting and performance capabilities when subjected to vehicle traffic loading. The test results are shown on Figure No. A-28.

The following figures are attached and complete the Appendix:

Figure No. A-4	Key To Exploratory Boring Logs
Figure No’s. A-5 through A-21	Boring Logs
Figure No. A-22	Maximum Dry Density Test Results
Figure No. A-23	Atterberg Limits Test Results
Figure No. A-24	Gradation Test Results
Figure No's. A-25 and A-26	Direct Shear Strength Test Results
Figure No. A-27	Consolidation Test Results
Figure No. A-28	Results of R (Resistance) Value Test

Appendix “A”

Boring Logs and Laboratory Test Results



LEGEND

B-#17 Indicates approximate location of exploratory drilled test boring

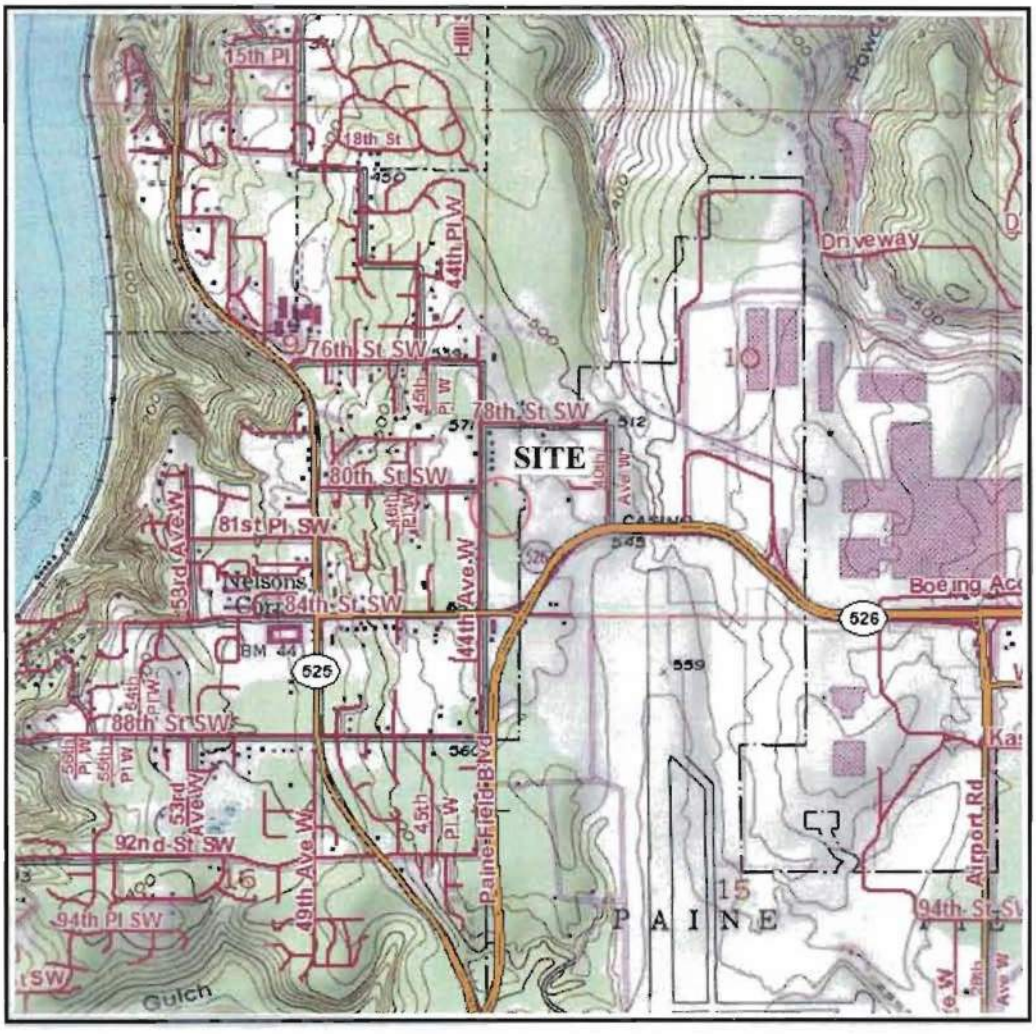
Approximate Scale: 1"=90'

SITE EXPLORATION PLAN

Project No. 1390.001.G

PACIFIC SEAFOODS
DISTRIBUTION FACILITY

Figure No. 2



MUKILTEO QUADRANGLE
WASHINGTON
7.5 MINUTE SERIES (TOPOGRAPHIC)

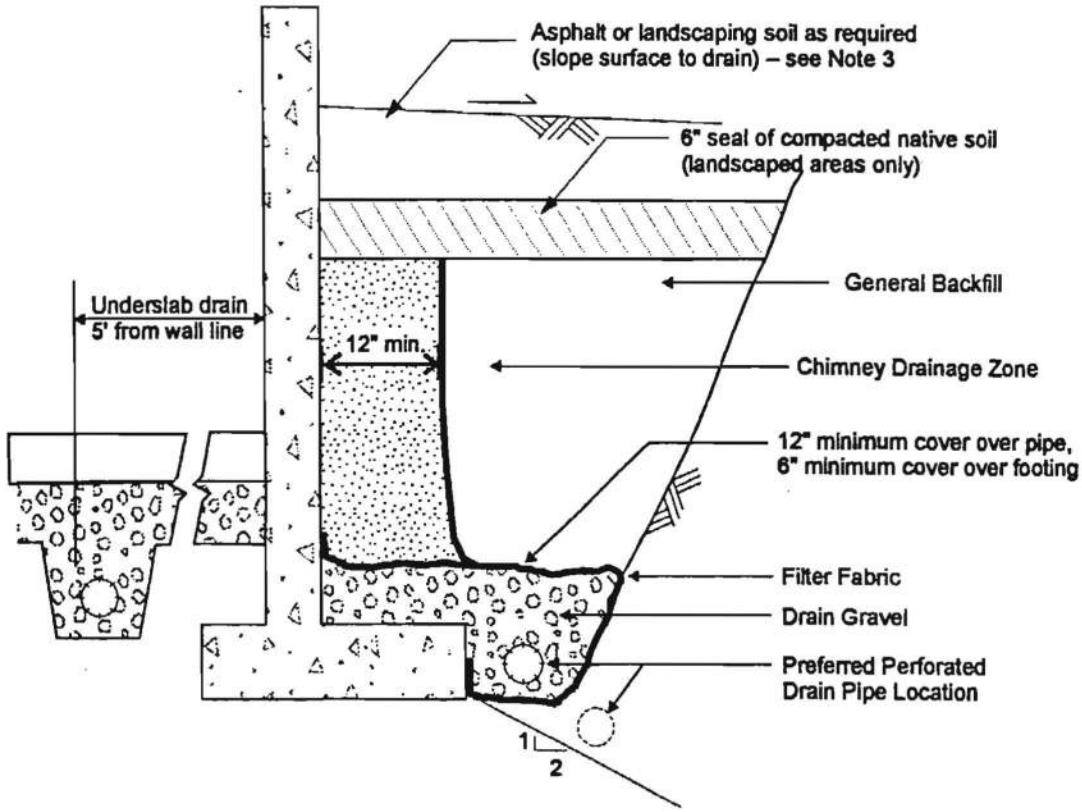
SCALE 1:24 000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER

SITE VICINITY MAP

Project No. 1390.001.G	**PACIFIC SEAFOODS DISTRIBUTION FACILITY**	Figure No. 1



SCHEMATIC - NOT TO SCALE

NOTES:

1. Filter Fabric to be non-woven geotextile (Amoco 4545, Mirafi 140N, or equivalent)
2. Lay perforated drain pipe on minimum 0.5% gradient, widening excavation as required. Maintain pipe above 2:1 slope, as shown.
3. All-granular backfill is recommended for support of slabs, pavements, etc. (see text for structural fill).
4. Drain gravel to be clean, washed ¾" to 1½" gravel.
5. General backfill to be on-site gravels, or ¾"-0 or 1½"-0 crushed rock compacted to 92% Modified Proctor (AASHTO T-180).
6. Chimney drainage zone to be 12" wide (minimum) zone of clean washed, medium to coarse sand or drain gravel if protected with filter fabric. Alternatively, prefabricated drainage structures (Miradrain 6000 or similar) may be used.

PERIMETER FOOTING/RETAINING WALL DRAIN DETAIL

Project No. 1390.001.G	PACIFIC SEAFOODS DISTRIBUTION FACILITY	Figure No. 3

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS — LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS			
200	40	10	4	3/4"	3"	12"	
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

†Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

REDMOND GEOTECHNICAL SERVICES
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KEY TO EXPLORATORY BORING LOGS
Unified Soil Classification System (ASTM D-2487)

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-4

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 580'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#1
	X			25.4	ML	Dark brown, wet, soft, organic, sandy, clayey SILT (Topsoil)
	X	27		22.7	SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravels and roots (Highly Weathered Glacial Drift)
5					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-5

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY:	Gregory Drilling	RIG:	CME 55	DATE:	4/10/15
BORING DIAMETER:	6.0"	DRIVE WEIGHT:	140#	DROP:	30"
ELEVATION:	580'±				

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#2
					GM/ ML	FILL: Gray-brown, very moist, medium dense, slightly organic, slightly clayey, silty and sandy GRAVEL with topsoil
	X	26		24.9	SM	NATIVE GROUND: Orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravels and roots (Highly Weathered Glacial Drift)
5	X	30		20.5		
					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
	X	37		19.4		
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G	PACIFIC SEAFOODS	FIGURE NO. A-6

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling	RIG: CME 55	DATE: 4/10/15
BORING DIAMETER: 6.0"	DRIVE WEIGHT: 140#	DROP: 30"	ELEVATION: 580'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#3
					ML/ SM	FILL: Dark brown, very moist highly organic, poorly compacted, clayey, sandy SILT to silty SAND
	X	3			ML	NATIVE GROUND: Dark brown, very moist to wet, soft, highly organic, sandy, clayey SILT (OLd Topsoil Zone)
5	X	24			SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weatheted Glacial Drift)
					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10	X	32				
						Total Depth = 11.5 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G	PACIFIC SEAFOODS	FIGURE NO. A-7

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 585'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#4
					ML	Dark brown, very moist to wet, soft, organic, sandy, clayey SILT (Topsoil)
					SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravels and roots (Highly Weathered Glacial Drift)
	X	24		23.7		
5						
	X	28		19.7	SM	Gray to gray-brown, very moisr, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
	X	33		18.8		
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-8

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 588' ±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#5
5	X	4			SM	FILL: Medium to gray-brown, moist to very moist, poorly compacted, slightly clayey, silty SAND with gravel and traces of organics
	X	5				
					ML	NATIVE GROUND: Dark brown, very moist, soft, slightly organic, sandy, clayey SILT (Old Topsoil Zone)
10	X	29			SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravels and roots (Highly Weathered Glacial Drift)
					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
15						Total Depth = 10.0 feet No groundwater encountered at time of exploration
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-9

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 585'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#6
						FILL: Brown, moist, highly organic, Bark Chips and Topsoil
	X	6		26.8	ML	NATIVE GROUND: Dark brown, very moist to wet, soft, organic, sandy, clayey SILT (Topsoil)
5	X	27		23.0	SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10	X	35		18.5		
	X	39		18.1		
15						Total Depth = 15.0 feet No groundwater encountered at time of exploration
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-10

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 585'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#7
					ML	Dark brown, very moist to wet, soft, organic, sandy, clayey SILT (Topsoil)
					SM	Medium to orangish-brown, very moist to wet, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
	X	27				
5						
	X	26			SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10						
	X	33				
						Total Depth = 11.5 feet Minor groundwater seepage encountered at 2.0 feet at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-11

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 582'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#8
					GM	FILL: Gray-brown, moist, moderately well compacted, silty, sandy GRAVEL (Base)
					ML	NATIVE GROUND: Dark brown, moist to very moist, medium stiff to stiff, clayey, sandy SILT with trace of organics (Old Topsoil Zone)
	X	23				
5						
	X	34			SM	Medium to orangish-brown, very moist, medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weatheted Glacial Drift)
	X	36			SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-12

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling	RIG: CME 55	DATE: 4/10/15
BORING DIAMETER: 6.0"	DRIVE WEIGHT: 140#	DROP: 30"	ELEVATION: 578'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#9
					PCC	Portland Cement Concrete Slab
					GM	FILL: Gray-brown, damp, moderately well compacted, silty, sandy GRAVEL (Base)
	X	5		29.6		
					ML	NATIVE GROUND: Dark brown, very moist, medium stiff, sandy, clayey SILT with trace of organics (Old Topsoil Zone)
5	X	24		21.3	SM	Medium to orangish-brown, very moist, medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
10	X	40		17.7	SM	Gray to gray-brown, very moist medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 11.5 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G	PACIFIC SEAFOODS	FIGURE NO. A-13

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 581'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#10
					ML	Dark brown, very moist to wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	21			SM	Medium to orangish-brown, wet, loose to medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weatheted Glacial Drift)
5	X	28			SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
	X	35				
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-14

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 588'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#11
					SM	FILL: Medium to gray-brown, moist to very moist, poorly compacted, slightly clayey, silty SAND with gravel and traces of organics
	X	4				
5	X	5				
					ML	NATIVE GROUND: Dark brown, very moist, soft, slightly organic, sandy, clayey SILT (Old Topsoil Zone)
	X	23			SM	Medium to orangish-brown, very moist, loose to medium dense, clayey, silty SAND with occasional gravel and roots (Highly Weatheted Glacial Drift)
10					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
	X	36				
15						Total Depth = 15.0 feet No groundwater encountered at time of exploration
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-15

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 582'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#12
					ML	Dark brown, wet to saturated, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	22			SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
5	X	33			SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10						Total Depth = 6.5 feet Groundwater seepage encountered at a depth of 2 feet at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-16

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 578'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#13
					ML	Dark brown, wet to saturated, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	27			SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
5					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 5.0 feet Groundwater seepage encountered at a depth of 1.0 feet at time of exploration
10						
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-17

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 574'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#14
					ML	Dark brown, wet to saturated, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	24			SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
5					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 5.0 feet Groundwater seepage encountered at a depth of 1.0 feet at time of drilling
10						
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-18

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 569'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#15
					ML	Dark brown, saturated, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	26			SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
5					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 5.0 feet Groundwater encountered above surface grades at time of exploration
10						
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-19

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling RIG: CME 55 DATE: 4/10/15

BORING DIAMETER: 6.0" DRIVE WEIGHT: 140# DROP: 30" ELEVATION: 574'

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#16
						FILL: Bark Chjps
					ML	NATIVE GROUND: Dark brown, saturated, very soft, highly organic, sandy, clayey SILT (OLd Topsoil Zone)
	X	24				
5					SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
10						Total Depth = 5.0 feet Groundwater encountered at the ground surface at time of exploration
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G | PACIFIC SEAFOODS | FIGURE NO. A-20

REDMOND GEOTECHNICAL SERVICES

DRILLING COMPANY: Gregory Drilling	RIG: CME 55	DATE: 4/10/15
BORING DIAMETER: 6.0"	DRIVE WEIGHT: 140#	DROP: 30"	ELEVATION: 580'±

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION BORING NO. B-#17
					ML	Dark brown, wet to saturated, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X	28			SM	Medium to orangish-brown, wet to saturated, loose, clayey, silty SAND with occasional gravel and roots (Highly Weathered Glacial Drift)
5					SM	Gray to gray-brown, very moist, medium dense to dense, clayey, silty SAND with gravel and cobbles (Glacial Till)
						Total Depth = 5.0 feet Groundwater encountered at the ground surface at time of exploration
10						
15						
20						
25						
30						

BORING LOG

PROJECT NO. 1390.001.G	PACIFIC SEAFOODS	FIGURE NO. A-21

REDMOND GEOTECHNICAL SERVICES

MAXIMUM DENSITY TEST RESULTS

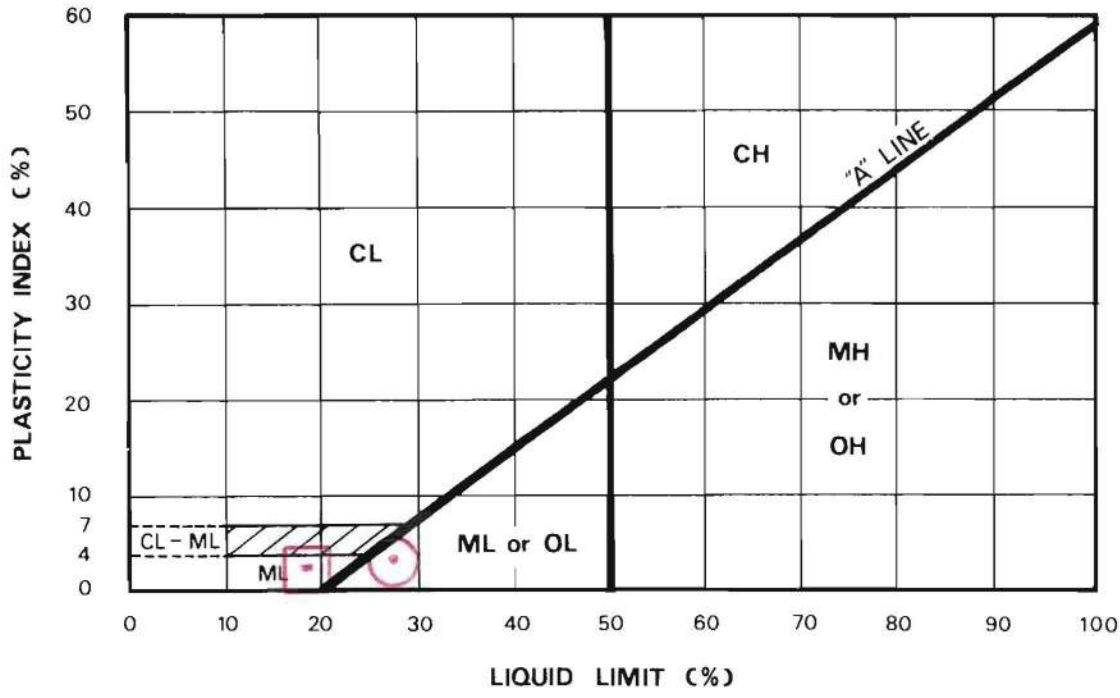
SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
B-#1 @ 1.0'	Medium to orangish-brown, clayey, silty SAND with gravel	108.0	14.5
B-#1 @ 3.5'	Gray to gray-brown, clayey, silty SAND with gravel and cobbles	112.0	13.0

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1390.001.G	PACIFIC SEAFOODS	FIGURE NO.: A-22



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
○	B-#1	1.0	25.4	28.2	3.9	32.2		ML
□	B-#1	3.5	22.7	19.1	3.1	27.1		ML

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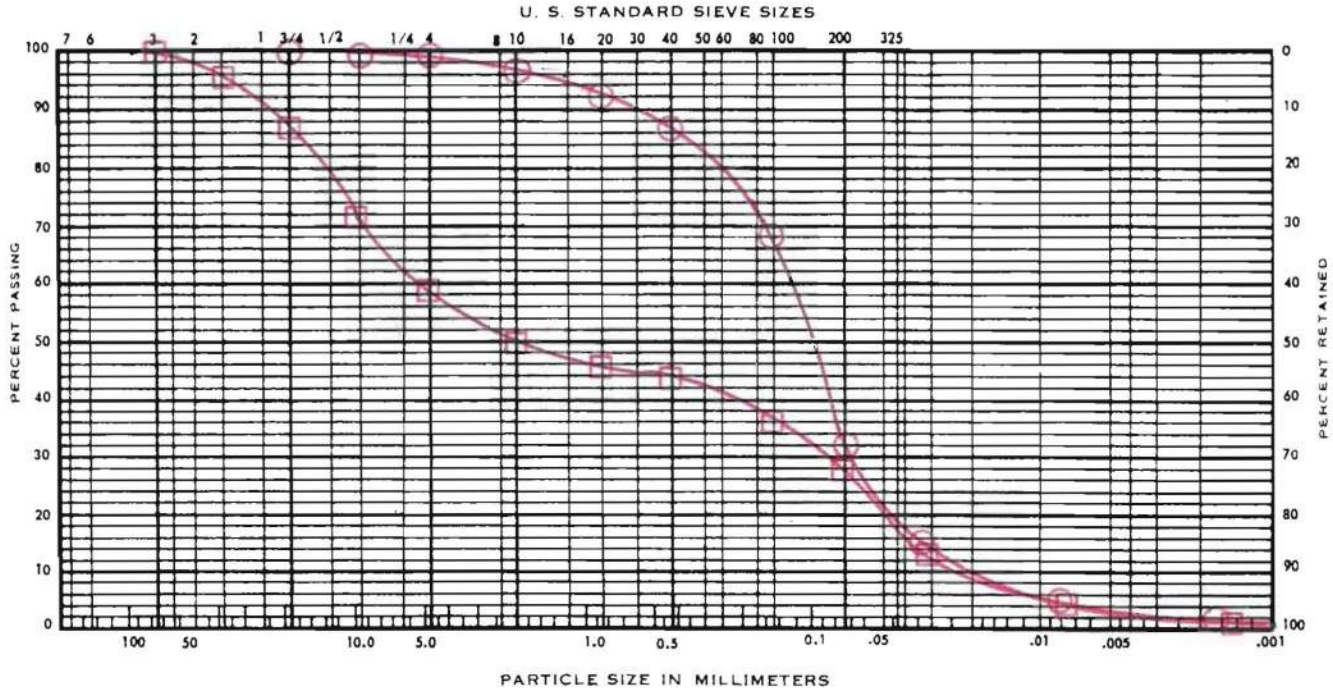
PLASTICITY CHART AND DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-23

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
⊖	B-#1	1.0		SM	Medium to orangish-brown, clayey, silty SAND with occasional gravel
⊟	B-#1	3.5		SM	Gray to gray-brown, clayey, silty SAND with gravel and cobbles

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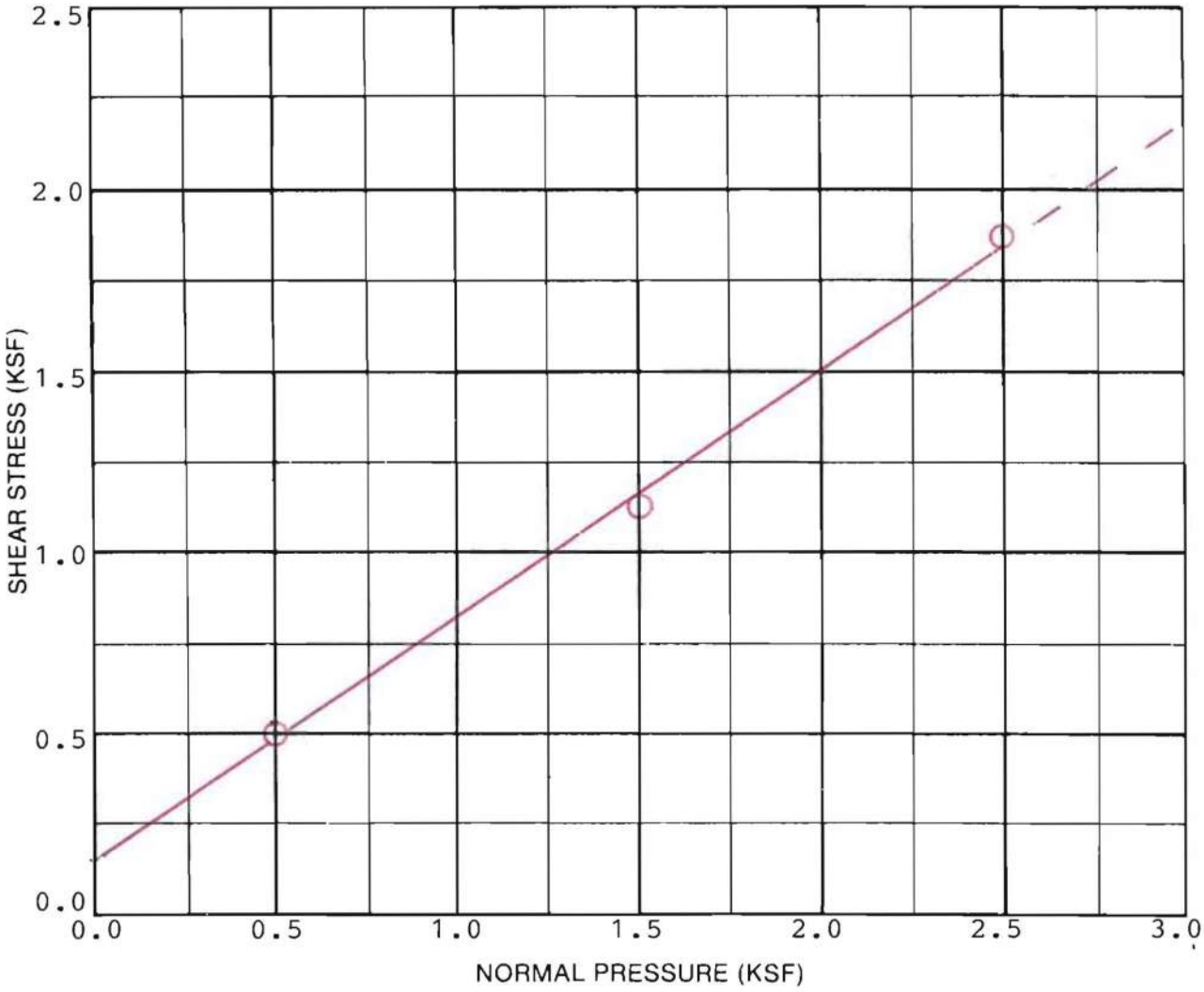
GRADATION TEST DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	FIGURE
1390.001.G		A-24



SAMPLE DATA	
DESCRIPTION: Medium to orangish-brown clayey, silty SAND (Remolded)	
BORING NO.: B-#1	
DEPTH (ft.): 1.0	ELEVATION (ft):
TEST RESULTS	
APPARENT COHESION (C): 150 psf	
APPARENT ANGLE OF INTERNAL FRICTION (Φ): 32°	

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.5	1.1	1.9	
INITIAL H_2O CONTENT (%)	14.5	14.5	14.5	
FINAL H_2O CONTENT (%)	14.2	12.1	8.8	
INITIAL DRY DENSITY (PCF)	98.0	98.0	98.0	
FINAL DRY DENSITY (PCF)	99.6	103.3	105.7	
STRAIN RATE: 0.02 inches per minute				

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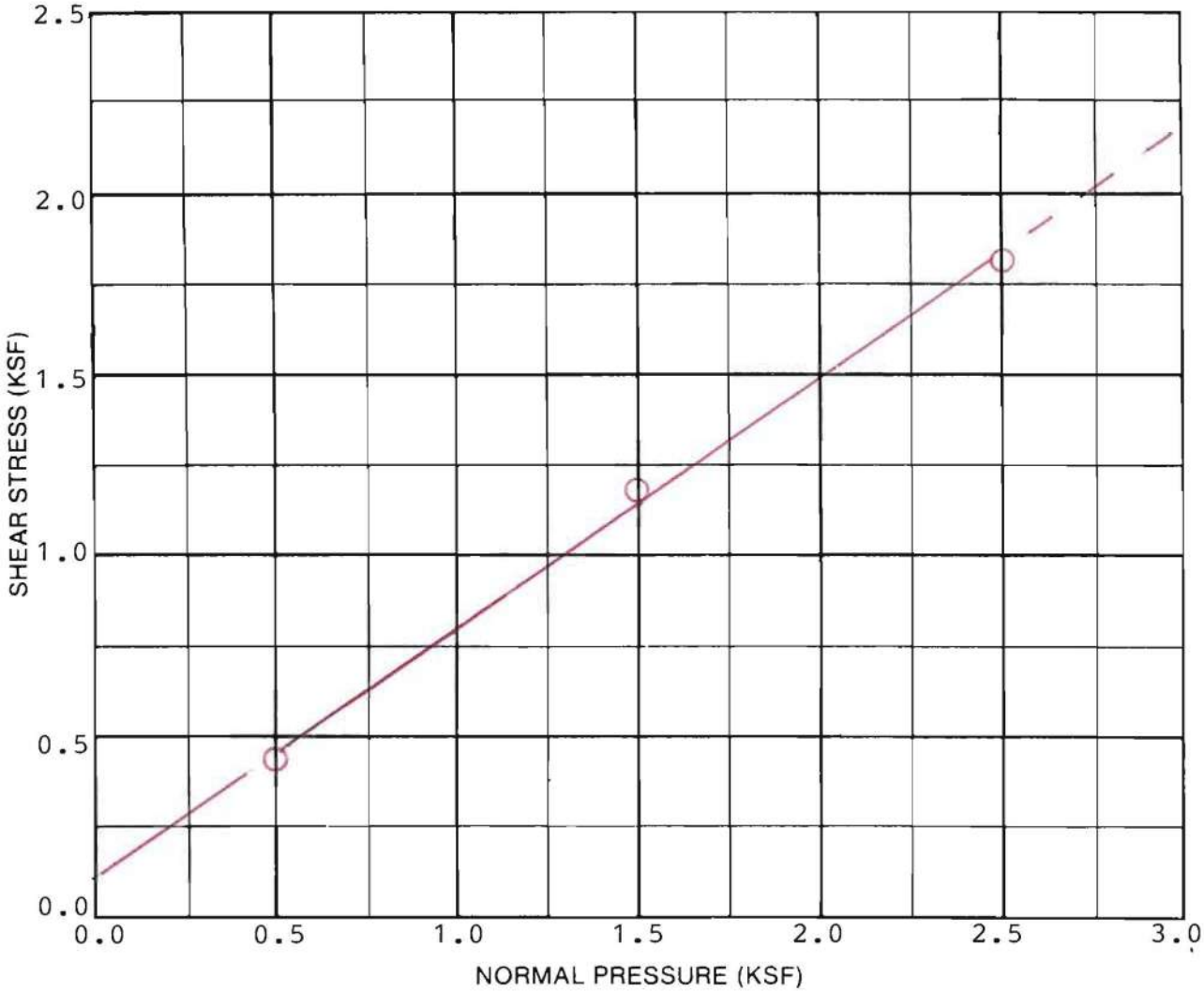
DIRECT SHEAR TEST DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-25



SAMPLE DATA	
DESCRIPTION:	Gray to gray-brown, clayey, silty SAND (Remolded)
BORING NO.	B-#1
DEPTH (ft.): 3.5	ELEVATION (ft):
TEST RESULTS	
APPARENT COHESION (C):	100 psf
APPARENT ANGLE OF INTERNAL FRICTION (Φ):	34°

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.45	1.20	1.80	
INITIAL H_2O CONTENT (%)	13.0	13.0	13.0	
FINAL H_2O CONTENT (%)	12.6	10.1	8.5	
INITIAL DRY DENSITY (PCF)	99.0	99.0	99.0	
FINAL DRY DENSITY (PCF)	99.8	103.6	106.7	
STRAIN RATE: 0.02 inches per minute				

REDMOND GEOTECHNICAL SERVICES
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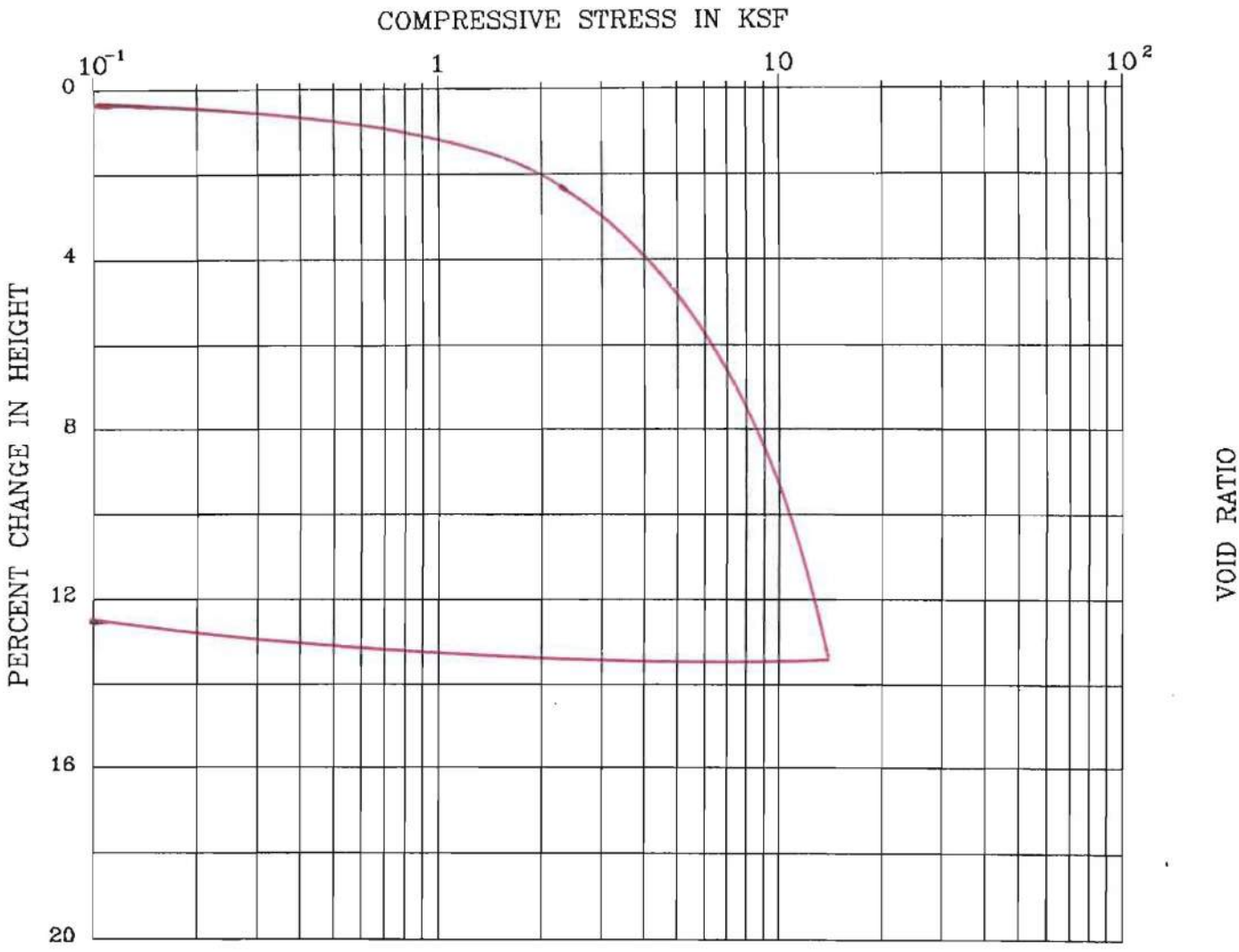
DIRECT SHEAR TEST DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-26



BORING : B-#6
DEPTH (ft) : 3.0
SPEC. GRAVITY : 2.5 (assumed)

DESCRIPTION : clayey, silty SAND (SM)
LIQUID LIMIT : 28.2
PLASTIC LIMIT : 24.3

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	26.4	86.7	88.7	
FINAL	16.6	99.3	92.9	

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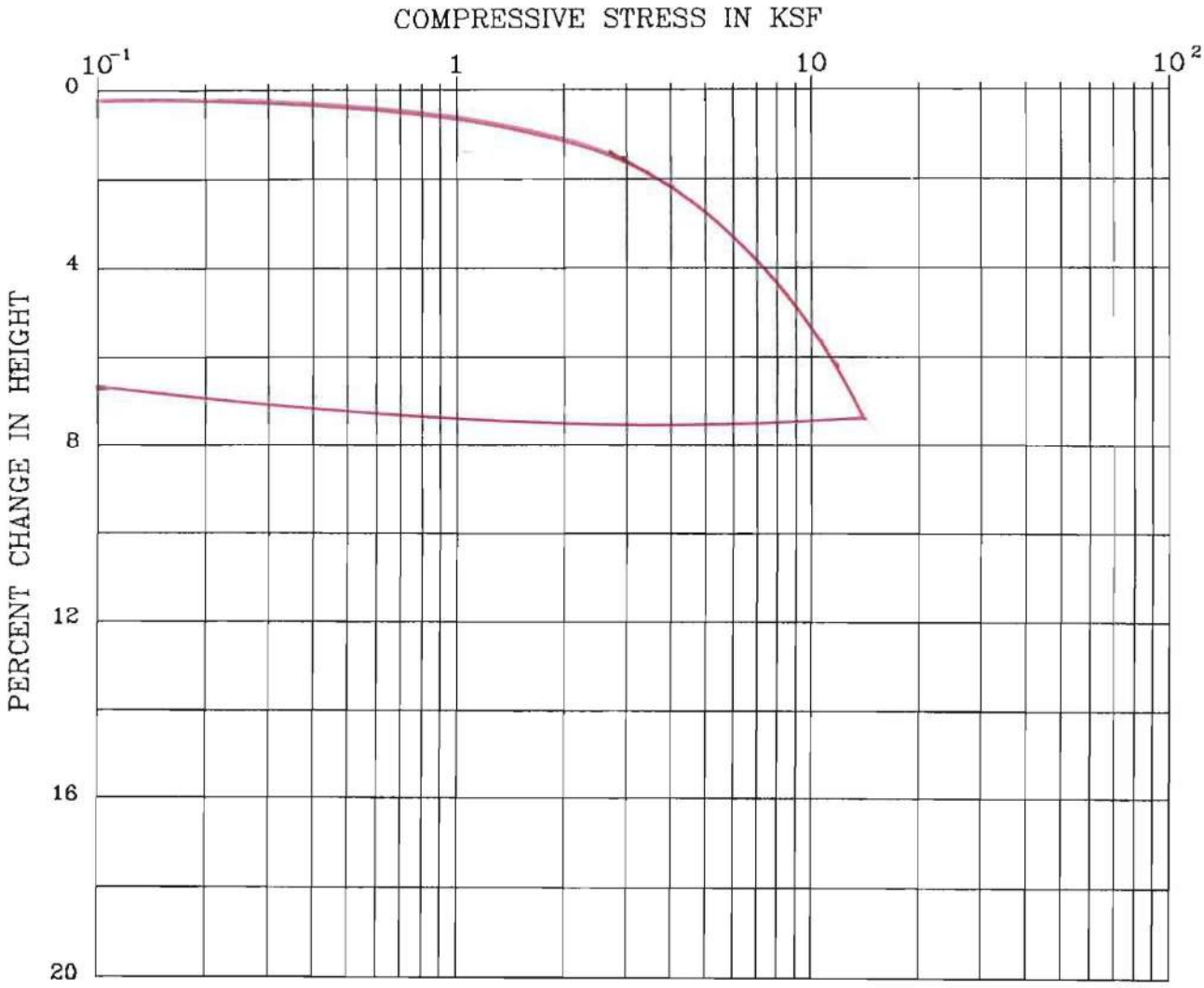
CONSOLIDATION TEST DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-27



BORING :B-$3 (Remolded) DESCRIPTION :clayey, silty SAND (SM)
DEPTH (ft) :3.0 LIQUID LIMIT :28.2
SPEC. GRAVITY :2.5 (assumed) PLASTIC LIMIT :24.3

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	15.0	97.5	91.0	
FINAL	10.2	104.4	94.7	

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CONSOLIDATION TEST DATA

PACIFIC SEAFOODS DISTRIBUTION FACILITY
Mukilteo, Washington

PROJECT NO.	DATE	
1390.001.G		Figure A-28

RESULTS OF R (RESISTANCE) VALUE TESTS

SAMPLE LOCATION: B-#1

SAMPLE DEPTH: 1.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	219	329	431
Expansion Dial (o.ooo1")	0	1	2
Expansion Pressure (psf)	0	3	8
Moisture Content (%)	17.3	14.1	10.7
Dry Density (pcf)	94.4	99.1	103.7
Resistance Value, "R"	22	34	45
"R"-Value at 300 psi Exudation Pressure = 33			

SAMPLE LOCATION: B-#16

SAMPLE DEPTH: 3.5 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	209	326	433
Expansion Dial (0.0001")	0	1	2
Expansion Pressure (psf)	0	3	8
Moisture Content (%)	17.6	14.5	11.1
Dry Density (pcf)	93.9	98.8	102.6
Resistance Value "R"	20	32	43
"R"-Value at 300 psi Exudation Pressure = 31			

REDMOND GEOTECHNICAL SERVICES

July 29, 2016

Mr. Tyson Wentz
PACLAND Engineering & Development
11400 SE 8th Street, Suite 345
Bellevue, Washington 98004

Dear Mr. Wentz:

Re: Supplemental Geotechnical Consultation Services, Proposed Pacific Seafood Processing Facility, 8007 44th Avenue West, Mukilteo, Washington

In accordance with your request, we are providing you with our opinion with regard to the use of an allowable infiltration rate of 0.30 inches per hour (in/hr) at the above subject project site.

As you are aware, we previously performed a Geotechnical Investigation at the site the results of which were presented in our formal report dated May 1, 2014. Additionally, we performed supplemental consultation services and Field (Pilot) Infiltration Testing Services at the site in accordance with the Washington State Department of Ecology Stormwater Management Manual for Western Washington Volume III Hydrologic Analysis and Flow Control BMP's test method the results of which were presented in our letter report dated May 29, 2015.

Specifically, we understand that the project proposes to use a storm water vault control structure and bio-filtration swale that will be open and/or lined at the bottom to promote infiltration and recharge to the existing easterly downstream wetland. Additionally, we understand that the storm water vault has been designed for an infiltration rate of 0.30 inches per hour (in/hr).

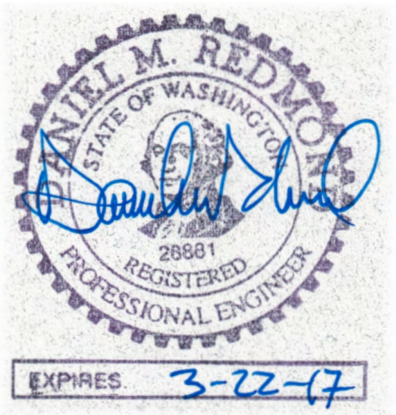
Based on the results of our previous pilot field infiltration testing at the site, we are generally of the opinion that an infiltration rate of 0.30 inches per hour (in/hr) is suitable for the project and the proposed storm water vault.

However, as was previously noted in the above supplemental letter report, the infiltration rate of 0.30 inches per hour is considered low by industry standards and will likely only provide a limited amount of recharge to the wetland. Additionally, as the rate of infiltration at and/or across the site may vary with time and/or with changes in site utilization, we recommend that a verification of the infiltration rate of the proposed storm water vault control structure be performed following its construction.

We appreciate this opportunity to be of service to you at this time and trust that the above information is suitable to your present needs.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer



APPENDIX C

WWHM2012 OUTPUT FOR VAULT SIZING

WWHM2012
PROJECT REPORT

Project Name: Pacific Seafood vault2
Site Name:
Site Address:
City :
Report Date: 8/23/2016
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version : 2015/09/30

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

High Flow Threshold for POC 1: 50 year

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

High Flow Threshold for POC 2: 50 year

PREDEVELOPED LAND USE

Name : Ext Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	1.94
C, Pasture, Mod	1.94
C, Lawn, Flat	.51
Pervious Total	4.39

Impervious Land Use	acre
ROADS FLAT	0.59
DRIVEWAYS FLAT	0.93
Impervious Total	1.52
Basin Total	5.91

Element Flows To:
Surface **Interflow** **Groundwater**

MITIGATED LAND USE

Name : BUILDING
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	**0**

Impervious Land Use	acre
ROOF TOPS FLAT	**1.43**
Impervious Total	**1.43**
Basin Total	**1.43**

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 40 ft.
Length : 120 ft.
Depth: 11 ft.
Infiltration On
Infiltration rate: 0.3
Infiltration safety factor: 2
Total Volume Infiltrated (ac-ft.): 383.527
Total Volume Through Riser (ac-ft.): 109.45
Total Volume Through Facility (ac-ft.): 492.977
Percent Infiltrated: 77.8
Total Precip Applied to Facility: 0
Total Evap From Facility: 0

Discharge Structure
Riser Height: 10.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 2 in. **Elevation:** 0.5 ft.
Orifice 2 Diameter: 0.75 in. **Elevation:** 4.5 ft.
Orifice 3 Diameter: 6 in. **Elevation:** 9.7 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.110	0.000	0.000	0.000
0.1222	0.110	0.013	0.000	0.066
0.2444	0.110	0.026	0.000	0.066
0.3667	0.110	0.040	0.000	0.066
0.4889	0.110	0.053	0.000	0.066
0.6111	0.110	0.067	0.036	0.066
0.7333	0.110	0.080	0.052	0.066
0.8556	0.110	0.094	0.064	0.066
0.9778	0.110	0.107	0.075	0.066
1.1000	0.110	0.121	0.084	0.066
1.2222	0.110	0.134	0.092	0.066
1.3444	0.110	0.148	0.099	0.066
1.4667	0.110	0.161	0.106	0.066
1.5889	0.110	0.175	0.113	0.066
1.7111	0.110	0.188	0.119	0.066
1.8333	0.110	0.202	0.125	0.066
1.9556	0.110	0.215	0.131	0.066
2.0778	0.110	0.229	0.136	0.066
2.2000	0.110	0.242	0.141	0.066
2.3222	0.110	0.255	0.146	0.066
2.4444	0.110	0.269	0.151	0.066
2.5667	0.110	0.282	0.156	0.066
2.6889	0.110	0.296	0.160	0.066
2.8111	0.110	0.309	0.165	0.066
2.9333	0.110	0.323	0.169	0.066
3.0556	0.110	0.336	0.173	0.066
3.1778	0.110	0.350	0.177	0.066
3.3000	0.110	0.363	0.181	0.066
3.4222	0.110	0.377	0.185	0.066
3.5444	0.110	0.390	0.189	0.066
3.6667	0.110	0.404	0.193	0.066
3.7889	0.110	0.417	0.196	0.066
3.9111	0.110	0.431	0.200	0.066
4.0333	0.110	0.444	0.204	0.066
4.1556	0.110	0.457	0.207	0.066
4.2778	0.110	0.471	0.211	0.066
4.4000	0.110	0.484	0.214	0.066
4.5222	0.110	0.498	0.220	0.066
4.6444	0.110	0.511	0.226	0.066
4.7667	0.110	0.525	0.232	0.066
4.8889	0.110	0.538	0.236	0.066
5.0111	0.110	0.552	0.241	0.066
5.1333	0.110	0.565	0.245	0.066
5.2556	0.110	0.579	0.250	0.066
5.3778	0.110	0.592	0.254	0.066
5.5000	0.110	0.606	0.258	0.066
5.6222	0.110	0.619	0.261	0.066
5.7444	0.110	0.633	0.265	0.066
5.8667	0.110	0.646	0.269	0.066
5.9889	0.110	0.659	0.272	0.066
6.1111	0.110	0.673	0.276	0.066
6.2333	0.110	0.686	0.280	0.066
6.3556	0.110	0.700	0.283	0.066
6.4778	0.110	0.713	0.286	0.066
6.6000	0.110	0.727	0.290	0.066
6.7222	0.110	0.740	0.293	0.066

6.8444	0.110	0.754	0.296	0.066
6.9667	0.110	0.767	0.300	0.066
7.0889	0.110	0.781	0.303	0.066
7.2111	0.110	0.794	0.306	0.066
7.3333	0.110	0.808	0.309	0.066
7.4556	0.110	0.821	0.312	0.066
7.5778	0.110	0.835	0.315	0.066
7.7000	0.110	0.848	0.318	0.066
7.8222	0.110	0.862	0.321	0.066
7.9444	0.110	0.875	0.324	0.066
8.0667	0.110	0.888	0.327	0.066
8.1889	0.110	0.902	0.330	0.066
8.3111	0.110	0.915	0.333	0.066
8.4333	0.110	0.929	0.336	0.066
8.5556	0.110	0.942	0.338	0.066
8.6778	0.110	0.956	0.341	0.066
8.8000	0.110	0.969	0.344	0.066
8.9222	0.110	0.983	0.347	0.066
9.0444	0.110	0.996	0.349	0.066
9.1667	0.110	1.010	0.352	0.066
9.2889	0.110	1.023	0.355	0.066
9.4111	0.110	1.037	0.357	0.066
9.5333	0.110	1.050	0.360	0.066
9.6556	0.110	1.064	0.363	0.066
9.7778	0.110	1.077	0.638	0.066
9.9000	0.110	1.090	0.805	0.066
10.022	0.110	1.104	0.925	0.066
10.144	0.110	1.117	1.024	0.066
10.267	0.110	1.131	1.111	0.066
10.389	0.110	1.144	1.189	0.066
10.511	0.110	1.158	1.273	0.066
10.633	0.110	1.171	1.836	0.066
10.756	0.110	1.185	2.640	0.066
10.878	0.110	1.198	3.327	0.066
11.000	0.110	1.212	3.707	0.066
11.122	0.110	1.225	4.042	0.066
11.244	0.000	0.000	4.327	0.000

Name : Parking
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Flat	**.08**
Pervious Total	**0.08**

Impervious Land Use	**acre**
ROADS FLAT	**1.27**
Impervious Total	**1.27**
Basin Total	**1.35**

Element Flows To:

Surface	Interflow	Groundwater
Center Island swales	Center Island swales	

Name : Center Island swales
Bottom Length: 60.00 ft.
Bottom Width: 16.00 ft.
Manning's n: 0.24
Channel bottom slope 1: 0.01 To 1
Channel Left side slope 0: 3 To 1
Channel right side slope 2: 3 To 1
Infiltration On
Infiltration rate: 0.3
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 38.546
Total Volume Through Riser (ac-ft.): 114.993
Total Volume Through Facility (ac-ft.): 153.54
Percent Infiltrated: 25.1
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.

Element Flows To:

Outlet 1	Outlet 2
Biofiltration Swale	

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.022	0.000	0.000	0.000
0.0056	0.022	0.000	0.001	0.006
0.0111	0.022	0.000	0.005	0.006
0.0167	0.022	0.000	0.010	0.006
0.0222	0.022	0.000	0.017	0.006
0.0278	0.022	0.000	0.025	0.006
0.0333	0.022	0.000	0.034	0.006
0.0389	0.022	0.000	0.044	0.006
0.0444	0.022	0.001	0.055	0.006
0.0500	0.022	0.001	0.067	0.006
0.0556	0.022	0.001	0.080	0.006
0.0611	0.022	0.001	0.094	0.006
0.0667	0.022	0.001	0.109	0.006
0.0722	0.022	0.001	0.124	0.006
0.0778	0.022	0.001	0.141	0.006
0.0833	0.022	0.001	0.158	0.006
0.0889	0.022	0.002	0.176	0.006
0.0944	0.022	0.002	0.195	0.006
0.1000	0.022	0.002	0.215	0.006

0.1056	0.022	0.002	0.235	0.006
0.1111	0.023	0.002	0.256	0.006
0.1167	0.023	0.002	0.278	0.007
0.1222	0.023	0.002	0.300	0.007
0.1278	0.023	0.002	0.324	0.007
0.1333	0.023	0.003	0.348	0.007
0.1389	0.023	0.003	0.372	0.007
0.1444	0.023	0.003	0.398	0.007
0.1500	0.023	0.003	0.423	0.007
0.1556	0.023	0.003	0.450	0.007
0.1611	0.023	0.003	0.477	0.007
0.1667	0.023	0.003	0.505	0.007
0.1722	0.023	0.003	0.534	0.007
0.1778	0.023	0.004	0.563	0.007
0.1833	0.023	0.004	0.593	0.007
0.1889	0.023	0.004	0.623	0.007
0.1944	0.023	0.004	0.655	0.007
0.2000	0.023	0.004	0.686	0.007
0.2056	0.023	0.004	0.719	0.007
0.2111	0.023	0.004	0.751	0.007
0.2167	0.023	0.005	0.785	0.007
0.2222	0.023	0.005	0.819	0.007
0.2278	0.023	0.005	0.854	0.007
0.2333	0.024	0.005	0.889	0.007
0.2389	0.024	0.005	0.925	0.007
0.2444	0.024	0.005	0.961	0.007
0.2500	0.024	0.005	0.998	0.007
0.2556	0.024	0.005	1.036	0.007
0.2611	0.024	0.006	1.074	0.007
0.2667	0.024	0.006	1.113	0.007
0.2722	0.024	0.006	1.152	0.007
0.2778	0.024	0.006	1.192	0.007
0.2833	0.024	0.006	1.233	0.007
0.2889	0.024	0.006	1.274	0.007
0.2944	0.024	0.006	1.315	0.007
0.3000	0.024	0.007	1.357	0.007
0.3056	0.024	0.007	1.400	0.007
0.3111	0.024	0.007	1.443	0.007
0.3167	0.024	0.007	1.487	0.007
0.3222	0.024	0.007	1.531	0.007
0.3278	0.024	0.007	1.576	0.007
0.3333	0.024	0.007	1.621	0.007
0.3389	0.024	0.007	1.667	0.007
0.3444	0.024	0.008	1.713	0.007
0.3500	0.024	0.008	1.760	0.007
0.3556	0.025	0.008	1.808	0.007
0.3611	0.025	0.008	1.856	0.007
0.3667	0.025	0.008	1.904	0.007
0.3722	0.025	0.008	1.953	0.007
0.3778	0.025	0.008	2.003	0.007
0.3833	0.025	0.009	2.053	0.007
0.3889	0.025	0.009	2.103	0.007
0.3944	0.025	0.009	2.154	0.007
0.4000	0.025	0.009	2.206	0.007
0.4056	0.025	0.009	2.258	0.007
0.4111	0.025	0.009	2.311	0.007
0.4167	0.025	0.009	2.364	0.007

0.4222	0.025	0.010	2.418	0.007
0.4278	0.025	0.010	2.472	0.007
0.4333	0.025	0.010	2.526	0.007
0.4389	0.025	0.010	2.581	0.007
0.4444	0.025	0.010	2.637	0.007
0.4500	0.025	0.010	2.693	0.007
0.4556	0.025	0.010	2.750	0.007
0.4611	0.025	0.011	2.807	0.007
0.4667	0.025	0.011	2.865	0.007
0.4722	0.025	0.011	2.923	0.007
0.4778	0.026	0.011	2.981	0.007
0.4833	0.026	0.011	3.041	0.007
0.4889	0.026	0.011	3.100	0.007
0.4944	0.026	0.011	3.160	0.007
0.5000	0.026	0.012	3.221	0.007
0.5056	0.026	0.012	3.282	0.007

Name : Dev Site
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Flat	**.74**
Pervious Total	**0.74**

Impervious Land Use	**acre**
ROADS FLAT	**1.46**
DRIVEWAYS FLAT	**0.93**
Impervious Total	**2.39**
Basin Total	**3.13**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Biofiltration Swale	Biofiltration Swale	

Name : Biofiltration Swale
Bottom Length: 100.00 ft.
Bottom Width: 30.00 ft.
Manning's n: 0.24
Channel bottom slope 1: 0.016 To 1
Channel Left side slope 0: 3 To 1
Channel right side slope 2: 3 To 1
Infiltration On
Infiltration rate: 0.3
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 107.018

Total Volume Through Riser (ac-ft.): 324.122
Total Volume Through Facility (ac-ft.): 431.14
Percent Infiltrated: 24.82
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.

Element Flows To:
Outlet 1 **Outlet 2**
Vault 1

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.068	0.000	0.000	0.000
0.0111	0.069	0.000	0.013	0.020
0.0222	0.069	0.001	0.041	0.020
0.0333	0.069	0.002	0.081	0.021
0.0444	0.069	0.003	0.131	0.021
0.0556	0.069	0.003	0.190	0.021
0.0667	0.069	0.004	0.258	0.021
0.0778	0.069	0.005	0.334	0.021
0.0889	0.070	0.006	0.418	0.021
0.1000	0.070	0.007	0.508	0.021
0.1111	0.070	0.007	0.606	0.021
0.1222	0.070	0.008	0.711	0.021
0.1333	0.070	0.009	0.822	0.021
0.1444	0.070	0.010	0.940	0.021
0.1556	0.071	0.010	1.064	0.021
0.1667	0.071	0.011	1.194	0.021
0.1778	0.071	0.012	1.330	0.021
0.1889	0.071	0.013	1.472	0.021
0.2000	0.071	0.014	1.620	0.021
0.2111	0.071	0.014	1.773	0.021
0.2222	0.071	0.015	1.932	0.021
0.2333	0.072	0.016	2.096	0.021
0.2444	0.072	0.017	2.266	0.021
0.2556	0.072	0.018	2.441	0.021
0.2667	0.072	0.018	2.622	0.021
0.2778	0.072	0.019	2.807	0.022
0.2889	0.072	0.020	2.998	0.022
0.3000	0.073	0.021	3.194	0.022
0.3111	0.073	0.022	3.394	0.022
0.3222	0.073	0.022	3.600	0.022
0.3333	0.073	0.023	3.810	0.022
0.3444	0.073	0.024	4.026	0.022
0.3556	0.073	0.025	4.246	0.022
0.3667	0.073	0.026	4.471	0.022
0.3778	0.074	0.027	4.701	0.022
0.3889	0.074	0.027	4.935	0.022
0.4000	0.074	0.028	5.174	0.022
0.4111	0.074	0.029	5.418	0.022
0.4222	0.074	0.030	5.666	0.022

0.4333	0.074	0.031	5.919	0.022
0.4444	0.075	0.032	6.176	0.022
0.4556	0.075	0.032	6.438	0.022
0.4667	0.075	0.033	6.704	0.022
0.4778	0.075	0.034	6.974	0.022
0.4889	0.075	0.035	7.249	0.022
0.5000	0.075	0.036	7.529	0.022
0.5111	0.075	0.037	7.812	0.023
0.5222	0.076	0.037	8.100	0.023
0.5333	0.076	0.038	8.392	0.023
0.5444	0.076	0.039	8.689	0.023
0.5556	0.076	0.040	8.990	0.023
0.5667	0.076	0.041	9.295	0.023
0.5778	0.076	0.042	9.604	0.023
0.5889	0.077	0.042	9.917	0.023
0.6000	0.077	0.043	10.23	0.023
0.6111	0.077	0.044	10.55	0.023
0.6222	0.077	0.045	10.88	0.023
0.6333	0.077	0.046	11.21	0.023
0.6444	0.077	0.047	11.54	0.023
0.6556	0.077	0.048	11.88	0.023
0.6667	0.078	0.049	12.22	0.023
0.6778	0.078	0.049	12.57	0.023
0.6889	0.078	0.050	12.92	0.023
0.7000	0.078	0.051	13.27	0.023
0.7111	0.078	0.052	13.63	0.023
0.7222	0.078	0.053	13.99	0.023
0.7333	0.079	0.054	14.36	0.023
0.7444	0.079	0.055	14.73	0.023
0.7556	0.079	0.056	15.10	0.024
0.7667	0.079	0.056	15.48	0.024
0.7778	0.079	0.057	15.86	0.024
0.7889	0.079	0.058	16.25	0.024
0.8000	0.079	0.059	16.64	0.024
0.8111	0.080	0.060	17.03	0.024
0.8222	0.080	0.061	17.43	0.024
0.8333	0.080	0.062	17.83	0.024
0.8444	0.080	0.063	18.24	0.024
0.8556	0.080	0.064	18.64	0.024
0.8667	0.080	0.064	19.06	0.024
0.8778	0.081	0.065	19.47	0.024
0.8889	0.081	0.066	19.89	0.024
0.9000	0.081	0.067	20.32	0.024
0.9111	0.081	0.068	20.75	0.024
0.9222	0.081	0.069	21.18	0.024
0.9333	0.081	0.070	21.61	0.024
0.9444	0.081	0.071	22.05	0.024
0.9556	0.082	0.072	22.49	0.024
0.9667	0.082	0.073	22.94	0.024
0.9778	0.082	0.073	23.39	0.024
0.9889	0.082	0.074	23.85	0.025
1.0000	0.082	0.075	24.30	0.025
1.0111	0.082	0.076	24.77	0.025

ANALYSIS RESULTS

Stream Protection Duration

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

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.82
Total Impervious Area:3.66

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.496905
5 year	0.687259
10 year	0.82884
25 year	1.026244
50 year	1.187292
100 year	1.360809

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.156909
5 year	1.599355
10 year	1.928317
25 year	2.386851
50 year	2.760843
100 year	3.163708

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

Year	Predeveloped	Mitigated
1949	0.456	1.053
1950	0.654	1.501
1951	0.491	1.269
1952	0.443	1.007
1953	0.581	1.441
1954	0.926	1.850
1955	0.622	1.420
1956	0.313	0.647
1957	0.550	1.140
1958	1.090	2.626
1959	0.446	1.111
1960	0.412	0.934
1961	1.534	3.761
1962	0.520	1.249
1963	0.719	1.649
1964	0.377	0.818
1965	0.332	0.771
1966	0.340	0.829
1967	0.959	2.384

1968	0.527	1.315
1969	1.074	2.438
1970	0.376	0.886
1971	0.562	1.366
1972	0.715	1.781
1973	0.567	1.369
1974	0.699	1.757
1975	0.562	1.331
1976	0.375	0.906
1977	0.370	0.893
1978	0.334	0.703
1979	0.741	1.676
1980	0.336	0.793
1981	0.375	0.896
1982	0.375	0.916
1983	0.518	1.209
1984	0.439	1.094
1985	0.683	1.729
1986	0.736	1.535
1987	0.555	1.370
1988	0.427	1.033
1989	0.520	1.180
1990	0.322	0.772
1991	0.433	1.075
1992	0.450	1.016
1993	0.342	0.806
1994	0.319	0.737
1995	0.357	0.879
1996	0.565	1.076
1997	0.843	1.487
1998	0.625	1.575
1999	0.336	0.717
2000	0.866	2.035
2001	0.347	0.867
2002	0.325	0.799
2003	0.436	1.104
2004	0.841	2.028
2005	0.398	0.990
2006	0.619	1.293
2007	0.604	1.180
2008	0.450	0.985
2009	0.422	1.028

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

Rank	Predeveloped	Mitigated
1	1.5335	3.7612
2	1.0903	2.6258
3	1.0742	2.4376
4	0.9586	2.3843
5	0.9258	2.0348
6	0.8662	2.0276
7	0.8431	1.8503
8	0.8406	1.7815
9	0.7410	1.7566
10	0.7356	1.7294

11	0.7186	1.6758
12	0.7147	1.6492
13	0.6992	1.5754
14	0.6832	1.5349
15	0.6537	1.5007
16	0.6250	1.4873
17	0.6224	1.4407
18	0.6188	1.4196
19	0.6044	1.3697
20	0.5809	1.3691
21	0.5675	1.3659
22	0.5645	1.3312
23	0.5623	1.3150
24	0.5617	1.2931
25	0.5553	1.2689
26	0.5500	1.2485
27	0.5273	1.2094
28	0.5203	1.1797
29	0.5201	1.1797
30	0.5178	1.1397
31	0.4912	1.1112
32	0.4558	1.1043
33	0.4505	1.0936
34	0.4502	1.0757
35	0.4461	1.0750
36	0.4431	1.0530
37	0.4386	1.0327
38	0.4363	1.0283
39	0.4330	1.0161
40	0.4274	1.0070
41	0.4215	0.9901
42	0.4120	0.9850
43	0.3979	0.9337
44	0.3765	0.9159
45	0.3758	0.9059
46	0.3755	0.8964
47	0.3752	0.8929
48	0.3746	0.8856
49	0.3695	0.8795
50	0.3567	0.8670
51	0.3467	0.8290
52	0.3415	0.8179
53	0.3402	0.8060
54	0.3358	0.7993
55	0.3355	0.7929
56	0.3336	0.7715
57	0.3319	0.7710
58	0.3247	0.7374
59	0.3223	0.7172
60	0.3192	0.7025
61	0.3129	0.6468

Stream Protection Duration
POC #1

Facility FAILED duration standard for 1+ flows.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2485	1675	14983	894	Fail
0.2579	1477	13845	937	Fail
0.2674	1271	12722	1000	Fail
0.2769	1112	11781	1059	Fail
0.2864	981	10818	1102	Fail
0.2959	895	10033	1121	Fail
0.3054	801	9263	1156	Fail
0.3148	722	8566	1186	Fail
0.3243	643	7843	1219	Fail
0.3338	576	7304	1268	Fail
0.3433	505	6731	1332	Fail
0.3528	467	6267	1341	Fail
0.3623	412	5756	1397	Fail
0.3717	383	5358	1398	Fail
0.3812	329	4954	1505	Fail
0.3907	294	4626	1573	Fail
0.4002	255	4273	1675	Fail
0.4097	233	4021	1725	Fail
0.4192	207	3730	1801	Fail
0.4286	187	3506	1874	Fail
0.4381	170	3240	1905	Fail
0.4476	158	3054	1932	Fail
0.4571	141	2866	2032	Fail
0.4666	133	2704	2033	Fail
0.4760	123	2517	2046	Fail
0.4855	109	2372	2176	Fail
0.4950	100	2222	2222	Fail
0.5045	96	2118	2206	Fail
0.5140	94	2005	2132	Fail
0.5235	84	1881	2239	Fail
0.5329	78	1774	2274	Fail
0.5424	72	1675	2326	Fail
0.5519	69	1564	2266	Fail
0.5614	64	1472	2300	Fail
0.5709	59	1396	2366	Fail
0.5804	56	1317	2351	Fail
0.5898	50	1246	2492	Fail
0.5993	47	1179	2508	Fail
0.6088	44	1123	2552	Fail
0.6183	41	1061	2587	Fail
0.6278	34	1002	2947	Fail
0.6373	33	952	2884	Fail
0.6467	29	906	3124	Fail
0.6562	27	848	3140	Fail
0.6657	25	797	3188	Fail
0.6752	24	761	3170	Fail
0.6847	23	731	3178	Fail
0.6942	21	693	3300	Fail
0.7036	19	660	3473	Fail
0.7131	18	625	3472	Fail
0.7226	15	587	3913	Fail
0.7321	15	559	3726	Fail
0.7416	13	532	4092	Fail
0.7511	13	502	3861	Fail
0.7605	13	484	3723	Fail

0.7700	11	458	4163	Fail
0.7795	11	436	3963	Fail
0.7890	11	419	3809	Fail
0.7985	11	396	3600	Fail
0.8080	11	377	3427	Fail
0.8174	11	361	3281	Fail
0.8269	9	348	3866	Fail
0.8364	9	330	3666	Fail
0.8459	7	314	4485	Fail
0.8554	7	299	4271	Fail
0.8649	7	292	4171	Fail
0.8743	6	280	4666	Fail
0.8838	6	264	4400	Fail
0.8933	6	254	4233	Fail
0.9028	6	248	4133	Fail
0.9123	6	233	3883	Fail
0.9218	6	224	3733	Fail
0.9312	5	213	4260	Fail
0.9407	5	203	4059	Fail
0.9502	5	197	3940	Fail
0.9597	4	191	4775	Fail
0.9692	4	182	4550	Fail
0.9787	4	173	4325	Fail
0.9881	4	163	4075	Fail
0.9976	4	156	3900	Fail
1.0071	4	151	3775	Fail
1.0166	4	146	3650	Fail
1.0261	4	140	3500	Fail
1.0356	4	133	3325	Fail
1.0450	4	127	3175	Fail
1.0545	4	122	3050	Fail
1.0640	4	116	2900	Fail
1.0735	4	115	2875	Fail
1.0830	3	108	3600	Fail
1.0925	2	105	5250	Fail
1.1019	2	103	5150	Fail
1.1114	2	101	5050	Fail
1.1209	1	99	9900	Fail
1.1304	1	95	9500	Fail
1.1399	1	94	9400	Fail
1.1494	1	91	9100	Fail
1.1588	1	85	8500	Fail
1.1683	1	84	8400	Fail
1.1778	1	83	8300	Fail
1.1873	1	81	8100	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.3032 **acre-feet**
On-line facility target flow: 0.4518 **cfs.**

Adjusted for 15 min: 0.4518 **cfs.**
Off-line facility target flow: 0.2566 **cfs.**
Adjusted for 15 min: 0.2566 **cfs.**

LID Report

LID Technique	Used for Water Quality?	Total Volumn Percent Treatment Needs (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft.)	Cumulative Volumn Infiltration Credit	Percent Volumn Infiltrated	Water Quality Treated	Comment
Center Island swales POC	N	139.75			N	25.10		
Total Volume Infiltrated		139.75	0.00	0.00		25.10	0.00	0% No Treat. Credit

Compliance with LID Standard 8
Duration Analysis Result = Failed

Stream Protection Duration

Predeveloped Landuse Totals for POC #2
Total Pervious Area:4.39
Total Impervious Area:1.52

Mitigated Landuse Totals for POC #2
Total Pervious Area:0.82
Total Impervious Area:5.09

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.52135
5 year	0.721503
10 year	0.87044
25 year	1.078179
50 year	1.247715
100 year	1.430424

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.157733
5 year	0.193959
10 year	0.219547
25 year	0.253712
50 year	0.280521
100 year	0.308525

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1949	0.481	0.151

1950	0.686	0.165
1951	0.520	0.160
1952	0.463	0.128
1953	0.614	0.121
1954	0.962	0.141
1955	0.648	0.184
1956	0.318	0.159
1957	0.569	0.177
1958	1.152	0.178
1959	0.470	0.158
1960	0.432	0.180
1961	1.619	0.195
1962	0.551	0.163
1963	0.754	0.170
1964	0.390	0.159
1965	0.350	0.128
1966	0.359	0.125
1967	1.017	0.169
1968	0.557	0.204
1969	1.127	0.154
1970	0.396	0.131
1971	0.593	0.158
1972	0.755	0.177
1973	0.599	0.123
1974	0.741	0.149
1975	0.591	0.136
1976	0.396	0.174
1977	0.391	0.158
1978	0.346	0.113
1979	0.771	0.207
1980	0.349	0.149
1981	0.396	0.134
1982	0.396	0.211
1983	0.544	0.160
1984	0.463	0.163
1985	0.723	0.185
1986	0.767	0.298
1987	0.587	0.205
1988	0.450	0.160
1989	0.543	0.109
1990	0.338	0.141
1991	0.457	0.169
1992	0.472	0.129
1993	0.357	0.149
1994	0.337	0.145
1995	0.377	0.152
1996	0.580	0.201
1997	0.863	0.334
1998	0.659	0.139
1999	0.345	0.141
2000	0.918	0.152
2001	0.366	0.116
2002	0.342	0.148
2003	0.462	0.126
2004	0.890	0.215
2005	0.421	0.174
2006	0.631	0.219

2007	0.624	0.154
2008	0.470	0.339
2009	0.444	0.152

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	1.6192	0.3386
2	1.1518	0.3340
3	1.1270	0.2981
4	1.0165	0.2186
5	0.9621	0.2145
6	0.9179	0.2107
7	0.8902	0.2070
8	0.8634	0.2054
9	0.7711	0.2044
10	0.7668	0.2005
11	0.7546	0.1952
12	0.7537	0.1849
13	0.7410	0.1845
14	0.7230	0.1798
15	0.6862	0.1776
16	0.6594	0.1767
17	0.6483	0.1766
18	0.6315	0.1740
19	0.6239	0.1739
20	0.6142	0.1703
21	0.5992	0.1690
22	0.5932	0.1686
23	0.5909	0.1651
24	0.5872	0.1629
25	0.5801	0.1629
26	0.5694	0.1602
27	0.5569	0.1602
28	0.5507	0.1598
29	0.5438	0.1589
30	0.5430	0.1586
31	0.5198	0.1582
32	0.4807	0.1579
33	0.4724	0.1575
34	0.4704	0.1544
35	0.4700	0.1539
36	0.4630	0.1523
37	0.4626	0.1518
38	0.4618	0.1516
39	0.4574	0.1509
40	0.4498	0.1495
41	0.4441	0.1494
42	0.4318	0.1493
43	0.4208	0.1478
44	0.3961	0.1451
45	0.3959	0.1409
46	0.3959	0.1407
47	0.3956	0.1406
48	0.3906	0.1391
49	0.3897	0.1362

50	0.3774	0.1341
51	0.3664	0.1314
52	0.3586	0.1290
53	0.3574	0.1279
54	0.3501	0.1277
55	0.3494	0.1256
56	0.3460	0.1248
57	0.3455	0.1227
58	0.3416	0.1214
59	0.3382	0.1163
60	0.3372	0.1134
61	0.3181	0.1086

Stream Protection Duration
POC #2
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2607	1569	269	17	Pass
0.2706	1364	236	17	Pass
0.2806	1177	208	17	Pass
0.2906	1049	180	17	Pass
0.3006	940	127	13	Pass
0.3105	852	96	11	Pass
0.3205	761	63	8	Pass
0.3305	684	30	4	Pass
0.3404	611	0	0	Pass
0.3504	540	0	0	Pass
0.3604	473	0	0	Pass
0.3703	437	0	0	Pass
0.3803	398	0	0	Pass
0.3903	356	0	0	Pass
0.4003	306	0	0	Pass
0.4102	276	0	0	Pass
0.4202	241	0	0	Pass
0.4302	221	0	0	Pass
0.4401	199	0	0	Pass
0.4501	179	0	0	Pass
0.4601	162	0	0	Pass
0.4700	146	0	0	Pass
0.4800	135	0	0	Pass
0.4900	125	0	0	Pass
0.5000	114	0	0	Pass
0.5099	106	0	0	Pass
0.5199	97	0	0	Pass
0.5299	93	0	0	Pass
0.5398	89	0	0	Pass
0.5498	81	0	0	Pass
0.5598	75	0	0	Pass
0.5697	71	0	0	Pass
0.5797	67	0	0	Pass
0.5897	62	0	0	Pass
0.5997	60	0	0	Pass
0.6096	55	0	0	Pass

0.6196	51	0	0	Pass
0.6296	43	0	0	Pass
0.6395	41	0	0	Pass
0.6495	38	0	0	Pass
0.6595	36	0	0	Pass
0.6694	32	0	0	Pass
0.6794	29	0	0	Pass
0.6894	27	0	0	Pass
0.6994	25	0	0	Pass
0.7093	25	0	0	Pass
0.7193	24	0	0	Pass
0.7293	22	0	0	Pass
0.7392	20	0	0	Pass
0.7492	19	0	0	Pass
0.7592	15	0	0	Pass
0.7692	14	0	0	Pass
0.7791	12	0	0	Pass
0.7891	12	0	0	Pass
0.7991	12	0	0	Pass
0.8090	12	0	0	Pass
0.8190	11	0	0	Pass
0.8290	11	0	0	Pass
0.8389	11	0	0	Pass
0.8489	11	0	0	Pass
0.8589	11	0	0	Pass
0.8689	9	0	0	Pass
0.8788	8	0	0	Pass
0.8888	8	0	0	Pass
0.8988	7	0	0	Pass
0.9087	7	0	0	Pass
0.9187	6	0	0	Pass
0.9287	6	0	0	Pass
0.9386	6	0	0	Pass
0.9486	6	0	0	Pass
0.9586	6	0	0	Pass
0.9686	5	0	0	Pass
0.9785	5	0	0	Pass
0.9885	5	0	0	Pass
0.9985	5	0	0	Pass
1.0084	5	0	0	Pass
1.0184	4	0	0	Pass
1.0284	4	0	0	Pass
1.0383	4	0	0	Pass
1.0483	4	0	0	Pass
1.0583	4	0	0	Pass
1.0683	4	0	0	Pass
1.0782	4	0	0	Pass
1.0882	4	0	0	Pass
1.0982	4	0	0	Pass
1.1081	4	0	0	Pass
1.1181	4	0	0	Pass
1.1281	3	0	0	Pass
1.1380	3	0	0	Pass
1.1480	3	0	0	Pass
1.1580	2	0	0	Pass
1.1680	2	0	0	Pass
1.1779	2	0	0	Pass

1.1879	1	0	0	Pass
1.1979	1	0	0	Pass
1.2078	1	0	0	Pass
1.2178	1	0	0	Pass
1.2278	1	0	0	Pass
1.2377	1	0	0	Pass
1.2477	1	0	0	Pass

Water Quality BMP Flow and Volume for POC #2
On-line facility volume: 0.3135 **acre-feet**
On-line facility target flow: 0.47 **cfs.**
Adjusted for 15 min: 0.47 **cfs.**
Off-line facility target flow: 0.2668 **cfs.**
Adjusted for 15 min: 0.2668 **cfs.**

LID Report

LID Technique	Used for Treatment?	Total Volumn Needs Treatment (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft.)	Cumulative Volumn Infiltration Credit	Percent Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	N	448.62			N	77.80		
Biofiltration Swale	N	392.38			N	24.82		
Center Island swales	N	139.75			N	25.10		
Total Volume Infiltrated		980.75	0.00	0.00		49.09	0.00	0% No Treat. Credit

Compliance with LID Standard 8
Duration Analysis Result = Failed

Perlnd and Implnd Changes

No changes have been made.

APPENDIX D

CONVEYANCE ANAYLSIS
(TO BE SUBMITTED LATER)

APPENDIX E

OPERATIONS AND MAINTENANCE CHECKLISTS

The owner or operator of the project shall be responsible for maintaining the stormwater facilities in accordance with local requirements. Proper maintenance is important for adequate functioning of the stormwater facilities. Operations and maintenance guidelines are provided below.

No. 2 – Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Poisonous/Noxious Vegetation	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Contaminants and Pollution	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Rodent Holes	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1)
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Piping	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway	Rock Missing	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

No. 3 – Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See “Catch Basins” (No. 5)	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).

No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure 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 "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

Biofiltration Swale

- Inspect biofilters at least once every 6 months, preferably during storm events, and also after storm events of > 0.5 inch rainfall/ 24 hours. Maintain adequate grass growth and eliminate bare spots.
- Mow grasses, if needed for good growth {typically maintain at 4 – 9 inches and not below design flow level (King County, 1998)}.
- Remove sediment as needed at head of the swale if grass growth is inhibited in greater than 10 percent of the swale, or if the sediment is blocking the distribution and entry of the water (King County, 1998).
- Remove leaves, litter, and oily materials, and re-seed or resod, and regrade, as needed. Clean curb cuts and level spreaders as needed.

Prevent scouring and soil erosion in the biofilter. If flow channeling occurs, regrade and reseed the biofilter, as necessary.

Maintain access to biofilter inlet, outlet, and to mowing (Figure 9.4.8)

- If a swale is equipped with underdrains, vehicular traffic on the swale bottom (other than grass mowing equipment) should be avoided to prevent damage to the drainpipes.