STORMWATER DRAINAGE REPORT

McDONALD'S REDEVELOPMENT

POULSBO, WASHINGTON

April 12, 2018

Prepared for:

City of Poulsbo
200 NE Moe Street
Poulsbo, WA 98370

Reviewed by:

Jenelle Taflin, P.E., LEED AP
Associate Principal
jtaflin@navixeng.com

NAVIX
SITE | CIVIL

11400 s.e. 8th street, suite 345
bellevue, wa 98004
navixeng.com

t 425.453.9501
f 425.453.8208
e info@navixeng.com

TABLE OF CONTENTS

PROJECT OVERVIEW

Existing Conditions

The project is located at 20533 Viking Avenue NE, Poulsbo, Washington. The site is approximately 1.64 acres and is currently occupied by an existing 5,051 SF McDonalds Restaurant, 59-stall paved parking lot, and single-lane drive-thru. The existing building, parking lot, drive-thru, and associated underground utilities will be demolished as part of this redevelopment.

Proposed Improvements

The proposed development consists of a new 4,806 SF McDonalds Restaurant, retaining walls, 56-stall asphalt paved parking lot, dual-lane drive-thru, and associated underground utilities.

Design Criteria

The proposed stormwater management facilities have been designed to the 2012 Department of Ecology Surface Water Management Manual for Western Washington with 2014 Amendments (2012 Manual). Standard flow control requirements will apply to this project. Water quality treatment thresholds will apply to all proposed pollution-generating surfaces.

Jurisdictional Requirements

Table 1 below summarizes the City of Poulsbo stormwater requirements.

TABLE 1

JURISDICTIONAL REQUIREMENTS	
Duration Analysis:	Standard Flow Control
2-year Peak Flow:	Match 50% of the peak flow
50-year Peak Flow:	Match full peak flow
Water Quality Design Flow Rate:	91% of the runoff volume (Preceding detention facilities) or the full 2-year release rate (Downstream of detention facilities)
Downstream Analysis:	Level 1 (1/4 mile downstream) *

*The project proposes full infiltration of site runoff; therefore, a downstream analysis is not required.

Project Location

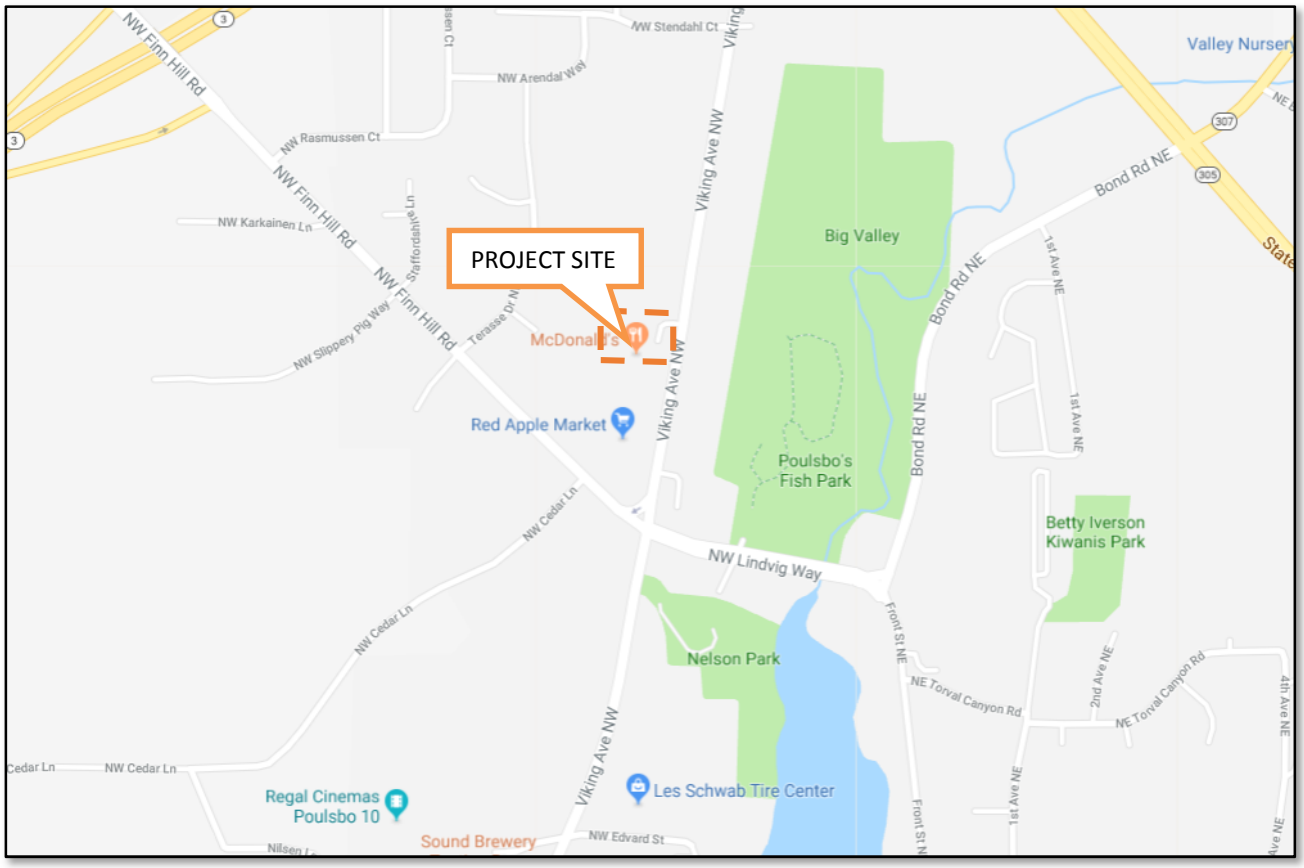


Figure 1: Vicinity Map

Location: 20533 Viking Avenue NE, Poulsbo, WA

Section, Township, Range: NE ¼, Section 15, Township 26 N, Range 1 E W. M.

Parcel Number(s): 152601-1-020-2002 and 15601-1-112-2001

Size: 71,381 SF (1.64 AC)

City, County, State: Poulsbo, King County, Washington State

Governing Agency: City of Poulsbo

Design Criteria: 2012 Department of Ecology Surface Water Management Manual for Western Washington with 2014 Amendments

Zoning: C-2 Viking Avenue

MINIMUM REQUIREMENTS

Minimum requirements for the proposed project have been determined as shown Figures 2.4.1 and 2.4.2 from the 2012 Manual below.

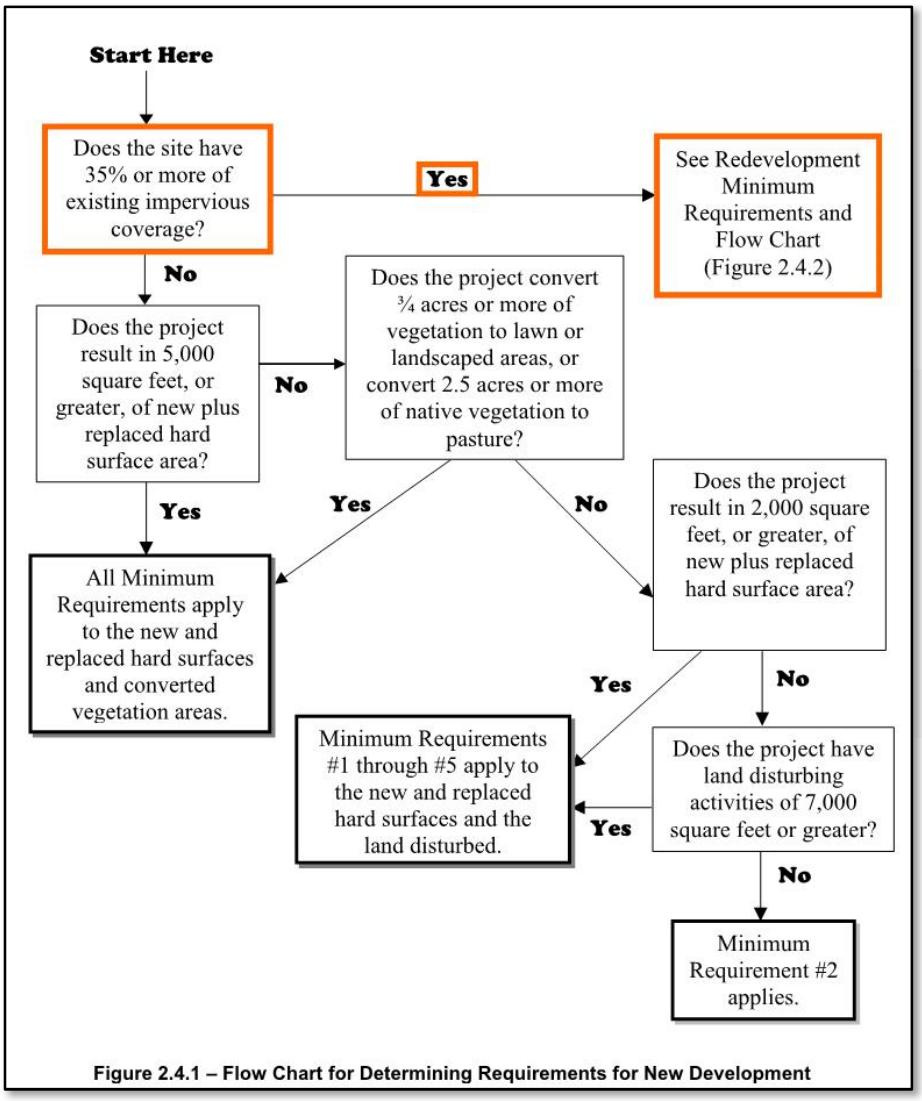


Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

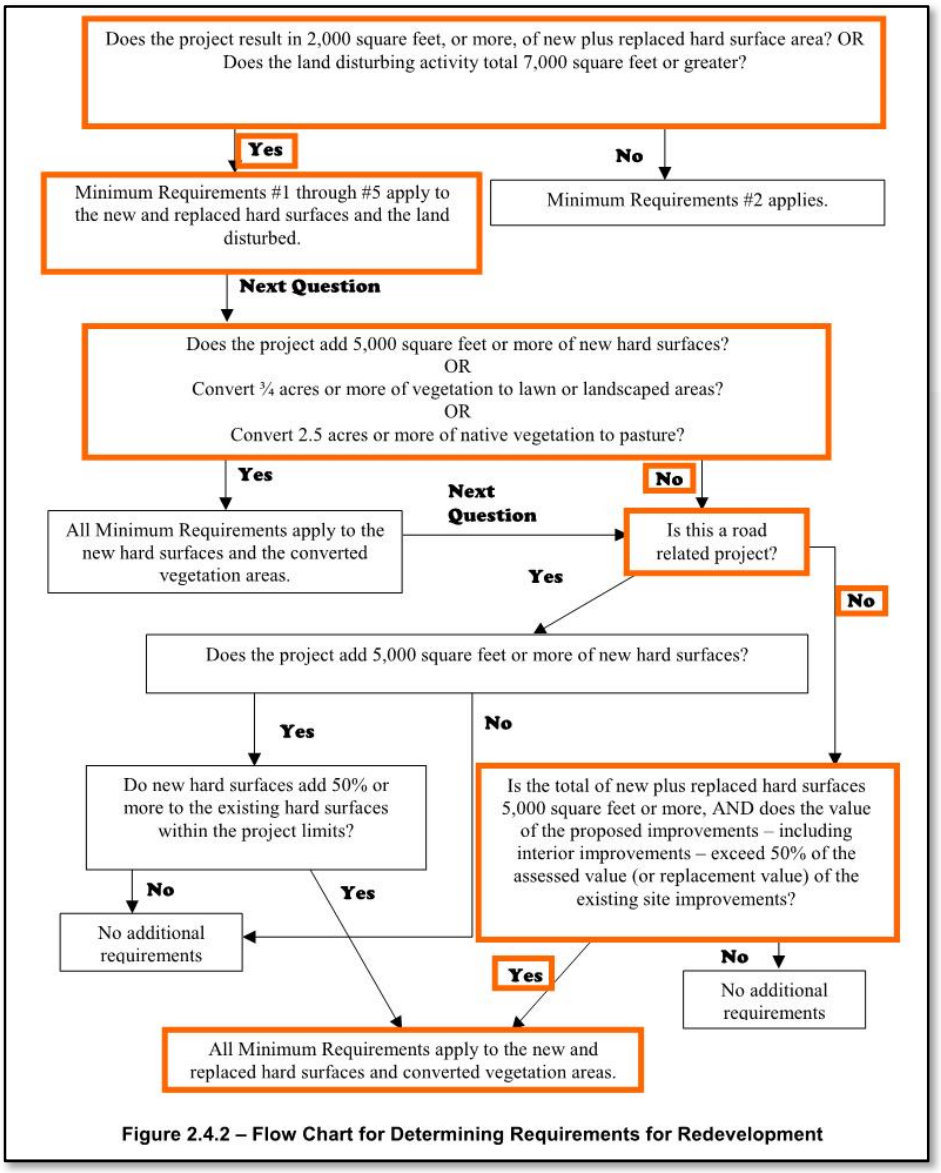


Figure 2.4.2 – Flow Chart for Determining Requirements for Redevelopment

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. Stormwater Site Plans shall be prepared in accordance with Volume I, Chapter 3 of the 2012 Manual.

Response: *A stormwater site plan will be prepared for the proposed development. The stormwater site plan will include the design drawings and the final version of this report.*

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. The objective of Construction SWPPP is to control erosion and prevent sediment and other pollutants from leaving the site during the

construction phase of a project and to have fully functional stormwater facilities and BMPs for the developed site upon completion of construction.

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 SWPP Plan (SWPPP) as part of the Stormwater Site Plan.

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 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.*

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 2012 Manual.

Source Control BMPs include Operational BMPs and Structural Source Control BMPs. Refer to Volume IV of the DOE Manual for Source Control BMP design details and Volume II, Chapter 4 of the 2012 Manual for Source Control BMP construction sites.

Structural Source Control BMPs shall be identified in the stormwater site plan and shall be shown on all applicable plans submitted for permit review and approval.

Response: *All available and relevant source control BMPs will be applied to this project. This includes, but is 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 existing site currently discharges to the municipal system located with Viking Ave NW. Runoff from the proposed project will discharge to an underground infiltration trench. No negative impacts to the outfall from the project are proposed.*

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 onsite to the extent feasible without causing flooding or erosion impacts.

Projects that trigger Minimum Requirements #1-5 only shall either:

- Use On-site Stormwater Management BMPs from List #1 (see List #1 provided below) for all surfaces within each type of surface in List #1; or

- Demonstrate compliance with the LID Performance Standard (described below). Projects selecting this option cannot use Rain Gardens. They may choose to use Bioretention BMPs as described in Chapter 7 of Volume V of the 2012 Manual to achieve the LID Performance Standard.

Projects that trigger Minimum Requirements #1-9 must meet the requirements in Table 2.5.1:

Table 2.5.1 On-site Stormwater Management Requirements for Projects Triggering Minimum Requirements #1 - #9

Project Type and Location	Requirement
New development on any parcel inside the UGA, or new development outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
New development outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13.
Redevelopment on any parcel inside the UGA, or redevelopment outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
Redevelopment outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13.

Response: *As shown in Figure 1.6 below, this project triggers all nine requirements, and the project developer has elected to address on-site stormwater management by meeting the LID Performance Standard. The proposed infiltration facility will be used to meet the LID Performance Standard as described in the Flow Control Facility and the On-site Stormwater BMPs sections of this report. Additionally, BMP T5.13 Post-Construction Soil Quality and Depth will be installed in accordance with the 2012 Manual.*

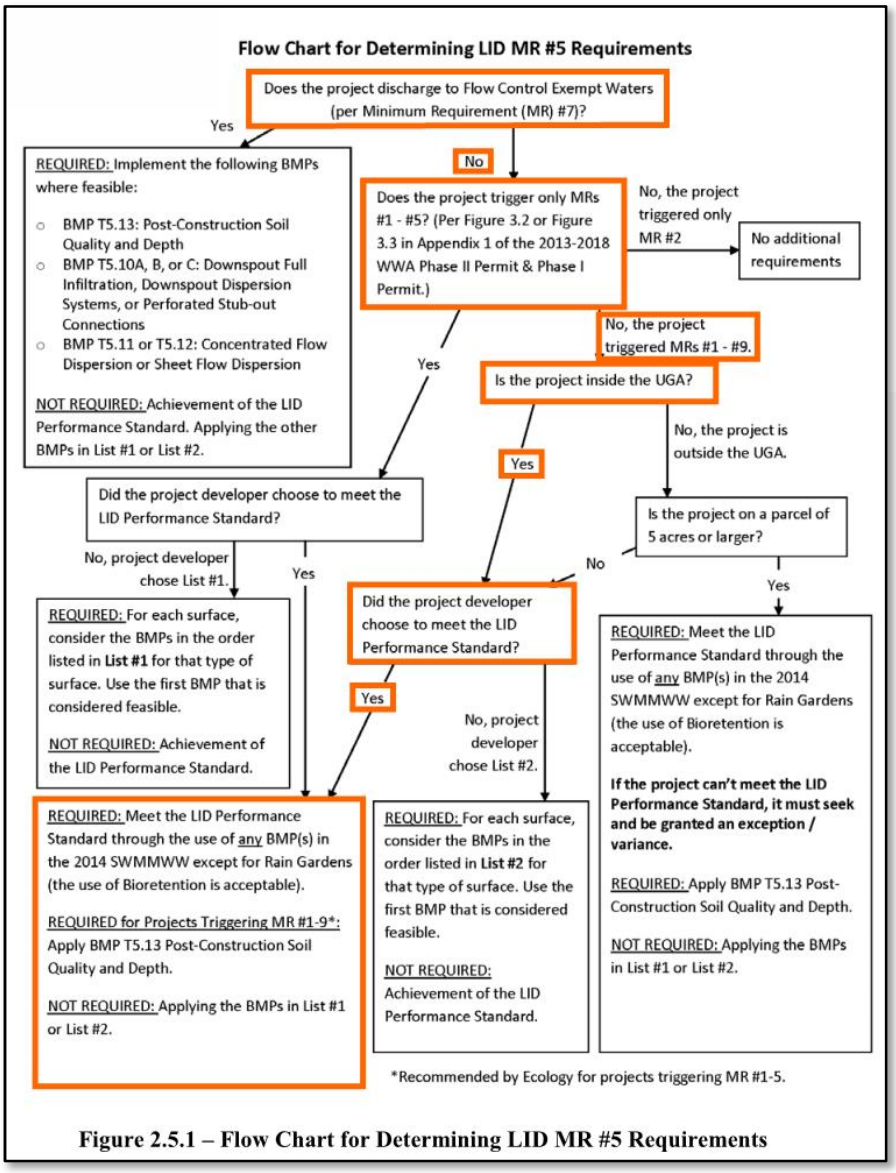


Figure 2.5.1 – Flow Chart for Determining LID MR #5 Requirements

Minimum Requirement #6: Runoff Treatment

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) is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

Direct discharge of untreated stormwater from pollution-generating hard surfaces to ground water is prohibited, except for the discharge achieved by infiltration or dispersion of runoff through use of On-site Stormwater Management BMPs, in accordance with Chapter 5, Volume V and Chapter 7, Volume V of the 2012 Manual; or by infiltration through soils meeting the suitability criteria in Chapter 3 of Volume III of the 2012 Manual.

Response: *This project will construct greater than 5,000 square feet of PGHS in a threshold discharge area, and stormwater treatment facilities will be provided as part of this redevelopment. Basic water quality treatment for the PGIS will be provided by means of a StormFilter Water Quality facility that will be adequately designed to treat runoff from all pollution-generating surfaces. The StormFilter Water Quality facility will discharge to the underground infiltration facility.*

This project is a high-use site. Therefore, an oil control device is required and provided by means of an oil/water separator upstream of water quality facility.

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 requirements below apply to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody.

Response: *Flow control will be provided by means of an underground infiltration facility, which will be designed to fully infiltrate the 100-year site runoff per the 2012 Manual. An emergency overflow pipe will be provided to safely convey flows larger than the 100-year event to the point of discharge from the project site.*

Minimum Requirement #8: Wetlands Protection

The wetland protection requirements apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system. 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.

Response: *As shown in Figure 2 below, no existing wetlands are located on or near the project site.*

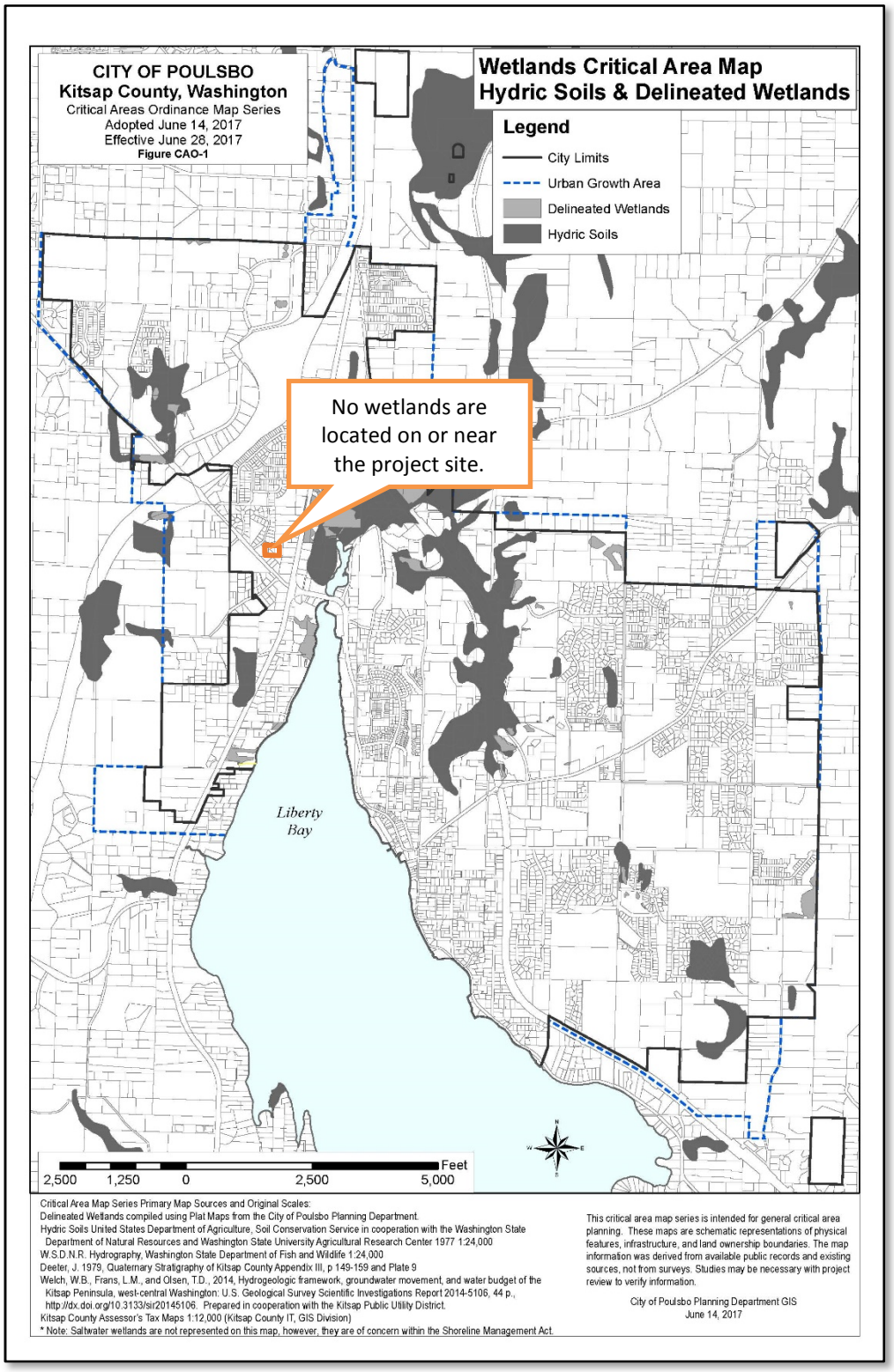


Figure 2: City of Poulsbo Hydric Soils and Delineated Wetlands Map

Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual that is consistent with the provisions in Volume V 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 City.

Response: *An Operation and Maintenance Manual is provided in Appendix B of this report.*

EXISTING CONDITIONS

The project is located at 20533 Viking Avenue NE, Poulsbo, Washington. The site is approximately 1.64 acres and is currently occupied by an existing 5,051 SF McDonalds Restaurant, 59-stall paved parking lot, and single-lane drive-thru. The existing building, parking lot, drive-thru, and associated underground utilities will be demolished as part of this redevelopment.

The property is bordered by two single-family residences to the north, Viking Avenue NW to the east, a single-family residence across the asphalt driveway to the south, and a mini-storage facility to the west, and Viking Ave NW right-of-way to the east. See Appendix A for the Existing Conditions Exhibit and see Figure 3 below for the Existing Conditions Map.

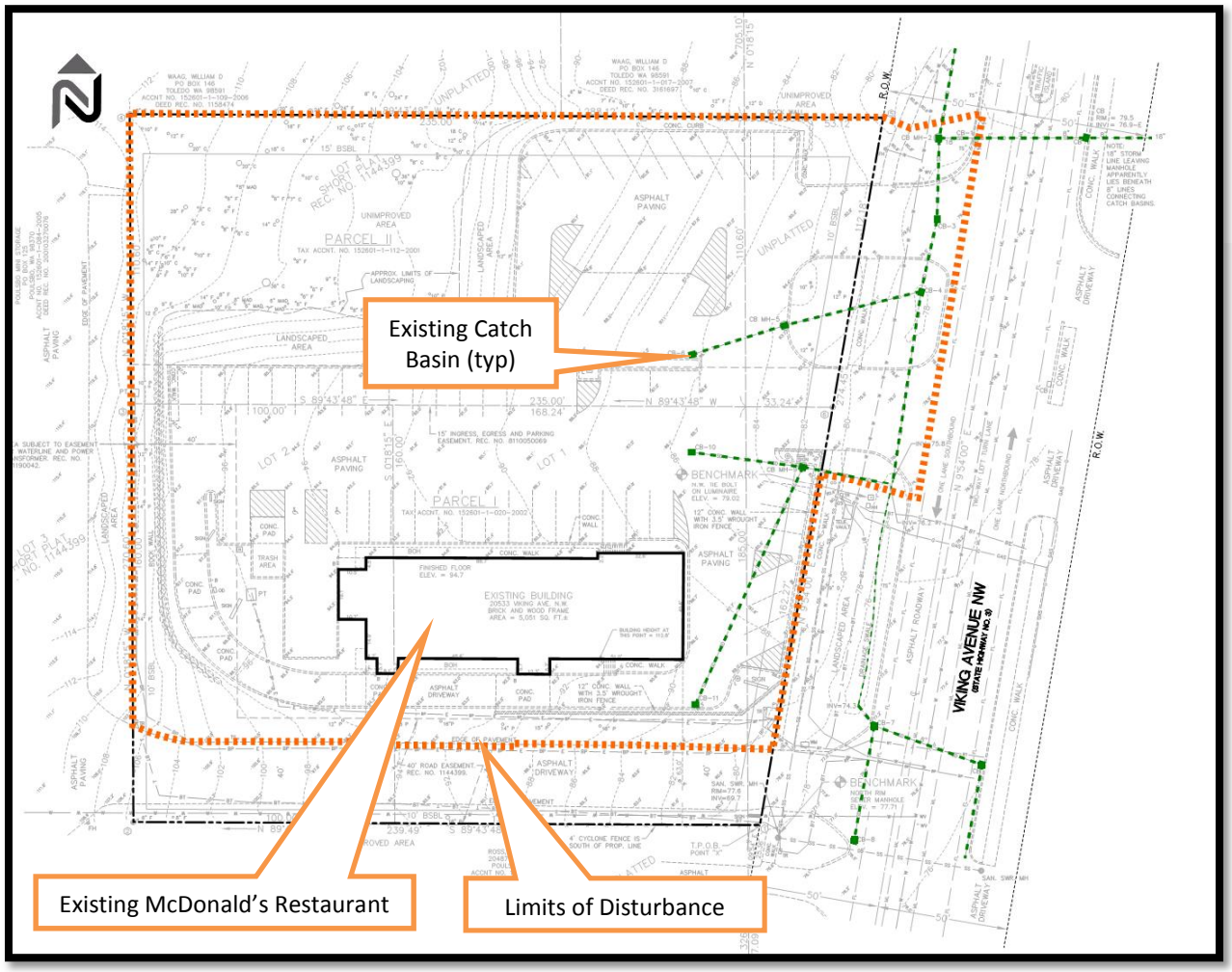


Figure 3: Existing Conditions Map

Pre-Development Stormwater Runoff

The existing site is divided into two subbasins (north and south) as shown in Figure 4 below. Both subbasins ultimately discharge to Liberty Bay.

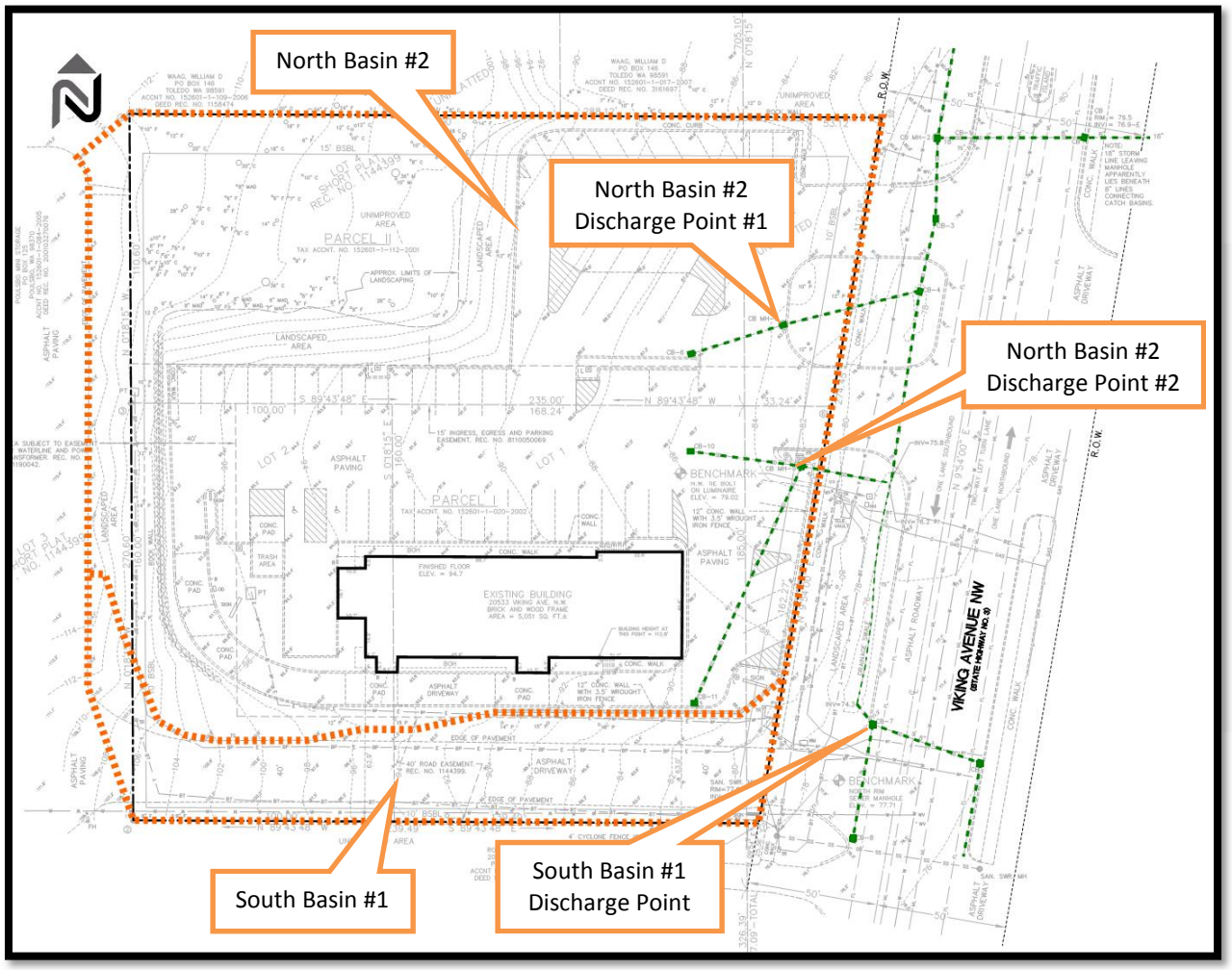


Figure 4: Existing Subbasins

Runoff from the south side of the existing development, including the roof, drive-thru, and a portion of the parking area, is collected in a series of catch basins and closed conveyance pipes and discharges to an off-site drainage swale in the site frontage. The drainage swale directs runoff south where it is picked up by a culvert and conveyed to the closed conveyance system with in Viking Avenue NW. The closed conveyance system continues across Viking Avenue NW and is conveyed south. The ultimate discharge is Liberty Bay.

Runoff from the north side of the existing development, including the northern parking area, is collected in a series of catch basins and closed conveyance pipes and discharges to an off-site municipal catch basin in the landscape area along Viking Avenue NW. The municipal storm system routes runoff to the north where it is conveyed by an 18" storm pipe to the east to the estuary that discharges to Liberty Bay.

Soils Conditions

Per the Geotechnical Engineering Report by The Riley Group, Inc., dated November 10, 2017, on-site soil conditions consist of up to 7.5 feet of loose to dense fill underlain by native outwash deposits. The native soil varies from gravelly sand with trace of silt to sand with a trace of gravel and silt.

Groundwater seepage was encountered from 10 to 11.5 feet below ground surface in three of the six borings. Per the Geotechnical Engineering Report, groundwater was likely at its seasonal low static level during the field exploration and is expected to be higher in the winter and spring.

Based on the on-site soils, infiltration is likely feasible on-site, and the recommended design infiltration rate is 3 inches per hour.

DEVELOPED CONDITIONS

The proposed development consists of a new 4,806 SF McDonalds Restaurant, 56-stall asphalt paved parking lot, dual-lane drive-thru, and associated underground utilities. The site will comprise of 1.53 acres of paved asphalt and sidewalks. Three of the existing buildings and the southern carport structure will be demolished as part of this redevelopment. A retaining wall will be constructed along the north, south, east, and west sides of the project site.

See Figure 5 below for the Proposed Conditions Map. See Appendix A for the Developed Conditions Exhibit.

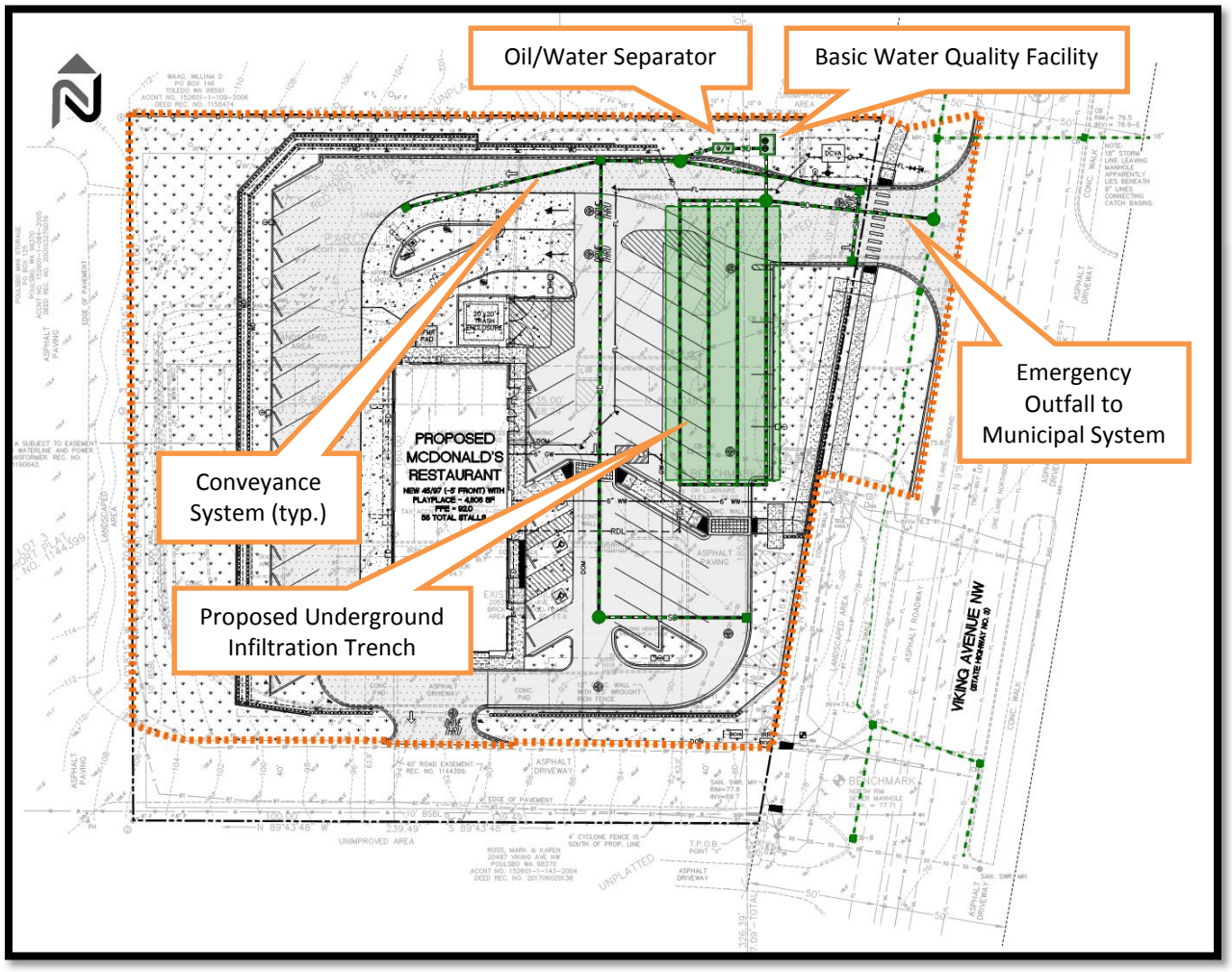


Figure 5: Proposed Conditions Map

Post-Development Stormwater Runoff

Stormwater will be collected on the project site and managed on-site in accordance with the 2012 Manual.

Runoff will be managed in a single subbasin in the proposed conditions. Runoff from the proposed development will be conveyed through a network of catch basins and closed conveyance pipes to an oil/water separator and then to a StormFilter facility for basic water quality treatment. Runoff will then

be routed to an underground infiltration facility sized in accordance with the requirements of the 2012 Manual. An emergency overflow pipe will be provided to safely convey runoff from events larger than the 100-year to the municipal storm system at the existing off-site manhole to the southeast of the project site.

See the Permanent Stormwater Control Plan section for further details regarding the proposed drainage system.

OFFSITE ANALYSIS

The project proposes to fully infiltrate runoff on-site and utilize an emergency overflow connection to the existing municipal storm system for flows larger than the 100-year event. Therefore, an off-site analysis is not required per the 2012 Manual.

Existing Site Hydrology

The total site is approximately 1.64 acres and is currently occupied by an existing McDonalds building, associated parking and drive thru. The existing building will be demolished as part of this redevelopment.

Runoff from the south side of the existing development, including the roof, drive-thru, and a portion of the parking area, is collected in a series of catch basins and closed conveyance pipes and discharges to an off-site drainage swale in the site frontage. The drainage swale directs runoff south where it is picked up by a culvert and conveyed to the closed conveyance system with in Viking Avenue NW. The closed conveyance system continues across Viking Avenue NW and is conveyed south. The ultimate discharge is Liberty Bay.

Runoff from the north side of the existing development, including the northern parking area, is collected in a series of catch basins and closed conveyance pipes and discharges to an off-site municipal catch basin in the landscape area along Viking Avenue NW. The municipal storm system routes runoff to the north where it is conveyed by an 18" storm pipe to the east to the estuary that discharges to Liberty Bay.

A small amount of run-on from the landscaped area of the adjacent parcel to the west appears to enter the project site. The existing asphalt driveway on the north side of the project site will not be disturbed as part of this development. Therefore, flow control facilities were addressed to account for this run-on in addition to the proposed development in accordance with the 2012 DOE Standards.

The existing conditions within the project's site area are listed in Table 3 below.

Table 3

Existing Surface Conditions		
Proposed Area		**Description**
(AC)	**(SF)**	
1.64	71,381	Forested (Pervious)
1.64	**71,381**	**Total Existing Conditions**

See Figure 6 for the Existing Surface Conditions Map.

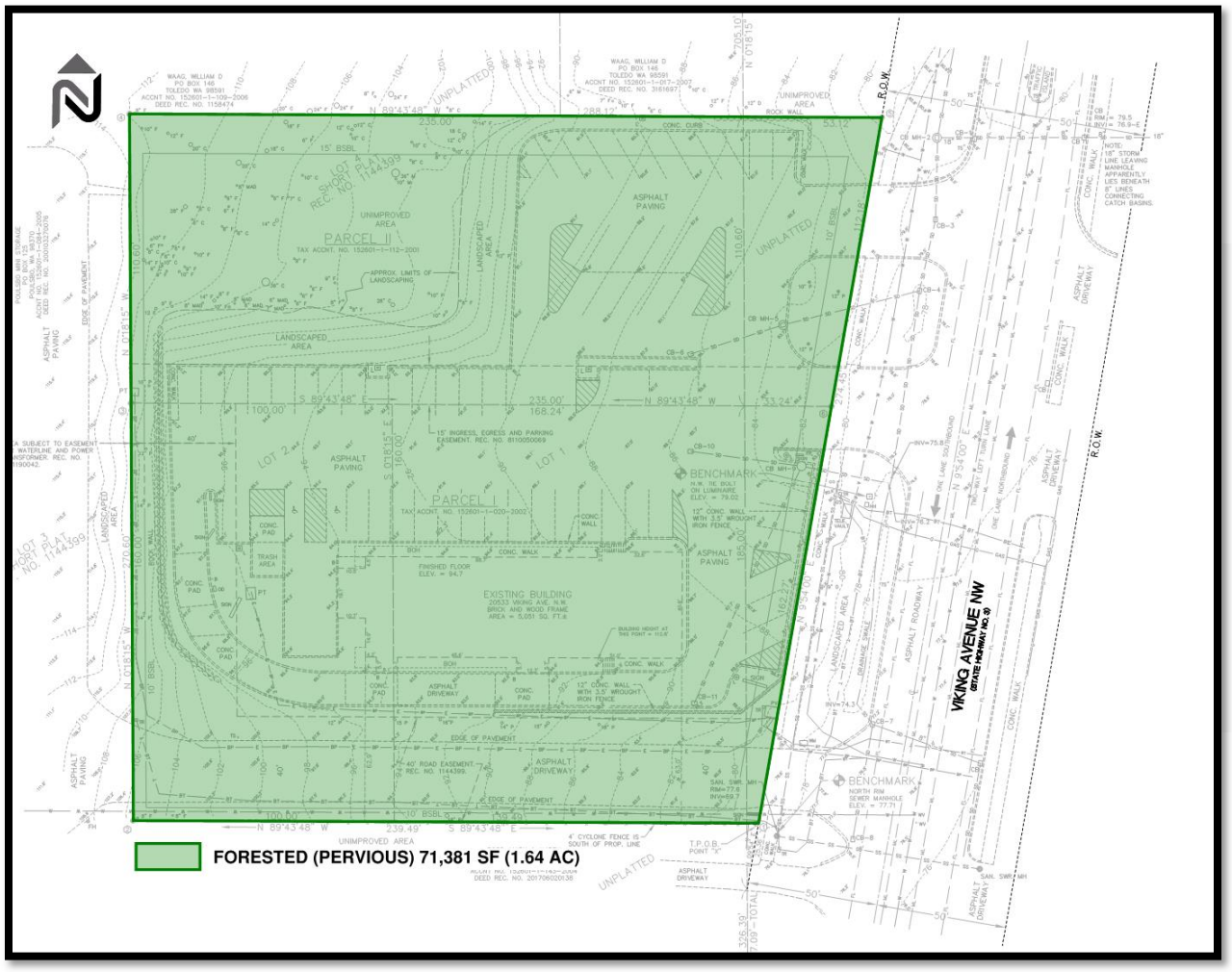


Figure 6: Existing Surface Conditions

Developed Site Hydrology

Proposed site surface coverage areas are delineated in Figure 7 below. See the Developed Conditions Exhibit in Appendix A of this report. The proposed conditions within the site area are listed in Table 4.

Table 4

Developed Surface Conditions		
Proposed Area		**Description**
(AC)	**(SF)**	
0.58	25,130	Pervious
1.06	46,251	Impervious
1.64	**71,381**	**Total Site Area**

See Figure 7 for the Developed Surface Conditions Map.

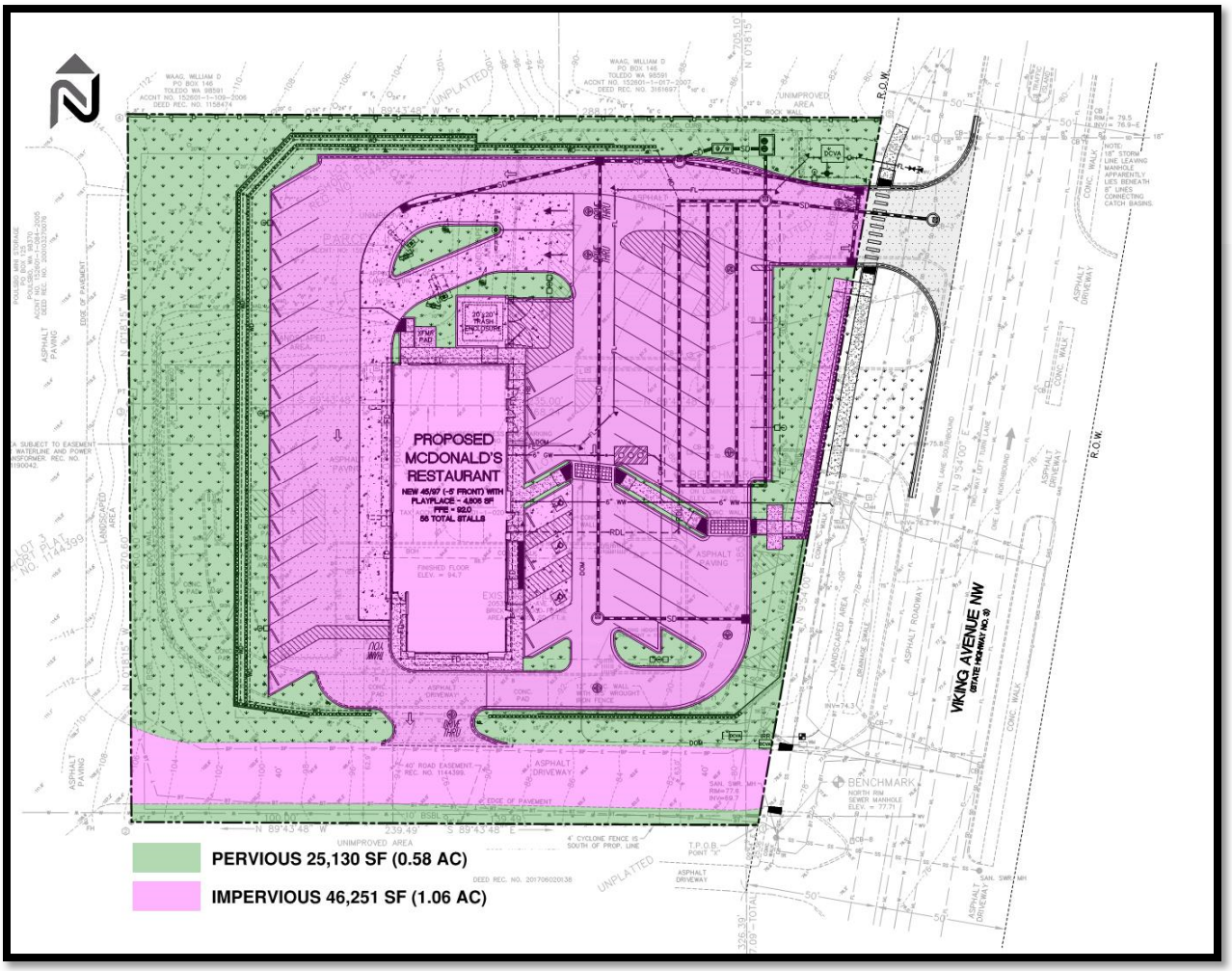


Figure 7: Developed Surface Conditions

Nearby Receiving Waters

Runoff from the project site will be fully infiltrated. The emergency overflow will be ultimately routed to Liberty Bay, which is located southeast of the project site. However, because the site was designed to infiltrate the 100-year event, an offsite analysis was not performed in accordance with the 2012 Manual.

Flow Control System

As described above, an underground infiltration facility was designed to fully infiltrate runoff from the proposed project in accordance with the requirements of the 2012 Manual.

Flow control from the entire 1.64-acre on-site area is provided by means of an underground infiltration trench system sized to retain the full 100-year peak flow in accordance with the 2012 DOE Manual. Per the Geotechnical Engineering Report by the Riley Group, Inc., dated November 10, 2017, the design infiltration rate is 3-inches/hour. The proposed stormwater flow control system consists of a 44’ wide x 105’ long x 5’ deep infiltration trench.

WWHM2012 was utilized to model the pre- and post-development runoff flows in 15-minute timesteps. The areas from Tables 3 and 4 above were inputted for the existing and developed conditions, respectively. The WWHM2012 input and output report is included in Appendix C, and a summary of the outputs is provided below.

WWHM2012
PROJECT REPORT

Project Name: MCD Poulsbo_Infiltration Sizing_180329
Site Name: MCD Poulsbo
Site Address: 20533 Viking Ave NW
City : Poulsbo
Report Date: 3/29/2018
Gage : Quilcene
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/02/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	1.64
Pervious Total	1.64

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.64

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.58
Pervious Total	**0.58**

Impervious Land Use	acre
ROADS FLAT	0.95
ROOF TOPS FLAT	0.11
Impervious Total	**1.06**
Basin Total	**1.64**

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Name : Gravel Trench Bed 1
Bottom Length: 105.00 ft.
Bottom Width: 44.00 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 5
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 3
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 299.566
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 299.566
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 4.5 ft.
Riser Diameter: 12 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.106	0.000	0.000	0.000
0.0556	0.106	0.001	0.000	0.320
0.1111	0.106	0.003	0.000	0.320
0.1667	0.106	0.005	0.000	0.320
0.2222	0.106	0.007	0.000	0.320
0.2778	0.106	0.009	0.000	0.320
0.3333	0.106	0.011	0.000	0.320
0.3889	0.106	0.013	0.000	0.320

0.4444	0.106	0.015	0.000	0.320
0.5000	0.106	0.017	0.000	0.320
0.5556	0.106	0.019	0.000	0.320
0.6111	0.106	0.021	0.000	0.320
0.6667	0.106	0.023	0.000	0.320
0.7222	0.106	0.025	0.000	0.320
0.7778	0.106	0.027	0.000	0.320
0.8333	0.106	0.029	0.000	0.320
0.8889	0.106	0.031	0.000	0.320
0.9444	0.106	0.033	0.000	0.320
1.0000	0.106	0.035	0.000	0.320
1.0556	0.106	0.036	0.000	0.320
1.1111	0.106	0.038	0.000	0.320
1.1667	0.106	0.040	0.000	0.320
1.2222	0.106	0.042	0.000	0.320
1.2778	0.106	0.044	0.000	0.320
1.3333	0.106	0.046	0.000	0.320
1.3889	0.106	0.048	0.000	0.320
1.4444	0.106	0.050	0.000	0.320
1.5000	0.106	0.052	0.000	0.320
1.5556	0.106	0.054	0.000	0.320
1.6111	0.106	0.056	0.000	0.320
1.6667	0.106	0.058	0.000	0.320
1.7222	0.106	0.060	0.000	0.320
1.7778	0.106	0.062	0.000	0.320
1.8333	0.106	0.064	0.000	0.320
1.8889	0.106	0.066	0.000	0.320
1.9444	0.106	0.068	0.000	0.320
2.0000	0.106	0.070	0.000	0.320
2.0556	0.106	0.071	0.000	0.320
2.1111	0.106	0.073	0.000	0.320
2.1667	0.106	0.075	0.000	0.320
2.2222	0.106	0.077	0.000	0.320
2.2778	0.106	0.079	0.000	0.320
2.3333	0.106	0.081	0.000	0.320
2.3889	0.106	0.083	0.000	0.320
2.4444	0.106	0.085	0.000	0.320
2.5000	0.106	0.087	0.000	0.320
2.5556	0.106	0.089	0.000	0.320
2.6111	0.106	0.091	0.000	0.320
2.6667	0.106	0.093	0.000	0.320
2.7222	0.106	0.095	0.000	0.320
2.7778	0.106	0.097	0.000	0.320
2.8333	0.106	0.099	0.000	0.320
2.8889	0.106	0.101	0.000	0.320
2.9444	0.106	0.103	0.000	0.320
3.0000	0.106	0.105	0.000	0.320
3.0556	0.106	0.106	0.000	0.320
3.1111	0.106	0.108	0.000	0.320
3.1667	0.106	0.110	0.000	0.320
3.2222	0.106	0.112	0.000	0.320
3.2778	0.106	0.114	0.000	0.320
3.3333	0.106	0.116	0.000	0.320
3.3889	0.106	0.118	0.000	0.320
3.4444	0.106	0.120	0.000	0.320
3.5000	0.106	0.122	0.000	0.320
3.5556	0.106	0.124	0.000	0.320
3.6111	0.106	0.126	0.000	0.320
3.6667	0.106	0.128	0.000	0.320

3.7222	0.106	0.130	0.000	0.320
3.7778	0.106	0.132	0.000	0.320
3.8333	0.106	0.134	0.000	0.320
3.8889	0.106	0.136	0.000	0.320
3.9444	0.106	0.138	0.000	0.320
4.0000	0.106	0.140	0.000	0.320
4.0556	0.106	0.141	0.000	0.320
4.1111	0.106	0.143	0.000	0.320
4.1667	0.106	0.145	0.000	0.320
4.2222	0.106	0.147	0.000	0.320
4.2778	0.106	0.149	0.000	0.320
4.3333	0.106	0.151	0.000	0.320
4.3889	0.106	0.153	0.000	0.320
4.4444	0.106	0.155	0.000	0.320
4.5000	0.106	0.157	0.000	0.320
4.5556	0.106	0.159	0.138	0.320
4.6111	0.106	0.161	0.389	0.320
4.6667	0.106	0.163	0.703	0.320
4.7222	0.106	0.165	1.046	0.320
4.7778	0.106	0.167	1.383	0.320
4.8333	0.106	0.169	1.683	0.320
4.8889	0.106	0.171	1.921	0.320
4.9444	0.106	0.173	2.088	0.320
5.0000	0.106	0.175	2.203	0.320

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.64
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.58
Total Impervious Area:1.06

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.013975
5 year	0.050199
10 year	0.095153
25 year	0.184181
50 year	0.27891
100 year	0.401976

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0070	478	0	0	Pass
0.0097	293	0	0	Pass
0.0125	206	0	0	Pass
0.0152	148	0	0	Pass
0.0180	130	0	0	Pass
0.0207	103	0	0	Pass
0.0235	82	0	0	Pass
0.0262	66	0	0	Pass
0.0290	63	0	0	Pass
0.0317	52	0	0	Pass
0.0345	44	0	0	Pass
0.0372	33	0	0	Pass
0.0399	32	0	0	Pass
0.0427	28	0	0	Pass
0.0454	20	0	0	Pass
0.0482	19	0	0	Pass
0.0509	18	0	0	Pass
0.0537	17	0	0	Pass
0.0564	15	0	0	Pass
0.0592	15	0	0	Pass
0.0619	15	0	0	Pass
0.0647	13	0	0	Pass
0.0674	11	0	0	Pass
0.0702	10	0	0	Pass
0.0729	10	0	0	Pass
0.0757	10	0	0	Pass
0.0784	9	0	0	Pass
0.0811	8	0	0	Pass
0.0839	7	0	0	Pass
0.0866	7	0	0	Pass
0.0894	7	0	0	Pass
0.0921	7	0	0	Pass
0.0949	6	0	0	Pass
0.0976	6	0	0	Pass
0.1004	5	0	0	Pass
0.1031	5	0	0	Pass
0.1059	5	0	0	Pass
0.1086	4	0	0	Pass
0.1114	4	0	0	Pass
0.1141	4	0	0	Pass
0.1169	3	0	0	Pass
0.1196	3	0	0	Pass
0.1223	3	0	0	Pass
0.1251	3	0	0	Pass
0.1278	2	0	0	Pass
0.1306	2	0	0	Pass
0.1333	2	0	0	Pass
0.1361	2	0	0	Pass
0.1388	2	0	0	Pass
0.1416	2	0	0	Pass

0.1443	2	0	0	Pass
0.1471	2	0	0	Pass
0.1498	2	0	0	Pass
0.1526	2	0	0	Pass
0.1553	2	0	0	Pass
0.1581	2	0	0	Pass
0.1608	2	0	0	Pass
0.1635	2	0	0	Pass
0.1663	2	0	0	Pass
0.1690	2	0	0	Pass
0.1718	2	0	0	Pass
0.1745	2	0	0	Pass
0.1773	2	0	0	Pass
0.1800	2	0	0	Pass
0.1828	2	0	0	Pass
0.1855	2	0	0	Pass
0.1883	2	0	0	Pass
0.1910	2	0	0	Pass
0.1938	2	0	0	Pass
0.1965	2	0	0	Pass
0.1993	2	0	0	Pass
0.2020	2	0	0	Pass
0.2047	2	0	0	Pass
0.2075	2	0	0	Pass
0.2102	2	0	0	Pass
0.2130	2	0	0	Pass
0.2157	2	0	0	Pass
0.2185	1	0	0	Pass
0.2212	1	0	0	Pass
0.2240	1	0	0	Pass
0.2267	1	0	0	Pass
0.2295	1	0	0	Pass
0.2322	1	0	0	Pass
0.2350	1	0	0	Pass
0.2377	1	0	0	Pass
0.2405	1	0	0	Pass
0.2432	1	0	0	Pass
0.2459	1	0	0	Pass
0.2487	1	0	0	Pass
0.2514	1	0	0	Pass
0.2542	1	0	0	Pass
0.2569	1	0	0	Pass
0.2597	1	0	0	Pass
0.2624	1	0	0	Pass
0.2652	1	0	0	Pass
0.2679	1	0	0	Pass
0.2707	1	0	0	Pass
0.2734	0	0	0	Pass
0.2762	0	0	0	Pass
0.2789	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0131 **acre-feet**
On-line facility target flow: 0.2584 **cfs.**
Adjusted for 15 min: 0.2584 **cfs.**
Off-line facility target flow: 0.1459 **cfs.**
Adjusted for 15 min: 0.1459 **cfs.**

On-Site Stormwater BMPs

As described in the Minimum Requirements section of this report, the project developer has elected to address on-site stormwater management by meeting the LID Performance Standard. The proposed infiltration facility will be used to meet the LID Performance Standard. full infiltration was selected to meet Minimum Requirement #5 (On-Site Stormwater BMPs) using the LID Performance Standard option in lieu of using List #2.

As shown in the Flow Control System section above, the proposed infiltration facility was sized to infiltrate 100% of site runoff in accordance with Section 3.3 of Volume III of the 2012 Manual.

Additionally, BMP T5.13 Post-Construction Soil Quality and Depth will be installed in accordance with the 2012 Manual.

Water Quality System

This commercial redevelopment is subject to Enhanced Water Quality Treatment. The water quality design flow for preceding detention is equal to 91% of the developed water quality volume, as determined using WWHM2012 per the 2017 Standards.

Runoff from pollution-generating surfaces will be routed to a Modular Wetland System for enhanced water quality treatment. Per the Department of Ecology's GULD approval, the Modular Wetland System treats the off-line 15-minute water quality flow rate as calculated by WWHM2012. The Modular Wetland System includes a pretreatment chamber for presettling and an internal high flow bypass weir system to accommodate higher flows without the need for a flow splitter.

The stormwater runoff from the project site will be directed to an oil/water separator followed by a StormFilter vault. The StormFilter vault was sized using 91% of the 24-hour runoff volume as estimated by WWHM. The water quality flow rate from the project site is 0.14 CFS with a peak 100-year developed flow rate of 1.72 CFS to the StormFilter system.

Using the water quality design flow rate of 0.14 CFS, the five (5) 18" Cartridges ca treat up to 0.15 CFS, as shown below, which is more than the required water quality flow rate of the project site. Futhermore, the StormFilter vault can bypass up to 1.8 CFS.

CONTECH ENGINEERED SOLUTIONS

Size and Cost Estimate

Prepared by Mike Gillette on April 3, 2018

McDonalds Poulsbo – Stormwater Treatment System

Poulsbo, WA

Information provided:

- Presiding agency = City of Poulsbo

Structure ID	SFMH
Water Quality Flow Rate (cfs)	0.14
Peak Flow Rate (cfs)	1.72
Number of cartridges	5
Cartridge flow rate (gpm)	12.53
Media type	PSORB
Structure size	8'x6' vault
Approximate Price	$28,000

Assumptions:

- Media = Phosphosorb cartridges providing basic level treatment per DOE
- System depth is 8' from rim to outlet
- Drop required from inlet to outlet = 2.3' minimum

Size and cost estimates:

The StormFilter is a flow-based system, and is therefore sized by calculating the peak water quality flow rate associated with the design storm. The water quality flow rate was calculated by the consulting engineer using WWHM and was provided to Contech Engineered Solutions LLC for the purposes of developing this estimate.

The StormFilter for this site was sized based on the above water quality flow rate. To accommodate this flow rate, Contech Engineered Solutions recommends using (5) – 18" cartridges with PSORB media in an 8x6 vault. The estimated cost of this system is shown in the above table; this estimate includes a complete system delivered to the job site. The final system cost will depend on the actual depth of the units and whether extras like doors rather than castings are specified. The contractor is responsible for setting the StormFilter manhole and all external plumbing.

Typically the StormFilter manhole has an internal bypass capacity of 1.8 cfs. Since the peak discharge is not expected to exceed this rate, a high-flow bypass upstream of the StormFilter system is not required.

11815 NE Glenn Widing Dr., Portland OR 97220
Toll-free: 800.548.4667 Fax: 800.561.1271

CONTECH ENGINEERED SOLUTIONS

Determining Number of Cartridges for Flow Based Systems

CONTECH Engineered Solutions Designer:	MSG
Date	4/3/2018

Site Information

Project Name	Mcdonalds - Poulsbo
Project State	Washington
Project Location	Poulsbo
Drainage Area, Ad	1.53 ac
Impervious Area, Ai	0.95 ac
Pervious Area, Ap	0.58
% Impervious	62%
Runoff Coefficient, Rc	0.61
Water quality flow	0.14 cfs
Peak storm flow	1.72 cfs

Filter System

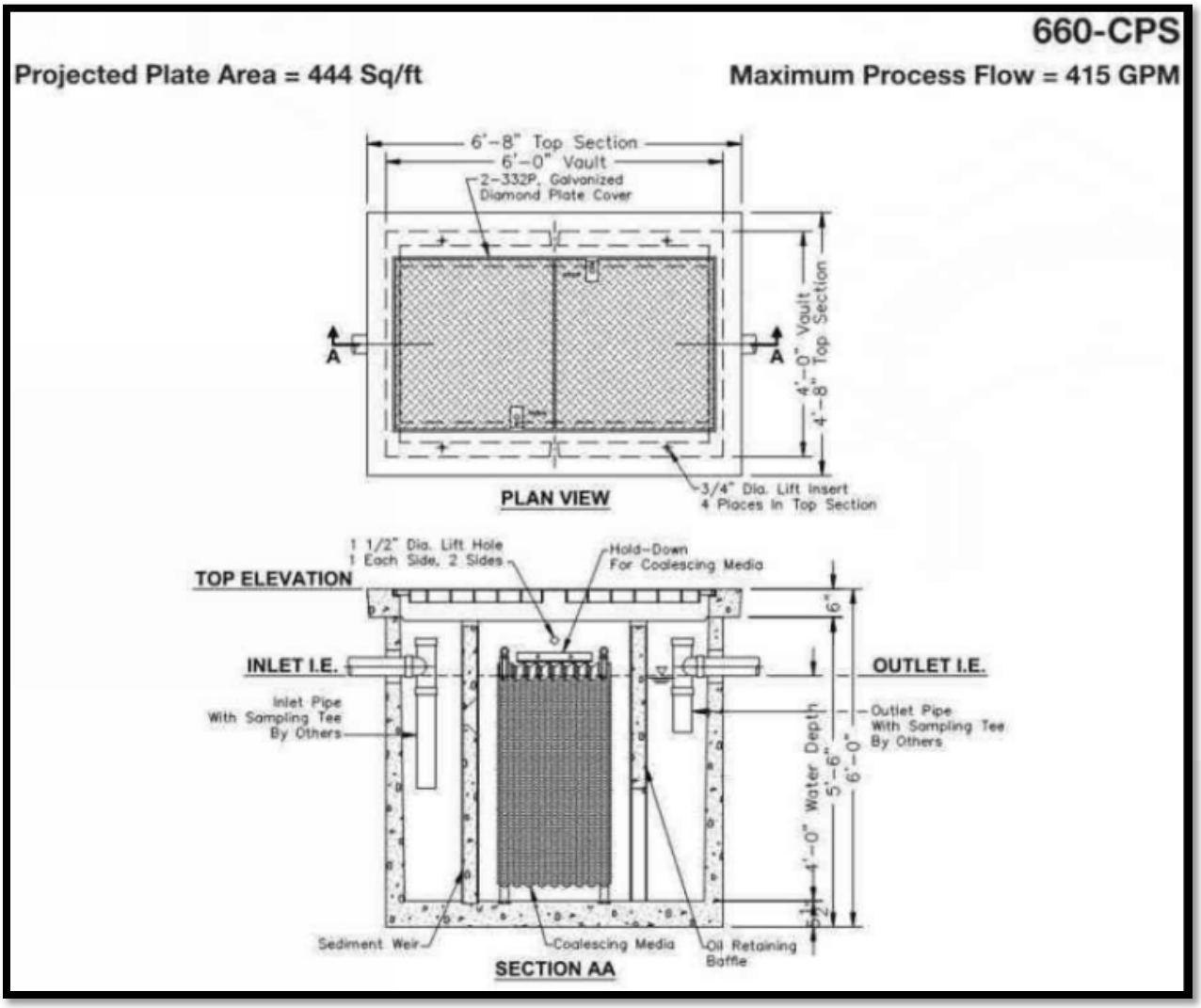
Filtration brand	StormFilter
Cartridge height	18 in
Specific Flow Rate	1.67 gpm/ft²
Flow rate per cartridge	12.53 gpm

SUMMARY

Number of Cartridges	5

This project meets the threshold for a High-Use Site. Therefore, oil control is provided by means of an oil/water separator upstream of the water quality facility.

Using the 100-year flow rate of 0.40 CFS and conversion factor of 1 CFS = 448.8 GPM, the required treatment peak rate is 179.5 GPM. The proposed 660-CPS Oil/Water Separator, as shown below, provides oil/water treatment for up to 415 GPM, which is greater than the 179.5 GPM required.



Conveyance System Analysis and Design

Furthermore, as shown in the Manning's Calculations on the below, the maximum flow rate for a 12-inch storm drainage pipe at a minimum slope of 0.5% is 2.70 CFS, which is far greater than the 100-year, peak flow for the entire site in the developed condition of 0.4 CFS.

The proposed conveyance system, therefore, provides sufficient capacity for on-site conveyance for the full range of developed, peak flows including the 100-year peak flow event (0.4 CFS).

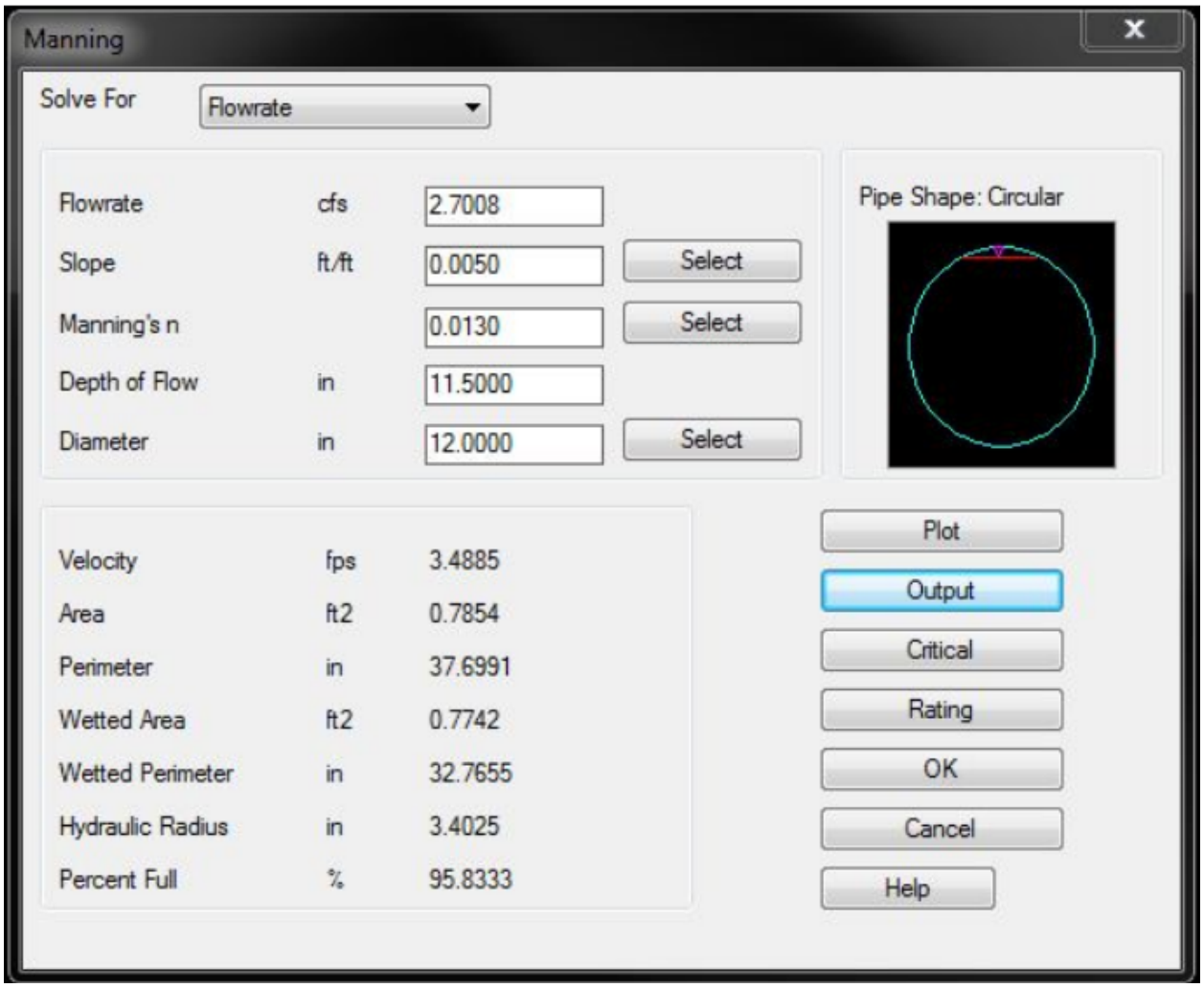


Figure 8: Manning's Calculation for Twelve-Inch Pipe

100-Year Flood/Overflow Condition

Review of the most recent FIRM maps indicates that the project site does not lie within the 100-year flood plain. The portion of FIRM containing the subject property is included below.

The stormwater system for this project has been designed to address all storm events, including the 100-year, 24-hour storm, in accordance with the design criteria described previously. The emergency overflow route will be into the existing public conveyance system.

Per the FEMA Flood Insurance Rate Map panel 53035C0207F excerpt in Figure 9 below, the site does not appear to fall within a designated flooding area.

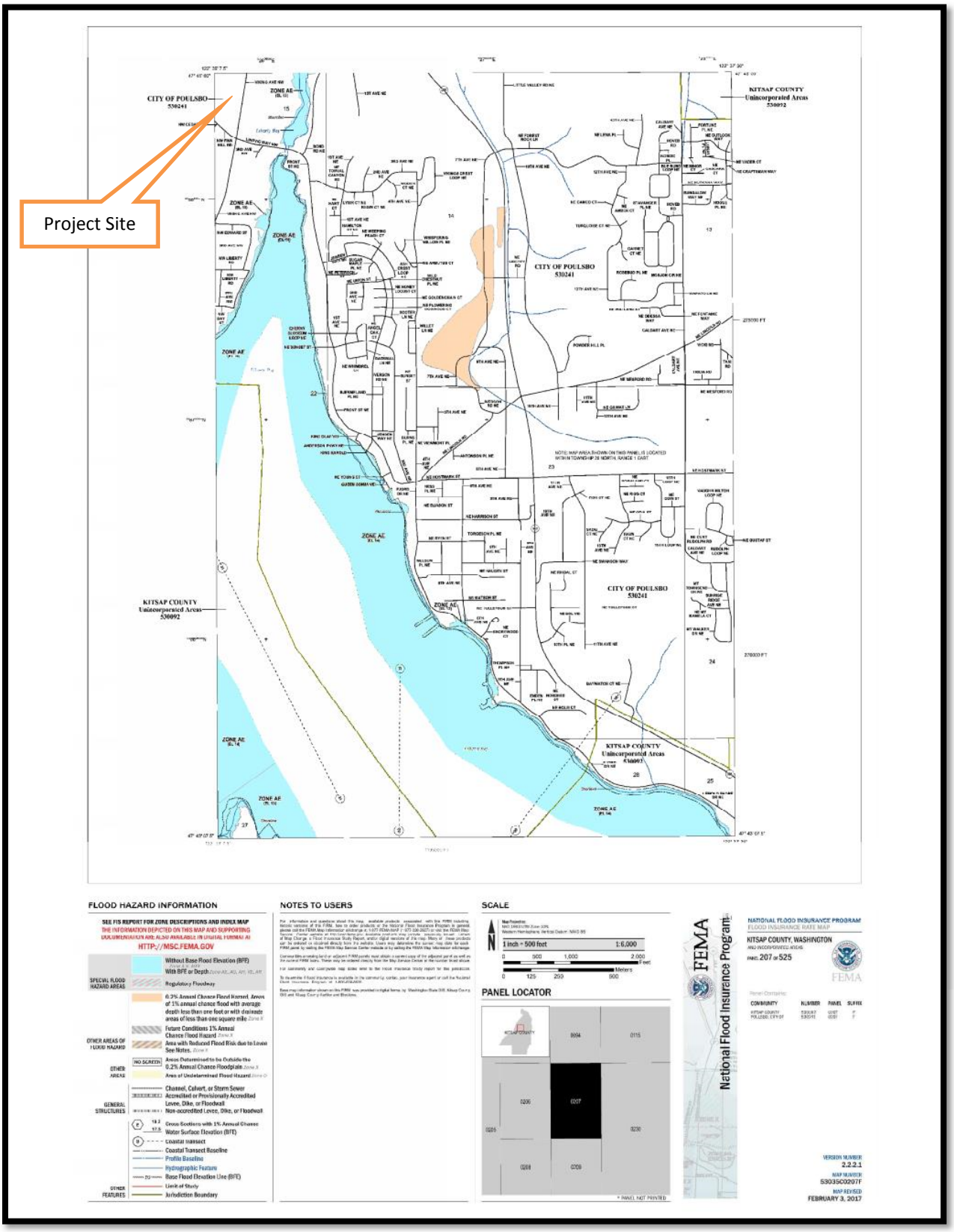


Figure 9: FEMA FIRM

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

All erosion and sediment control measures shall be governed by the requirements of the City of Poulsbo and the 2012 Manual. A temporary erosion and sedimentation control plan has been prepared and full CSWPPP will be provided prior to construction.

THIRTEEN ELEMENTS OF CSWPPP

Element 1: Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.
- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable. If it is not practicable to retain the duff layer in place, it should be stockpiled on-site, covered to prevent erosion, and replaced immediately upon completion of the ground disturbing activities.

Element 2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route, if possible, or two for linear projects such as roadways where more than one access is necessary for large equipment maneuvering.
- Access points shall be stabilized with a pad of quarry spalls or crushed rock prior to traffic leaving the construction site to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on-site, if applicable.
- If sediment is tracked off site, public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather, if necessary to prevent sediment from entering waters of the state. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
- Street wash wastewater shall be controlled by pumping back onsite, or otherwise be prevented from discharging into systems tributary to state surface waters.

Element 3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- Downstream analysis is necessary if changes in flows could impair or alter conveyance systems, stream banks, bed sediment or aquatic habitat.
- Where necessary to comply with Minimum Requirement #7, stormwater retention/detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e. g. impervious surfaces).
- The local permitting agency may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.

- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

Element 4: Install Sediment Controls

- Prior to leaving a construction site, or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The Local Permitting Authority shall inspect and approve areas stabilized by means other than pavement or quarry spalls.
- Sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.
- BMPs intended to trap sediment on site must be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.

Element 5: Stabilize Soils

- All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion.
- From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
- Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and when possible, be located away from storm drain inlets, waterways and drainage channels.
- Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so that:
    - from October 1 through April 30 no soils shall remain exposed and unworked for more than 2 days; and
    - from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days.

Element 6: Protect Slopes

- Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Off-site stormwater (run-on) shall be diverted away from slopes and disturbed areas with interceptor dikes 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 shall handle the peak flow from a 10 year, 24 hour event assuming a Type 1A rainfall distribution. Alternatively, the 10-year and 25-year, 1-hour flow rates indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. Consult the local drainage requirements for sizing permanent pipe slope drains.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Check dams shall be placed at regular intervals within channels that are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.

Element 7: Protect Drain Inlets

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- All approach roads shall be kept clean. All sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the State.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced 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

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected 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.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

Element 9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste). On-site fueling tanks shall include secondary containment.

- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash or tire bath wastewater, shall be discharged to a separate on-site treatment system or to the sanitary sewer.
- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources 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, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause or contribute to a violation of the water quality standard for pH in the receiving water.
- Construction sites with significant concrete work shall adjust the pH of stormwater if necessary to prevent violations of water quality standards.

Element 10: Control De-Watering

- Foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through a stormwater sediment pond.
- Highly turbid or otherwise contaminated dewatering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, 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 sewer discharge with local sewer district approval, if there is no other option, or 5) use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Element 11: Maintain BMPs

- All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMP specifications.
- All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element 12: Manage the Project

- Phasing of Construction - Development projects shall be phased where feasible in order to prevent soil erosion and, to the maximum extent practicable, the transport of sediment from the site during construction. Re-vegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.
- Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e. g. , subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.
- Seasonal Work Limitations - From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:
  1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters; and
  2. Limitations on activities and the extent of disturbed areas; and
  3. Proposed erosion and sediment control measures.

  Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. The local permitting authority shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:
  - If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
  - If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

  The following activities are exempt from the seasonal clearing and grading limitations:
  1. Routine maintenance and necessary repair of erosion and sediment control BMPs;
  2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
  3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.
- Coordination with Utilities and Other Contractors - The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

  Inspection and Monitoring - All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. The person must have the skills to 1) assess the site conditions and construction activities that could impact the quality of stormwater, and 2) assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

- For construction sites one acre or larger that discharge stormwater to surface waters of the state, a Certified Erosion and Sediment Control Specialist shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be obtained through an approved training program that meets the erosion and sediment control training standards established by Ecology. Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.
- Maintaining an Updated Construction SWPPP - The Construction SWPPP shall be retained on-site or within reasonable access to the site.
  The SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
  The SWPPP shall be modified, if during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) calendar days following the inspection.

Protect Low Impact Development BMPs

- Protect all bioretention and rain garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on the portions of the site that drain into bioretention and/or rain garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Pavements fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures from the city of Bellevue stormwater manual (now or hereafter amended), or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID BMPs that have been excavated to final grade to retain the infiltration rate of the soils.

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 and Trap
- 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.

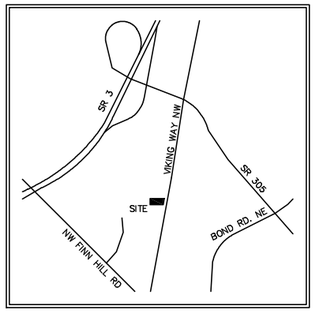
Because vegetative cover is the most important form of erosion control, construction practices must adhere to stringent cover requirements. More specifically, the contractor will not be allowed to leave soils open for more than 14 days and, in some cases, immediate seeding will be required.

Temporary Sediment Trap
The temporary sediment trap was sized using WWHM2012 in accordance with the 2017 Standards. The provided surface area is 1,450 SF, which meets the required surface area based on the WWHM2012 output as indicated below:

2 * (2-year peak developed flow) / 0.00096 = 2 * (0.695 CFS) / 0.00096 = 1,447.92 SF

APPENDIX A

SITE EXHIBITS



VICINITY MAP
NOT TO SCALE

MERIDIAN:
CITY OF POULSBO SHORT PLAT NO. 114399.

LEGEND

---BP---BP---	BURIED POWER
---BT---BT---	BURIED TELEPHONE
---FL---FL---	FOG LINE
---G---G---	GAS
---ML---ML---	MEDIAN LINE
---SD---SD---	STORM DRAIN
---SS---SS---	SANITARY SEWER
---W---W---	WATER
B.	BOLLARD
B.O.H.	BUILDING OVERHANG
B.S.B.L.	BUILDING SETBACK LINE
C.	CEDAR
C.B.	CATCH BASIN
C.L.	CENTERLINE
C.O.	CLEAN OUT
D.	DECIDUOUS
F.	FIR
F.H.	FIRE HYDRANT
F.P.	FLAG POLE
H.H.	HAND HOLE
L.	LUMINAIRE
MAD.	MADRONNA
M.H.	MANHOLE
O.D.	ORDER DEVICE
P.	PINE
P.T.	POWER TRANSFORMER
P.V.	POWER VAULT
R.O.W.	RIGHT OF WAY
T.P.O.B.	TRUE POINT OF BEGINNING
T.R.	TELEPHONE RISER
T.S.	TRAFFIC SIGN
W.M.	WATER METER
W.V.	WATER VALVE
+00.0	SPOT ELEVATION

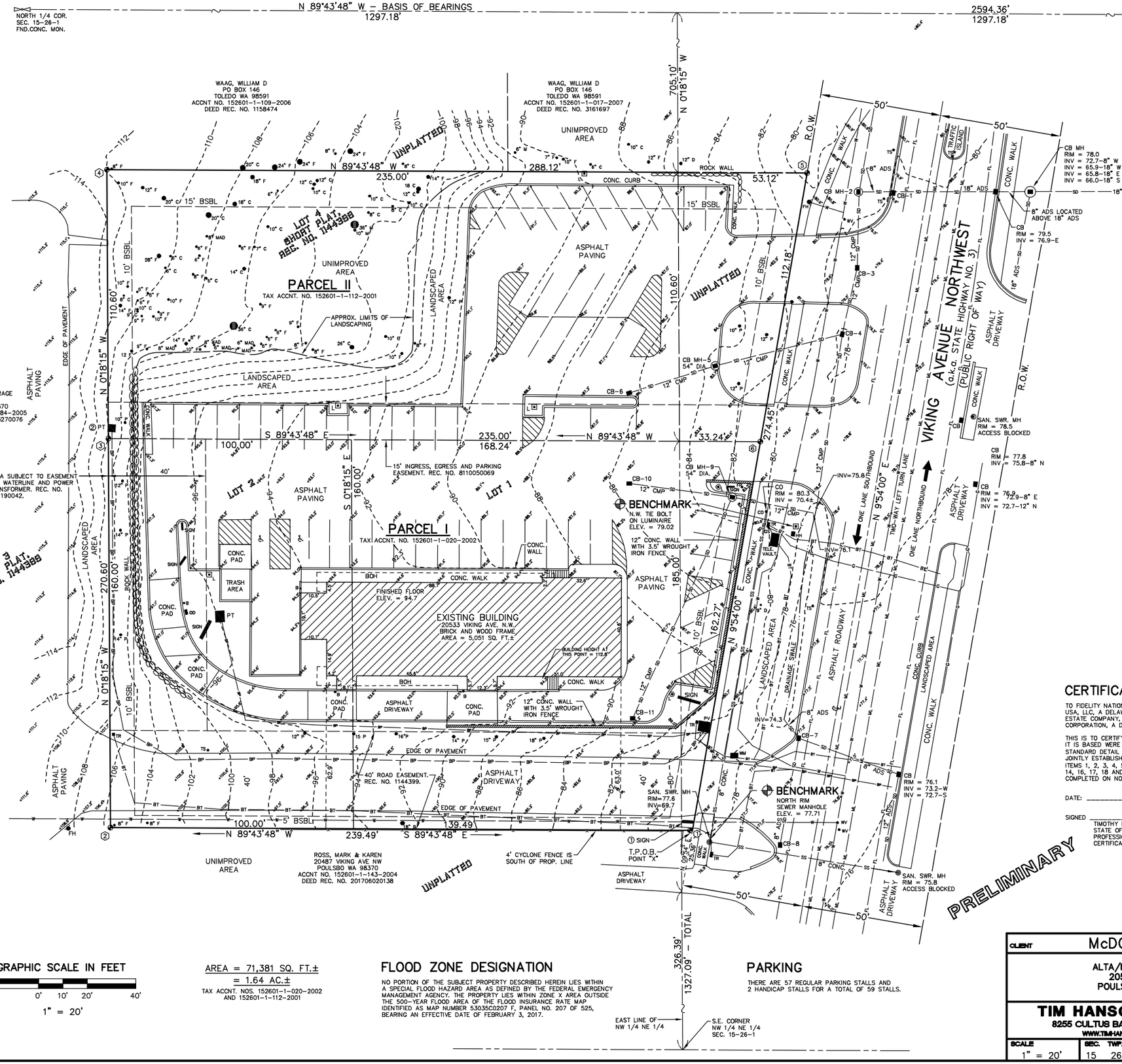
NOTE:
THE UTILITIES SHOWN HEREON, UNLESS SHOWN WITH SURFACE APPURTENANCES, ARE PER PUBLIC RECORD ONLY. PRIOR TO ANY CONSTRUCTION AND/OR EXCAVATION, THEIR EXACT LOCATION SHOULD BE DETERMINED BY CALLING ONE-CALL LOCATE AT 1-800-424-5555.

ZONING C-2 VIKING

THE PROPERTY AND PROPERTIES TO THE WEST AND SOUTH ARE ZONED C-2 VIKING. THE PROPERTY TO THE NORTH IS ZONED RESIDENTIAL MEDIUM.

FRONT YARD SETBACK:	10'
SIDE YARD SETBACK:	5'
REAR YARD SETBACK:	10'
SIDE OR REAR YARD SETBACK ADJACENT TO R ZONE:	15'
MAX. AVE. BUILDING HEIGHT:	35'

NOTE: ZONING INFORMATION SHOWN IS THE RESULT OF LOCAL RESEARCH. THE ALTA/NSPS REQUIRED ZONING LETTER OR REPORT WAS NOT PROVIDED.



GRAPHIC SCALE IN FEET
20' 0' 10' 20' 40'
1" = 20'

AREA = 71,381 SQ. FT.±
= 1.64 AC.±
TAX ACCNT. NOS. 152601-1-020-2002 AND 152601-1-112-2001

FLOOD ZONE DESIGNATION

NO PORTION OF THE SUBJECT PROPERTY DESCRIBED HEREIN LIES WITHIN A SPECIAL FLOOD HAZARD AREA AS DEFINED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY. THE PROPERTY LIES WITHIN ZONE X AREA OUTSIDE THE 500-YEAR FLOOD AREA OF THE FLOOD INSURANCE RATE MAP IDENTIFIED AS MAP NUMBER 53035C0207 F, PANEL NO. 207 OF 525, BEARING AN EFFECTIVE DATE OF FEBRUARY 3, 2017.

PARKING

THERE ARE 57 REGULAR PARKING STALLS AND 2 HANDICAP STALLS FOR A TOTAL OF 59 STALLS.

PROJECT BENCHMARK

WSDOT GP18305-47

BRASS DISC MONUMENT IN CASE LOCATED ON EAST SIDE OF SR 305 APPROX. 0.1 MILES SOUTH OF SR 307.

ELEV. = 30.213'

DATUM – NAVD 88

CORNER LEGEND ○

1. SET 5/8" REBAR WITH PLASTIC CAP OFFSET 1.00' WEST; LS 18903.
2. SET 5/8" REBAR WITH PLASTIC CAP; LS 18903.
3. SET 5/8" REBAR WITH PLASTIC CAP; LS 18903.
4. SET 5/8" REBAR WITH PLASTIC CAP; LS 18903.
5. SET 5/8" REBAR WITH PLASTIC CAP; LS 18903.
6. SET MAG NAIL WITH WASHER; LS 18903.

ENCROACHMENT LEGEND ○

1. SIGN AT SOUTHEAST CORNER ENCROACHES
2. TRANSFORMER ALONG EAST PROPERTY LINE IS OUTSIDE OF EASEMENT AREA.

STORM DRAIN SCHEDULE

CB-1
RIM = 79.9
INV. = 77.5-W

CB MH-2
RIM = 80.9
INV. = 72.2-N,S
INV. = 70.8-E
8" E. UNACCESSIBLE

CB-3
RIM = 79.3
INV. = 73.7-N,S

CB-4
RIM = 77.5
INV. = 74.4-N,S,E

CB MH-5
RIM = 83.6
INV. = 79.2
OVERFLOW ELEV. BLOCKED

CB-6
RIM = 86.0
INV. = 84.0-E

CB-7
RIM = 77.1
INV. = 74.0-S,NW
INV. = 73.8-E

CB-8
RIM = 76.4
INV. = 74.6-N

CB MH-9
RIM = 82.7
INV. = 76.9-E,W,S
12" OVERFLOW = 74.9

CB-10
RIM = 85.5
INV. = 82.7-E

CB-11
RIM = 89.3
INV. = 86.4-N

CERTIFICATE

TO FIDELITY NATIONAL TITLE COMPANY OF WASHINGTON; MCDONALD'S USA, LLC, A DELAWARE LIMITED LIABILITY COMPANY; MCDONALD'S REAL ESTATE COMPANY, A DELAWARE CORPORATION; AND MCDONALD'S CORPORATION, A DELAWARE CORPORATION:

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 1, 2, 3, 4, 5, 6(A), 6(B), 7(A), 7(B), 7(C), 8, 9, 11, 13, 14, 16, 17, 18 AND 19 OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED ON NOVEMBER1, 2017.

DATE: _____

SIGNED _____
TIMOTHY E. HANSON
STATE OF WASHINGTON
PROFESSIONAL LAND SURVEYOR
CERTIFICATE NO. 18903

TIMOTHY E. HANSON STATE OF WASHINGTON 18903 REGISTERED PROFESSIONAL LAND SURVEYOR

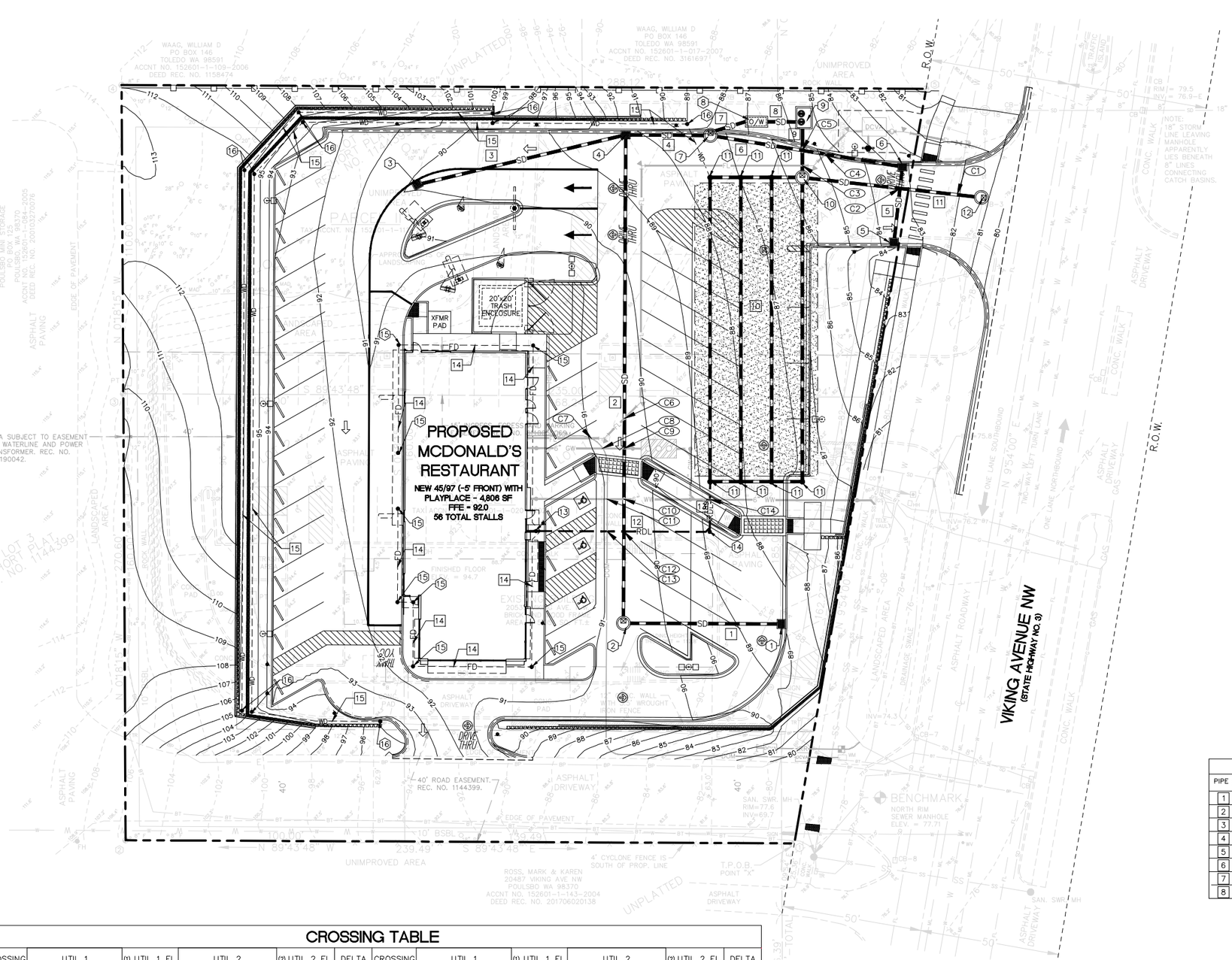
PRELIMINARY

SHEET 1 OF 2

CLIENT	McDONALD'S CORPORATION
	ALTA/NSPS LAND TITLE SURVEY AT 20553 VIKING AVENUE NORTHWEST, POULSBO, KITSAP COUNTY, WASHINGTON

TIM HANSON AND ASSOCIATES, INC.
8255 CULTUS BAY ROAD CLINTON, WA 98236 (425) 822-7271
WWW.TIMHANSONASSOCIATES.COM TIMHANSON@WHIDBEY.COM

SCALE	SEC.	TWP.	RGE.	FIELD BOOK	DATE	PROJECT NO.
1" = 20'	15	26	1	183	NOV. 2017	17013



LEGEND:

SCALE: 1 INCH = 20 FEET

- STORM DRAINAGE PIPE — SD — (6-03A/C-2.2) (6-05/C-2.2)
- ROOF DRAIN LEADER — RDL — (6-03A/C-2.2) (6-05/C-2.2)
- FOOTING DRAIN — FD — (6-03A/C-2.2) (6-05/C-2.2) (3/C-2.3)
- WALL DRAIN — WD —
- INFILTRATION TRENCH (3/C-2.4)
- TYPE 1/1L CATCH BASIN (5-01/C-2.3) (5-02/C-2.3)
- TYPE 2 CATCH BASIN (5-03/C-2.3)
- STORM DRAIN CLEANOUT (1/C-2.3) (2/C-2.3)
- CONTECH STORMWATER FILTER (2/C-2.4)
- OIL/WATER SEPARATOR O/W (1/C-2.4)

NOTE: 18" STORM LINE LEAVING MANHOLE APPARENTLY LIES BENEATH 8" LINES CONNECTING CATCH BASINS.

STRUCTURE SCHEDULE

#	DESCRIPTION	#	DESCRIPTION
1	CB TYPE 1 RIM = 88.40 12" IE = 85.40	10	TYPE 2-48" WITH SOLID LID RIM = 85.64 12" IE = 77.25 12" IE = 82.25
2	TYPE 2-48" WITH SOLID LID RIM = 90.57 12" IE = 85.11	11	12" STORM CLEANOUT RIM = TO FINISH GRADE 12" IE = 77.25
3	CB TYPE 1 RIM = 89.93 12" IE = 86.93	12	REMOVE EXISTING CB AND REPLACE WITH TYPE 2-48" NEW RIM = 81.2± EX. 12" IE = 73.7± (N,S) NEW 12" IE = 73.7± (W)
4	CB TYPE 1L WITH SOLID LID RIM = 88.11 12" IE = 84.23	13	6" STORM CLEANOUT RIM = 91.93 12" IE = 84.97
5	CB TYPE 1 RIM = 83.59 12" IE = 80.59	14	6" STORM CLEANOUT RIM = 88.87 6" IE = 76.66
6	CB TYPE 1 RIM = 83.13 12" IE = 80.13	15	4" STORM CLEANOUT RIM = TO FINISH GRADE 4" IE = AS REQ'D TO MEET 0.5% MINIMUM PIPE SLOPE.
7	TYPE 2-48" WITH GRATED LID RIM = 87.28 12" IE = 79.78	16	4" WALL DRAIN CLEANOUT RIM = TO FINISH GRADE 4" IE = AS REQ'D TO MEET 1.0% MINIMUM PIPE SLOPE. (SEE WALL PLANS BY OTHERS FOR DETAILS)
8	OIL/WATER SEPARATOR MODEL 660-CPS RIM = 86.77 12" IE = 79.71 (1/C-2.4)		
9	CONTECH STORMWATER FILTER RIM = 85.60 12" IE = 79.65 12" IE = 77.35 (2/C-2.4)		

PIPE SCHEDULE

PIPE #	DIAMETER	LENGTH (FT.)	SLOPE (FT./FT.)	PIPE #	DIAMETER	LENGTH (FT.)	SLOPE (FT./FT.)
1	12" CPEP	57	.005	9	12" CPEP	20	.005
2	12" CPEP	175	.005	10	105'L x 44'W x 5'D INFILTRATION TRENCH (SEE SHEET C-2.4 FOR DETAILS)		
3	12" CPEP	77	.035				
4	12" CPEP	30	.148	11	12" CPEP	65	.132
5	12" CPEP	27	.017	12	6" CPEP (RDL)	62	.134
6	12" CPEP	70	.005	13	6" CPEP (RDL)	18	.134
7	12" CPEP	14	.005	14	4" PERFORATED PVC	.005 MIN.	
8	12" CPEP	13	.005	15	4" WALL DRAIN (SEE WALL PLANS BY OTHERS FOR DETAILS)	.010 MIN.	

CROSSING TABLE

CROSSING	UTIL 1	(1) UTIL 1 EL.	UTIL 2	(2) UTIL 2 EL.	DELTA	CROSSING	UTIL 1	(1) UTIL 1 EL.	UTIL 2	(2) UTIL 2 EL.	DELTA
C1	12" STORM	75.85	EX. 8" WATER MAIN	76.35	0.50'	C8	6" SEWER (GW)	82.96	2" WATER (DOM)	85.75	2.79'
C2	12" STORM	78.58	12" STORM	80.27	1.69'	C9	6" SEWER (GW)	82.81	12" STORM	84.80	1.99'
C3	12" STORM	78.27	6" WATER (FIRE)	81.83	3.56'	C10	6" SEWER (WW)	82.42	12" STORM	84.89	2.47'
C4	12" STORM	80.99	6" WATER (FIRE)	81.83	0.84'	C11	6" SEWER (WW)	82.54	2" WATER (DOM)	85.80	3.26'
C5	12" STORM	78.30	12" STORM	79.95	1.65'	C12	6" STORM (RDL)	84.45	12" STORM	84.95	0.50'
C6	12" STORM	84.75	6" WATER (FIRE)	85.25	0.50'	C13	6" STORM (RDL)	85.30	2" WATER (DOM)	85.80	0.50'
C7	2" WATER (DOM)	85.75	6" WATER (FIRE)	85.25	0.50'	C14	6" STORM (RDL)	78.76	6" SEWER (WW)	81.14	2.38'

(1) ALL UTILITY 1 ELEVATIONS ARE TO CROWN OF PIPE, UNLESS OTHERWISE NOTED.

(2) ALL UTILITY 2 ELEVATIONS ARE TO INVERT OF PIPE, UNLESS OTHERWISE NOTED.
18" MIN. CLEARANCE, WATER / SAN. SEWER
6" MIN. CLEARANCE ALL OTHER CROSSINGS

(2) UTILITY 2
(1) UTILITY 1

SEE SHEETS C-2.2, C-2.3, AND C-2.4 FOR GRADING AND DRAINAGE NOTES AND DETAILS.

SPOT ELEVATIONS SHOWN ALONG CURB LINES ARE SHOWN AT TOP OF PAVEMENT ELEVATION UNLESS OTHERWISE NOTED.

ALL CATCH BASINS SHALL BE STAMPED WITH "OUTFALL TO STREAM, DUMP NO POLLUTANTS"

NAVIX
SITE | CIVIL
11400 s.e. 8th street | suite 345
bellevue, wa 98004
t: 425.453.9501 | f: 425-453-8208
www.navixeng.com

CLIENT/OWNER

MCDONALD'S USA, LLC

PROJECT NAME

McDonald's
RESTAURANT REDEVELOPMENT

NAVIX PROJECT NUMBER: 50-127-057

PROJECT ADDRESS

20533 VIKING AVE NW POULSBO, WA 98370

STAMP

VENESSA E. ELIZABETH TIPPIN — STATE OF WASHINGTON — 41872 — REGISTERED PROFESSIONAL ENGINEER
04/xx/2018

REVISIONS

REV	ISSUED FOR:	DATE
1	PRE-APPLICATION	01.22.18
2	INITIAL SUBMITTAL	04.XX.18

SECTION, TOWNSHIP, RANGE:

NW 1/4 AND NE 1/4 OF NE 1/4 OF SECTION 15, TOWNSHIP 26 NORTH, RANGE 01 EAST, W.M.

PROJECT TEAM

REVIEWED BY: J.TAFLIN
DESIGNED BY: J.GREEN

SHEET NAME

DRAINAGE PLAN

SHEET NUMBER

C-2.0

B:\Washington\Poulsbo\MCD\2017\2Drawings\POMD_120C.dwg Apr 12, 2018 - 12:33pm

APPENDIX B

OPERATION AND MAINTENANCE MANUAL

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. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	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. 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.
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
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. 15 – Manufactured Media Filters)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

No. 17 – Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Facet International
a CLARCOR company

Operations & Maintenance Manual for Concrete Vault Type Oil/Water Separator using Facet International Coalescing Plate Packs

Table of Contents

(Low to Moderate Solids Content Design)

1 .0 INTRODUCTION

The Facet International, Inc. MPak® vault system (See Figure 1) is an enhanced gravity separation system for the removal of oil and solids from wastewater. Oil droplets, being lighter (lower specific gravity) than water, tend to rise and separate from the wastewater. In a similar manner, the higher specific gravity (heavier) solids particles fall to the bottom of the separator.

The Facet International MPak system enhances this separation by the use of special patented coalescing plates (U.S. Patent No. 4,897,206) to remove droplets much more efficiently than simple gravity separators.

The separator contains an inlet separation section set off from the rest of the separator by an inlet weir, a plate section, and an outlet section set off by an outlet weir.

The coalescing plates are made of calcium carbonate-filled polypropylene, stacked and bound together with sturdy rods and supports into modular plate packs known as MPaks. MPaks are available in either 1/4" or 1/2" nominal plate spacing. Spacing to be utilized will be based on the conditions and separation efficiency required.

The oil/water mixture flows into the separator and enters the coalescing plates. As the oil/water mixture passes horizontally through the plates, the oil droplets rise to meet the bottom of the next plate above them, where they are collected. From this point the oil droplets merge to form larger droplets that will rise through the holes located in the peaks. The oil droplets will continue to rise to the top of the separator to form an oil layer, which can then be removed periodically from the top of the separator by means of a vacuum truck or portable skimming device. Frequency of oil removal from the separator that is required will depend on the amount of oil entering the unit. An estimate of the quantity of oil to be captured by the separator may be found in the separator quotation. Actual oil removed depends on the amount of oil entering the separator. Optional equipment could include standpipe type skimmers that would remove the oil from the separator to an (optional) oil holding tank.

Most of the solids drop into the bottom of the inlet collection area. Some additional solids enter the plate packs and are separated there. Solid particles that are captured by the plate packs fall to the bottom of the plate area through the solids removal holes in the "valleys" of the plates. Space has been provided under the plates for these solids. The MPaks are designed to be cleaned in place with an optional cleaning wand (See section 5.3 Maintenance).

2.0 SYSTEM DESCRIPTION AND REQUIREMENTS

Note: The following description of a separator is a general one and some systems may vary due to differing requirements.

2.1 Inlet Section

In the inlet section of the separator, gross amounts of oil including all large drops will rise to the surface by gravity. Large solid particles will fall to the bottom and remain there until removed by

vacuum truck or other means. The inlet section is separated from the plate section by the inlet weir. Please see Figure 1 for a cutaway of the separator showing this weir.

2.2 MPak (Coalescing Plate Pack) Section

The MPak area of the separator will contain one to three rows of plate packs. The number and size of plate packs are determined by the process design conditions. These coalescing plate packs will be either 1/4" or 1/2" nominal plate spacing. A typical detail of the installation of packs is shown as Figure 2.

Oil droplets not large enough to separate in the inlet chamber enter the plate packs and are captured on the underside of the plates. The oil droplets then merge to form larger droplets and run upward along the sloped bottom of the plates to the holes located in the peaks. The oil exits the holes at the peaks and rises vertically to the surface. The processed water flows out of the coalescing plate region under the oil dam into the outlet section.

2.3 Outlet Section

The outlet section is equipped with a weir arrangement that causes the water to flow under the first weir (oil dam) and over the second weir. This effectively traps any separated oil in the first two sections of the separator.

Water flows out of the area beyond the second weir and exits the separator.

2.4 Skimmers (optional)

The optional oil skimmers allow the oil to flow out of the separator to a holding tank. A skimmer should be located at each end of the separator. The skimmers are vertically adjustable to allow for variations in oil level that occur due to variations in the inlet oil level concentration as well as variations in water flow.

The skimmers are adjustable up or down by turning the locknuts on the supporting bracket. When adjusting the skimmers, first rotate the upper part of the skimmer (expansion joint) to loosen it before making vertical adjustments with the locknuts. The inner tube moves inside the outer pipe to get the necessary adjustments. The oil flows over the top of the skimmer and down into the connecting pipe to the oil holding tank (if provided). The skimmer should be adjusted so that the top of the skimmer is less than 3/8 inch above the waste water level with very little oil accumulated and with a normal flow rate. Access to the skimmer adjustment is through the access cover.

If floating or other type skimmers are provided, refer to manufacturer's instructions on installation/adjustment of these devices.

3.0 SAFETY

a) Normal fire prevention measures should be enforced around oil.

b) Care should be taken in keeping the area clean as oil/water mixtures can be dangerous, toxic, or hazardous.

4.0 SYSTEM INSTALLATION

Flow into the separator should be controlled at the recommended flow rate for the particular application. The maximum allowable flow rate may be found on the computer sizing provided with the quotation. The vault must be vented to the atmosphere through the top covers. The flow through the separator is normally gravity flow.

If a pump is used for the inlet oil/water mixture, it is recommended that a positive displacement pump or an air diaphragm pump be used. This will minimize the emulsification so the performance of the separator will not be adversely affected. Use of centrifugal pumps, globe valves or other high shear devices can cause unduly small droplet sizes and reduce performance.

Excessive pressure drop in the inlet piping must be avoided, as this will cause emulsification of the oil, which will adversely affect the separator performance.

The separator vault should be level to within 1/16 inch per foot and adequately strong to support the weight of the separator full of water. In areas where the water table fluctuates, care should be taken to ensure that the vault will not be damaged if it is empty when the water table rises.

It is recommended that the water effluent pipe (in addition to the inlet pipe) be gravity flow. The outlet pipe must be arranged so as to be free flowing. If the outlet pipe is too small or has a high-pressure drop, water will “back up" into the separator, causing problems. External piping should be supported separately, not supported from the separator.

To install the separator, follow these steps:

1) Connect the oil/water inlet piping to separator inlet connection (Figure 1). It is recommended that a full port ball valve of the same size as the inlet piping be installed in the influent line to control the flow. The inlet valve (if provided) should be located at least ten pipe diameters upstream of the separator. **NOTE:** Excessive throttling causes turbulence and emulsification. Emulsification may adversely affect separator performance.

2) Connect the water outlet piping to the water outlet connection (Figure 1). No valving is necessary as the weir will control the height of the oil/water mixture in the separator.

5.0 SYSTEM OPERATION

5.1 Initial Start-Up

The following procedure shall be followed after the installation of the Separator or after the Separator has been drained or pumped out and is ready to be restarted. This procedure assumes that the separator is delivered with plates installed. If plates are to be field installed, follow the procedure provided in the Maintenance section below.

1) Ensure there are no obstructions in the oil outlet or water outlet pipe.

2) Remove cover (or open access hatches).

3) Fill tank with clean water to avoid contaminating the Separator outlet area with oil.

4) Open the (user supplied) inlet valve to allow the oil/water mixture into the tank. Adjust for the desired flow rate as shown on the nameplate or on the proposal if no nameplate is attached. Calculations which include flow rate have been provided with the proposal.

5) Check to see if there is an oil build-up on the surface.

6) With flow at the required flow and some (at least 1/8") oil accumulation, set the oil skimmer to 3/8 inch above the water level.

7) Check for leaks of water into the oil.

8) Determine if effluent meets requirements after 15 minutes of run time. (optional)

9) Replace cover (or close hatches) after oil begins to flow out of the skimmer pipe (if provided).

5.2 Normal Operation

Do not exceed the recommended flow rate, which has been previously determined. The unit can operate at any flow less than what is recommended.

The flow of skimmed oil out of the skimmer pipe, once a sufficient quantity of oil has accumulated in the Separator, varies with the concentration of oil entering the system. Only oil should be removed since the oil outlet skimmer is set above the water level. Oil is lighter than water so the oil will rise higher than the water level and be skimmed off if the skimmer is adjusted properly.

NOTE: An oil layer will always remain on the surface when the skimmer is adjusted properly.

If skimmers are not provided, it is necessary to remove oil with a vacuum truck or portable skimmer. Frequency of oil removal will be a function of oil concentration in the inlet. IT IS THE RESPONSIBILITY OF THE OWNER TO REMOVE OIL PROMPTLY TO ENSURE ONLY OIL GETS OUT OF THE SEPARATOR AND NOT INTO THE OUTLET LINE. If the oil is not removed regularly, it may accumulate in enough volume to displace most of the water in the separator and eventually begin going under the oil dam.

The frequency of solids removal is dependent on the solids concentration in the influent and can best be determined during operations.

5.3 Maintenance

1) After the initial month of operation, the vault should be cleaned out as follows:

   a) Remove cover (or open hatches).

   b) Lower oil skimmer(s) if provided to remove all the accumulated oil or pump the oil layer out of the vault.

   c) Remove water from the vault.

   d) Clean the vault by flushing with a hose and examine the plates for blockage.

   e) Remove accumulated sludge with a vacuum truck or positive displacement pump such as an air operated diaphragm pump. Dispose of the sludge properly as it will contain some hydrocarbons.

   f) To re-start operations, follow the steps in Section 5.1 Initial Start-up.

   NOTE: If sludge level is 6" or more in the inlet chamber, the cleaning interval should be shortened. If less that 6" depth, interval can be increased.

2) After approximately (3) three months in operation, the Separator vault and plates should be cleaned. Inspect the inlet chamber and the entrance to the plate packs. If sludge is accumulating in the inlet chamber verify if accumulation is taking place in the plate pack entrance. If no sludge is apparent in the plate packs, clean inlet chamber and proceed with "Start-up" as defined in Section 5.1 - Initial Start-Up. If sludge is apparent in the plates of a depth 3" or less from the bottom, flush plates with water hose and return to operation. If sludge is 3" or greater, clean plates and establish a more frequent cleaning schedule or a method to reduce the inflow of solids. Minimum maintenance should not extend past six-month intervals.

Generally cleaning of the plate packs without removing them from the vault is recommended if it is possible to access the top of the plates safely. Two methods may be used to clean the plates:

NOTE: **DO NOT** disassemble the plate packs.

5.3 Maintenance (cont.)

a) Cleaning in place with a pressurized cleaning wand:

To clean the plates, connect an (optional) cleaning wand to regular city water pressure. Check the wand to ensure that the inlet screen is in place. The wand should be provided with a valve to start and stop the water flow. A positive displacement "Sandpiper" type pump or vacuum truck should be provided for removal of the solids (along with some water) after they have been fluidized by the cleaning process.

The procedure used is as follows:

1. Using the cleaning wand or a hose, fluidize the dirt in the inlet chamber and suck it out with the pump, along with some water.

2. Insert the wand in one of the cleaning holes in the row nearest the inlet of the pack. Start water flow through the wand to begin moving the solids out of the inlet end of the pack into the area immediately in front of the plates where the pump could remove them.

3. Push the wand gently down into the cleaning hole until it reaches bottom, maintaining water flow through the wand. Move the wand up and down through the hole to ensure that the plates in the vicinity of the hole are thoroughly cleaned.

4. Move the wand to another cleaning hole in the same row and repeat the process.

5. Continue cleaning the area served by each hole in turn until the entire pack area has been cleaned of solids.

Repeat steps 1-5 above for each pack.

b) Flushing with fire hose or steam:

Clean the plate pack assemblies by flushing with water from the sides. A 1-1/2 inch fire hose at 10-15 psi or a standard garden hose at normal city water pressure (30-35 psi) are effective cleaning tools. In a similar manner, steam can also be used to flush plate packs, but CARE MUST BE TAKEN TO NOT GET THE PLATES TOO HOT. **NOTE**: Plates do not need to be cleaned until white. A thin coating of oil does not harm performance of the system.

It may be necessary to remove some or all of the packs for cleaning outside of the vault if the fire hose method is utilized.

In addition to cleaning the plates, clean the skimmers and oil removal pipes (if provided) by flushing with a hose and hot water.

Hose down the interior of the vault and remove any oil and solids with the vacuum hose.

NOTE: Caution should be taken that cleaning does not result in a pollution problem.

5.4 Re-installation of coalescing plate packs (if they have been removed).

To replace the plates, follow this procedure:

1) The plate packs are designed to fit snugly within the separator.

2) Position plate packs in the same configuration (rows) as when removed.

3) Install plate packs one at a time, one row in length and one row in width, being sure the outer packs are adequately sealed against the vault wall in the same manner as before they were removed.

4) After all packs are installed, check to ensure that the packs are even and touching, forming one (or two if provided) rows of packs across the channel and that they are securely butted against the backing angle at the bottom of the separator. Please see Figure 2 for a sketch of this angle installation. Install the upper channel to ensure the plates are secured in place.

5) Secure hold down channel per Figure 2, ensuring it is snugly in place.

6) Check to see that no possibility of fluid by-passing can occur around the plates and the side wall of the tank as well as between plate pack assemblies since this could adversely affect the efficiency of the separator.

7) Re-start the separator as outlined in section 5. 1, Initial Start-Up.

CONTECH STORMWATER SOLUTIONS

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Stormwater Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.

3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water in the cartridge bay for more that 24 hours after end of rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Stormwater Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Stormwater Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Stormwater Solutions for suggested attachment devices.

Important: Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Stormwater Solutions performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
   a. If desired, apply a light coating of FDA approved silicon lube to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe.
   b. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Stormwater Solutions.

Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

RECYCLED PAPER

CONTECH STORMWATER SOLUTIONS

800.925.5240
contechstormwater.com

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

CONTECH® STORMWATER SOLUTIONS INC.

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

CONTECH® STORMWATER SOLUTIONS INC.

APPENDIX C

GEOTECHNICAL REPORT

GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

THE RILEY GROUP, INC.
17522 BOTHELL WAY NORTHEAST
BOTHELL, WASHINGTON 98011

PREPARED FOR:

MCDONALD'S USA, LLC
12131 113TH AVENUE NORTHEAST, SUITE 103
KIRKLAND, WASHINGTON 98034

RGI PROJECT NO. 2017-210

POULSBO MCDONALD'S 46-0134
20533 VIKING AVENUE NORTHWEST
POULSBO, WASHINGTON 98370

NOVEMBER 10, 2017

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

RILEYGROUP

November 10, 2017

Mr. Adam Brandenburg
McDonald's USA, LLC
12131 113th Avenue Northeast, Suite 103
Kirkland, Washington 98034

Subject: **Geotechnical Engineering Report**
Poulsbo McDonald's 46-0134
20533 Viking Avenue Northwest
Poulsbo, Washington 98370
RGI Project No. 2017-210

Dear Mr. Brandenburg:

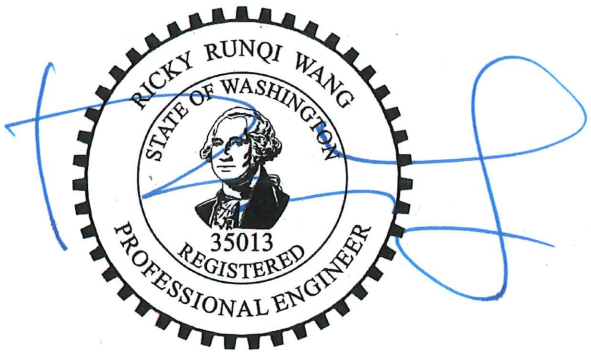
As requested, The Riley Group, Inc. (RGI) has prepared this Geotechnical Engineering Report (GER) for the above-referenced site. Our services were completed in accordance with our proposal PRP2017-292 dated September 13, 2017 and authorized by McDonald's USA, LLC on the same day. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the borings completed by RGI at the site on October 25, 2017.

RGI recommends the project plans and specifications be submitted for a general review so that RGI may confirm that the recommendations in this GER are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this GER.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

THE RILEY GROUP, INC.



11/10/2017

Ricky R. Wang, PhD, PE
Principal Engineer

TABLE OF CONTENTS

LIST OF APPENDICES

Executive Summary

This Executive Summary should be used in conjunction with the entire GER for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and this GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of six borings to depths up to 16.5 feet below ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified.

Soil Conditions: The site is underlain by up to 7.5 feet of loose to dense fill consisting of silty sand with trace of gravel to gravelly sand with trace of silt over native soil. The native soil is medium dense to very dense gravelly sand with trace of silt to sand with trace of gravel and silt.

Groundwater: Groundwater seepage was encountered from 10 to 11.5 feet bgs in three of our borings.

Foundations: Foundations for the proposed building can be supported on conventional continuous and spread footings bearing on medium dense native soil or structural fill.

Slab-on-grade: Slab-on-grade floors for the proposed building can be supported on compacted native soil.

Pavements: The following pavement sections are recommended:

- **For heavy truck traffic areas**: 4 inches of Hot Mix Asphalt over 8 inches of crushed rock base (CRB)
- **For general parking areas**: 3 inches of Hot Mix Asphalt over 6 inches of CRB
- **For drive-thru areas**: 5 inches of concrete over 4 inches of CRB

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the proposed Poulsbo McDonald's 46-0134 in Poulsbo, Washington. The purpose of this GER is to assess subsurface conditions and provide geotechnical recommendations for the construction of a new McDonald's restaurant. Our scope of services included field explorations, laboratory testing, engineering analyses, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, RGI should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project Description

The project site is located at 20533 Viking Avenue Northwest in Poulsbo, Washington. The approximate location of the site is shown on Figure 1.

The site is currently occupied by an existing McDonald's building with associated drive-thru on the site. RGI understands that the existing structures will be demolished and a new McDonald's building and associated drive aisles and drive-thru will be constructed at the site.

Our understanding of the project is based on Site Sketch A prepared by Freiheit and Ho Architects dated July 3, 2017. RGI anticipates that the proposed building will be supported on perimeter walls with bearing loads of 1 to 2 kips per linear foot, and a series of columns with a maximum load up to 50 kips. Slab-on-grade floor loading of 250 pounds per square foot (psf) are expected. RGI also expects that no major grading will be needed to reach the final grade.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On October 25, 2017, RGI observed the drilling of six borings. Borings B-2, B-3, and B-6 were drilled close to the existing building and B-1, B-4, and B-5 were located in the parking area. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist who continuously observed

the drilling. These logs included visual classifications of the materials encountered during drilling as well as our interpretation of the subsurface conditions between samples. The boring logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 LABORATORY TESTING

During the field investigation, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Samples retrieved from the borings were tested for moisture content and grain size analysis to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 SURFACE

The site is a trapezoidal-shaped parcel of land about 0.93 acre. The site is bound to the north by undeveloped property, to the west and south by commercial properties, and to the east by Viking Avenue Northwest.

The site is occupied by an existing McDonald's building in the middle of the site and paved parking. The existing building will be demolished to make way for the new restaurant about 5,218 square feet in the same area.

4.2 GEOLOGY

Review of the *Geologic Map of the Washington - Southwest Quadrant – Timothy J. Walsh* (1987) indicates that the soil in the project vicinity consists of undifferentiated outwash deposits (Map Unit Qgo), which is recessional and proglacial stratified sand and gravel; locally contains silt and clay. The native soil observed at the boring locations appears to match the description.

4.3 SOILS

The site is underlain by up to 7.5 feet of loose to dense fill consisting of silty sand with trace of gravel to gravelly sand with trace of silt over native soil. The native soil is medium dense to very dense gravelly sand with trace of silt to sand with trace of gravel and silt. The fill was encountered in Borings B-5 and B-6 to 2 and 7.5 feet respectively.

More detailed descriptions of the subsurface conditions encountered are presented in the borings are included in Appendix A. Sieve analyses were performed on five selected soil samples. The grain-size distribution curves are included in Appendix A.

4.4 GROUNDWATER

Groundwater seepage was encountered from 10 to 11.5 feet bgs in three of our borings. Based on the geology and the time of the field exploration was performed, RGI expects that the groundwater level should represent is near the season low static level. We expect groundwater will be higher in the winter and spring months.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation.

4.5 SEISMIC CONSIDERATIONS

Based on the 2012/2015 International Building Code (IBC), RGI recommends the follow seismic parameters in Table 1 be used for design.

Table 1 IBC Seismic Parameters

2012/2015 IBC Parameter	Value
Site Soil Class[1]	D[2]
Site Latitude	47.74935 N
Site Longitude	122.65519 W
Maximum considered earthquake spectral response acceleration parameters (g)	S_s =1.305, S_1 =0.524
Spectral response acceleration parameters adjusted for site class (g)	S_{ms} =1.305, S_{m1} =0.786
Design spectral response acceleration parameters (g)	S_{ds} =0.870, S_{d1} =0.524

1 Note: In general accordance with the USGS *2012/2015 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2 Note: The *2012/2015 International Building Code* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 16.5 feet, and this seismic site class definition considers that similar soil continues below the maximum depth of the subsurface exploration.

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

RGI reviewed the soil conditions encountered during field exploration and assessed the potential for liquefaction of the site's soil during an earthquake. Based on the density of the sandy soils and the depth of the groundwater, the potential of soil liquefaction during an earthquake event is low to negligible.

4.6 GEOLOGIC HAZARD AREAS

Regulated geologically hazardous areas include erosion, landslide, earthquake, or other geological hazards. Based on the conditions observed on the site, the site does not contain geologically hazardous areas.

5.0 Discussion and Recommendations

5.1 GEOTECHNICAL CONSIDERATIONS

Based on our study, the site is suitable for the proposed construction from a geotechnical standpoint. The foundations for the proposed building can be supported on conventional spread footings bearing on competent native soil or structural fill. Slab-on-grade floors and pavements can be similarly supported. Loose soil may be encountered at the footing or slab subgrade and it should be recompacted or replaced with structural fill.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 EARTHWORK

RGI expects that site grading will consist of shallow cuts and fills to achieve building and pavement grades and excavation for utilities including storm, water, sanitary sewer, and other utilities.

5.2.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall

- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.2.2 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. The site soils consisted of loose to medium dense sand.

Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1.5:1 (Horizontal:Vertical). If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered. For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least 5 feet from the top of the cut.
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting.
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized.

- Surface water is diverted away from the excavation.
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures.

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2.3 Stripping and Site Preparation

Stripping should include removal of the existing foundations and pavements. The borings encountered 3 to 5 inches of asphalt concrete paving underlain by crushed rock base.

RGI anticipates that some areas of loose may be present on the site after stripping operations are complete. Prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should be proofrolled under the observation of RGI and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of a RGI representative. This observer will assess the subgrade conditions prior to filling.

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. In order to maximize utilization of site soils as structural fill, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather, if possible. If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond what would be expected during the drier summer and fall months.

5.2.4 Structural Fill

Once site preparation is complete, cuts and fills can be made to establish desired building grades. Prior to placing fill, RGI recommends proof-rolling as described above. RGI recommends fill below the foundation and floor slab, behind retaining walls, and below

pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is the moisture that results in the greatest compacted dry density with a specified compactive effort.

The native soil should be suitable for use as structural fill if the moisture can be properly controlled at the time of compaction. It may be necessary to import clean, granular soils to complete site work that meets the grading requirements listed in Table 2.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
4 inches	100
¾ inch	70 minimum
No. 4	35 to 60
No. 200	0 to 5*

*Based on minus 3/4 inch fraction.

Prior to use, a RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils	95	+2	-2
General Fill (non-structural areas)	On-site granular or approved imported fill soils	90	+3	-2
Pavement, Subgrade and Base Course	On-site granular or approved imported fill soils	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundation can be supported on conventional spread footings bearing on competent native soil or structural fill. Loose soil, if encountered at the footing subgrade, should be overexcavated and replaced with structural fill. Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf[1]
Friction Coefficient	0.25
Passive pressure (equivalent fluid pressure)	250 pcf[2]
Minimum foundation dimensions	Columns: 24 inches Walls: 16 inches

1 psf = pounds per square foot

2 pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because it can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.4. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

With spread-footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 RETAINING WALL

If retaining walls are needed for a detention vault or site retaining walls, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H for restrained walls should be applied to the wall surface. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in the Section 5.3.

5.5 SLAB-ON-GRADE CONSTRUCTION

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. We expect it will be possible to moisture condition and compact the native soil to the requirements of structural fill.

Immediately below the floor slab, RGI recommends placing a 4-inch-thick capillary break layer of clean, free-draining pea gravel, washed rock, or crushed rock that has less than 5

percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter-thick plastic membrane should be placed on a 4-inch-thick layer of clean gravel or rock.

For the anticipated floor slab loading, we estimate post-construction floor settlements of ¼- to ½-inch. For thickness design of the slab subjected to point loading from storage racks, RGI recommends using a subgrade modulus (K_S) of 150 pounds per square inch per inch of deflection.

5.6 DRAINAGE

5.6.1 SURFACE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE

RGI recommends installing perimeter foundation drains, details shown on Figure 3. The foundation drains and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge. Considering the native soil is fairly permeable, the footing drain may be eliminated in area covered by sidewalk or pavement.

5.6.3 INFILTRATION

RGI performed a field infiltration test at 7.5 feet in borings B-2. The soil encountered at the infiltration depth consisted of sand with 8 percent fines. The infiltration test was performed through the hollow stem auger. The field test was performed in general accordance with the falling head percolation test procedure (*Onsite Wastewater Treatment and Disposal Systems,* EPA, 1980). A field rate of 50 inches per hour was observed.

RGI also performed grain size analysis for the soil samples below the depth of infiltration test. The design saturated hydraulic conductivity was determined (*Section 3.3.6 of Stormwater Management Manual for Western Washington, 2012/2015*). Table 6 summarizes our results of analysis:

Table 6 Saturated Design Hydraulic Conductivity

Test Location	Test Depth (feet)	$K_{sat\ design}$
B-2	5	8.2 inches/hour
B-2	7.5	43 inches/hour
B-2	10	5.4 inches/hour
B-5	7.5	3.2 Inches/hour*
B-6	5	7.6 inches/hour

- D10 was estimated from the sieve

Based on field test result and the grain size analysis, RGI recommends that an allowable infiltration rate of 8 inches per hour be used. The bottom of the infiltration system should be at least 3 feet over the seasonal high groundwater level and should not be located in the area of B-5. The groundwater level at the time of drilling was 10 feet bgs and we expect it will rise during the wet season. Groundwater monitoring over the wet season may be required to determine wet season groundwater levels.

The soils exposed in the surface of the infiltration facility area should consist of sandy or gravelly soils. If an unsuitable layer is encountered, they should be over-excavated and replaced with gravel. A geotechnical engineer or geologist should observe the infiltration facility construction.

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Poulsbo specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.4. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by ASTM D1557. The native soils may be used as backfill provided they can be adequately moisture conditioned and compacted. Imported structural fill may be required for trench backfill.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.2 of this GER and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. This condition should be verified by proofrolling with heavy construction equipment or hand probe by inspector.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For heavy truck traffic areas**: 4 inches of Hot Mix Asphalt (HMA) over 8 inches of crushed rock base (CRB)
- **For general parking areas**: 3 inches of HMA over 6 inches of CRB

The asphalt paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for Hot Mix Asphalt Class 1/2 inch and CRB surfacing.

- **For drive-thru areas**: 5 inches of concrete over 4 inches of CRB

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than two percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a proposal.

7.0 Limitations

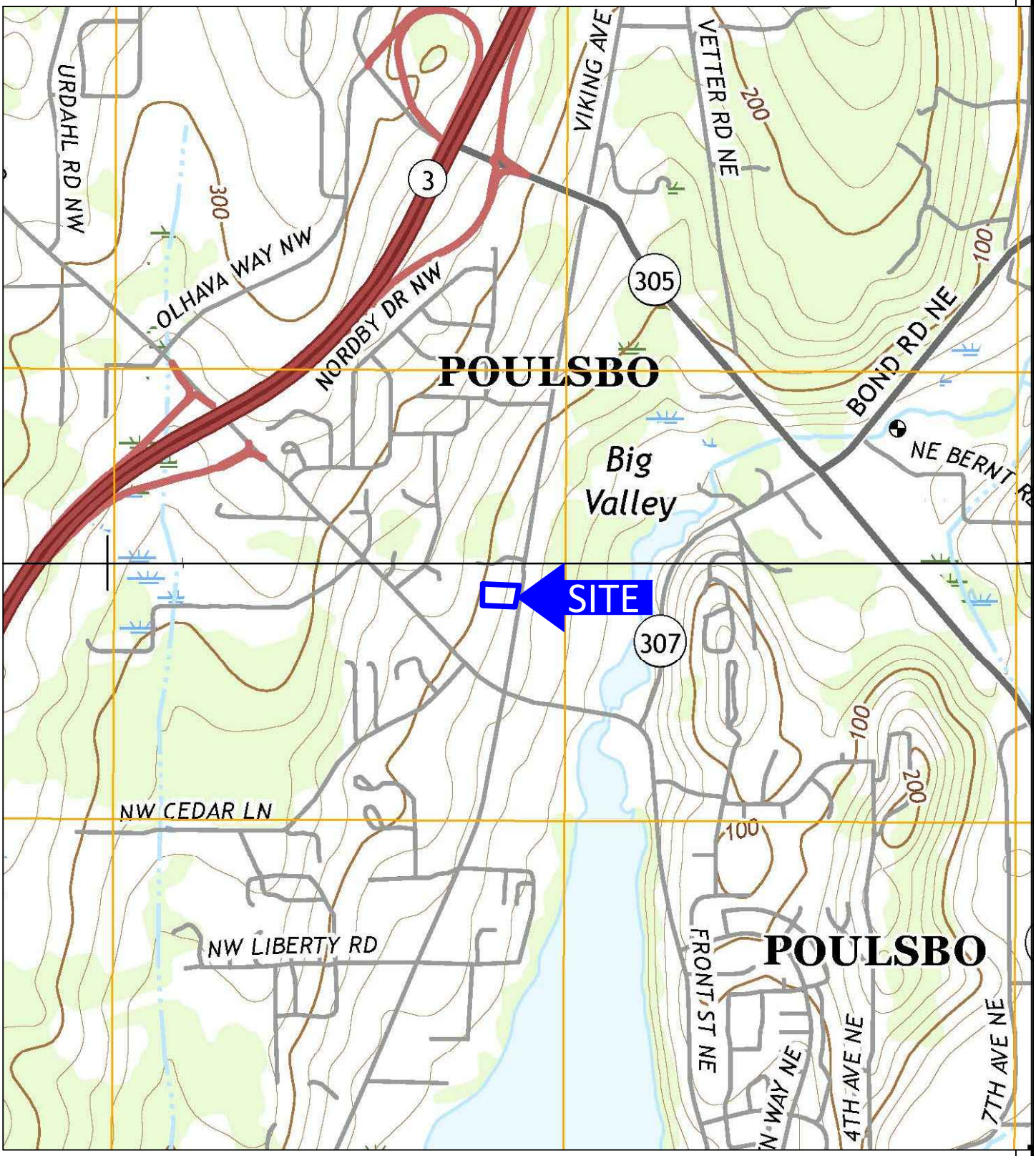
This GER is the property of RGI, McDonald's USA, LLC, and their designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This GER is intended for specific application to the Proposed Poulsbo McDonald's

46-0134 project at 20533 Viking Avenue Northwest in Poulsbo, Washington, and for the exclusive use of McDonald's USA, LLC and its authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this GER are based upon data obtained from the exploration performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

It is McDonald's USA, LLC's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this GER in its entirety. The use of information contained in this GER for bidding purposes should be done at the contractor's option and risk.



USGS, 2017, Lofall, Washington
USGS, 2017, Poulsbo, Washington
7.5-Minute Quadrangle

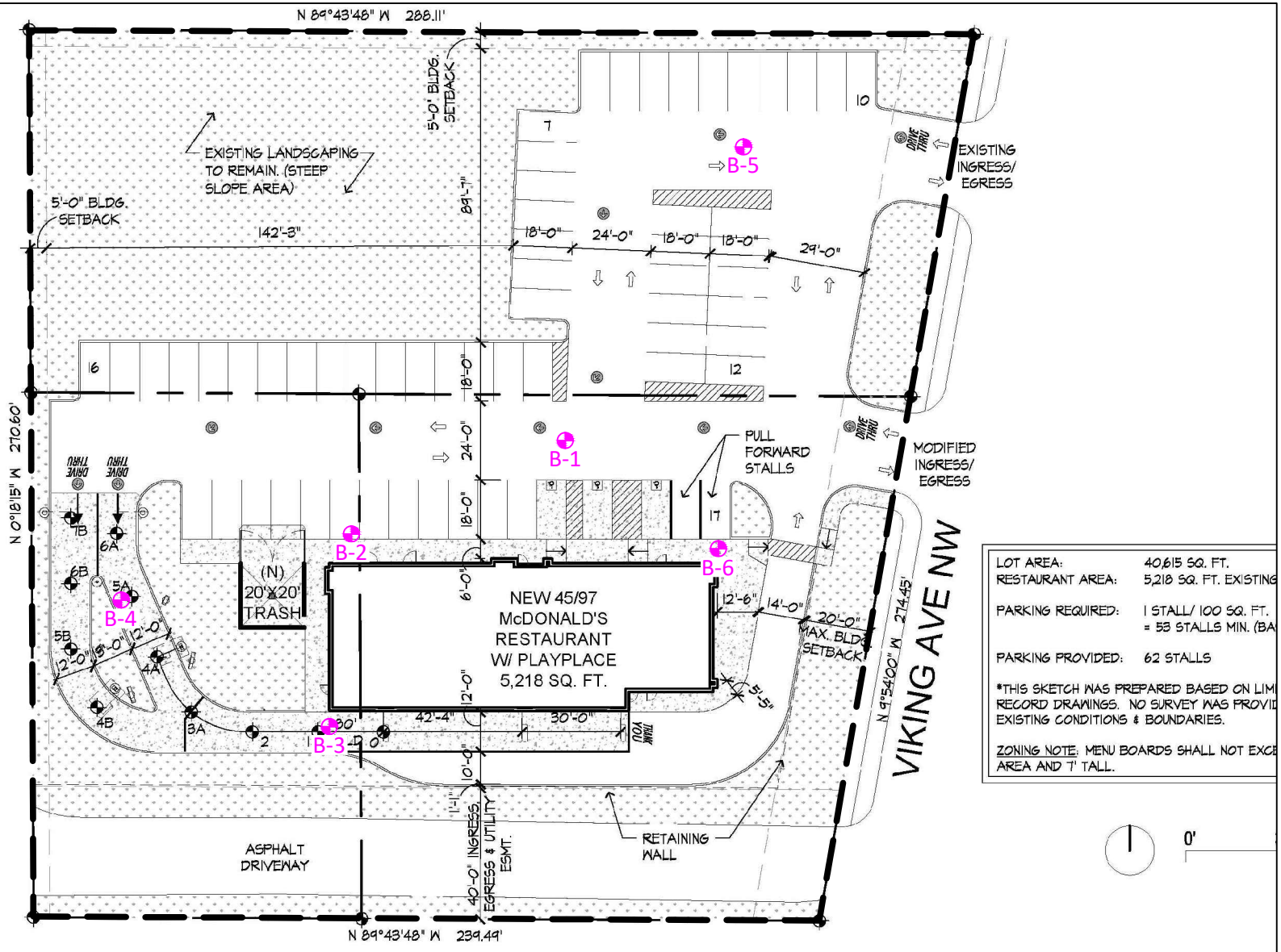
Approximate Scale: 1"=1000'

0 500 1000 2000

N

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

Poulsbo McDonald's 46-0134		Figure 1
RGI Project Number 2017-210	Site Vicinity Map	Date Drawn: 11/2017
Address: 20533 Viking Avenue Northwest, Poulsbo, Washington 98370		



Approximate Scale: 1"=80'

0 40 80 160

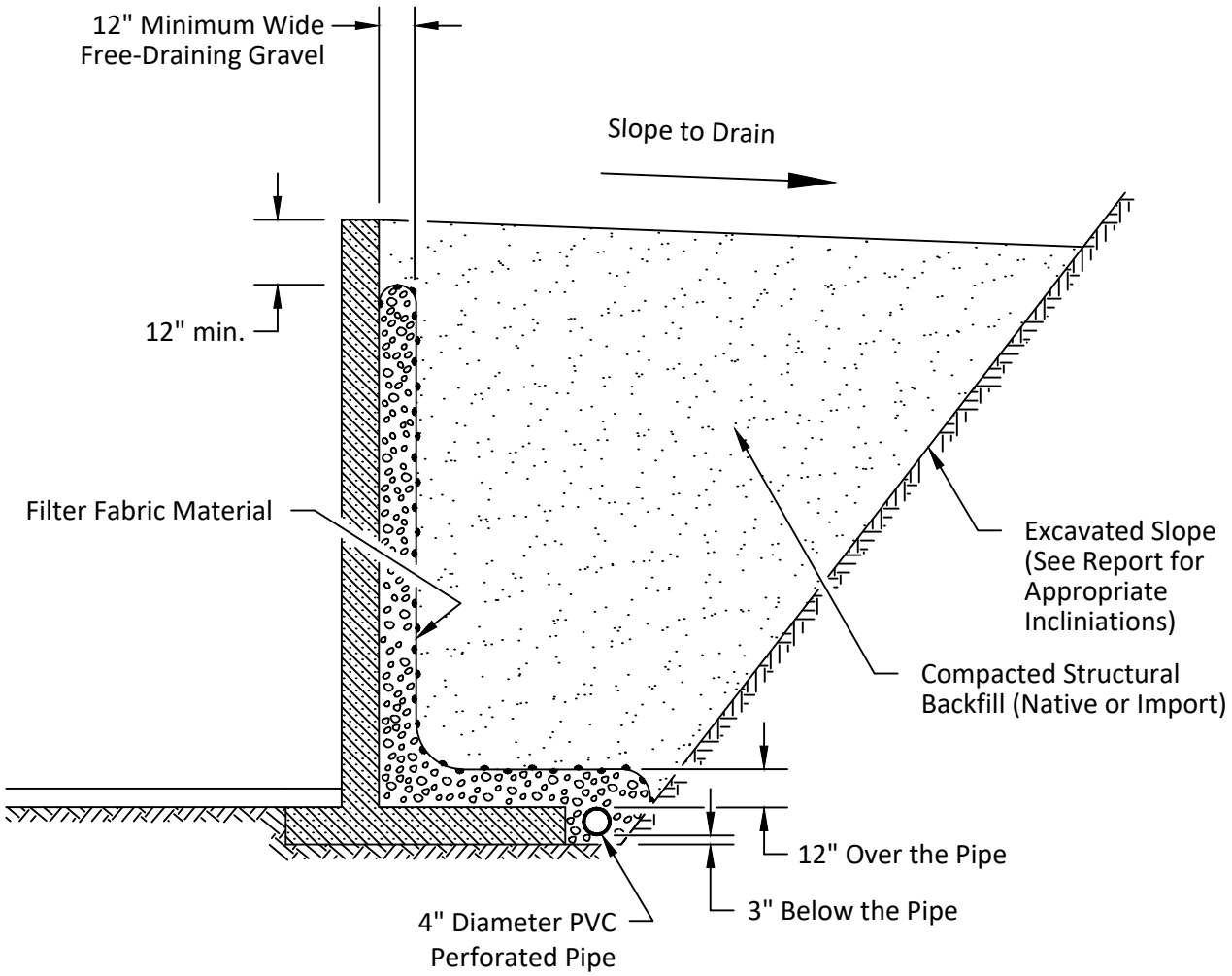
N

= Boring by RGI, 10/25/17

= Site boundary

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

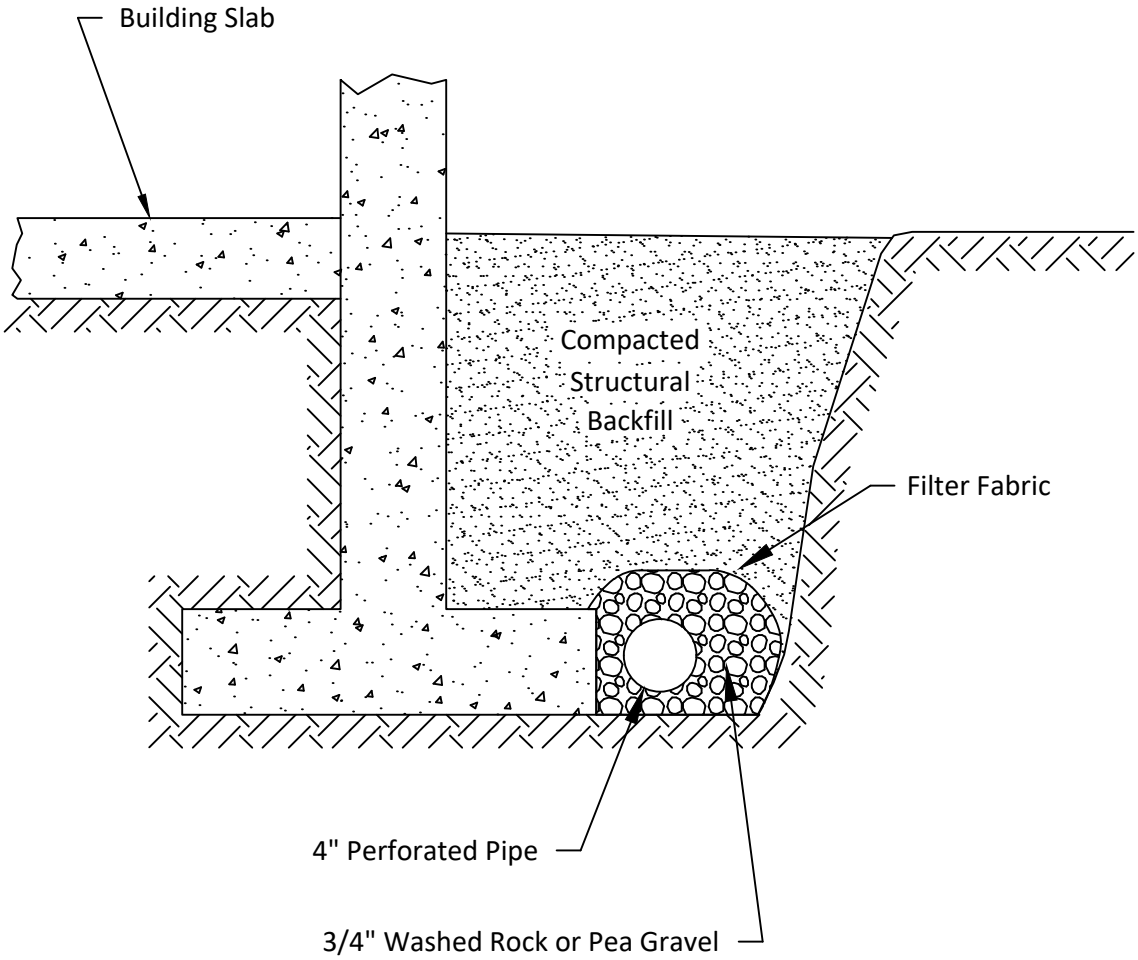
Poulsbo McDonald's 46-0134		Figure 2
RGI Project Number 2017-210	Geotechnical Exploration Plan	Date Drawn: 11/2017
Address: 20533 Viking Avenue Northwest, Poulsbo, Washington 98370		



Not to Scale

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

Poulsbo McDonald's 46-0134		Figure 3
RGI Project Number 2017-210	Retaining Wall Drainage Detail	Date Drawn: 11/2017
Address: 20533 Viking Avenue Northwest, Poulsbo, Washington 98370		



Not to Scale

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

Poulsbo McDonald's 46-0134		Figure 4
RGI Project Number 2017-210	Typical Footing Drain Detail	Date Drawn: 11/2017
Address: 20533 Viking Avenue Northwest, Poulsbo, Washington 98370		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On October 25, 2017, RGI explored the subsurface soil conditions at the site by observing the drilling of six borings to a maximum depth of 16.5 feet below existing grade. The boring locations are shown on Figure 2. The boring locations were approximately determined by measurements from existing property lines and paved roads.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with the American Society of Testing and Materials D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the boring logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses for the greater than 75 micrometer portion of the samples were performed in accordance with American Society of Testing and Materials D422 Standard Test Method for Particle-Size Analysis of Soils (ASTM D422) on five of the samples, the results of which are attached in Appendix A.

Project Name: **Poulsbo McDonald's 46-0134**
Project Number: **2017-210**
Client: **McDonald's USA, LLC**

RILEYGROUP

Boring No.: **B-1**
Sheet 1 of 1

Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **14 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **11.5 feet**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Asphalt		4.5" Asphalt concrete over crushed rock	
						SP		Light brown to gray, SAND with trace silt and gravel, very dense, damp to wet	
			B1-2.5	49					3%
	5								
			B1-7.5	87					6%
	10								
		▽						Groundwater seepage	
			B1-12.5	53					22%
	15							Boring terminated 14 feet bgs	
	20								
	25								
	30								

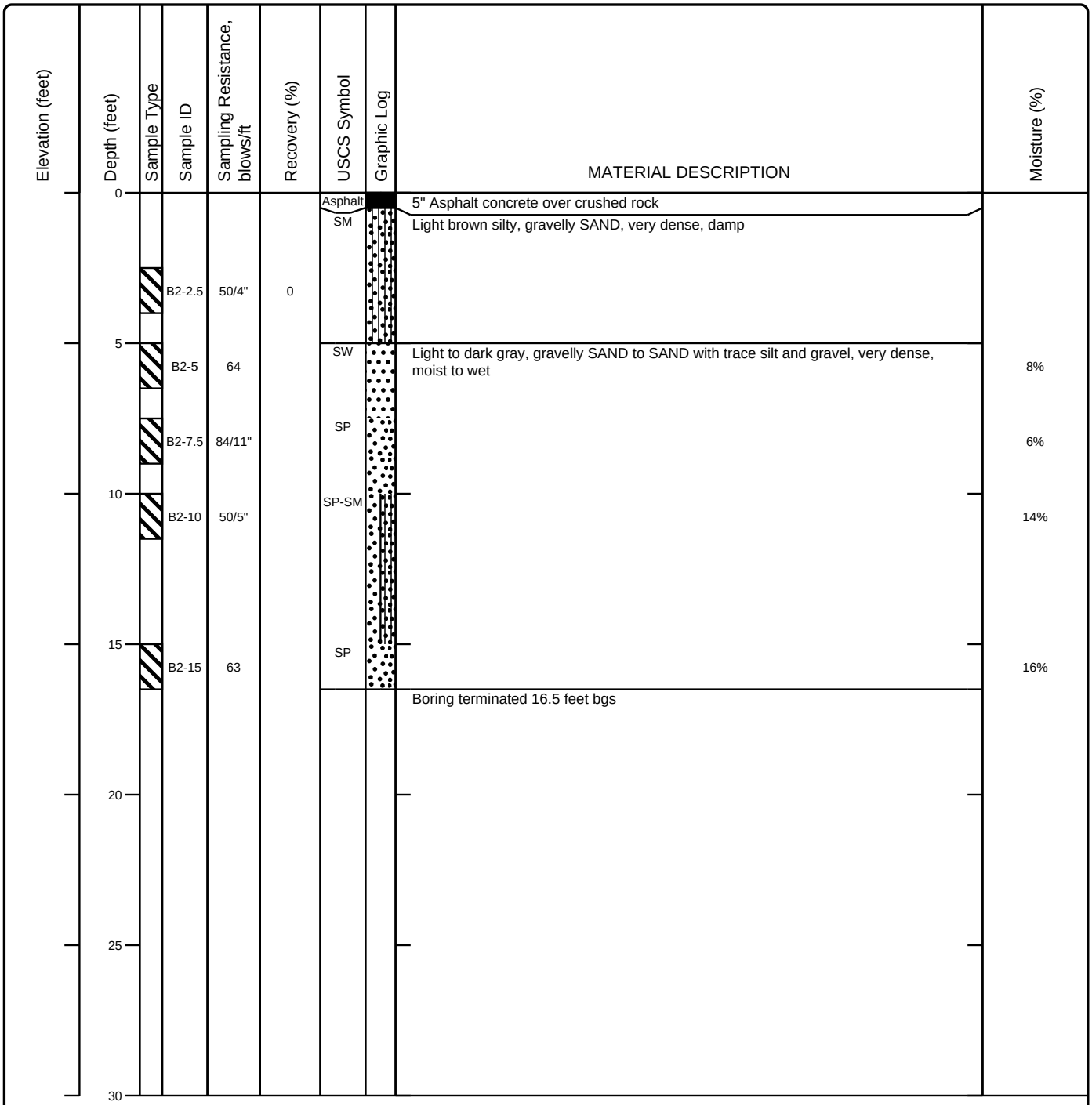
The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **Poulsbo McDonald's 46-0134**
Project Number: **2017-210**
Client: **McDonald's USA, LLC**

RILEYGROUP

Boring No.: **B-2**
Sheet 1 of 1

Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **16.5 feet**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **Not encountered**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	



Project Name: **Poulsbo McDonald's 46-0134**
Project Number: **2017-210**
Client: **McDonald's USA, LLC**

RILEYGROUP

Boring No.: B-3
Sheet 1 of 1

Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Gravel**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **15.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **Not encountered**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					SP		Dark brown to gray, SAND with gravel and trace silt to gravelly SAND, very dense, damp to moist	
			B3-2.5	84					9%
	5		B3-5	50/4"					7%
			B3-7.5	50/2"					5%
	10		B3-10	50/2"	0			No recovery	
	15		B3-15	50/3"	0			No recovery	
								Boring terminated 15.5 feet bgs	
	20								
	25								
	30								

The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **Poulsbo McDonald's 46-0134**
Project Number: **2017-210**
Client: **McDonald's USA, LLC**

RILEYGROUP

Boring No.: **B-4**
Sheet 1 of 1

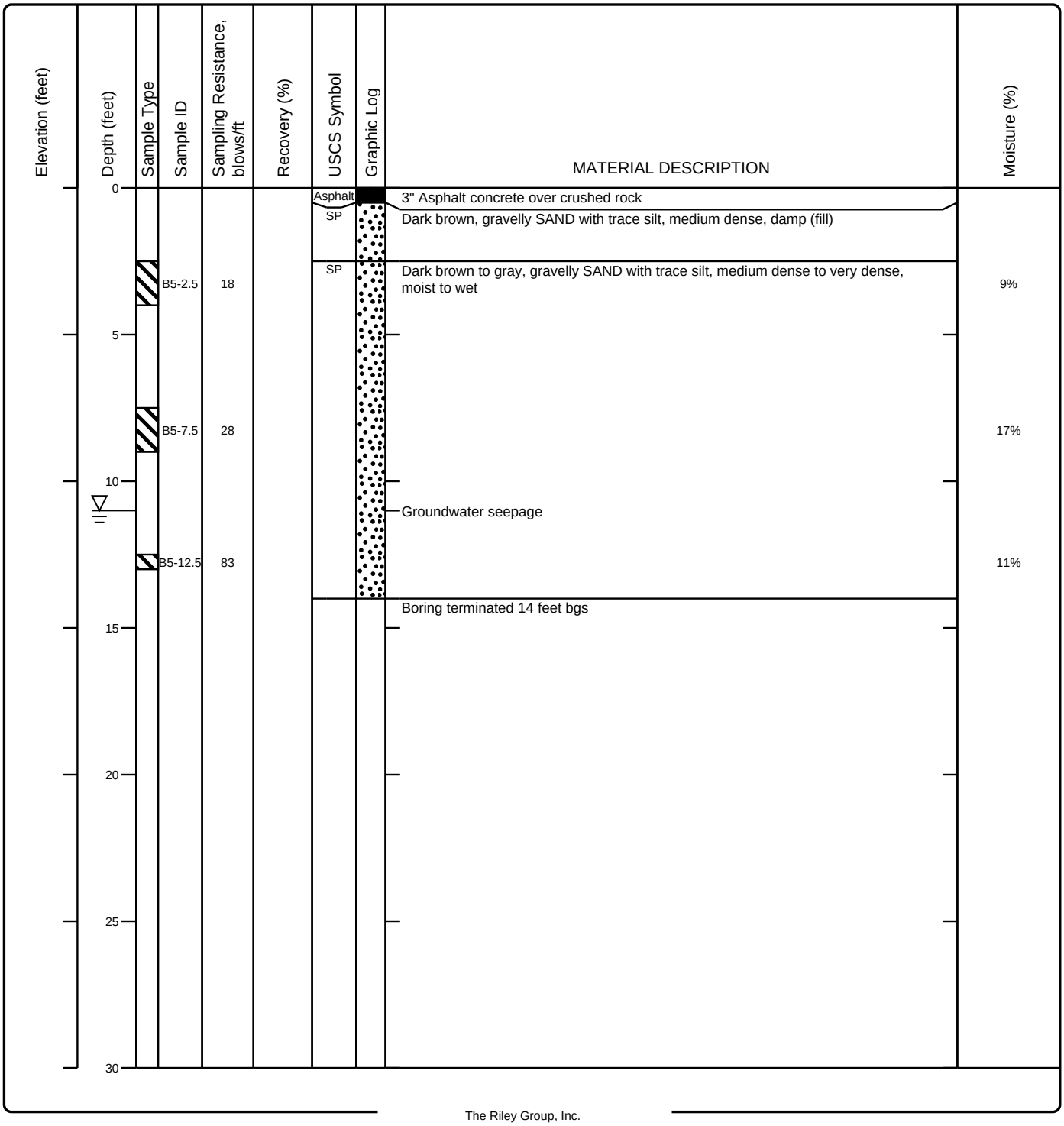
Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **13 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **Not encountered**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Asphalt		5" Asphalt concrete over crushed rock	
						SP		Light gray to brown, SAND with gravel and trace silt to gravelly SAND, very dense, damp to moist	
			B4-2.5	73					8%
	5								
			B4-7.5	73					5%
	10								
			B4-12.5	50/5"					4%
								Boring terminated 13 feet bgs	
	15								
	20								
	25								
	30								

The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **Poulsbo McDonald's 46-0134** Project Number: **2017-210** Client: **McDonald's USA, LLC**	Boring No.: **B-5** **Sheet 1 of 1**

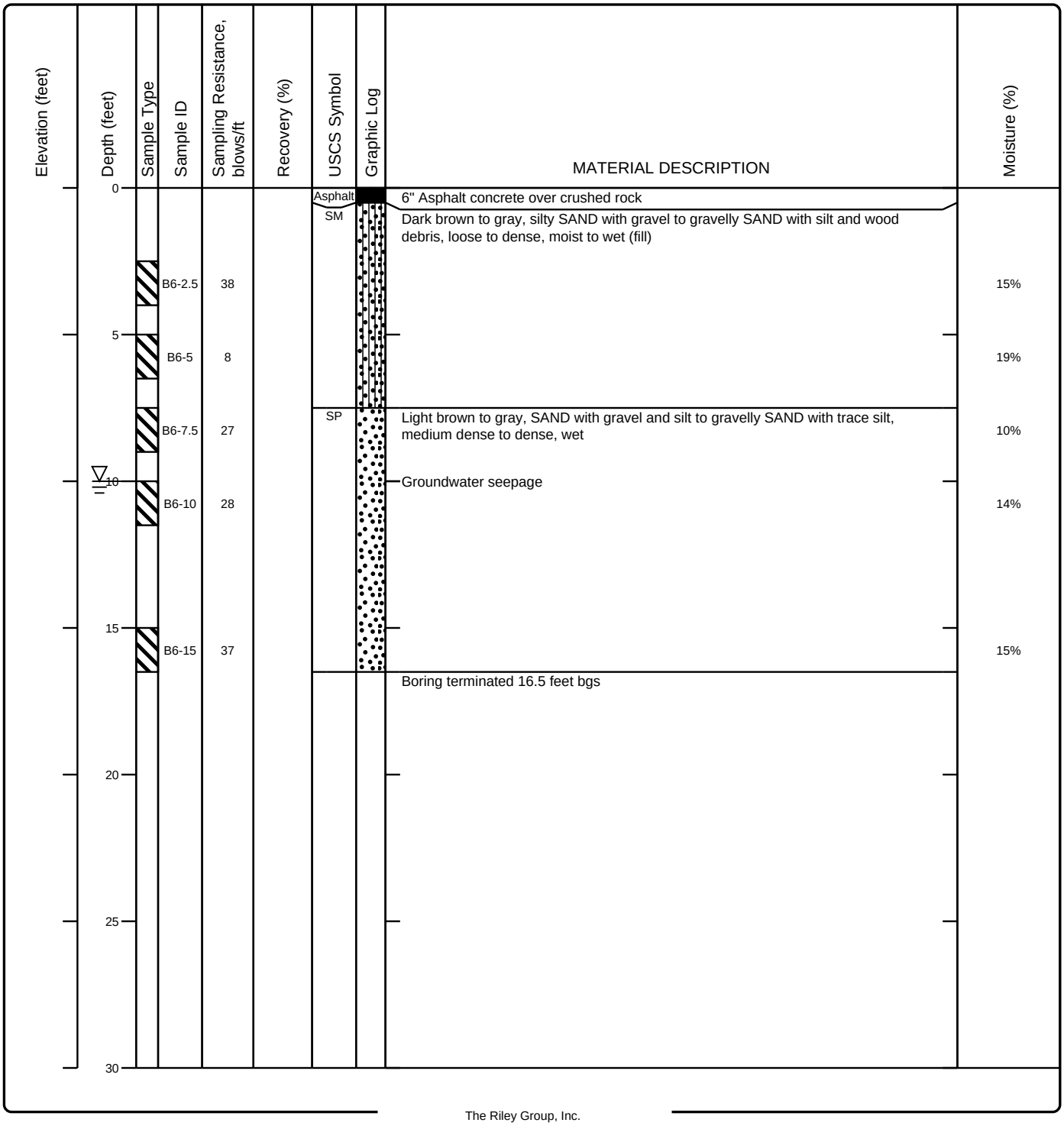
Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **14 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **11 feet**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **Poulsbo McDonald's 46-0134**	Boring No.: **B-6**
Project Number: **2017-210**	**Sheet 1 of 1**
Client: **McDonald's USA, LLC**	

Date(s) Drilled: **10/25/17**	Logged By: **AO**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6"**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **n/a**
Groundwater Level and Date Measured: **10 feet**	Sampling Method(s): **SPT**	Hammer Data : **140lbs, 30" drop**
Borehole Backfill: **Bentonite**	Location: **20533 Viking Avenue Northwest, Poulsbo, Washington 98370**	



Project Name: **Poulsbo McDonald's 46-0134**

Project Number: **2017-210**

Client: **McDonald's USA, LLC**

RILEYGROUP

Key to Log of Boring

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample ID: Sample identification number.
5. Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7. USCS Symbol: USCS symbol of the subsurface material.
8. Graphic Log: Graphic depiction of the subsurface material encountered.
9. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10. Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS


Asphaltic Concrete (AC)


Silty SAND (SM)


Poorly graded SAND (SP)


Poorly graded SAND with Silt (SP-SM)


Well graded SAND (SW)

TYPICAL SAMPLER GRAPHIC SYMBOLS


Auger sampler


Bulk Sample


3-inch-OD California w/ brass rings


CME Sampler


Continuous


Grab Sample


2.5-inch-OD Modified California w/ brass liners


Pitcher Sample


2-inch-OD unlined split spoon (SPT)


Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS


Water level (at time of drilling, ATD)


Water level (after waiting)


Minor change in material properties within a stratum

Inferred/gradational contact between strata

Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Poulsbo McDonald's		**SAMPLE ID/TYPE**	B2	
PROJECT NO.	2017-210		**SAMPLE DEPTH**	5'	
TECH/TEST DATE	LW	11/1/2017	**DATE RECEIVED**	10/30/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	558.8
Wt Dry Soil & Tare (gm)	(w2)	428.3
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	130.5
Weight of Dry Soil (gm)	(w5=w2-w3)	412.8
Moisture Content (%)	(w4/w5)*100	32

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

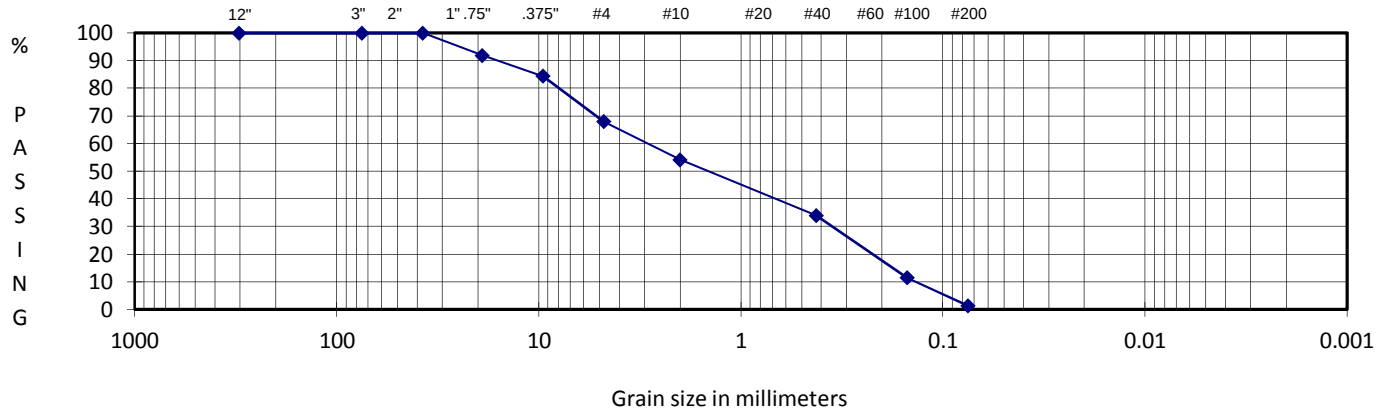
Weight Of Sample (gm)		428.3
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		412.8

% COBBLES	**0.0**
% C GRAVEL	**8.1**
% F GRAVEL	**24.0**
% C SAND	**13.7**
% M SAND	**20.2**
% F SAND	**32.7**
% FINES	**1.3**
% TOTAL	**100.0**

D10 (mm)	0.15
D30 (mm)	0.35
D60 (mm)	3
Cu	20.0
Cc	0.3

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	49.1	33.60	8.14	91.86	fine gravel
0.50"					fine gravel
0.375"	80.1	64.60	15.65	84.35	fine gravel
#4	148.1	132.60	32.12	67.88	coarse sand
#10	204.7	189.20	45.83	54.17	medium sand
#20					medium sand
#40	287.9	272.40	65.99	34.01	fine sand
#60					fine sand
#100	381.0	365.50	88.54	11.46	fine sand
#200	422.8	407.30	98.67	1.33	fines
PAN					silt/clay



DESCRIPTION	Gravelly SAND
USCS	SW

Prepared For:
McDonalds

Reviewed By: KW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Poulsbo McDonald's		**SAMPLE ID/TYPE**	B2	
PROJECT NO.	2017-210		**SAMPLE DEPTH**	7.5'	
TECH/TEST DATE	LW	11/1/2017	**DATE RECEIVED**	10/30/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	460.9
Wt Dry Soil & Tare (gm)	(w2)	402.6
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	58.3
Weight of Dry Soil (gm)	(w5=w2-w3)	387.1
Moisture Content (%)	(w4/w5)*100	15

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

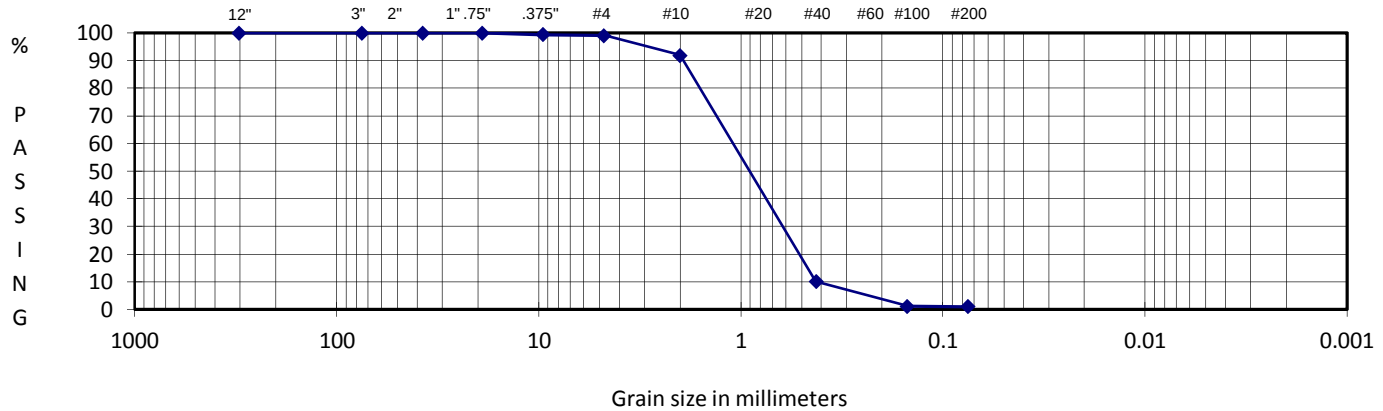
Weight Of Sample (gm)		402.6
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		387.1

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**1.0**
% C SAND	**7.2**
% M SAND	**81.7**
% F SAND	**9.1**
% FINES	**0.9**
% TOTAL	**100.0**

D10 (mm)	0.43
D30 (mm)	0.6
D60 (mm)	1.2
Cu	2.8
Cc	0.7

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.5	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	17.9	2.40	0.62	99.38	fine gravel
#4	19.5	4.00	1.03	98.97	coarse sand
#10	47.3	31.80	8.21	91.79	medium sand
#20					medium sand
#40	363.7	348.20	89.95	10.05	fine sand
#60					fine sand
#100	398.5	383.00	98.94	1.06	fine sand
#200	399.0	383.50	99.07	0.93	fines
PAN					silt/clay



DESCRIPTION	SAND
USCS	SP

Prepared For:
McDonalds

Reviewed By: KW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Poulsbo McDonald's		**SAMPLE ID/TYPE**	B2	
PROJECT NO.	2017-210		**SAMPLE DEPTH**	10'	
TECH/TEST DATE	LW	11/1/2017	**DATE RECEIVED**	10/30/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	558.2
Wt Dry Soil & Tare (gm)	(w2)	491.4
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	66.8
Weight of Dry Soil (gm)	(w5=w2-w3)	475.9
Moisture Content (%)	(w4/w5)*100	14

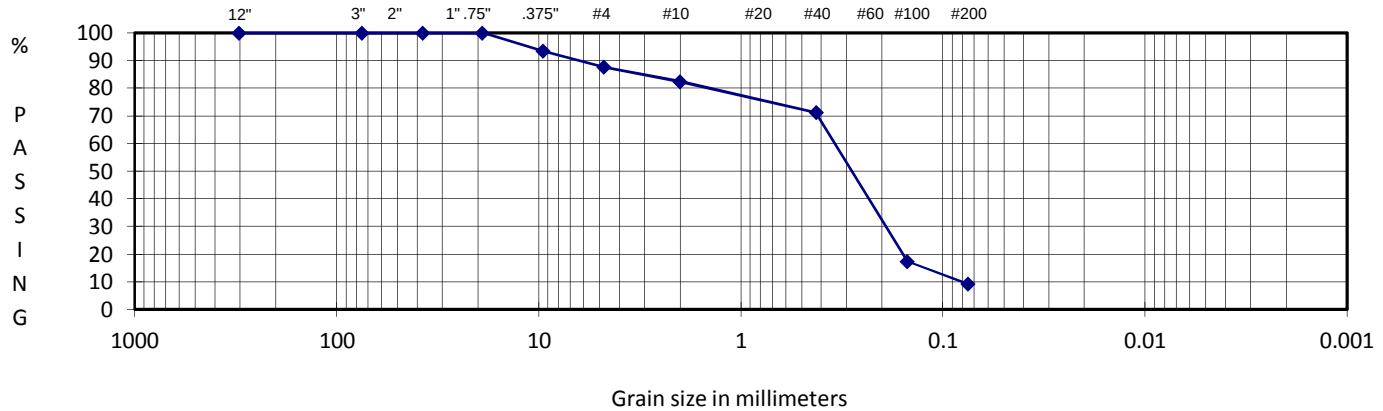
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		491.4
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		475.9

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**12.5**
% C SAND	**5.2**
% M SAND	**11.3**
% F SAND	**61.9**
% FINES	**9.2**
% TOTAL	**100.0**
D10 (mm)	0.08
D30 (mm)	0.19
D60 (mm)	0.35
Cu	4.4
Cc	1.3

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.5	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	47.2	31.70	6.66	93.34	fine gravel
#4	74.8	59.30	12.46	87.54	coarse sand
#10	99.4	83.90	17.63	82.37	medium sand
#20					medium sand
#40	153.2	137.70	28.93	71.07	fine sand
#60					fine sand
#100	408.9	393.40	82.66	17.34	fine sand
#200	447.8	432.30	90.84	9.16	fines
PAN					silt/clay



DESCRIPTION	Poorly-graded SAND with silt and trace gravel
USCS	SP-SM

Prepared For:
McDonalds

Reviewed By: KW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Poulsbo McDonald's		**SAMPLE ID/TYPE**	B5	
PROJECT NO.	2017-210		**SAMPLE DEPTH**	7.5'	
TECH/TEST DATE	LW	11/1/2017	**DATE RECEIVED**	10/30/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	129.8
Wt Dry Soil & Tare (gm)	(w2)	112.3
Weight of Tare (gm)	(w3)	8.2
Weight of Water (gm)	(w4=w1-w2)	17.5
Weight of Dry Soil (gm)	(w5=w2-w3)	104.1
Moisture Content (%)	(w4/w5)*100	17

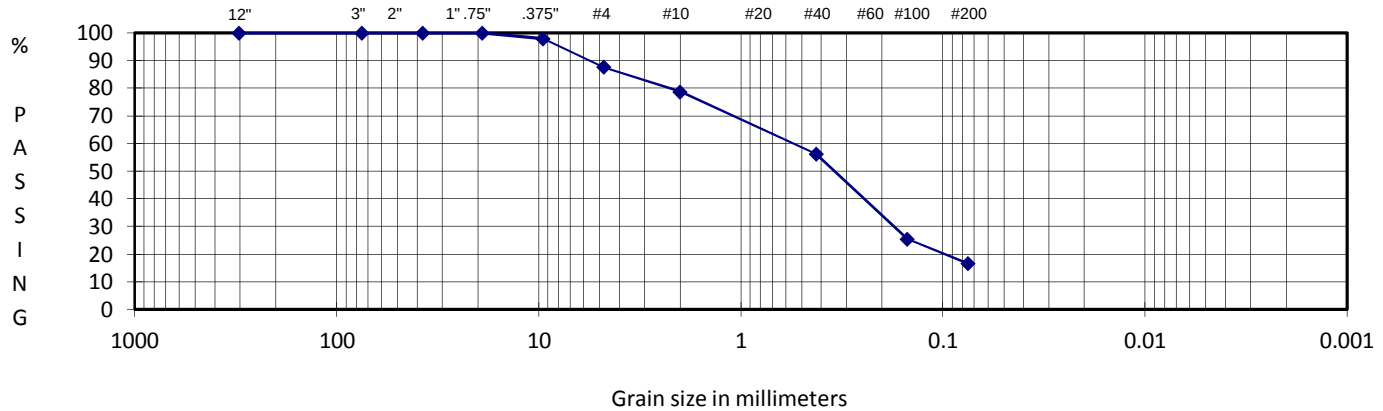
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		112.3
Tare Weight (gm)		8.2
(W6) Total Dry Weight (gm)		104.1

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**12.5**
% C SAND	**8.8**
% M SAND	**22.5**
% F SAND	**39.6**
% FINES	**16.6**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	8.2	0.00	0.00	100.00	cobbles
3.0"	8.2	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	8.2	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	8.2	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	10.4	2.20	2.11	97.89	fine gravel
#4	21.2	13.00	12.49	87.51	coarse sand
#10	30.4	22.20	21.33	78.67	medium sand
#20					medium sand
#40	53.8	45.60	43.80	56.20	fine sand
#60					fine sand
#100	85.8	77.60	74.54	25.46	fine sand
#200	95.0	86.80	83.38	16.62	fines
PAN					silt/clay



DESCRIPTION	Silty SAND with trace gravel
USCS	SM

Prepared For:
McDonalds

Reviewed By: KW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Poulsbo McDonald's		**SAMPLE ID/TYPE**	B6	
PROJECT NO.	2017-210		**SAMPLE DEPTH**	5'	
TECH/TEST DATE	LW	11/1/2017	**DATE RECEIVED**	10/30/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	584.2
Wt Dry Soil & Tare (gm)	(w2)	427.1
Weight of Tare (gm)	(w3)	15.3
Weight of Water (gm)	(w4=w1-w2)	157.1
Weight of Dry Soil (gm)	(w5=w2-w3)	411.8
Moisture Content (%)	(w4/w5)*100	38

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

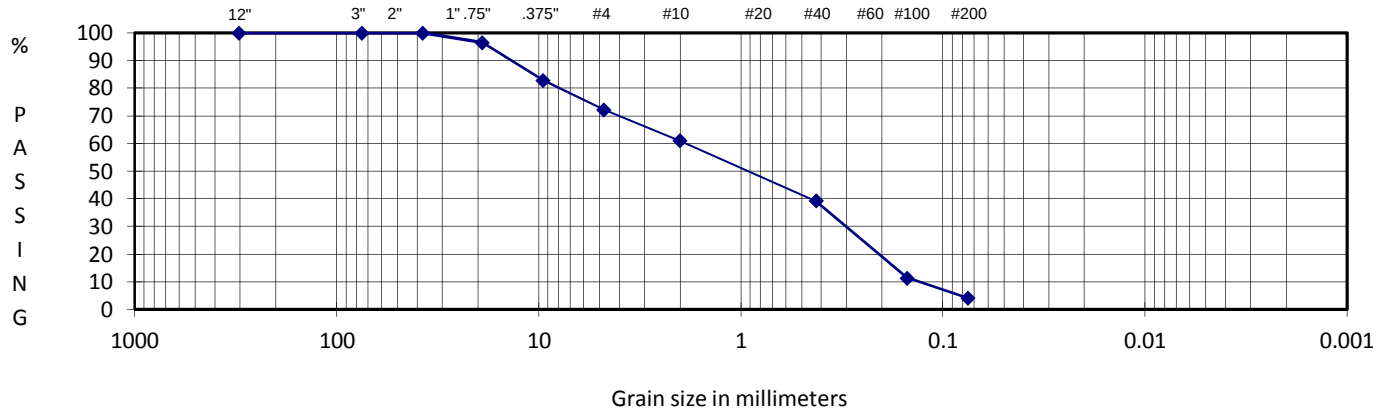
Weight Of Sample (gm)		427.1
Tare Weight (gm)		15.3
(W6) Total Dry Weight (gm)		411.8

% COBBLES	**0.0**
% C GRAVEL	**3.5**
% F GRAVEL	**24.3**
% C SAND	**11.2**
% M SAND	**21.9**
% F SAND	**35.1**
% FINES	**4.0**
% TOTAL	**100.0**

D10 (mm)	0.15
D30 (mm)	0.3
D60 (mm)	2
Cu	13.3
Cc	0.3

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.3	0.00	0.00	100.00	cobbles
3.0"	15.3	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.3	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	29.8	14.50	3.52	96.48	fine gravel
0.50"					fine gravel
0.375"	86.3	71.00	17.24	82.76	fine gravel
#4	129.8	114.50	27.80	72.20	coarse sand
#10	176.0	160.70	39.02	60.98	medium sand
#20					medium sand
#40	266.0	250.70	60.88	39.12	fine sand
#60					fine sand
#100	380.4	365.10	88.66	11.34	fine sand
#200	410.7	395.40	96.02	3.98	fines
PAN					silt/clay



DESCRIPTION	Poorly-graded SAND with some gravel
USCS	SP

Prepared For:
McDonalds

Reviewed By: KW

RILEYGROUP