Annual Groundwater Quality Report
2021 Bioremediation Program
Blaine Marina, Inc. Cleanup Site
Blaine, Washington

July 13, 2022

Prepared for

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TABLE OF CONTENTS

Page

LIST OF ABBREVIATIONS AND ACRONYMS v
1.0 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Cleanup Activities 1-1
1.3 Site Bioremediation History 1-1
2.0 BIOREMEDIATION PROGRAM SUMMARY 2-1
2.1 Approach and Procedures 2-1
2.2 Implementation Event Details – 2021 2-2
2.2.1 Nitrate Infiltration 2-2
2.2.2 Quarterly Performance Monitoring 2-3
3.0 BIOREMEDIATION PERFORMANCE ASSESSMENT 3-1
3.1 Groundwater Quality 3-1
3.1.1 Nitrate Distribution 3-1
3.1.2 Light Non-Aqueous Phase Liquid Occurrence 3-2
3.2 Surface Water Quality 3-2
4.0 RESTORATION TIMEFRAME ANALYSIS 4-1
5.0 CONCLUSIONS AND NEXT STEPS 5-1
6.0 UPCOMING SCHEDULE – 2022 6-1
7.0 USE OF THIS REPORT 7-1
8.0 REFERENCES 8-1

FIGURES

Figure | Title

1 Vicinity Map
2 Site Plan
3 Gasoline-Range Total Petroleum Hydrocarbon Concentrations in Groundwater
4 Diesel-Range Total Petroleum Hydrocarbon Concentrations in Groundwater
5 Nitrate Distribution
6 Proposed Trench Locations

TABLES

Table	Title
1	Bioremediation Infiltration Summary
2	Treatment Performance Sampling Summary – 2021
3	Groundwater Elevations
4	Groundwater Analytical Results
5	Groundwater Results – Bioremediation Summary
6	Surface Water Analytical Results

APPENDIX

Appendix	Title
A	Restoration Timeframe Analysis

LIST OF ABBREVIATIONS AND ACRONYMS

CAP	cleanup action plan
Ecology	Washington State Department of Ecology
EDR	engineering design report
IHS	indicator hazardous substance
Landau	Landau Associates, Inc.
LNAPL	light non-aqueous phase liquid
mg-N/L	milligrams nitrogen per liter
MNA	monitored natural attenuation
NAPL	non-aqueous phase liquid
On Site	On Site Environmental
OP	observation point
Port	Port of Bellingham
redox	oxidation-reduction
Site	Blaine Marina, Inc. cleanup site
TPH	total petroleum hydrocarbons
TPH-D	diesel-range total petroleum hydrocarbons
TPH-G	gasoline-range total petroleum hydrocarbons
UIC	Underground Injection Control
Work Plan	groundwater bioremediation work plan

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1.0 INTRODUCTION

Landau Associates, Inc. (Landau) has prepared this annual groundwater quality report to provide details regarding implementation of the ongoing bioremediation cleanup action currently in progress at the Blaine Marina, Inc. cleanup site (Site) in Blaine, Washington (Figure 1). This work is being conducted by the Port of Bellingham (Port), under a Consent Decree (No. 18-2-01266-37) between the Washington State Department of Ecology (Ecology) and the Port (Ecology 2018). Following source removal in 2018, the bioremediation program described herein was initiated in 2019. This document summarizes the bioremediation program performance including infiltration and groundwater quality sampling activities conducted in 2021, and provides recommendations, where warranted, for proposed changes in the bioremediation approach.

1.1 Background

The Site is located at Blaine Harbor, at the north end of Drayton Harbor in Blaine, Washington, as shown on Figure 1. Blaine Marina, Inc. leased the area from the 1950s until 2015 and operated a bulk fuel storage and transfer facility at the Site. Operations at the facility resulted in the release of petroleum hydrocarbons to soil and groundwater. The Port conducted a series of preliminary investigations beginning in 1990 and completed the remedial investigation and feasibility study in August 2015 (Landau 2015). A pre-remedial design investigation was conducted in 2017 to further assess the extent of contamination and to support preparation of the construction plans, specifications, and engineering design report (EDR; Landau 2018).

1.2 Cleanup Activities

In 2018, the Port completed most of the required cleanup activities described in the cleanup action plan (CAP; Ecology 2017), and detailed in the EDR (Landau 2018). The primary cleanup activities completed in 2018 included removing approximately 4,000 tons of soil contaminated with petroleum hydrocarbons and light non-aqueous phase liquid (LNAPL) from the excavation. Additional demolition and Site restoration activities were required to complete the soil removal, since buildings were located above the source area where contaminant levels were highest. The contaminated materials were removed from the Site and disposed of at an offsite Resource Conservation and Recovery Act Subtitle D landfill facility. Through soil excavation and LNAPL removal in the source area, an equivalent of approximately 16,000 gallons of petroleum hydrocarbons were removed (Landau 2019a). The ongoing cleanup activities discussed herein relate to addressing the residual contamination left-in-place outside of the source area.

1.3 Site Bioremediation History

After completion of the source removal activities described above, the Port implemented a bioremediation treatment program to address the remaining residual contamination; treatment is ongoing. The cleanup activities discussed herein were conducted in accordance with the groundwater

bioremediation work plan (Work Plan; Landau 2019b), as approved by Ecology. The Work Plan provides details regarding implementation of enhanced, *in situ*, anaerobic bioremediation in groundwater. Bioremediation activities are focused on stimulating the naturally occurring process by allowing a nitrate solution to infiltrate into the groundwater. The nitrate solution is introduced into the subsurface using four infiltration trenches that were installed in 2018 during source removal efforts. The infiltration trenches consist of clean sand and gravel backfill material to allow large quantities of nitrate solution to infiltrate into the source area, in and adjacent to where the contaminated soil was excavated and replaced with clean backfill material.

The Port will continue implementing cleanup activities in cooperation with Ecology until concentrations of the indicator hazardous substances (IHSs) in groundwater are reduced sufficiently to meet the cleanup requirements detailed in the CAP. The groundwater IHSs identified in the CAP include benzene, total petroleum hydrocarbons (TPH) in the gasoline and diesel range (TPH-G and TPH-D, respectively) and total naphthalenes. However, bioremediation treatment performance is evaluated using analysis of TPH-G, TPH-D, oil-range TPH, and nitrogen.

Treatment and performance evaluation activities are summarized in annual reports to document and share updates on the cleanup progress. At some future point when treatment is largely complete, further nitrate infiltration may be suspended and a period of monitored natural attenuation (MNA) implemented to confirm that cleanup standards are achieved and maintained. The transition to MNA would be made in coordination with Ecology when data indicate a reasonable restoration timeframe is expected without the further addition of nitrate. Once cleanup standards have been achieved, groundwater monitoring will be conducted for four additional consecutive quarters to confirm that compliance is maintained throughout potential seasonal fluctuations.

2.0 BIOREMEDIATION PROGRAM SUMMARY

As summarized above and detailed in the Work Plan (Landau 2019b) and previous annual reports (Landau 2020, 2021), nitrate solution is introduced into Site groundwater to stimulate anaerobic bioremediation. Nitrate provides the terminal electron acceptor necessary for naturally occurring aquifer bacteria to degrade petroleum hydrocarbons. The bacteria use petroleum hydrocarbons as electron donors in oxidation-reduction (redox) reactions to generate energy for growth and reproduction.

2.1 Approach and Procedures

Nitrate solution is introduced at the Site into four infiltration trenches through four pairs of infiltration ports. These are shown on Figure 2 with trench infiltration ports labeled as OP-1/OP-2, OP-3/OP-4, OP-5/OP-6, and OP-7/OP-8.[1] The paired infiltration ports are connected in the subsurface by perforated piping installed horizontally near the groundwater table. Nitrate mixing procedures are described in detail in previous annual reports (Landau 2020, 2021). Two of the infiltration trenches (OP-3/OP-4 and OP-5/OP-6) were installed within the excavation area during the contaminant source removal, and two additional trenches (OP-1/OP-2 and OP-7/OP-8) were installed outside of the excavated area to target the highest levels of petroleum hydrocarbon contamination remaining on Site after the source-area excavation. Like the trenches installed within the backfilled excavation, OP-1/OP-2 and OP-7/OP-8 were constructed with gravel and perforated piping. However, since OP-1/OP-2 and OP-7/OP-8 were installed into areas of finer-grained soils (silt and clay), only a smaller volume of nitrate solution can be added before the trenches are full.

Based on the desired distribution and estimated pore volumes, remediation at the Site is generally carried out by adding approximately 38,000 gallons of nitrate solution during each infiltration event. Approximately 36,000 gallons infiltrate into the excavation area through OP-3/OP-4 and OP-5/OP-6, and approximately 2,000 gallons into the east trench OP-1/OP-2. Due to a much lower infiltration rate at OP-7/OP-8, a more limited volume (250 to 400 gallons) of nitrate solution has been successfully applied at this location. To accommodate for this condition and to address persistent elevated concentrations of TPH near MW-7, hot spot treatments were conducted at OP-7/OP-8 during the latter half of 2021 (eight events). The hot spot treatments used smaller-batch volumes with higher concentrations of nitrate, as described in Section 2.2.1.

Multiple nitrate infiltration events are typically required to complete treatment of petroleum hydrocarbon mass present in groundwater as non-aqueous phase liquid (NAPL) and sorbed onto aquifer soils. Petroleum hydrocarbon concentrations in groundwater will continue to fluctuate during treatment until the non-aqueous mass is depleted. Upon depletion of available nitrate, contaminant mass will rebound due to dissolution of remaining NAPL and desorption from soil surfaces. Periodic nitrate addition will be necessary until NAPL-, sorbed-, and aqueous-phase contamination has been

[1] OP = Observation point.

adequately treated to maintain TPH concentrations in groundwater below cleanup levels. Fluctuations in TPH concentrations also occur as groundwater levels rise and fall due to seasonal changes in rainfall, or tidal influence causes the groundwater to contact high smear-zone contamination that may be adsorbed to soil surfaces above the typical water table.

2.2 Implementation Event Details – 2021

This section describes the sequenced approach to nitrate infiltration and treatment performance assessments conducted in 2021. In general, nitrate treatment events occur twice per year, with several hot spot treatments implemented at trench OP-7/OP-8. Quarterly groundwater monitoring was completed at the 11 groundwater monitoring wells shown on Figure 2. The 2021 timeline of nitrate solution infiltration and monitoring events is summarized below.

- March 2021: Hot spot treatment
- June 2021: 1st Quarter performance assessment and nitrate solution infiltration[2]
- July 2021: 2nd Quarter performance assessment and two hot spot treatments[2]
- August 2021: Hot spot treatment
- September 2021: Hot spot treatment
- October 2021: 3rd Quarter performance assessment and hot spot treatment
- November 2021: Nitrate solution infiltration and hot spot treatment
- December 2021: 4th Quarter performance assessment and hot spot treatment.

2.2.1 Nitrate Infiltration

Two infiltration events and seven hot spot treatments were conducted in 2021, with the timing, infiltration volumes, and concentrations selected based on Landau's interpretation of groundwater trends (primarily TPH and nitrate concentrations). Treatment events in 2021 were conducted to maintain elevated nitrate concentrations in the excavation and surrounding areas of residual contamination, and to address persistent TPH near MW-7 where nitrate has not been detected. Persistent TPH at MW-7 and nitrate not detected at that well indicate that nitrate that infiltrates at trench OP-7/OP-8 is consumed along the groundwater flow path before reaching MW-7. The events in 2021 were completed in accordance with requirements set forth in the CAP, the EDR, and the Washington State Underground Injection Control (UIC) permit per Chapter 173-218 of the Washington Administrative Code.

Full infiltration events in the excavation area were conducted in June and November 2021. Infiltration trench pairs OP-1/OP-2, OP-3/OP-4, and OP-5/OP-6 were treated as planned for both events. A summary of nitrate volumes and solution concentrations for infiltration events is provided in Table 1.

[2] 1st and 2nd quarter performance monitoring events were conducted one month apart.

Eight additional hot spot infiltration events were conducted at OP-7/OP-8. These events were conducted in March, twice in July, and monthly in August through December. A total of 2,200 gallons of solution infiltrated into the OP-7/OP-8 trench over ten events (two semi-annual and eight hot spot) throughout 2021 as summarized in Table 1. The volume allowed to infiltrate to OP-7/OP-8 during each event ranged from 50 to 400 gallons.

2.2.2 Quarterly Performance Monitoring

Landau personnel conduct quarterly monitoring to evaluate the performance of the bioremediation program. Performance monitoring is conducted to evaluate and document remedial progress, and to provide information for tracking and potentially modifying the infiltration approach. Performance assessments currently include measurements of the groundwater elevations, and analysis of groundwater samples to assess TPH concentrations and to evaluate the proper distribution of nitrate solution.

Although not a Site IHS, nitrate is monitored during the quarterly events to evaluate the distribution of nitrate for desired treatment, and to evaluate the longevity of the nitrate as it is being consumed in the bioremediation process. Additionally, marine surface water samples are collected and analyzed for nitrate to confirm that the nitrate solution is not negatively impacting surface water. Nitrate analyses were conducted by OnSite Environmental Inc. and the other analyses were conducted by ALS laboratory in Everett, Washington. Quarterly groundwater and surface water monitoring is conducted according to the monitoring matrix provided in Table 2.

An oil/water interface probe is used when measuring the depth to groundwater. If a measurable thickness of LNAPL is detected, groundwater samples are not collected for analysis of IHS parameters from that location. If LNAPL is present then IHS concentrations are assumed to be greater than the applicable cleanup levels. However, if LNAPL is measurable at a location where it has not been previously observed, a sample of the LNAPL is collected to help characterize the LNAPL at that location. Nitrate analysis is typically conducted for wells, including wells with NAPL,[3] to confirm that the infiltration solution is reaching the targeted areas. Cumulative groundwater elevations and measured LNAPL thicknesses through 2021 are provided in Table 3.

The Port plans to resume IHS parameter monitoring when treatment performance data suggest that Site groundwater data are comparable to established cleanup levels and will evaluate IHSs at selected wells on an annual basis. Table 2 shows the treatment performance assessment parameters for the Site, along with the analytical methods used by the Ecology-accredited laboratories.

[3] Prior to 2021, only nitrate from MW-9 was analyzed due to measurable LNAPL in the well, but LNAPL monitoring results from 2020 indicated that LNAPL accumulation was no longer occurring in the well. Sampling resumed at MW-9 in 2021 for the first time since the cleanup activities began and analysis consisted of all IHS and performance indicator parameters. In 2021, well MW-10 was sampled for nitrate analysis only due to the presence of LNAPL.

3.0 BIOREMEDIATION PERFORMANCE ASSESSMENT

This section summarizes the analytical results used in assessing the performance and progress of the bioremediation program in 2021. The cumulative laboratory analytical results for groundwater are summarized in Table 4 with comparisons to the cleanup levels established in the CAP. Table 5 summarizes the analytical data that are used for evaluating bioremediation performance. Cumulative surface water results are summarized in Table 6. Laboratory analytical reports are maintained on file and available upon request.

3.1 Groundwater Quality

The TPH-G, TPH-D, and nitrate results used for tracking remedial progress are shown on Figures 3 through 5. These parameters are discussed below as bioremediation treatment performance indicators for the Site.

Continued treatment is needed at wells with measurable LNAPL, or where TPH-G or TPH-D concentrations in groundwater are above cleanup levels. In 2021, LNAPL thickness was measured during one or more quarters at MW-9 (1 quarter) and MW-10 (4 quarters). LNAPL present at MW-5 in 2020 was not observed in 2021. The TPH-D cleanup level was exceeded at MW-5 (June, July, and October) and at MW-14 (July and October). TPH-G was detected in all samples collected from MW-9 during 2021 with both the October and December results exceeding the cleanup level. TPH-G concentrations also exceeded the cleanup level at MW-7 for all the sampling events, including the baseline event. The cumulative results from MW-7 indicate a slow, but steady, decrease of TPH-G concentrations. Due to the slow rate of this decline, the Port implemented a monthly hot spot treatment approach in 2021 in an effort to accelerate hydrocarbon degradation in this area. Cumulative TPH-G and TPH-D concentration results for each well are shown on Figures 3 and 4, respectively.

3.1.1 Nitrate Distribution

Nitrate was detected in 2021 at all wells analyzed except for MW-7. These detections indicate an effective distribution of nitrate electron acceptor to the areas of residual contamination, except for the area between MW-12 and MW-7. Detected concentrations in 2021 ranged from 0.07 milligrams nitrogen per liter (mg-N/L) (2nd quarter; MW-5) to 475 mg-N/L (2nd quarter; MW-13). The cumulative nitrate results are shown on Figure 5.

The continued absence of nitrate at MW-7 in 2021 indicates that nitrate solution that infiltrated at OP-7/OP-8 is being consumed between MW-12 and MW-7. The hot spot treatment approach was implemented at OP-7/OP-8 in 2021 to improve nitrate distribution and longevity toward MW-7. Additional donor distribution is needed in this area in 2022.

Concentrations of nitrate remained significantly higher at wells MW-12, MW-13, and MW-14 (approximately 35 to 40 feet from the shoreline) than at wells MW-5, MW-6, and MW-7 (immediately

adjacent to the shoreline). This reduction indicates that the nitrate is being used for bioremediation, and not being lost to the surface water. It also indicates that the infiltration program is providing an appropriate mass of nitrate for treatment while protecting surface water from nitrate impacts (see Section 3.2).

3.1.2 Light Non-Aqueous Phase Liquid Occurrence

LNAPL thicknesses measured at monitoring wells MW-9 and MW-10 in 2021 declined compared to prior results. While TPH-G and TPH-D concentrations at MW-9 exceeded the cleanup levels in 2021, the LNAPL thickness was measured at 0 feet in three of the four readings collected. Only the July measurement identified LNAPL was present, and the thickness was less than historical measurements at 0.02 feet. At MW-10, the LNAPL thickness ranged from 0.04 to 0.19 feet in 2021, significantly thinner than the 2020 thicknesses ranging from 0.14 to 0.47 feet. No LNAPL was observed in MW-5 in 2021.

The persistent LNAPL accumulation observed at MW-10 suggests that nitrate infiltration and mounding of the groundwater table at the Site are effectively causing desorption and mobilization of residual LNAPL trapped within the soil pore spaces. Persistent nitrate at MW-10 confirms radial flow of infiltrated fluid from excavation areas toward MW-10. In 2021, LNAPL was removed at MW-10 using hydrocarbon sorbent socks and by pump in October 2021. While the LNAPL thickness has varied, it appears to be generally declining. Ongoing LNAPL monitoring will continue at all of the groundwater wells throughout the Site in2022.

3.2 Surface Water Quality

As described in the Work Plan and required by the UIC permit, surface water samples are collected during the performance assessments to confirm that nitrate concentrations are within acceptable limits. Although no marine surface water criteria are established for nitrate based on the Model Toxics Control Act cleanup levels, the primary concern for nitrate in marine surface water is that it can act as a nutrient and exacerbate algal blooms that occur naturally during summer months.

During each performance assessment event, two surface water samples are collected immediately adjacent to the shoreline (within 1 foot of the actual contact between the water and shoreline, which varies during tidal fluctuations), and at the base of the water column (within 2 inches of the sediment surface). Surface water sampling results are summarized in Table 6 and were compared to a Site-specific benchmark value of 20 mg-N/L nitrate + nitrite. The combined nitrate + nitrite surface water sampling results from 2021 ranged from 0.09 to 0.52 mg-N/L, and nitrate and nitrite were not detected in the June 2021 samples. The cumulative surface water data collected since bioremediation indicate that the program is being conducted in a manner protective of surface water quality.

4.0 RESTORATION TIMEFRAME ANALYSIS

A Mann-Kendall analysis was performed using concentration data collected to-date from selected wells to evaluate trends and conduct a predictive analysis to estimate the restoration timeframe for individual wells (Appendix A). Wells were selected for analysis to provide adequate locations to be representative of Site conditions. For example, MW-12 and MW-13 were selected due to their proximity to the excavation area, MW-5 and MW-7 were selected to evaluate conditions along the shoreline, and MW-9 was selected because it is both a location that has had LNAPL and it helps inform the approximate restoration timeframe outside of the excavation area farther away from the shoreline.

The results of this analysis estimate cleanup in individual wells within the next 1 to 5 years. The longest restoration interval predicted was for well MW-7 where TPH-G and TPH-D concentrations have decreased since 2020 but remain above the cleanup level. As discussed previously, hot spot treatments were conducted in 2021 to increase the degradation rate of the contaminants near MW-7 and decrease the overall Site restoration timeframe. Additional focused treatment will be necessary upgradient of MW-7 in 2022 to accelerate Site treatment.

5.0 CONCLUSIONS AND NEXT STEPS

Overall, the Site is responding well to the bioremediation treatment program as LNAPL thicknesses and TPH concentrations are decreasing. The Port plans to continue treatment through 2022 to keep nitrate levels elevated and promote biodegradation of the LNAPL and residual TPH remaining in the soil and groundwater. The cumulative data (November 2018 through December 2021) included in this report show that TPH concentrations have decreased to below the cleanup levels throughout much of the Site but that continued treatment is needed in the vicinity of MW-4, MW-7, MW-9, MW-10, and MW-14 (continued emphasis is needed at well MW-7, where nitrate has not yet been detected and TPH concentrations remain elevated despite declining concentrations since 2020).

In March 2021, the Port implemented a hot spot treatment approach to increase the frequency of and nitrate concentrations in treatments near MW-7, including semi-monthly infiltrations to OP-7/OP-8 between June and December 2021. The results from July and October 2021 sampling indicate that this approach is contributing to decreasing concentrations of TPH at downgradient wells MW-12 and MW-7.

Cumulative TPH-D data through 2021 suggest that nitrate infiltration and mounding of the groundwater table at the Site are effectively causing desorption and mobilization of residual LNAPL trapped within the soil pore spaces. In 2021, this process resulted in increased TPH concentrations in some wells (MW-9) even while LNAPL thicknesses diminished to 0 feet. The Port will continue to monitor the Site for changes in LNAPL thicknesses and/or locations, and quarterly performance monitoring will be ongoing through 2022.

TPH concentrations are decreasing significantly and meet cleanup levels in most areas of the Site. In areas near the 2018 excavation, TPH concentrations are above cleanup levels but predictably declining and expected to be within compliance in the next 5 years. In areas of the Site near monitoring wells MW-7, MW-9, and MW-10, IHS concentrations remain elevated and additional focused infiltration efforts will be required to achieve cleanup levels on a schedule similar to the rest of the Site. Nitrate distribution and longevity has been favorable at MW-9 and MW-10 despite the presence of LNAPL; however, achievement of cleanup levels will be delayed as long as LNAPL remains.

The Port plans to continue nitrate solution infiltrations in the excavation area (OP-3/OP-4 and OP-5/OP-6) and proceed with additional targeted treatment near MW-7, MW-9, and MW-10. Planned targeted treatment for 2022 is as follows:

- MW-9: Use of higher nitrate concentrations in solution to infiltrate into trench OP-1/OP-2. Analytical results for MW-9 to date show that nitrate is being delivered, but the nitrate consumption is rapid in this area. The infiltrated nitrate solution concentration will be doubled at this trench in 2022.
- MW-10: Installation of an additional infiltration trench to the northwest (i.e., upgradient) of this well. The new trench (OP-9/OP-10) will be in the approximate location shown on Figure 6.

- MW-7: Installation of an additional infiltration trench to the west of MW-12 where nitrate has been effectively distributed. The new trench (OP-11/OP-12) will be in the approximate location shown on Figure 6.

The Port anticipates that ongoing bioremediation will reduce TPH concentrations throughout 2022, and will continue to review and assess the data to evaluate trends and adjust the bioremediation program as needed to achieve cleanup levels in a timely manner.

6.0 UPCOMING SCHEDULE – 2022

The schedule below summarizes plans for continued bioremediation in 2022. The Port will continue coordinating these events with Ecology and may adjust the schedule listed below as needed based on performance observations and to avoid conflicts with tenant operations and combine mobilizations, where possible.

- April 2022: 1st quarter performance assessment
- May 2022: Site-wide treatment event #7
- June 2022: 2nd quarter performance assessment
- July 2022: Potential installation of infiltration components near MW-10 and MW-7
- August 2022: 3rd quarter performance assessment
- September 2022: Site-wide treatment event #8
- November 2022: 4th quarter performance assessment.

7.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of the Port of Bellingham and applicable regulatory agencies for specific application to the Blaine Marina, Inc. cleanup site. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau, shall be at the user's sole risk. Landau warrants that within the limitations of scope, schedule, and budget, these services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. Landau makes no other warranty, either express or implied.

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Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Esri World Imagery.

G:\Projects\001\034\010\032\F01 VicinityMap.mxd 6/13/2022 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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Blaine Marina, Inc. Site Blaine, Washington	**Vicinity Map**	Figure 1

Legend

- Groundwater Monitoring Well
- Observation and Bioremediation Injection Point
- Treatment Trench
- Excavation Boundary

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Sources: Wilson Engineering topographic survey, 4/26/17; Wilson Engineering topographic survey, 11/02/11

0 20 40
Scale in Feet

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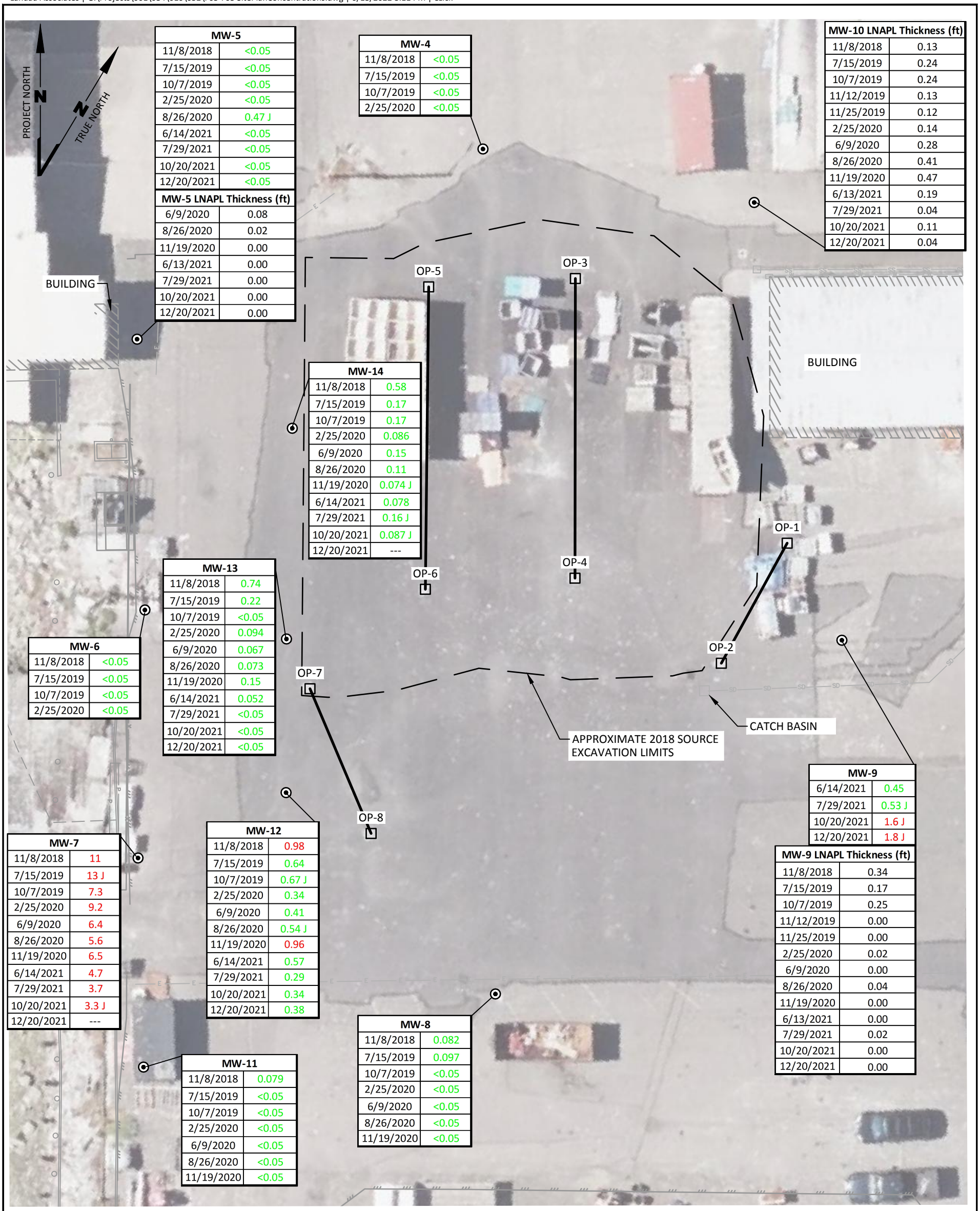
Blaine Marina, Inc. Site
Blaine, Washington

Site Plan

Figure
2



MW-5	
11/8/2018	<0.05
7/15/2019	<0.05
10/7/2019	<0.05
2/25/2020	<0.05
8/26/2020	0.47 J
6/14/2021	<0.05
7/29/2021	<0.05
10/20/2021	<0.05
12/20/2021	<0.05

MW-5 LNAPL Thickness (ft)	
6/9/2020	0.08
8/26/2020	0.02
11/19/2020	0.00
6/13/2021	0.00
7/29/2021	0.00
10/20/2021	0.00
12/20/2021	0.00

MW-4	
11/8/2018	<0.05
7/15/2019	<0.05
10/7/2019	<0.05
2/25/2020	<0.05

MW-10 LNAPL Thickness (ft)	
11/8/2018	0.13
7/15/2019	0.24
10/7/2019	0.24
11/12/2019	0.13
11/25/2019	0.12
2/25/2020	0.14
6/9/2020	0.28
8/26/2020	0.41
11/19/2020	0.47
6/13/2021	0.19
7/29/2021	0.04
10/20/2021	0.11
12/20/2021	0.04

MW-14	
11/8/2018	0.58
7/15/2019	0.17
10/7/2019	0.17
2/25/2020	0.086
6/9/2020	0.15
8/26/2020	0.11
11/19/2020	0.074 J
6/14/2021	0.078
7/29/2021	0.16 J
10/20/2021	0.087 J
12/20/2021	---

MW-13	
11/8/2018	0.74
7/15/2019	0.22
10/7/2019	<0.05
2/25/2020	0.094
6/9/2020	0.067
8/26/2020	0.073
11/19/2020	0.15
6/14/2021	0.052
7/29/2021	<0.05
10/20/2021	<0.05
12/20/2021	<0.05

MW-6	
11/8/2018	<0.05
7/15/2019	<0.05
10/7/2019	<0.05
2/25/2020	<0.05

MW-9	
6/14/2021	0.45
7/29/2021	0.53 J
10/20/2021	1.6 J
12/20/2021	1.8 J

MW-9 LNAPL Thickness (ft)	
11/8/2018	0.34
7/15/2019	0.17
10/7/2019	0.25
11/12/2019	0.00
11/25/2019	0.00
2/25/2020	0.02
6/9/2020	0.00
8/26/2020	0.04
11/19/2020	0.00
6/13/2021	0.00
7/29/2021	0.02
10/20/2021	0.00
12/20/2021	0.00

MW-7	
11/8/2018	11
7/15/2019	13 J
10/7/2019	7.3
2/25/2020	9.2
6/9/2020	6.4
8/26/2020	5.6
11/19/2020	6.5
6/14/2021	4.7
7/29/2021	3.7
10/20/2021	3.3 J
12/20/2021	---

MW-12	
11/8/2018	0.98
7/15/2019	0.64
10/7/2019	0.67 J
2/25/2020	0.34
6/9/2020	0.41
8/26/2020	0.54 J
11/19/2020	0.96
6/14/2021	0.57
7/29/2021	0.29
10/20/2021	0.34
12/20/2021	0.38

MW-11	
11/8/2018	0.079
7/15/2019	<0.05
10/7/2019	<0.05
2/25/2020	<0.05
6/9/2020	<0.05
8/26/2020	<0.05
11/19/2020	<0.05

MW-8	
11/8/2018	0.082
7/15/2019	0.097
10/7/2019	<0.05
2/25/2020	<0.05
6/9/2020	<0.05
8/26/2020	<0.05
11/19/2020	<0.05

Legend

- Groundwater Monitoring Well
- IHS Concentration(s) Exceed Cleanup Levels
- IHS Concentration(s) are Less Than Cleanup Levels
- Observation and Bioremediation Injection Points
- Treatment Trench
- Excavation Boundary

Sampling Location	
Date	Result

Notes

1. All results are reported in milligrams per liter (mg/L).
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

ft = feet
IHS = Indicator Hazardous Substances
J = Result is an estimated quantity. Associated numerical value is the approximate concentration of the analyte in the sample.
LNAPL = Light Non-Aqueous Phase Liquid
TPH-G = gasoline-range total petroleum hydrocarbons
--- = not analyzed

Cleanup level for TPH-G = 0.8 mg/L

Treatment Completion Dates	
Full Scale	OP-7/8 Hot Spot
6/14/2019	3/25/2021
11/25/2019	7/1/2021
4/16/2020	7/30/2021
10/16/2021	8/31/2021
6/14/2021	9/28/2021
11/23/2021	10/20/2021
	11/15/2021
	12/23/2021

Sources: Wilson Engineering topographic survey, 4/26/17; Wilson Engineering topographic survey, 11/02/11

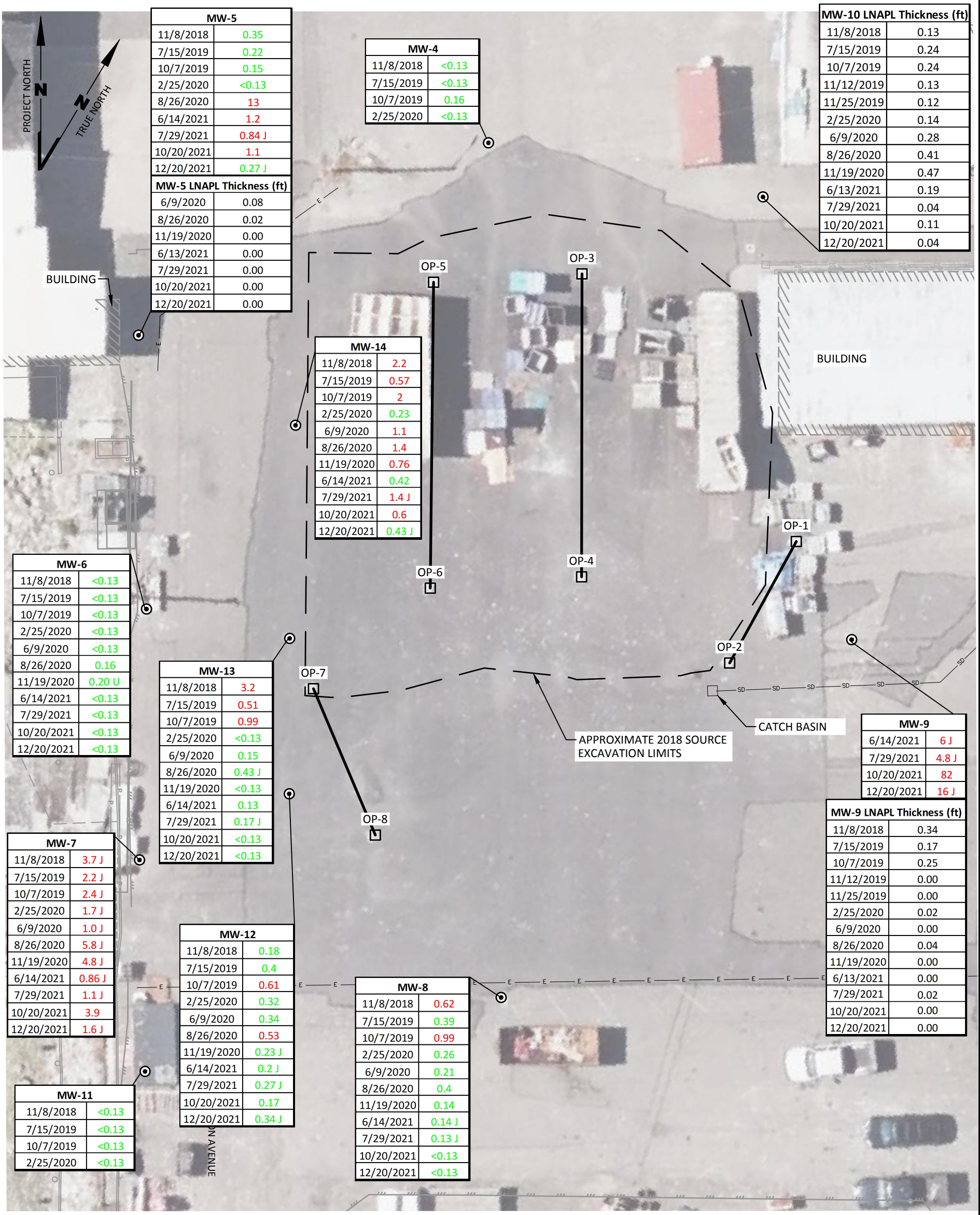
0 20 40
Scale in Feet

LANDAU ASSOCIATES

Blaine Marina, Inc. Site
Blaine, Washington

TPH-G Concentrations in Groundwater

Figure 3



MW-5	
11/8/2018	0.35
7/15/2019	0.22
10/7/2019	0.15
2/25/2020	<0.13
8/26/2020	13
6/14/2021	1.2
7/29/2021	0.84 J
10/20/2021	1.1
12/20/2021	0.27 J

MW-5 LNAPL Thickness (ft)	
6/9/2020	0.08
8/26/2020	0.02
11/19/2020	0.00
6/13/2021	0.00
7/29/2021	0.00
10/20/2021	0.00
12/20/2021	0.00

MW-4	
11/8/2018	<0.13
7/15/2019	<0.13
10/7/2019	0.16
2/25/2020	<0.13

MW-10 LNAPL Thickness (ft)	
11/8/2018	0.13
7/15/2019	0.24
10/7/2019	0.24
11/12/2019	0.13
11/25/2019	0.12
2/25/2020	0.14
6/9/2020	0.28
8/26/2020	0.41
11/19/2020	0.47
6/13/2021	0.19
7/29/2021	0.04
10/20/2021	0.11
12/20/2021	0.04

MW-14	
11/8/2018	2.2
7/15/2019	0.57
10/7/2019	2
2/25/2020	0.23
6/9/2020	1.1
8/26/2020	1.4
11/19/2020	0.76
6/14/2021	0.42
7/29/2021	1.4 J
10/20/2021	0.6
12/20/2021	0.43 J

MW-6	
11/8/2018	<0.13
7/15/2019	<0.13
10/7/2019	<0.13
2/25/2020	<0.13
6/9/2020	<0.13
8/26/2020	0.16
11/19/2020	0.20 U
6/14/2021	<0.13
7/29/2021	<0.13
10/20/2021	<0.13
12/20/2021	<0.13

MW-13	
11/8/2018	3.2
7/15/2019	0.51
10/7/2019	0.99
2/25/2020	<0.13
6/9/2020	0.15
8/26/2020	0.43 J
11/19/2020	<0.13
6/14/2021	0.13
7/29/2021	0.17 J
10/20/2021	<0.13
12/20/2021	<0.13

MW-9	
6/14/2021	6 J
7/29/2021	4.8 J
10/20/2021	82
12/20/2021	16 J

MW-9 LNAPL Thickness (ft)	
11/8/2018	0.34
7/15/2019	0.17
10/7/2019	0.25
11/12/2019	0.00
11/25/2019	0.00
2/25/2020	0.02
6/9/2020	0.00
8/26/2020	0.04
11/19/2020	0.00
6/13/2021	0.00
7/29/2021	0.02
10/20/2021	0.00
12/20/2021	0.00

MW-7	
11/8/2018	3.7 J
7/15/2019	2.2 J
10/7/2019	2.4 J
2/25/2020	1.7 J
6/9/2020	1.0 J
8/26/2020	5.8 J
11/19/2020	4.8 J
6/14/2021	0.86 J
7/29/2021	1.1 J
10/20/2021	3.9
12/20/2021	1.6 J

MW-12	
11/8/2018	0.18
7/15/2019	0.4
10/7/2019	0.61
2/25/2020	0.32
6/9/2020	0.34
8/26/2020	0.53
11/19/2020	0.23 J
6/14/2021	0.2 J
7/29/2021	0.27 J
10/20/2021	0.17
12/20/2021	0.34 J

MW-8	
11/8/2018	0.62
7/15/2019	0.39
10/7/2019	0.99
2/25/2020	0.26
6/9/2020	0.21
8/26/2020	0.4
11/19/2020	0.14
6/14/2021	0.14 J
7/29/2021	0.13 J
10/20/2021	<0.13
12/20/2021	<0.13

MW-11	
11/8/2018	<0.13
7/15/2019	<0.13
10/7/2019	<0.13
2/25/2020	<0.13

Legend

- Groundwater Monitoring Well
- IHS Concentration(s) Exceed Cleanup Levels
- IHS Concentration(s) are Less Than Cleanup Levels
- Observation and Bioremediation Injection Points
- Treatment Trench
- Excavation Boundary

Sampling Location	
Date	Result

Notes

1. All results are reported in milligrams per liter (mg/L).
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

ft = feet
IHS = Indicator Hazardous Substances
J = Result is an estimated quantity. Associated numerical value is the approximate concentration of the analyte in the sample.
LNAPL = Light Non-Aqueous Phase Liquid
TPH-D = diesel-range total petroleum hydrocarbons

Cleanup level for TPH-D = 0.5 mg/L

Treatment Completion Dates	
Full Scale	OP-7/8 Hot Spot
6/14/2019	3/25/2021
11/25/2019	7/1/2021
4/16/2020	7/30/2021
10/16/2021	8/31/2021
6/14/2021	9/28/2021
11/23/2021	10/20/2021
	11/15/2021
	12/23/2021

Sources: Wilson Engineering topographic survey, 4/26/17; Wilson Engineering topographic survey, 11/02/11

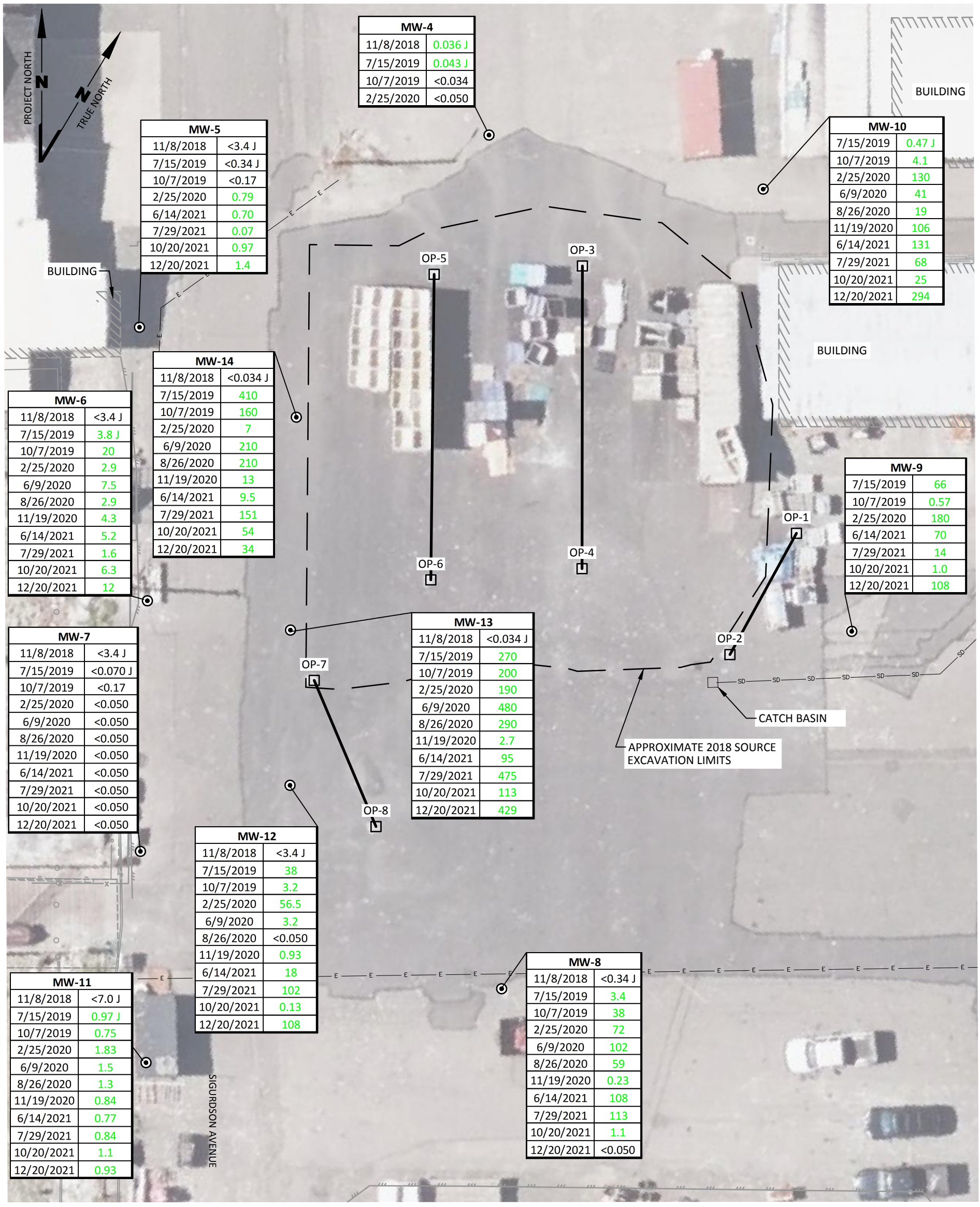
0 20 40
Scale in Feet

LANDAU ASSOCIATES

Blaine Marina, Inc. Site
Blaine, Washington

TPH-D Concentrations in Groundwater

Figure 4



MW-4	
11/8/2018	0.036 J
7/15/2019	0.043 J
10/7/2019	<0.034
2/25/2020	<0.050

MW-5	
11/8/2018	<3.4 J
7/15/2019	<0.34 J
10/7/2019	<0.17
2/25/2020	0.79
6/14/2021	0.70
7/29/2021	0.07
10/20/2021	0.97
12/20/2021	1.4

MW-10	
7/15/2019	0.47 J
10/7/2019	4.1
2/25/2020	130
6/9/2020	41
8/26/2020	19
11/19/2020	106
6/14/2021	131
7/29/2021	68
10/20/2021	25
12/20/2021	294

MW-6	
11/8/2018	<3.4 J
7/15/2019	3.8 J
10/7/2019	20
2/25/2020	2.9
6/9/2020	7.5
8/26/2020	2.9
11/19/2020	4.3
6/14/2021	5.2
7/29/2021	1.6
10/20/2021	6.3
12/20/2021	12

MW-14	
11/8/2018	<0.034 J
7/15/2019	410
10/7/2019	160
2/25/2020	7
6/9/2020	210
8/26/2020	210
11/19/2020	13
6/14/2021	9.5
7/29/2021	151
10/20/2021	54
12/20/2021	34

MW-9	
7/15/2019	66
10/7/2019	0.57
2/25/2020	180
6/14/2021	70
7/29/2021	14
10/20/2021	1.0
12/20/2021	108

MW-13	
11/8/2018	<0.034 J
7/15/2019	270
10/7/2019	200
2/25/2020	190
6/9/2020	480
8/26/2020	290
11/19/2020	2.7
6/14/2021	95
7/29/2021	475
10/20/2021	113
12/20/2021	429

MW-7	
11/8/2018	<3.4 J
7/15/2019	<0.070 J
10/7/2019	<0.17
2/25/2020	<0.050
6/9/2020	<0.050
8/26/2020	<0.050
11/19/2020	<0.050
6/14/2021	<0.050
7/29/2021	<0.050
10/20/2021	<0.050
12/20/2021	<0.050

MW-12	
11/8/2018	<3.4 J
7/15/2019	38
10/7/2019	3.2
2/25/2020	56.5
6/9/2020	3.2
8/26/2020	<0.050
11/19/2020	0.93
6/14/2021	18
7/29/2021	102
10/20/2021	0.13
12/20/2021	108

MW-11	
11/8/2018	<7.0 J
7/15/2019	0.97 J
10/7/2019	0.75
2/25/2020	1.83
6/9/2020	1.5
8/26/2020	1.3
11/19/2020	0.84
6/14/2021	0.77
7/29/2021	0.84
10/20/2021	1.1
12/20/2021	0.93

MW-8	
11/8/2018	<0.34 J
7/15/2019	3.4
10/7/2019	38
2/25/2020	72
6/9/2020	102
8/26/2020	59
11/19/2020	0.23
6/14/2021	108
7/29/2021	113
10/20/2021	1.1
12/20/2021	<0.050

Legend

- Groundwater Monitoring Well
- Green Text Indicates Nitrate was Detected Above the Laboratory Reporting Limit
- Observation and Bioremediation Injection Points
- Treatment Trench
- Excavation Boundary

Sampling Location	
Date	Result

Notes

1. All results are reported in milligrams nitrogen per liter (mg-N/L).
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

J = Result is an estimated quantity. Associated numerical value is the approximate concentration of the analyte in the sample.

Treatment Completion Dates	
Full Scale	OP-7/8 Hot Spot
6/14/2019	3/25/2021
11/25/2019	7/1/2021
4/16/2020	7/30/2021
10/16/2021	8/31/2021
6/14/2021	9/28/2021
11/23/2021	10/20/2021
	11/15/2021
	12/23/2021

Sources: Wilson Engineering topographic survey, 4/26/17; Wilson Engineering topographic survey, 11/02/11

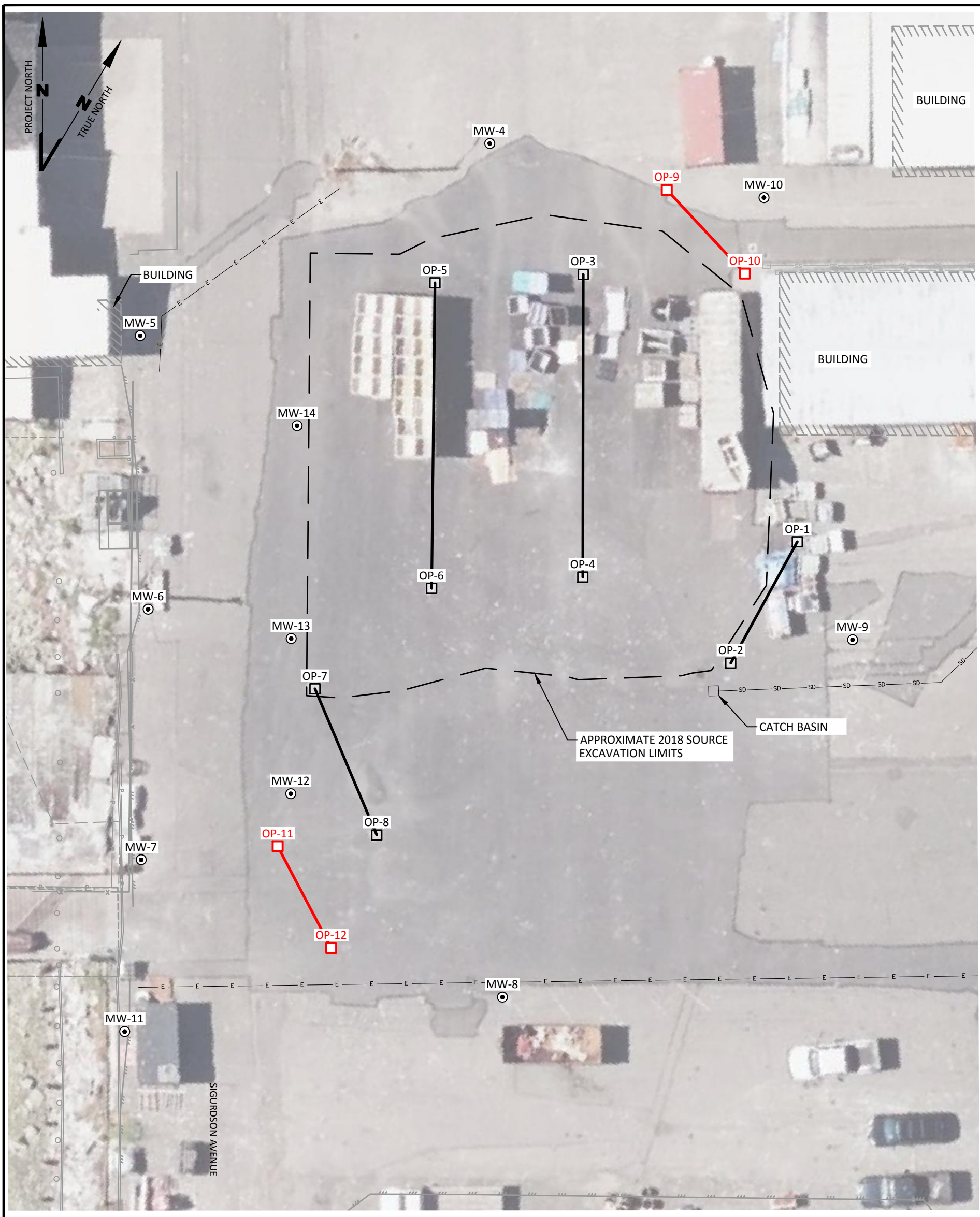
0 20 40
Scale in Feet

LANDAU ASSOCIATES

Blaine Marina, Inc. Site
Blaine, Washington

Nitrate Distribution

Figure 5



Legend

- Proposed Observation and Bioremediation Injection Point
- Proposed Treatment Trench
- Groundwater Monitoring Well
- Observation and Bioremediation Injection Point
- Treatment Trench
- Excavation Boundary

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Sources: Wilson Engineering topographic survey, 4/26/17; Wilson Engineering topographic survey, 11/02/11

0 20 40
Scale in Feet

LANDAU ASSOCIATES

Blaine Marina, Inc. Site
Blaine, Washington

Proposed Trench Locations

Figure 6

Table 1
Bioremediation Infiltration Summary
Blaine Marina, Inc.
Blaine, Washington

Injection Well Pair	First Injection - June 2019						Second Injection - November 2019					
	Nitrate Dose	Nitrate Concentration		Injection Solution			Nitrate Dose	Nitrate Concentration		Injection Solution		
		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)
OP-1/2	5x	5,000	1,129	2,000	38	2	8x	8,000	1,806	2,000	62.5	2
OP-3/4	5x	5,000	1,129	18,000	338	18	5x	5,000	1,129	18,000	350	18
OP-5/6	5x	5,000	1,129	18,000	338	18	5x	5,000	1,129	18,000	350	18
OP-7/8	5x	5,000	1,129	2,000	38	2	8x	8,000	1,806	2,000	62.5	2
Totals:				**40,000**	**752**	**40**				**40,000**	**825**	**40**

Table 1
Bioremediation Infiltration Summary
Blaine Marina, Inc.
Blaine, Washington

Injection Well Pair	Third Injection - April 2020						Fourth Injection - October 2020					
	Nitrate Dose	Nitrate Concentration		Injection Solution			Nitrate Dose	Nitrate Concentration		Injection Solution		
		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)
OP-1/2	8x	8,000	1,806	2,000	60	2	8x	8,000	1,806	2,100	62	2
OP-3/4	5x	5,000	1,129	18,000	345	18	5x	5,000	1,129	19,100	347	18
OP-5/6	5x	5,000	1,129	18,000	345	18	5x	5,000	1,129	18,000	324	18
OP-7/8	(a)						5x	5,000	1,129	800	17	2
Totals:				**38,000**	**750**	**38**				**40,000**	**750**	**40**

Table 1
Bioremediation Infiltration Summary
Blaine Marina, Inc.
Blaine, Washington

Injection Well Pair	Fifth Injection - June 2021						Sixth Injection - November 2021					
	Nitrate Dose	Nitrate Concentration		Injection Solution			Nitrate Dose	Nitrate Concentration		Injection Solution		
		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)		mg NO_3/L	mg NO_3-N/L	Volume (gal)	AN Solution (gal)	Yeast Extract (lbs)
OP-1/2	8x	8,000	1,806	1,950	90	2	8x	8,000	1,806	2,000	77	2
OP-3/4	5x	5,000	1,129	19,500	450	20	5x	5,000	1,129	21,100	485	21
OP-5/6	5x	5,000	1,129	17,000	450	17	5x	5,000	1,129	15,000	363	15
OP-7/8	10x	10,000	2,258	2,000[b]	120[b]	2[b]	20x	20,000	4,516	250[c]	25[c]	0.25[c]
Totals:				**40,450**	**1,110**	**41**				**38,350**	**950**	**38**

Notes:

(a) Nitrate infiltration was not conducted at the OP-7/OP-8 in April 2020 due to decreased injection rates and short circuiting injection solution in the surrounding area.

(b) June totals for OP-7/OP-8 are a sum of seven hot spot treatment events from March through October 2021.

(c) November totals for OP-7/OP-8 are a sum of three hot spot treatment events from November through December 2021.

Abbreviations and Acronyms:

AN = ammonium nitrate

gal = gallons

lbs = pounds

mg NO_3/L = milligrams of nitrate per liter

mg NO_3-N/L = milligrams nitrate as nitrogen per liter

Table 2
Treatment Performance Sampling Summary – 2021
Blaine Marina, Inc.
Blaine, Washington

Sample Type	Location	1Q21				2Q21				3Q21				4Q21			
		TPH-Gx[a]	TPH-Dx[a]	Volatiles[b]	General Chemistry[c]	TPH-Gx[a]	TPH-Dx[a]	Volatiles[b]	General Chemistry[c]	TPH-Gx[a]	TPH-Dx[a]	Volatiles[b]	General Chemistry[c]	TPH-Gx[a]	TPH-Dx[a]	Volatiles[b]	General Chemistry[c]
Groundwater	MW-4																
	MW-5	X[1]	X[1]	X	X	X[1]	X[1]		X	X[1]	X[1]		X	X[1]	X[1]		X
	MW-6		X		X		X		X		X		X		X		X
	MW-7	X	X	X	X	X	X		X	X	X		X	X	X		X
	MW-8		X		X		X		X		X		X		X		X
	MW-9	X[1]	X[1]	X[1]	X	X[1]	X[1]		X	X[1]	X[1]		X	X[1]	X[1]		X
	MW-10				X[2]				X[2]				X[2]				X[2]
	MW-11				X[2]				X[2]				X[2]				X[2]
	MW-12	X	X	X	X	X	X		X	X	X		X	X	X		X
	MW-13	X	X	X	X	X	X		X	X	X		X	X	X		X
	MW-14	X	X	X	X	X	X		X	X	X		X	X	X		X
Surface Water	SW-2				X[2]				X[2]				X[2]				X[2]
	SW-3				X[2]				X[2]				X[2]				X[2]

Notes:

[a] TPH-Gx and TPH-Dx = Gasoline- and diesel-range organics (mg/L; NWTPH-Gx and NWTPH-Dx with silica-gel cleanup)

[b] Volatiles = Benzene, Naphthalene (mg/L; SW-846 8260C)

[c] General Chemistry = Nitrate/Nitrite, Sulfate (mg/L; EPA 353.3/SM 5310C)

[1] Sampled if no product present - Typically occurs when there is no measureable LNAPL or thickness is less than 0.1 ft.

[2] Sulfate not sampled at this location

One duplicate sample collected per quarter.

Actual sampling parameters collected at each location varies by event based on the current treatment and monitoring goals at the Site

Acronyms

EPA = US Environmental Protection Agency

LNAPL = light non-aqueous phase liquid

mg/L = milligrams per liter

NWTPH -Dx = Northwest total petroleum hydrocarbon extended-range diesel analysis

NWTPH-Gx = Northwest total petroleum hydrocarbon extended-range gasoline analysis

TPH = Total Petroleum Hydrocarbons

Table 3
Groundwater Elevations
Blaine Marina, Inc. - Blaine, Washington

Monitoring Well	Sampling Date	TOC Elevation (ft)	Depth to LNAPL (ft from TOC)	LNAPL Thickness (ft)	Depth to Groundwater (ft from TOC)	Groundwater Elevation (ft)
MW-4	11/8/2018	16.67	--	0.00	8.33	8.34
	7/15/2019	16.67	--	0.00	9.02	7.65
	10/7/2019	16.67	--	0.00	10.32	6.35
	2/25/2020	16.67	--	0.00	8.23	8.44
	6/9/2020	16.67	--	0.00	8.29	8.38
	8/26/2020	16.67	--	0.00	9.05	7.62
	11/19/2020	16.67	--	0.00	7.46	9.21
	6/13/2021	16.67	--	0.00	8.05	8.62
	7/29/2021	16.67	--	0.00	8.97	7.70
	10/20/2021	16.67	--	0.00	7.91	8.76
	12/20/2021	16.67	--	0.00	7.51	9.16
	4/28/2022	16.67	--	0.00	8.75	7.92
MW-5	11/8/2018	15.61	--	0.00	7.24	8.37
	7/15/2019	15.61	--	0.00	8.92	6.69
	10/7/2019	15.61	--	0.00	9.43	6.18
	2/25/2020	15.61	--	0.00	7.12	8.49
	6/9/2020	15.61	6.76	0.08	6.84	8.83
	8/26/2020	15.61	8.18	0.02	8.2	7.43
	11/19/2020	15.61	--	0.00	5.39	10.22
	6/13/2021	15.61	--	0.00	7.09	8.52
	7/29/2021	15.61	--	0.00	7.32	8.29
	10/20/2021	15.61	--	0.00	6.18	9.43
	12/20/2021	15.61	--	0.00	5.43	10.18
	4/28/2022	15.61	--	0.00	7.61	8.00
MW-6	11/8/2018	15.63	--	0.00	7.12	8.51
	7/15/2019	15.63	--	0.00	7.97	7.66
	10/7/2019	15.63	--	0.00	8.85	6.78
	2/25/2020	15.63	--	0.00	7.19	8.44
	6/9/2020	15.63	--	0.00	6.77	8.86
	8/26/2020	15.63	--	0.00	8.51	7.12
	11/19/2020	15.63	--	0.00	6.38	9.25
	6/13/2021	15.63	---	0.00	7.25	8.38
	7/29/2021	15.63	--	0.00	8.14	7.49
	10/20/2021	15.63	--	0.00	5.79	9.84
	12/20/2021	15.63	--	0.00	5.44	10.19
	4/28/2022	15.63	--	0.00	7.69	7.94
MW-7	11/8/2018	15.77	--	0.00	7.41	8.36
	7/15/2019	15.77	--	0.00	8.25	7.52
	10/7/2019	15.77	--	0.00	8.60	7.17
	2/25/2020	15.77	--	0.00	7.40	8.37
	6/9/2020	15.77	--	0.00	7.18	8.59
	8/26/2020	15.77	--	0.00	9.78	5.99
	11/19/2020	15.77	--	0.00	6.61	9.16
	6/13/2021	15.77	---	0.00	7.86	7.91
	7/29/2021	15.77	--	0.00	8.18	7.59
	10/20/2021	15.77	--	0.00	6.04	9.73
	12/20/2021	15.77	--	0.00	6.14	9.63
	4/28/2022	15.77	--	0.00	8.11	7.66

Table 3
Groundwater Elevations
Blaine Marina, Inc. - Blaine, Washington

Monitoring Well	Sampling Date	TOC Elevation (ft)	Depth to LNAPL (ft from TOC)	LNAPL Thickness (ft)	Depth to Groundwater (ft from TOC)	Groundwater Elevation (ft)
MW-8	11/8/2018	15.98	--	0.00	8.08	7.9
	7/15/2019	15.98	--	0.00	8.52	7.46
	10/7/2019	15.98	--	0.00	8.79	7.19
	2/25/2020	15.98	--	0.00	7.81	8.17
	6/9/2020	15.98	--	0.00	7.84	8.14
	8/26/2020	15.98	--	0.00	8.58	7.4
	11/19/2020	15.98	--	0.00	7.04	8.94
	6/13/2021	15.98	--	0.00	8.3	7.68
	7/29/2021	15.98	--	0.00	8.44	7.54
	10/20/2021	15.98	--	0.00	7.12	8.86
	12/20/2021	15.98	--	0.00	6.96	9.02
	4/28/2022	15.98	--	0.00	8.29	7.69
MW-9	11/8/2018	15.61	7.29	0.34	7.63	8.25
	7/15/2019	15.61	8.07	0.17	8.24	7.51
	10/7/2019	15.61	7.71	0.25	7.96	7.85
	11/12/2019	15.61	7.35	0.00	7.35	8.26
	11/25/2019	15.61	7.77	0.00	7.77	7.84
	2/25/2020	15.61	7.33	0.02	7.35	8.28
	6/9/2020	15.61	--	0.00	7.84	7.77
	8/26/2020	15.61	7.68	0.04	7.72	7.92
	11/19/2020	15.61	--	0.00	6.42	9.19
	6/13/2021	15.61	--	0.00	7.7	7.91
	7/29/2021	15.61	8.03	0.02	8.05	7.58
	10/20/2021	15.61	--	0.00	7.04	8.57
	12/20/2021	15.61	--	0.00	6.11	9.50
	4/28/2022	15.61	7.25	0.01	7.26	8.36
MW-10	11/8/2018	16.12	7.67	0.13	7.8	8.42
	7/15/2019	16.12	8.19	0.24	8.43	7.88
	10/7/2019	16.12	8.07	0.24	8.31	8.00
	11/12/2019	16.12	8.22	0.13	8.35	7.87
	11/25/2019	16.12	7.8	0.12	7.92	8.30
	2/25/2020	16.12	7.34	0.14	7.48	8.75
	6/9/2020	16.12	7.69	0.28	7.97	8.37
	8/26/2020	16.12	8.11	0.41	8.52	7.93
	11/19/2020	16.12	6.76	0.47	7.23	9.27
	6/13/2021	16.12	8.12	0.19	8.31	7.96
	7/29/2021	16.12	8.41	0.04	8.45	7.70
	10/20/2021	16.12	7.58	0.11	7.69	8.52
	12/20/2021	16.12	6.71	0.04	6.75	9.40
	4/28/2022	16.12	7.85	0.03	7.88	8.26
MW-11	11/8/2018	15.62	--	0.00	7.38	8.24
	7/15/2019	15.62	--	0.00	9.15	6.47
	10/7/2019	15.62	--	0.00	10.93	4.69
	2/25/2020	15.62	--	0.00	7.44	8.18
	6/9/2020	15.62	--	0.00	7.29	8.33
	8/26/2020	15.62	--	0.00	9.48	6.14
	11/19/2020	15.62	--	0.00	5.9	9.72
	6/13/2021	15.62	--	0.00	9.22	6.4

Table 3
Groundwater Elevations
Blaine Marina, Inc. - Blaine, Washington

Monitoring Well	Sampling Date	TOC Elevation (ft)	Depth to LNAPL (ft from TOC)	LNAPL Thickness (ft)	Depth to Groundwater (ft from TOC)	Groundwater Elevation (ft)
MW-11	7/29/2021	15.62	--	0.00	8.98	6.64
	10/20/2021	15.62	--	0.00	6.71	8.91
	12/20/2021	15.62	--	0.00	5.89	9.73
	4/28/2022	15.62	--	0.00	8.65	6.97
MW-12	11/8/2018	16.06	--	0.00	7.71	8.35
	7/15/2019	16.06	--	0.00	8.55	7.51
	10/7/2019	16.06	--	0.00	8.90	7.16
	2/25/2020	16.06	--	0.00	7.78	8.28
	6/9/2020	16.06	--	0.00	7.96	8.10
	8/26/2020	16.06	--	0.00	7.69	8.37
	11/19/2020	16.06	--	0.00	7.13	8.93
	6/13/2021	16.06	--	0.00	8.4	7.66
	7/29/2021	16.06	--	0.00	8.47	7.59
	10/20/2021	16.06	--	0.00	6.82	9.24
	12/20/2021	16.06	--	0.00	5.62	10.44
	4/28/2022	16.06	--	0.00	8.37	7.69
MW-13	11/8/2018	16.13	--	0.00	7.71	8.42
	7/15/2019	16.13	--	0.00	8.60	7.53
	10/7/2019	16.13	--	0.00	8.85	7.28
	2/25/2020	16.13	--	0.00	7.47	8.66
	6/9/2020	16.13	--	0.00	7.70	8.43
	8/26/2020	16.13	--	0.00	8.66	7.47
	11/19/2020	16.13	--	0.00	6.96	9.17
	6/13/2021	16.13	--	0.00	8.33	7.8
	7/29/2021	16.13	--	0.00	8.45	7.68
	10/20/2021	16.13	--	0.00	6.95	9.18
	12/20/2021	16.13	--	0.00	6.59	9.54
	4/28/2022	16.13	--	0.00	8.16	7.97
MW-14	11/8/2018	16.36	--	0.00	8.01	8.35
	7/15/2019	16.36	--	0.00	8.78	7.58
	10/7/2019	16.36	--	0.00	9.15	7.21
	2/25/2020	16.36	--	0.00	7.45	8.91
	6/9/2020	16.36	--	0.00	7.96	8.40
	8/26/2020	16.36	--	0.00	8.71	7.65
	11/19/2020	16.35	--	0.00	6.71	9.64
	6/14/2021	16.35	--	0.00	8.41	7.94
	7/29/2021	16.35	--	0.00	8.45	7.90
	10/20/2021	16.35	--	0.00	7.44	8.91
	12/20/2021	16.35	--	0.00	6.63	9.72
	4/28/2022	16.35	--	0.00	8.04	8.31
OP-1	11/8/2018	15.41	--	0.00	6.84	8.57
	7/15/2019	15.41	--	0.00	7.49	7.92
	10/7/2019	15.41	--	0.00	7.29	8.12
	2/25/2020	15.41	--	0.00	6.26	9.15
	6/9/2020	15.41	--	0.00	6.96	8.45
	8/26/2020	15.41	7.35	0.11	7.46	8.04
	11/19/2020	15.41	5.92	0.03	5.95	9.48
	6/13/2021	15.41	--	0.00	7.42	7.99

Table 3
Groundwater Elevations
Blaine Marina, Inc. - Blaine, Washington

Monitoring Well	Sampling Date	TOC Elevation (ft)	Depth to LNAPL (ft from TOC)	LNAPL Thickness (ft)	Depth to Groundwater (ft from TOC)	Groundwater Elevation (ft)
OP-1	7/29/2021	15.41	--	0.00	7.39	8.02
	10/20/2021	15.41	--	0.00	5.78	9.63
	12/20/2021	15.41	--	0.00	5.67	9.74
	4/28/2022	15.41	--	0.00	6.88	8.53
OP-2	11/8/2018	14.52	5.93	0.23	6.16	8.54
	7/15/2019	14.52	6.61	0.12	6.73	7.89
	10/7/2019	14.52	6.32	0.01	6.33	8.20
	2/25/2020	14.52	--	0.00	5.35	9.17
	6/9/2020	14.52	6.06	0.02	6.08	8.46
	8/26/2020	14.52	6.41	0.19	6.6	8.07
	11/19/2020	14.52	4.98	0.01	4.99	9.54
	6/13/2021	14.52	--	0.00	8.40	6.12
	7/29/2021	14.52	--	0.00	6.46	8.06
	10/20/2021	14.52	--	0.00	5.61	8.91
	12/20/2021	14.52	--	0.00	4.71	9.81
	4/28/2022	14.52	--	0.00	5.86	8.66
OP-3	11/8/2018	15.63	--	0.00	6.96	8.67
	7/15/2019	15.63	--	0.00	--	dry
	10/7/2019	15.63	--	0.00	7.38	8.25
	2/25/2020	15.63	--	0.00	6.43	9.20
	6/9/2020	15.63	--	0.00	7.01	8.62
	8/26/2020	15.63	--	0.00	--	dry
	11/19/2020	15.63	--	0.00	5.67	9.96
	6/13/2021	15.63	--	0.00	--	dry
	7/29/2021	15.63	--	0.00	7.44	8.19
	10/20/2021	15.63	--	0.00	6.49	9.14
	12/20/2021	15.63	--	0.00	5.48	10.15
	4/28/2022	15.63	--	0.00	6.87	8.76
OP-4	11/8/2018	15.05	--	0.00	6.44	8.61
	7/15/2019	15.05	--	0.00	7.13	7.92
	10/7/2019	15.05	--	0.00	6.93	8.12
	2/25/2020	15.05	--	0.00	5.75	9.30
	6/9/2020	15.05	--	0.00	6.52	8.53
	8/26/2020	15.05	--	0.00	6.93	8.12
	11/19/2020	15.05	--	0.00	5.28	9.77
	6/13/2021	15.05	--	0.00	6.82	8.23
	7/29/2021	15.05	--	0.00	6.85	8.20
	10/20/2021	15.05	--	0.00	5.95	9.10
	12/20/2021	15.05	--	0.00	5.09	9.96
	4/28/2022	15.05	--	0.00	6.47	8.58
OP-5	11/8/2018	15.93	7.2	0.01	7.21	8.73
	7/15/2019	15.93	--	0.00	7.26	8.67
	10/7/2019	15.93	--	0.00	7.27	8.66
	2/25/2020	15.93	--	0.00	6.41	9.52
	6/9/2020	15.93	--	0.00	7.25	8.68
	8/26/2020	15.93	--	0.00	7.26	8.67
	11/19/2020	15.93	--	0.00	5.96	9.97
	6/13/2021	15.93	--	0.00	7.31	8.62

Table 3
Groundwater Elevations
Blaine Marina, Inc. - Blaine, Washington

Monitoring Well	Sampling Date	TOC Elevation (ft)	Depth to LNAPL (ft from TOC)	LNAPL Thickness (ft)	Depth to Groundwater (ft from TOC)	Groundwater Elevation (ft)
OP-5	7/29/2021	15.93	--	0.00	7.29	8.64
	10/20/2021	15.93	--	0.00	6.14	9.79
	12/20/2021	15.93	--	0.00	5.79	10.14
	4/28/2022	15.93	--	0.00	7.16	8.77
OP-6	11/8/2018	15.42	--	0.00	6.52	8.9
	7/15/2019	15.42	--	0.00	6.53	8.89
	10/7/2019	15.42	--	0.00	6.51	8.91
	2/25/2020	15.42	--	0.00	6.03	9.39
	6/9/2020	15.42	--	0.00	6.52	8.90
	8/26/2020	15.42	--	0.00	6.54	8.88
	11/19/2020	15.42	--	0.00	5.51	9.91
	6/13/2021	15.42	--	0.00	6.50	8.92
	7/29/2021	15.42	--	0.00	6.54	8.88
	10/20/2021	15.42	--	0.00	6.28	9.14
	12/20/2021	15.42	--	0.00	5.41	10.01
	4/28/2022	15.42	--	0.00	6.55	8.87
OP-7	11/8/2018	15.31	--	0.00	7.18	8.13
	7/15/2019	15.31	--	0.00	7.06	8.25
	10/7/2019	15.31	--	0.00	7.07	8.24
	2/25/2020	15.31	--	0.00	5.10	10.21
	6/9/2020	15.31	--	0.00	6.52	8.79
	8/26/2020	15.31	--	0.00	6.84	8.47
	11/19/2020	15.31	--	0.00	3.2	12.11
	6/13/2021	15.31	--	0.00	6.86	8.45
	7/29/2021	15.31	--	0.00	7.07	8.24
	10/20/2021	15.31	--	0.00	5.27	10.04
	12/20/2021	15.31	--	0.00	4.55	10.76
	4/28/2022	15.31	--	0.00	6.44	8.87
OP-8	11/8/2018	15.72	--	0.00	7.36	8.36
	7/15/2019	15.72	--	0.00	7.30	8.42
	10/7/2019	15.72	--	0.00	4.91	10.81
	2/25/2020	15.72	--	0.00	5.25	10.47
	6/9/2020	15.72	--	0.00	6.62	9.10
	8/26/2020	15.72	--	0.00	6.65	9.07
	11/19/2020	15.72	--	0.00	2.1	13.62
	6/13/2021	15.72	--	0.00	5.23	10.49
	7/29/2021	15.72	--	0.00	6.99	8.73
	10/20/2021	15.72	--	0.00	3.39	12.33
	12/20/2021	15.75	--	0.00	2.45	13.30
	4/28/2022	15.75	--	0.00	4.29	11.46

Abbreviations/Acronyms:

ft = feet

LNAPL = light non-aqueous phase liquid

TOC = top of casing

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Laboratory Sample ID, Sampling Date, Sample Type													
		MW-4 EV18110065-07 11/8/2018 N	MW-4 EV19070106-03 7/15/2019 N	MW-4 EV19100043-02 10/7/2019 N	MW-4 EV20020153-03 2/25/2020 N	MW-4 EV22040163-08 4/28/2022 N	MW-5 EV18110065-02 11/8/2018 N	MW-5 EV19070106-06 7/15/2019 N	MW-5 EV19100043-04 10/7/2019 N	MW-5 EV20020153-06 2/25/2020 N	MW-5 EV20080140-11 8/26/2020 N	MW-5 EV21060076-01 6/14/2021 N	MW-5 EV21070148-04 7/29/2021 N	MW-5 EV21100112-04 10/20/2021 N	MW-5 EV21120136-09 12/20/2021 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/DxSG)															
Gasoline Range C5-C12	0.8	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	**0.47 J**	0.05 U	0.05 U	0.05 U	0.05 U
Diesel Range C12-C24	0.5	0.13 U	0.13 U	**0.16**	0.13 U	0.13 U	**0.35**	**0.22**	**0.15**	0.13 U	**13**	**1.2**	**0.84 J**	**1.1**	**0.27 J**
Motor Oil Range C24-C40	0.5	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.2 U	0.25 U	0.25 U	0.25 U	0.25 U
Combined TPH (b)	0.5	0.25 U	0.25 U	**0.16**	0.25 U	0.25 U	**0.35**	**0.22**	**0.15**	0.25 U	**13**	**1.2**	**0.84 J**	**1.1**	**0.27 J**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	0.0020 U	--	--	--
Naphthalene	0.083 (d)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	0.0020 U	--	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	**0.16 J**	**0.19 J**	0.15 U	0.22 U	0.22 U	15 UJ	1.5 UJ	0.76 U	**3.5**	--	**3.1**	**0.30**	**4.3**	**6.0**
Nitrate (mg-N/L; calc.)	N/A	**0.036 J**	**0.043 J**	0.034 U	0.050 U	0.050 U	3.4 UJ	0.34 UJ	0.17 U	**0.79**	--	**0.70**	**0.07**	**0.97**	**1.4**
Sulfate	N/A	**130**	**110**	**120**	**100**	**130**	**2,300**	**2,000**	**1,900**	**2,000**	--	**2,000**	**2,300**	**2,200**	**1,800**
Total Organic Carbon	N/A	**1.8**	--	--	--	--	1.0 U	--	--	--	--	--	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Laboratory Sample ID, Sampling Date, Sample Type													
		MW-5 EV22040163-03 4/28/2022 N	MW-6 EV18110065-03 11/8/2018 N	MW-6 EV19070106-02 7/15/2019 N	MW-6 EV19100043-06 10/7/2019 N	MW-6 EV20020153-02 2/25/2020 N	MW-6 EV20060047-02 6/9/2020 N	MW-6 EV20080140-02 8/26/2020 N	MW-6 EV20110126-01 11/19/2020 N	MW-6 EV21060076-02 6/14/2021 N	MW-6 EV21070148-03 7/29/2021 N	MW-6 EV21100112-06 10/20/2021 N	MW-6 EV21120136-07 12/20/2021 N	MW-6 EV22040163-01 4/28/2022 N	MW-7 EV18110065-08 11/8/2018 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D															
Gasoline Range C5-C12	0.8	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	--	--	--	--	--	--	--	0.05 U	**11**
Diesel Range C12-C24	0.5	**0.68**	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	**0.16**	0.20 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	**3.3 J**
Motor Oil Range C24-C40	0.5	0.25 U	0.25 U	0.25 U	0.25 U	**0.29**	0.25 U	**0.31**	**0.67**	0.25 U	0.25 U	0.25 U	0.25 U	**0.4**	**0.4**
Combined TPH (b)	0.5	**0.68**	0.25 U	0.25 U	0.25 U	**0.29**	0.25 U	**0.47**	**0.67**	0.25 U	0.25 U	0.25 U	0.25 U	**0.4**	**3.7 J**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--	--	--	--	--	--	--	0.0020 UJ
Naphthalene	0.083 (d)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--	--	--	--	--	--	--	**0.047**
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	0.22 U	15 UJ	**17 J**	**88**	**13**	**33**	**13**	**19**	**23**	**7.1**	**28**	**51**	**80**	15 UJ
Nitrate (mg-N/L; calc.)	N/A	0.050 U	3.4 UJ	**3.8 J**	**20**	**2.9**	**7.5**	**2.9**	**4.3**	**5.2**	**1.6**	**6.3**	**12**	**18**	3.4 UJ
Sulfate	N/A	**2,000**	**1,700**	**1,300**	**530**	**840**	**310**	**1,100**	**640**	**790**	**1,600**	**690**	**160**	**590**	**1,500**
Total Organic Carbon	N/A	--	1.0 U	--	--	--	--	--	--	--	--	--	--	--	**3.0**

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Laboratory Sample ID, Sampling Date, Sample Type													
		MW-7 EV18110065-01 11/8/2018 FD	MW-7 EV19070106-07 7/15/2019 N	MW-7 EV19070106-01 7/15/2019 FD	MW-7 EV19100043-03 10/7/2019 N	MW-7 EV19100043-01 10/7/2019 FD	MW-7 EV20020153-07 2/25/2020 N	MW-7 EV20020153-01 2/25/2020 FD	MW-7 EV20060047-04 6/9/2020 N	MW-7 EV20060047-01 6/9/2020 FD	MW-7 EV20080140-04 8/26/2020 N	MW-7 EV20080140-01 8/26/2020 FD	MW-7 EV20110126-02 11/19/2020 N	MW-7 EV20110126-08 11/19/2020 FD	MW-7 EV21060076-03 6/14/2021 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D															
Gasoline Range C5-C12	0.8	**10**	**13 J**	**10 J**	**7.3**	**7.2**	**9.2**	**11**	**6.4**	**6.3**	**5.6**	**5.5**	**6.5**	**6.6**	**4.7**
Diesel Range C12-C24	0.5	**3.7 J**	**2.2 J**	**1.7 J**	**2.4 J**	**2.2 J**	**1.7 J**	**2 J**	**1.0 J**	**1.1 J**	**5.8**	**6.6**	**4.8 J**	**4.6 J**	**0.86 J**
Motor Oil Range C24-C40	0.5	**0.45**	**0.3**	**0.3**	0.25 U	0.25 U	0.25 U	**0.28**	0.25 U	0.25 U	1.2 U	**0.54**	0.50 U	0.50 U	0.25 U
Combined TPH (b)	0.5	**4.15 J**	**2.5 J**	**2.0 J**	**2.4 J**	**2.2 J**	**1.7 J**	**2.28 J**	**1.0 J**	**1.1 J**	**5.8**	**7.14**	**4.8 J**	**4.6 J**	**0.86 J**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	0.0020 UJ	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 UJ	0.0020 UJ	--	--	--	--	--	--	0.0020 U
Naphthalene	0.083 (d)	**0.043**	**0.03**	**0.032**	**0.038 J**	**0.027 J**	**0.018 J**	**0.018 J**	--	--	--	--	--	--	**0.0038**
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	1.5 U	0.31 UJ	1.5 UJ	0.76 U	0.76 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U
Nitrate (mg-N/L; calc.)	N/A	0.34 U	0.070 UJ	0.34 UJ	0.17 U	0.17 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Sulfate	N/A	**1,500**	**960**	**980**	**740**	**700**	**1,100**	**1,100**	**1,200**	**1,300**	**1,200**	**1,200**	**1,400**	**1,300**	**1,500**
Total Organic Carbon	N/A	**3.7**	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type													
		MW-7 EV21070148-02 7/29/2021 N	MW-7 EV21070148-01 7/29/2021 FD	MW-7 EV21100112-02 10/20/2021 N	MW-7 EV21100112-01 10/20/2021 FD	MW-7 EV21120136-05 12/20/2021 N	MW-7 EV21120136-02 12/20/2021 FD	MW-7 EV22040163-04 4/28/2022 N	MW-7 EV22040163-05 4/28/2022 FD	MW-8 EV18110065-10 11/8/2018 N	MW-8 EV19070106-10 7/15/2019 N	MW-8 EV19100043-08 10/7/2019 N	MW-8 EV20020153-10 2/25/2020 N	MW-8 EV20060047-05 6/9/2020 N	MW-8 EV20080140-05 8/26/2020 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D															
Gasoline Range C5-C12	0.8	**3.7**	**3.7**	**3.3 J**	**5.1 J**	(c)	(c)	**4.2 J**	**3.4 J**	**0.082**	**0.097**	0.05 U	0.05 U	0.05 U	0.05 U
Diesel Range C12-C24	0.5	**1.1 J**	**1.1 J**	**3.9**	**3.8**	**1.6 J**	**1.4 J**	**1.3 J**	**1.4 J**	**0.62**	**0.39**	**0.99**	**0.26**	**0.210**	**0.4**
Motor Oil Range C24-C40	0.5	0.25 U	0.25 U	**0.99 J**	**0.56 J**	**0.47**	**0.28**	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	**0.7**	0.25 U	0.25 U
Combined TPH (b)	0.5	**1.1 J**	**1.1 J**	**4.89 J**	**4.36 J**	**2.07 J**	**1.68 J**	**1.3 J**	**1.4 J**	**0.62**	**0.39**	**0.99**	**0.96**	**0.210**	**0.4**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	--	--	--	--	--	--	0.0020 UJ	0.0020 UJ	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--
Naphthalene	0.083 (d)	--	--	--	--	--	--	**0.0029 J**	**0.0026 J**	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	0.22 U	**0.24**	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	1.5 UJ	**15**	**170**	**320**	**450**	**260**
Nitrate (mg-N/L; calc.)	N/A	0.050 U	**0.054**	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.34 UJ	**3.4**	**38**	**72**	**102**	**59**
Sulfate	N/A	**1,500**	**1,500**	**1,300**	**1,400**	**1,600**	**1,600**	**1,200**	**1,200**	**190**	**25**	**170**	**400**	**360**	**400**
Total Organic Carbon	N/A	--	--	--	--	--	--	--	--	**2.5**	**--**	**--**	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type													
		MW-8 EV20110126-03 11/19/2020 N	MW-8 EV21060076-04 6/14/2021 N	MW-8 EV21070148-05 7/29/2021 N	MW-8 EV21100112-08 10/20/2021 N	MW-8 EV21120136-08 12/20/2021 N	MW-8 EV22040163-11 4/28/2022 N	MW-9 EV19070106-05 7/15/2019 N	MW-9 EV19100043-11 10/7/2019 N	MW-9 EV20020153-05 2/25/2020 N	MW-9 EV21060076-05 6/14/2021 N	MW-9 EV21070148-07 7/29/2021 N	MW-9 EV21100112-09 10/20/2021 N	MW-9 EV21120136-01 12/20/2021 N	MW-9 EV22040163-12 4/28/2022 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D															
Gasoline Range C5-C12	0.8	0.05 U	--	--	--	--	0.05 U	--	--	--	**0.45**	**0.53 J**	**1.6 J**	**1.8 J**	**0.46**
Diesel Range C12-C24	0.5	**0.14**	**0.14 J**	**0.13 J**	0.13 U	0.13 U	0.13 U	--	--	--	**6 J**	**4.8 J**	**82**	**16 J**	**8**
Motor Oil Range C24-C40	0.5	0.25 U	**0.46 J**	0.25 U	0.25 U	0.25 U	0.25 U	--	--	--	0.5 U	0.25 U	5 U	1.2 U	0.5 U
Combined TPH (b)	0.5	**0.14**	**0.60 J**	**0.13 J**	0.25 U	0.25 U	0.25 U	--	--	--	**6 J**	**4.8 J**	**82**	**16 J**	**8**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	--	--	--	--	--	--	--	--	--	**0.0042**	--	--	--	--
Naphthalene	0.083 (d)	--	--	--	--	--	--	--	--	--	**0.0023**	--	--	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	**1.0**	**480**	**500**	**4.7**	0.22 U	**250**	**290**	**2.5**	**810**	**310**	**64**	**4.4**	**480**	**89**
Nitrate (mg-N/L; calc.)	N/A	**0.23**	**108**	**113**	**1.1**	0.050 U	**57**	**66**	**0.57**	**180**	**70**	**14**	**1.0**	**108**	**20**
Sulfate	N/A	**220**	**590**	**640**	**180**	**380**	**480**	**84**	**76**	**220**	**620**	**530**	**310**	**160**	**170**
Total Organic Carbon	N/A	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type														
		MW-10 EV19070106-04 7/15/2019 N	MW-10 EV19100043-12 10/7/2019 N	MW-10 EV20020153-04 2/25/2020 N	MW-10 EV20060047-06 6/9/2020 N	MW-10 EV20080140-06 8/26/2020 N	MW-10 EV20110126-09 11/19/2020 N	MW-10 2106-131-06 6/14/2021 N	MW-10 2107-306-10 7/29/2021 N	MW-10 2110-188-09 10/20/2021 N	MW-10 2112-216-11 12/20/2021 N	MW-10 EV22040163-10 4/28/2022 N	MW-11 EV18110065-09 11/8/2018 N	MW-11 EV19070106-09 7/15/2019 N	MW-11 EV19100043-05 10/7/2019 N	MW-11 EV20020153-09 2/25/2020 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D																
Gasoline Range C5-C12	0.8	--	--	--	--	--	--	--	--	--	--	**0.19**	**0.079**	0.05 U	0.05 U	0.05 U
Diesel Range C12-C24	0.5	--	--	--	--	--	--	--	--	--	--	**37**	0.13 U	0.13 U	0.13 U	0.13 U
Motor Oil Range C24-C40	0.5	--	--	--	--	--	--	--	--	--	--	2.5 U	0.25 U	0.25 U	0.25 U	0.25 U
Combined TPH (b)	0.5	--	--	--	--	--	--	--	--	--	--	**37**	0.25 U	0.25 U	0.25 U	0.25 U
Volatiles (mg/L; SW-846 8260C)																
Benzene	0.0024	--	--	--	--	--	--	--	--	--	--	--	0.0020 U	0.0020 U	0.0020 U	0.0020 U
Naphthalene	0.083 (d)	--	--	--	--	--	--	--	--	--	--	--	0.0020 U	0.0020 U	0.0020 U	0.0020 U
General Chemistry (mg/L; EPA 300.0/SM 5310C)																
Nitrate (mg/L)	N/A	**2.1 J**	**18**	**580**	**180**	**83**	**470**	**580**	**300**	**110**	**1,300**	**760**	31 UJ	**4.3 J**	**3.3**	**8.1**
Nitrate (mg-N/L; calc.)	N/A	**0.47 J**	**4.1**	**130**	**41**	**19**	**106**	**131**	**68**	**25**	**294**	**172**	7.0 UJ	**0.97 J**	**0.75**	**1.83**
Sulfate	N/A	**32**	**90**	**220**	**190**	**180**	**170**	--	--	--	--	**60**	**2,400**	**2,000**	**1,800**	**1,600**
Total Organic Carbon	N/A	--	--	--	--	--	--	--	--	--	--	--	1.0 U	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type														
		MW-11 EV20060047-03 6/9/2020 N	MW-11 EV20080140-03 8/26/2020 N	MW-11 EV20110126-04 11/19/2020 N	MW-11 2106-131-07 6/14/2021 N	MW-11 2107-306-05 7/29/2021 N	MW-11 2110-188-07 10/20/2021 N	MW-11 2112-216-02 12/20/2021 N	MW-11 EV22040163-02 4/28/2022 N	MW-12 EV18110065-06 11/8/2018 N	MW-12 EV19070106-12 7/15/2019 N	MW-12 EV19100043-10 10/7/2019 N	MW-12 EV20020153-12 2/25/2020 N	MW-12 EV20060047-08 6/9/2020 N	MW-12 EV20080140-08 8/26/2020 N	MW-12 EV20110126-05 11/19/2020 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D																
Gasoline Range C5-C12	0.8	0.05 U	0.05 U	0.05 U	--	--	--	--	0.05 U	**0.98**	**0.64**	**0.67 J**	**0.34**	**0.41**	**0.54 J**	**0.96**
Diesel Range C12-C24	0.5	--	--	--	--	--	--	--	0.13 U	**0.18**	**0.4**	**0.61**	**0.32**	**0.34**	**0.53**	**0.23 J**
Motor Oil Range C24-C40	0.5	--	--	--	--	--	--	--	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	**0.46**	0.25 U
Combined TPH (b)	0.5	--	--	--	--	--	--	--	0.25 U	**0.18**	**0.4**	**0.61**	**0.32**	**0.34**	**0.99**	**0.23 J**
Volatiles (mg/L; SW-846 8260C)																
Benzene	0.0024	--	--	--	--	--	--	--	--	0.0020 U	0.0020 U	**0.0023 J**	**0.0022**	--	--	--
Naphthalene	0.083 (d)	--	--	--	--	--	--	--	--	0.0020 U	0.0020 U	0.0020 UJ	**0.0025**	--	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)																
Nitrate (mg/L)	N/A	**6.7**	**5.8**	**3.7**	**3.4**	**3.7**	**5.0**	**4.1**	**2.3**	15 UJ	**170**	**14**	**250**	**14**	0.22 U	**4.1**
Nitrate (mg-N/L; calc.)	N/A	**1.5**	**1.3**	**0.84**	**0.77**	**0.84**	**1.1**	**0.93**	**0.52**	3.4 UJ	**38**	**3.2**	**56.5**	**3.2**	0.050 U	**0.93**
Sulfate	N/A	**1,500**	**1,600**	**2,600**	**--**	**--**	**--**	**--**	**1,900**	**1,700**	**620**	**360**	**420**	**430**	**860**	**1,800**
Total Organic Carbon	N/A	--	--	--	--	--	--	--	--	1.0 U	--	--	--	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type														
		MW-12 EV21060076-06 6/14/2021 N	MW-12 EV21070148-09 7/29/2021 N	MW-12 EV21100112-03 10/20/2021 N	MW-12 EV21120136-06 12/20/2021 N	MW-12 EV22040163-09 4/28/2022 N	MW-13 EV18110065-05 11/8/2018 N	MW-13 EV19070106-11 7/15/2019 N	MW-13 EV19100043-09 10/7/2019 N	MW-13 EV20020153-11 2/25/2020 N	MW-13 EV20060047-09 6/9/2020 N	MW-13 EV20080140-09 8/26/2020 N	MW-13 EV20110126-06 11/19/2020 N	MW-13 EV21060076-07 6/14/2021 N	MW-13 EV21070148-08 7/29/2021 N	MW-13 EV21100112-05 10/20/2021 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D																
Gasoline Range C5-C12	0.8	**0.57**	**0.29**	**0.34**	**0.38**	**0.47**	**0.74**	**0.22**	0.05 U	**0.094**	**0.067**	**0.073**	**0.15**	**0.052**	0.05 U	0.05 U
Diesel Range C12-C24	0.5	**0.2 J**	**0.27 J**	**0.17**	**0.34 J**	**0.33 J**	**3.2**	**0.51**	**0.99**	0.13 U	**0.150**	**0.43 J**	0.13 U	**0.13**	**0.17 J**	0.13 U
Motor Oil Range C24-C40	0.5	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	**0.41 J**	0.25 U	0.25 U	0.25 U	0.25 U	**0.9**	0.25 U	0.25 U	**0.27**	0.25 U
Combined TPH (b)	0.5	**0.2 J**	**0.27 J**	**0.17**	**0.34 J**	**0.33 J**	**3.61 J**	**0.51**	**0.99**	0.25 U	**0.150**	**1.33 J**	0.25 U	**0.13**	**0.44 J**	0.25 U
Volatiles (mg/L; SW-846 8260C)																
Benzene	0.0024	0.0020 U	--	--	--	--	**0.0029**	0.0020 U	**0.018**	0.0020 U	--	--	--	0.0020 U	--	--
Naphthalene	0.083 (d)	0.0020 U	--	--	--	--	**0.0048**	**0.0024**	0.0020 U	**0.0021**	--	--	--	0.0020 U	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)																
Nitrate (mg/L)	N/A	**81**	**450**	**0.58**	**480**	**88**	0.15 UJ	**1,200**	**900**	**860**	**2,100**	**1,300**	**12**	**420**	**2,100**	**500**
Nitrate (mg-N/L; calc.)	N/A	**18**	**102**	**0.13**	**108**	**20**	0.034 UJ	**270**	**200**	**190**	**480**	**290**	**2.7**	**95**	**475**	**113**
Sulfate	N/A	**1,400**	**980**	**1,700**	**1,300**	**530**	**98**	**69**	**330**	**130**	**120**	**280**	**87**	**250**	**220**	**490**
Total Organic Carbon	N/A	--	--	--	--	--	**8.8**	--	--	--	--	--	--	--	--	--

Table 4
Groundwater Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Analyte	Cleanup Level (a)	Sampling Location, Lab Sample ID, Sampling Date, Sample Type													
		MW-13 EV21120136-04 12/20/2021 N	MW-13 EV22040163-06 4/28/2022 N	MW-14 EV18110065-04 11/8/2018 N	MW-14 EV19070106-08 7/15/2019 N	MW-14 EV19100043-07 10/7/2019 N	MW-14 EV20020153-08 2/25/2020 N	MW-14 EV20060047-07 6/9/2020 N	MW-14 EV20080140-07 8/26/2020 N	MW-14 EV20110126-07 11/19/2020 N	MW-14 EV21060076-08 6/14/2021 N	MW-14 EV21070148-06 7/29/2021 N	MW-14 EV21100112-07 10/20/2021 N	MW-14 EV21120136-03 12/20/2021 N	MW-14 EV22040163-07 4/28/2022 N
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/D															
Gasoline Range C5-C12	0.8	0.05 U	0.05 U	**0.58**	**0.17**	**0.17**	**0.086**	**0.150**	**0.11**	**0.074 J**	**0.078**	**0.16 J**	**0.087 J**	R	0.05 U
Diesel Range C12-C24	0.5	0.13 U	0.13 U	**2.2**	**0.57**	**2**	**0.23**	**1.1**	**1.4**	**0.76**	**0.42**	**1.4 J**	**0.6**	**0.43 J**	**0.25**
Motor Oil Range C24-C40	0.5	**0.27**	0.25 U	**0.37 J**	0.25 U	0.25 U	0.25 U	**0.52**	**0.5**	0.25 U	**0.33**	0.25 U	0.25 U	0.25 U	0.25 U
Combined TPH (b)	0.5	**0.27**	0.25 U	**2.57 J**	**0.57**	**2**	**0.23**	**1.62**	**1.9**	**0.76**	**0.75**	**1.4 J**	**0.6**	**0.43 J**	**0.25**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	--	**0.0025**	**0.042**	**0.021**	**0.023**	0.0020 U	--	--	--	0.0020 U	--	--	--	0.0020 U
Naphthalene	0.083 (d)	--	0.0020 U	**0.0069**	**0.0025**	**0.0032**	**0.0021**	--	--	--	0.0020 U	--	--	--	0.0020 U
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	**1,900**	**1,900**	0.15 UJ	**1,800**	**690**	**30**	**940**	**950**	**59**	**42**	**670**	**240**	**150**	**130**
Nitrate (mg-N/L; calc.)	N/A	**429**	**429**	0.034 UJ	**410**	**160**	**7**	**210**	**210**	**13**	**9.5**	**151**	**54**	**34**	**29**
Sulfate	N/A	**200**	**180**	**55**	**35**	**46**	**31**	**31**	**22**	**52**	**29**	**54**	**54**	**62**	**47**
Total Organic Carbon	N/A	--	--	**15**	--	--	--	--	--	--	--	--	--	--	--

Notes:

All reported results are from post-source removal, which occurred in summer 2018.

MW-9 and MW-10 were not included in the baseline sampling event due to the presence NAPL.

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.

Bold = detected compound -- = not analyzed

Green Box = detected concentration is greater than the associated screening level.

(a) Cleanup level based on lowest Water Quality Standard or Practical Quantitation Limit (PQL).

(b) Combined TPH represents the sum of detected diesel- and motor oil-range constituents. If both diesel- and motor oil-range constituents were not detected at a concentration greater than the laboratory reporting limit, the greater of the two reporting limits is presented as the Combined TPH result.

(c) Due to a laboratory instrument failure, the analysis for the analyte was incomplete.

(d) Cleanup level based on total naphthalenes.

Abbreviations/Acronyms:

EPA = US Environmental Protection Agency
FD = field duplicate
ID = identification
mg/L = milligrams per liter
mg-N/L = milligrams nitrogen per liter
N = primary sample
N/A = not applicable
NAPL = non-aqueous phase liquid
NWTPH-Dx = Northwest total petroleum hydrocarbon extended-range diesel analytical method
NWTPH-Gx = Northwest total petroleum hydrocarbon extended-range gasoline analytical method
PQL = practical quantitation limit
SM = Standard Methods
TPH = total petroleum hydrocarbons

Table 5
Groundwater Results – Bioremediation Summary
Blaine Marina, Inc.
Blaine, Washington

Well Location	Sampling Date	Elapsed Time from Injection 1 (Days)	Elapsed Time from Injection 2 (Days)	Elapsed Time from Injection 3 (Days)	Elapsed Time from Injection 4 (Days)	Elapsed Time from Injection 5 (Days)	Elapsed Time from Injection 6 (Days)	Petroleum Hydrocarbons			Volatiles		Redox Conditions						Aquifer Parameters					Comments
								GRO mg/L	DRO mg/L	ORO mg/L	Benzene mg/L	Naphthalene mg/L	DO mg/L	ORP mV	Nitrate mg/L	Nitrate mg-N/L (calc.)	Iron II mg/L	Sulfate mg/L	Cond. (µS/cm)	Temp. (°C)	Turbidity (NTU)	TOC mg/L	pH (SU)	
Groundwater Cleanup Level[a]:								0.8	0.5	0.5	0.0024	0.083[b]	--	--	--	--	--	--	--	--	--	--	--	
MW-4	11/8/2018	Baseline						0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	0.39	-87.6	0.16 J	0.036 J	1.0	130	2,612	15.9	4.72	1.8	6.73	
	7/15/2019	31						0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	0.63	-62.4	0.19 J	0.043 J	4.0	110	1,755	16.5	23.10	--	6.93	
	10/7/2019	115	-49					0.05 U	0.16	0.25 U	0.0020 U	0.0020 U	1.77	-3.9	0.15 U	0.034 U	1.0	120	1,688	15.9	37.82	--	6.87	
	2/25/2020	256	92	-51				0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	0.72	-65.1	0.22 U	0.050 U	1.5	100	1,446	11.6	1.70	--	6.94	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.13 U	0.25 U	--	--	0.57	-49.5	0.22 U	0.050 U	4.0	130	1,626	11.9	26.60	--	6.86	
MW-5	11/8/2018	Baseline						0.05 U	0.35	0.25 U	0.0020 U	0.0020 U	1.62	149.0	15 UJ	3.4 UJ	0.0	2,300	34,024	12.6	2.20	1.0 U	7.11	
	7/15/2019	31						0.05 U	0.22	0.25 U	0.0020 U	0.0020 U	0.47	-225.6	1.5 UJ	0.34 UJ	1.0	2,000	36,516	18.3	9.77	--	7.42	
	10/7/2019	115	-49					0.05 U	0.15	0.25 U	0.0020 U	0.0020 U	0.61	-6.0	0.76 U	0.17 U	0.5	1,900	25,170	16.1	25.15	--	7.34	
	2/25/2020	256	92	-51				0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	6.81	107.1	3.5	0.79	0.0	2,000	30,271	8.1	2.30	--	7.53	
	8/26/2020	439	275	132	-51			0.47 J	**13**	1.2 U	--	--	0.88	-301.5	--	--	1.2	--	31,795	19.2	16.01	--	7.50	
	6/14/2021	731	567	424	241	0		0.05 U	**1.2**	0.25 U	0.0020 U	0.0020 U	3.0	64.8	3.1	0.70	0.0	2000	31,158	14.9	2.00	--	7.39	
	7/29/2021	776	612	469	286	45		0.05 U	**0.84 J**	0.25 U	--	--	0.90	-149.6	0.30	0.07	0.2	2300	36,998	20.0	1.21	--	7.10	
	10/20/2021	859	695	552	369	128	-34	0.05 U	**1.1**	0.25 U	--	--	2.99	-25.1	4.3	0.97	0.0	2200	36,839	15.1	10.53	--	7.22	
	12/20/2021	920	756	613	430	189	27	0.05 U	0.27 J	0.25 U	--	--	8.14	83.6	6.0	1.4	0.0	1800	50,158	9.4	0.90	--	7.59	
	4/28/2022	1049	885	742	559	318	156	0.05 U	**0.68**	0.25 U	0.0020 U	0.0020 U	0.79	2.3	0.22 U	0.050 U	0.5	2000	39,468	9.7	8.8	--	7.16	
MW-6	11/8/2018	Baseline						0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	0.72	195.0	15 UJ	3.4 UJ	0.0	1,700	25,802	13.4	19.57	1.0 U	6.79	
	7/15/2019	31						0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	4.34	6.1	17 J	3.8 J	0.0	1,300	25,900	20.0	27.84	--	7.03	
	10/7/2019	115	-49					0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	3.94	65.9	88	20	0.0	530	7,637	15.2	16.90	--	7.18	
	2/25/2020	256	92	-51				0.05 U	0.13 U	0.29	0.0020 U	0.0020 U	6.39	114.9	13	2.9	0.0	840	13,175	8.0	2.02	--	7.28	
	6/9/2020	361	197	54				--	0.13 U	0.25 U	--	--	7.10	181.0	33	7.5	0.0	310	6,878	12.2	0.98	--	7.43	
	8/26/2020	439	275	132	-51			--	0.16	0.31	--	--	1.86	148.2	13	2.9	0.0	1,100	19,865	18.6	5.20	--	7.15	
	11/19/2020	524	360	217	34			--	0.20 U	**0.67**	--	--	4.69	76.2	19	4.3	0.0	640	5,177	11.8	1.53	--	7.08	
	6/14/2021	731	567	424	241	0		--	0.13 U	0.25 U	--	--	3.24	87.1	23	5.2	0.0	790	8,865	15.1	0.62	--	7.65	
	7/29/2021	776	612	469	286	45		--	0.13 U	0.25 U	--	--	4.12	-85.1	7.1	1.6	0.0	1,600	27,752	19.0	3.03	--	6.99	
	10/20/2021	859	695	552	369	128	-34	--	0.13 U	0.25 U	--	--	7.03	-26.8	28	6.3	0.0	690	11,984	15.0	4.24	--	7.11	
	12/20/2021	920	756	613	430	189	27	--	0.13 U	0.25 U	--	--	5.10	-17.9	51	12	0.0	160	2,702	9.6	0.12	--	7.30	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.13 U	0.4	--	--	5.98	286.3	80	18	0.0	590	11,178	9.2	4.34	--	7.29	
MW-7	11/8/2018	Baseline						**11**	**3.3 J**	0.4	0.0020 UJ	0.047	0.56	-369.7	15 UJ	3.4 UJ	0.4	1,500	33,063	14.0	9.0	3.0	6.94	
	7/15/2019	31						**13 J**	**2.2 J**	0.3	0.0020 U	0.03	--	-389.5	0.31 UJ	0.070 UJ	0.4	960	27,198	17.7	0.98	--	7.04	Equipment malfunction prevented DO measurement
	10/7/2019	115	-49					**7.3**	**2.4 J**	0.25 U	0.0020 U	0.038 J	1.70	-279.3	0.76 U	0.17 U	0.0	740	15,810	15.3	3.62	--	7.05	
	2/25/2020	256	92	-51				**9.2**	**1.7 J**	0.25 U	0.0020 UJ	0.018 J	1.91	--	0.22 U	0.050 U	0.5	1,100	17,973	8.4	4.33	--	6.78	
	6/9/2020	361	197	54				**6.4**	**1.0 J**	0.25 U	--	--	1.46	-361.4	0.22 U	0.050 U	0.4	1,200	23,472	12.4	0.89	--	6.99	
	8/26/2020	439	275	132	-51			**5.6**	**5.8**	1.2 U	--	--	0.51	-378.8	0.22 U	0.050 U	0.5	1,200	29,099	18.2	2.71	--	7.00	
	11/19/2020	524	360	217	34			**6.5**	**4.8 J**	0.50 U	--	--	0.80	-339.4	0.22 U	0.050 U	0.5	1,400	28,060	12.4	1.10	--	7.04	
	6/14/2021	731	567	424	241	0		**4.7**	**0.86 J**	0.25 U	0.0020 U	0.0020 U	0.90	-374.7	0.22 U	0.050 U	0.0	1,500	29,886	14.0	1.20	--	7.00	
	7/29/2021	776	612	469	286	45		**3.7**	**1.1 J**	0.25 U	--	--	3.03	-363.8	0.22 U	0.050 U	0.0	1,500	29,706	17.8	0.77	--	6.91	
	10/20/2021	859	695	552	369	128	-34	**3.3 J**	**3.9**	**0.99 J**	--	--	0.42	-323.4	0.22 U	0.050 U	0.0	1,300	34,657	14.6	2.85	--	6.56	
	12/20/2021	920	756	613	430	189	27	(c)	**1.6 J**	0.47	--	--	5.66	-233.2	0.22 U	0.050 U	0.0	1,600	25,406	9.7	2.0	--	6.86	
	4/28/2022	1049	885	742	559	318	156	**4.2 J**	**1.3 J**	0.25 U	0.0020 UJ	0.0029 J	0.14	-355.8	0.22 U	0.050 U	0.0	1,200	24,631	10.1	5.0	--	6.90	

Table 5
Groundwater Results – Bioremediation Summary
Blaine Marina, Inc.
Blaine, Washington

Well Location	Sampling Date	Elapsed Time from Injection 1 (Days)	Elapsed Time from Injection 2 (Days)	Elapsed Time from Injection 3 (Days)	Elapsed Time from Injection 4 (Days)	Elapsed Time from Injection 5 (Days)	Elapsed Time from Injection 6 (Days)	Petroleum Hydrocarbons			Volatiles		Redox Conditions						Aquifer Parameters					Comments
								GRO mg/L	DRO mg/L	ORO mg/L	Benzene mg/L	Naphthalene mg/L	DO mg/L	ORP mV	Nitrate mg/L	Nitrate mg-N/L (calc.)	Iron II mg/L	Sulfate mg/L	Cond. (µS/cm)	Temp. (°C)	Turbidity (NTU)	TOC mg/L	pH (SU)	
Groundwater Cleanup Level[a]:								0.8	0.5	0.5	0.0024	0.083[b]	--	--	--	--	--	--	--	--	--	--	--	
MW-8	11/8/2018	Baseline						0.082	**0.62**	0.25 U	0.0020 U	0.0020 U	0.43	-221.9	1.5 UJ	0.34 UJ	0.6	190	5,522	14.3	0.73	2.5	7.15	
	7/15/2019	31						0.097	0.39	0.25 U	0.0020 U	0.0020 U	0.46	-114.1	15	3.4	0.8	25	1,520	19.2	8.64	--	7.55	
	10/7/2019	115	-49					0.05 U	**0.99**	0.25 U	0.0020 U	0.0020 U	0.42	107.8	170	38	0.0	170	1,590	18.0	0.72	--	7.46	
	2/25/2020	256	92	-51				0.05 U	0.26	**0.7**	0.0020 U	0.0020 U	0.12	-50.7	320	72	0.0	400	1,568	11.2	2.08	--	7.57	
	6/9/2020	361	197	54				0.05 U	0.21	0.25 U	--	--	1.01	-112.4	450	102	0.0	360	1,918	14.0	0.15	--	7.49	
	8/26/2020	439	275	132	-51			0.05 U	0.4	0.25 U	--	--	0.44	-122.3	260	59	1.1	400	2,898	18.9	3.01	--	7.34	
	11/19/2020	524	360	217	34			0.05 U	0.14	0.25 U	--	--	1.56	-158.9	1.0	0.23	1.5	220	2,993	14.9	1.08	--	7.38	
	6/14/2021	731	567	424	241	0		--	0.14 J	0.46 J	--	--	0.83	10.0	480	108	0.5	590	2,557	15.5	4.41	--	6.95	
	7/29/2021	776	612	469	286	45		--	0.13 J	0.25 U	--	--	1.50	-42.0	500	113	0.2	640	3,040	19.4	5.25	--	7.14	
	10/20/2021	859	695	552	369	128	-34	--	0.13 U	0.25 U	--	--	0.37	-149.6	4.7	1.1	0.0	180	2,257	17.3	4.41	--	7.15	
	12/20/2021	920	756	613	430	189	27	--	0.13 U	0.25 U	--	--	1.10	-3.3	0.22 U	0.050 U	1.0	380	1,441	13.8	1.70	--	7.70	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.13 U	0.25 U	--	--	0.12	-71.9	250	57	0.25	480	2,156	13.4	2.60	--	7.20	
MW-9	11/8/2018	Baseline						--	**--**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not sampled due to NAPL
	7/15/2019	31						--	--	--	--	--	0.62	-13.5	290	66	0.0	84	3,216	19.2	4.66	--	7.42	
	10/7/2019	115	-49					--	--	--	--	--	5.65	96.4	2.5	0.57	1.6	76	1,545	16.9	--	--	7.03	
	2/25/2020	256	92	-51				--	--	--	--	--	0.23	0.3	810	180	0.5	220	2,878	11.9	6.05	--	7.07	
	6/14/2021	731	567	424	241	0		0.45	**6 J**	0.5 U	**0.0042**	0.0023	1.04	11.4	310	70	0.0	620	2,524	16.1	10.89	--	7.00	
	7/29/2021	776	612	469	286	45		0.53 J	**4.8 J**	0.25 U	--	--	0.98	-89.4	64	14	0.0	530	2,752	20.1	10.72	--	7.20	
	10/20/2021	859	695	552	369	128	-34	**1.6 J**	**82**	5 U	--	--	0.46	-166.0	4.4	1.0	0.0	310	1,998	17.5	38.21	--	6.94	
	12/20/2021	920	756	613	430	189	27	**1.8 J**	**16 J**	1.2 U	--	--	2.60	41.1	480	108	0.0	160	1,225	13.5	48.9	--	7.27	
	4/28/2022	1049	885	742	559	318	156	0.46	**8**	0.5 U	--	--	0.13	-60.6	89	20	1.5	170	1,935	13.4	51.9	--	7.13	
MW-10	11/8/2018	Baseline						--	**--**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not sampled due to NAPL
	7/15/2019	31						--	--	--	--	--	0.74	-34.7	2.1 J	0.47 J	0.0	32	883	16.8	11.75	--	7.52	
	10/7/2019	115	-49					--	--	--	--	--	2.96	160.4	18	4.1	0.0	90	825	14.6	--	--	7.38	
	2/25/2020	256	92	-51				--	--	--	--	--	0.20	-12.6	580	130	1.0	220	1,618	11.2	6.26	--	7.63	
	6/9/2020	361	197	54				--	--	--	--	--	1.51	-46.0	180	41	0.0	190	1,140	13.0	--	--	7.98	
	8/26/2020	439	275	132	-51			--	--	--	--	--	0.80	-36.7	83	19	0.5	180	1,164	17.8	6.99	--	7.70	
	11/19/2020	524	360	217	34			--	--	--	--	--	1.53	-115.4	470	106	0.0	170	1,300	14.1	32.11	--	7.64	
	6/14/2021	731	567	424	241	0		--	--	--	--	--	0.27	-6.7	580	131	0.0	--	1,383	15.1	3.38	--	7.41	
	7/29/2021	776	612	469	286	45		--	--	--	--	--	1.45	-94.1	300	68	0.0	--	1,498	17.0	7.29	--	7.46	
	10/20/2021	859	695	552	369	128	-34	--	--	--	--	--	0.72	-53.2	110	25	0.0	--	1,144	15.5	18.36	--	7.35	
	12/20/2021	920	756	613	430	189	27	--	--	--	--	--	0.91	32.5	1300	294	0.0	--	1,373	13.1	8.3	--	7.60	
	4/28/2022	1049	885	742	559	318	156	0.19	**37**	2.5 U	--	--	0.49	-62.7	760	172	1.0	60	2,069	11.1	11.6	--	7.40	
MW-11	11/8/2018	Baseline						0.079	0.13 U	0.25 U	0.0020 U	0.0020 U	1.70	-102.9	31 UJ	7.0 UJ	0.8	2,400	36,231	14.7	0.11	1.0 U	7.13	
	7/15/2019	31						0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	2.92	-41.6	4.3 J	0.97 J	1.2	2,000	31,825	17.5	8.93	--	7.26	
	10/7/2019	115	-49					0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	2.86	138.2	3.3	0.75	0.0	1,800	26,293	15.4	0.16	--	7.29	
	2/25/2020	256	92	-51				0.05 U	0.13 U	0.25 U	0.0020 U	0.0020 U	5.40	15.3	8.1	1.8	0.5	1,600	24,146	8.9	1.89	--	7.45	
	6/9/2020	361	197	54				0.05 U	--	--	--	--	6.06	-134.3	6.7	1.5	0.2	1,500	26,301	12.5	0.00	--	7.51	
	8/26/2020	439	275	132	-51			0.05 U	--	--	--	--	2.55	22.7	5.8	1.3	0.0	1,600	26,840	16.7	1.38	--	7.21	
	11/19/2020	524	360	217	34			0.05 U	--	--	--	--	2.81	-114.6	3.7	0.84	0.5	2,600	31,839	12.8	1.20	--	7.64	
	6/14/2021	731	567	424	241	0		--	--	--	--	--	5.67	-123.4	3.4	0.77	0.0	--	30,802	13.5	0.50	--	7.74	
	7/29/2021	776	612	469	286	45		--	--	--	--	--	2.47	-33.7	3.7	0.84	0.0	--	17,428	16.8	0.00	--	7.39	
	10/20/2021	859	695	552	369	128	-34	--	--	--	--	--	3.64	-95.0	5.0	1.1	0.0	--	35,470	15.6	0.21	--	7.33	
	12/20/2021	920	756	613	430	189	27	--	--	--	--	--	0.16	195.0	4.1	0.93	0.0	--	26,578	10.5	0.38	--	7.47	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.13 U	0.25 U	--	--	5.21	226.8	2.3	0.52	0.0	1,900	37,799	9.4	0.60	--	7.44	

Table 5
Groundwater Results – Bioremediation Summary
Blaine Marina, Inc.
Blaine, Washington

Well Location	Sampling Date	Elapsed Time from Injection 1 (Days)	Elapsed Time from Injection 2 (Days)	Elapsed Time from Injection 3 (Days)	Elapsed Time from Injection 4 (Days)	Elapsed Time from Injection 5 (Days)	Elapsed Time from Injection 6 (Days)	Petroleum Hydrocarbons			Volatiles		Redox Conditions						Aquifer Parameters					Comments
								GRO mg/L	DRO mg/L	ORO mg/L	Benzene mg/L	Naphthalene mg/L	DO mg/L	ORP mV	Nitrate mg/L	Nitrate mg-N/L (calc.)	Iron II mg/L	Sulfate mg/L	Cond. (µS/cm)	Temp. (°C)	Turbidity (NTU)	TOC mg/L	pH (SU)	
Groundwater Cleanup Level[a]:								0.8	0.5	0.5	0.0024	0.083[b]	--	--	--	--	--	--	--	--	--	--	--	
MW-12	11/8/2018	Baseline						**0.98**	0.18	0.25 U	0.0020 U	0.0020 U	0.10	-291.9	15 UJ	3.4 UJ	0.0	1,700	33,594	15.0	0.88	1.0 U	7.34	
	7/15/2019	31						0.64	0.4	0.25 U	0.0020 U	0.0020 U	0.21	-122.9	170	38	0.0	620	12,938	18.4	3.72	--	8.17	
	10/7/2019	115	-49					0.67 J	**0.61**	0.25 U	0.0023 J	0.0020 UJ	0.14	-115.8	14	3.2	0.2	360	12,568	18.0	9.76	--	8.09	
	2/25/2020	256	92	-51				0.34	0.32	0.25 U	0.0022	0.0025	0.25	54.8	250	57	0.0	420	6,040	9.8	2.23	--	8.05	
	6/9/2020	361	197	54				0.41	0.34	0.25 U	--	--	0.50	-161.8	14	3.2	0.0	430	8,517	14.3	0.47	--	7.85	
	8/26/2020	439	275	132	-51			0.54 J	**0.53**	0.46	--	--	0.10	118.9	0.22 U	0.050 U	1.0	860	19,834	20.1	5.16	--	7.64	
	11/19/2020	524	360	217	34			**0.96**	0.23 J	0.25 U	--	--	0.45	-188.4	4.1	0.93	0.0	1,800	24,028	14.0	24.11	--	7.55	
	6/14/2021	731	567	424	241	0		**0.57**	0.2 J	0.25 U	0.0020 U	0.0020 U	1.51	-180.4	81	18	0.0	1,400	22,153	14.7	1.50	--	7.69	
	7/29/2021	776	612	469	286	45		0.29	0.27 J	0.25 U	--	--	0.25	-128.4	450	102	0.0	980	19,316	19.6	2.47	--	7.47	
	10/20/2021	859	695	552	369	128	-34	0.34	0.17	0.25 U	--	--	0.16	-303.8	0.58	0.13	1.1	1,700	32,056	17.2	6.58	--	7.54	
	12/20/2021	920	756	613	430	189	27	0.38	0.34 J	0.25 U	--	--	2.49	40.5	480	108	0.0	1,300	3,789	13.6	1.10	--	8.02	
	4/28/2022	1049	885	742	559	318	156	0.47	0.33 J	0.25 U	--	--	0.14	-120.4	88	20	0.0	530	9,298	12.4	3.0	--	7.68	
MW-13	11/8/2018	Baseline						0.74	**3.2**	0.41 J	**0.0029**	0.0048	0.13	25.4	0.15 UJ	0.034 UJ	0.0	98	4,085	15.1	18.74	8.8	7.03	
	7/15/2019	31						0.22	**0.51**	0.25 U	0.0020 U	0.0024	0.36	129.4	1,200	270	0.0	69	3,412	18.9	3.83	--	7.53	
	10/7/2019	115	-49					0.05 U	**0.99**	0.25 U	**0.018**	0.0020 U	0.20	22.0	900	200	0.0	330	2,533	16.5	62.02	--	7.78	
	2/25/2020	256	92	-51				0.094	0.13 U	0.25 U	0.0020 U	0.0021	0.26	63.4	860	190	0.0	130	2,535	10.8	1.42	--	7.21	
	6/9/2020	361	197	54				0.067	0.15	0.25 U	--	--	0.53	-7.4	2,100	480	0.0	120	4,046	14.8	0.21	--	7.12	
	8/26/2020	439	275	132	-51			0.073	0.43 J	**0.9**	--	--	0.18	50.5	1,300	290	0.0	280	3,940	20.2	3.99	--	7.09	
	11/19/2020	524	360	217	34			0.15	0.13 U	0.25 U	--	--	0.49	28.9	12	2.7	0.0	87	1,339	14.7	0.00	--	7.13	
	6/14/2021	731	567	424	241	0		0.052	0.13	0.25 U	0.0020 U	0.0020 U	0.31	9.7	420	95	0.0	250	2,955	15.6	1.12	--	6.96	
	7/29/2021	776	612	469	286	45		0.05 U	0.17 J	0.27	--	--	0.03	-133.2	2100	475	0.1	220	5,443	19.2	1.17	--	6.83	
	10/20/2021	859	695	552	369	128	-34	0.05 U	0.13 U	0.25 U	--	--	0.42	-215.4	500	113	0.0	490	3,621	17.1	2.75	--	6.90	
	12/20/2021	920	756	613	430	189	27	0.05 U	0.13 U	0.27	--	--	1.43	52.5	1,900	429	0.0	200	1,880	13.0	1.70	--	7.26	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.13 U	0.25 U	**0.0025**	0.0020 U	0.70	128.1	1,900	429	0.0	180	5,493	11.5	1.2	--	6.93	
MW-14	11/8/2018	Baseline						0.58	**2.2**	0.37 J	**0.042**	0.0069	0.97	150.1	0.15 UJ	0.034 UJ	0.0	55	1,160	14.5	0.71	15	7.02	
	7/15/2019	31						0.17	**0.57**	0.25 U	**0.021**	0.0025	0.30	85.6	1,800	410	0.0	35	3,832	21.1	1.37	--	6.70	
	10/7/2019	115	-49					0.17	**2**	0.25 U	**0.023**	0.0032	0.23	70.1	690	160	0.0	46	1,733	18.9	1.04	--	6.88	
	2/25/2020	256	92	-51				0.086	0.23	0.25 U	0.0020 U	0.0021	0.30	28.5	30	7	0.0	31	706	9.4	1.23	--	7.11	
	6/9/2020	361	197	54				0.15	**1.1**	**0.52**	--	--	0.66	-16.2	940	210	0.0	31	2,246	15.4	0.65	--	6.95	
	8/26/2020	439	275	132	-51			0.11	**1.4**	0.5	--	--	0.29	94.2	950	215	0.0	22	2,514	21.3	3.38	--	6.85	
	11/19/2020	524	360	217	34			0.074 J	**0.76**	0.25 U	--	--	0.52	36.0	59	13	0.0	52	1,279	13.9	0.38	--	6.84	
	6/14/2021	731	567	424	241	0		0.078	0.42	0.33	0.0020 U	0.0020 U	0.49	3.5	42	9.5	0.0	29	1,046	15.8	1.11	--	6.97	
	7/29/2021	776	612	469	286	45		0.16 J	**1.4 J**	0.25 U	--	--	0.51	-125.7	670	151	0.0	54	2,250	21.2	1.01	--	6.80	
	10/20/2021	859	695	552	369	128	-34	0.087 J	**0.6**	0.25 U	--	--	0.67	-45.4	240	54	0.0	54	1,662	16.5	3.07	--	6.84	
	12/20/2021	920	756	613	430	189	27	R	0.43 J	0.25 U	--	--	2.07	54.5	150	34	0.0	62	1,020	12.6	5.60	--	7.16	
	4/28/2022	1049	885	742	559	318	156	0.05 U	0.25	0.25 U	0.0020 U	0.0020 U	0.53	106.5	130	29	0.0	47	1,384	11.5	0.00	--	7.05	

Notes:

All reported results are from post-source removal, which occurred in summer 2018.

(a) Cleanup level based on lowest Water Quality Standard or Practical Quantitation Limit.

(b) Cleanup level based on total naphthalenes.

(c) Due to a laboratory instrument failure, the analysis for the analyte was incomplete.

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.

Bold = detected concentration is greater than the associated screening level.

-- = not analyzed

Abbreviations and Acronyms:

µS/cm = microSiemens per centimeter
°C = degrees Celsius
calc. = calculated
Cond. = conductivity
DO = dissolved oxygen
DRO = diesel-range organics
GRO = gasoline-range organics
mg/L = milligrams per liter
mg-N/L = milligrams nitrogen per liter
mV = millivolts
NAPL = non-aqueous phase liquid
NTU = nephelometric turbidity units
ORO = oil-range organics
ORP = oxidation-reduction potential
SU = standard unit
Temp. = temperature
TOC = total organic carbon

Table 6
Surface Water Analytical Results
Blaine Marina, Inc.
Blaine, Washington

Sampling Location	Laboratory Sample ID	Sampling Date	Analytical Method, Analyte, Unit of Measurement, Screening Level					
			EPA 300.0 Nitrate mg/L	Calc. Nitrate mg-N/L	EPA 300.0 Nitrite mg/L	Calc. Nitrite mg-N/L	Calc. Nitrate+Nitrite mg-N/L	EPA 350.1 Ammonia mg/L
			N/A	N/A	N/A	N/A	20	N/A
SW-1	EV18100074-01	10/9/2018	1.5 U	0.34 U	1.4 U	0.043 U	0.34 U	0.060
SW-2	EV18100074-02	10/9/2018	1.5 U	0.34 U	1.4 U	0.043 U	0.34 U	0.051
SW-1	EV19070105-01	7/15/2019	1.8	0.41	14 U	0.43 U	0.41	--
SW-1	EV19100044-01	10/7/2019	1.5 U	0.34 U	71 U	2.2 U	2.2 U	--
SW-2	EV19070105-02	7/15/2019	1.5 U	0.34 U	14 U	0.43 U	0.43 U	--
SW-2	EV19100044-02	10/7/2019	1.5 U	0.34 U	71 U	2.2 U	2.2 U	--
SW-2	02-259-01	2/25/2020	2.0	0.45	0.066 U	0.002 U	0.45	--
SW-3	02-259-02	2/25/2020	1.8	0.41	0.066 U	0.002 U	0.41	--
SW-2	06-111-01	6/9/2020	1.0	0.23	0.066 U	0.002 U	0.23	--
SW-3	06-111-02	6/9/2020	1.1	0.25	0.066 U	0.002 U	0.25	--
SW-2	08-266-01	8/26/2020	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--
SW-3	08-266-02	8/26/2020	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--
SW-2	11-209-01	11/19/2020	2.0	0.45	0.066 U	0.002 U	0.45	--
SW-3	11-209-02	11/19/2020	2.0	0.45	0.066 U	0.002 U	0.45	--
SW-2	06-131-11	6/14/2021	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--
SW-3	06-131-12	6/14/2021	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--
SW-2	07-307-02	7/29/2021	0.42	0.09	0.066 U	0.002 U	0.09	--
SW-3	07-307-01	7/29/2021	0.55	0.12	0.066 U	0.002 U	0.12	--
SW-2	2110-187-01	10/20/2021	1.2	0.27	0.066 U	0.002 U	0.27	--
SW-3	2110-187-02	10/20/2021	1.4	0.32	0.066 U	0.002 U	0.32	--
SW-2	2112-217-01	12/20/2021	2.1	0.47	0.066 U	0.002 U	0.47	--
SW-3	2112-217-02	12/20/2021	2.3	0.52	0.066 U	0.002 U	0.52	--
SW-2	2204-325-01	4/28/2022	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--
SW-3	2204-325-02	4/28/2022	0.22 U	0.050 U	0.066 U	0.002 U	0.050 U	--

Note:

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

Abbreviations and Acronyms:

-- = not analyzed
calc. = calculated
EPA = US Environmental Protection Agency
ID = identification
mg/L = milligrams per liter
mg-N/L = milligrams nitrogen per liter
N/A = not applicable

APPENDIX A

Restoration Timeframe Analysis

Appendix A
Restoration Timeframe Analysis

Approach

In order to calculate a predicted restoration timeframe, historical data from groundwater sampling events were used to identify trends through graphical representation. These trends were used to evaluate the likely timeframe within which concentrations at each location should fall below the cleanup level (CUL).

Prior to performing the calculations, each dataset was assessed to determine data useability. Data points that represented significant outliers were removed. These included:

- All data related to MW-10 was excluded from the restoration timeframe evaluation due to the presence of light non-aqueous phase liquids (LNAPL), which precludes the suitability of this type of analysis.
- Data associated with dates LNAPL was present in MW-9 were excluded from the restoration timeframe evaluation. Since LNAPL was present in this well until 2021, the resulting dataset for this well is too small to perform a reliable statistical analysis, but a preliminary estimate of restoration timeframe for this well was performed.
- Early data for MW-7 were excluded from the restoration timeframe evaluation due to a historical high concentration measured in this well in August 2020. The degradation rate following the peak in concentration will be more representative of current conditions at the well.
- LNAPL was observed in MW-5 in August 2020. Only data following the LNAPL observation will be representative of degradation rates under current conditions at the well. All data prior, and including, the date of LNAPL presence for MW-5 were removed from the restoration timeframe evaluation.
- Locations where sample results have consistently been below CULs (MW-4, MW-6, and MW-11) were excluded from the restoration timeframe evaluation.
- While MW-8 has had concentrations below CULs since 2019, it is included in the evaluation to provide an additional data point in the statistical analysis of the regression parameters (i.e., slope and intercept) representative of degradation rates for the entire site. Additional data add confidence (lowers the standard deviation) to the restoration timeframe estimate.

Prior to plotting, data were linearized to reformat the data by calculating a slope (k) and intercept (lnA), allowing the data to be plotted on a graph. These plots were then used to evaluate the restoration timeframe ((i.e., the value of t when C = CUL).

Linearizing Data using the Semi-Log Method

Data linearization was accomplished by using a semi-log function. The semi-log function is a common function where the change in the function is proportional to the function itself. Real-world examples

of this type of function include population increase, radioactive decay, and chemical degradation in the environment, for which data follow a general exponential function:

$$C = Ae^{kt}$$

Where A is the initial concentration, *e* is Euler's number (mathematical constant), k is the degradation rate, t is time, and C is the concentration at time = t. Taking the natural logarithm (ln) of both sides and rearranging the equation gives:

$$\ln C = kt + \ln A$$

This form of the function resembles the standard linear equation y = mx + b, where y = lnC, m = k, x = t, and b = lnA. Typically, y vs. x is plotted. With this new equation, we can linearize the data by plotting lnC vs. t instead.[1] The natural logarithm of the concentration data is calculated and plotted versus time. The linear trend that fits the lnC vs. t data is calculated by hand or using tools (i.e., Microsoft Excel plotting functions). Linearizing the data in this way allows us to calculate the unknown variables k [slope] and lnA [intercept].

Developing the Restoration Timeframe from Linearized Data

Once the unknown variables (k [slope] and lnA [intercept]) were calculated from the linear trend fit to the linearized raw data, the restoration timeframe was determined by rearranging the linearized exponential function to solve for t:

$$\ln C = kt + \ln A$$

$$\ln C - \ln A = kt$$

$$t = \frac{(\ln C - \ln A)}{k} = \frac{(\ln CUL - [intercept])}{[slope]}$$

The restoration timeframe can be visualized by modeling the data using the known variables (k [slope] and lnA [intercept]) and the general exponential function:

$$C = Ae^{kt} = e^{\ln A}e^{kt} = e^{(kt+\ln A)} = e^{([slope]t+[intercept])}$$

Using the known variables and setting t to a range of values, the concentration (C) at several points in time was estimated. These modeled C values and raw C data vs. t were plotted to demonstrate model fit and concentration reduction over time until the CUL is met.

[1] Linearizing the Equation. http://academic.macewan.ca/physlabs/Linearization.pdf. Accessed January 20, 2021.

Example: GRO Data at MW-7

To demonstrate the linearization of real data, gasoline-range organics (GRO) analytical data for MW-7 at the Blaine Marina, Inc. site will be used as an example.

1) Convert date to decimal value:

The date format in Microsoft Excel assigns a numerical value to the date with respect to the year 1900. To transform the date value to a year decimal value, the following equation was used:

$$Decimal\ value = 1900 + \left(\frac{Date}{365.25}\right)$$

This resulted in the following dataset:

Date	Date (Decimal)
11/8/2018	2018.8572
7/15/2019	2019.5373
10/7/2019	2019.7673
2/25/2020	2020.1533
6/9/2020	2020.4408
8/26/2020	2020.6543
11/19/2020	2020.8871

2) Convert GRO concentration to different units:

Next, multiple compound concentrations were added together to ensure that the natural logarithm of the value is a real and positive value. To convert the raw data, provided in units of milligrams per liter (mg/L), to molar units of nanomoles per liter (nmol/L) for GRO, the following equation was used:

$$\left(\frac{nmol}{L}\right) = \left(\frac{mg}{L}\right)\left(\frac{g}{1000\ mg}\right)\left(\frac{1\ mol\ GRO}{120\ g\ GRO}\right)\left(\frac{10^9\ nmol}{mol}\right)$$

This results in the following:

Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)
11/8/2018	2018.8572	11	91666.667
7/15/2019	2019.5373	13	108333.33
10/7/2019	2019.7673	7.3	60833.333
2/25/2020	2020.1533	9.2	76666.667
6/9/2020	2020.4408	6.4	53333.333
8/26/2020	2020.6543	5.6	46666.667
11/19/2020	2020.8871	6.5	54166.667

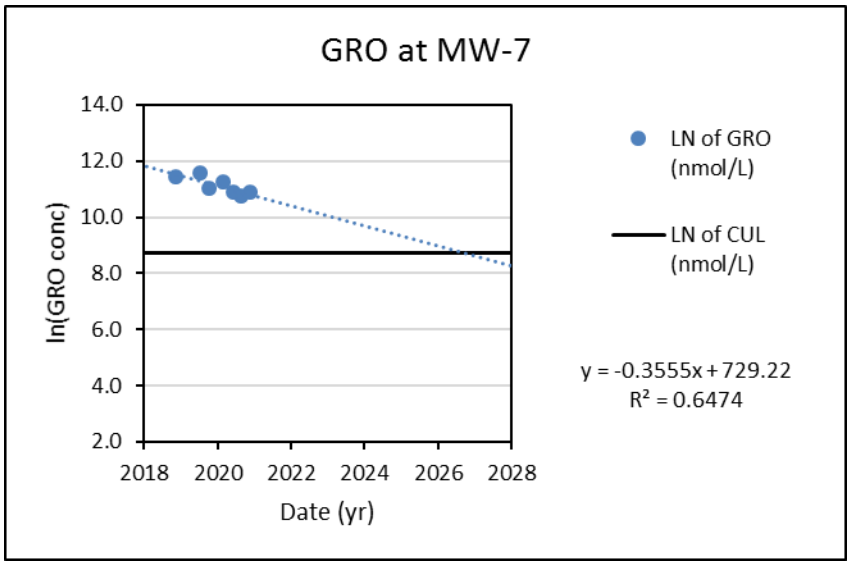
3) Take the natural logarithm of the concentration data:

The natural logarithm of the concentration data in then calculated in the converted units.

Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	ln(GRO)
11/8/2018	2018.8572	11	91666.667	11.4
7/15/2019	2019.5373	13	108333.33	11.6
10/7/2019	2019.7673	7.3	60833.333	11.0
2/25/2020	2020.1533	9.2	76666.667	11.2
6/9/2020	2020.4408	6.4	53333.333	10.9
8/26/2020	2020.6543	5.6	46666.667	10.8
11/19/2020	2020.8871	6.5	54166.667	10.9

4) Plot the lnC vs. t data and calculate the linear trend line:

The trend line (lnC vs, t) was plotted and a linear trend line fit to the dataset



From this linear trend line, the slope and intercept were calculated:

k = [slope] = -0.3555

lnA = [intercept] = 729.22

5) Calculate the restoration timeframe:

The [slope], [intercept], and CUL values were then used to calculate the restoration time frame:

$$CUL = \frac{0.8\ mg}{L} = \left(\frac{0.8 mg}{L}\right)\left(\frac{g}{1000\ mg}\right)\left(\frac{1\ mol\ GRO}{120\ g\ GRO}\right)\left(\frac{10^9\ nmol}{mol}\right) = 6153.8462\ nmol/L$$

$$t = \frac{(\ln CUL - [intercept])}{[slope]} = \frac{(\ln 6153.8462 - [729.22])}{[-0.3555]} = 2027$$

$$Restoration\ timeframe = t - [date\ of\ injection] = 2027 - 2018 = 9\ years$$

6) Model the data to visualize the restoration timeframe:

Data were then modeled to visualize the restoration timeframe. The model exponential function for the GRO data at MW-7 is:

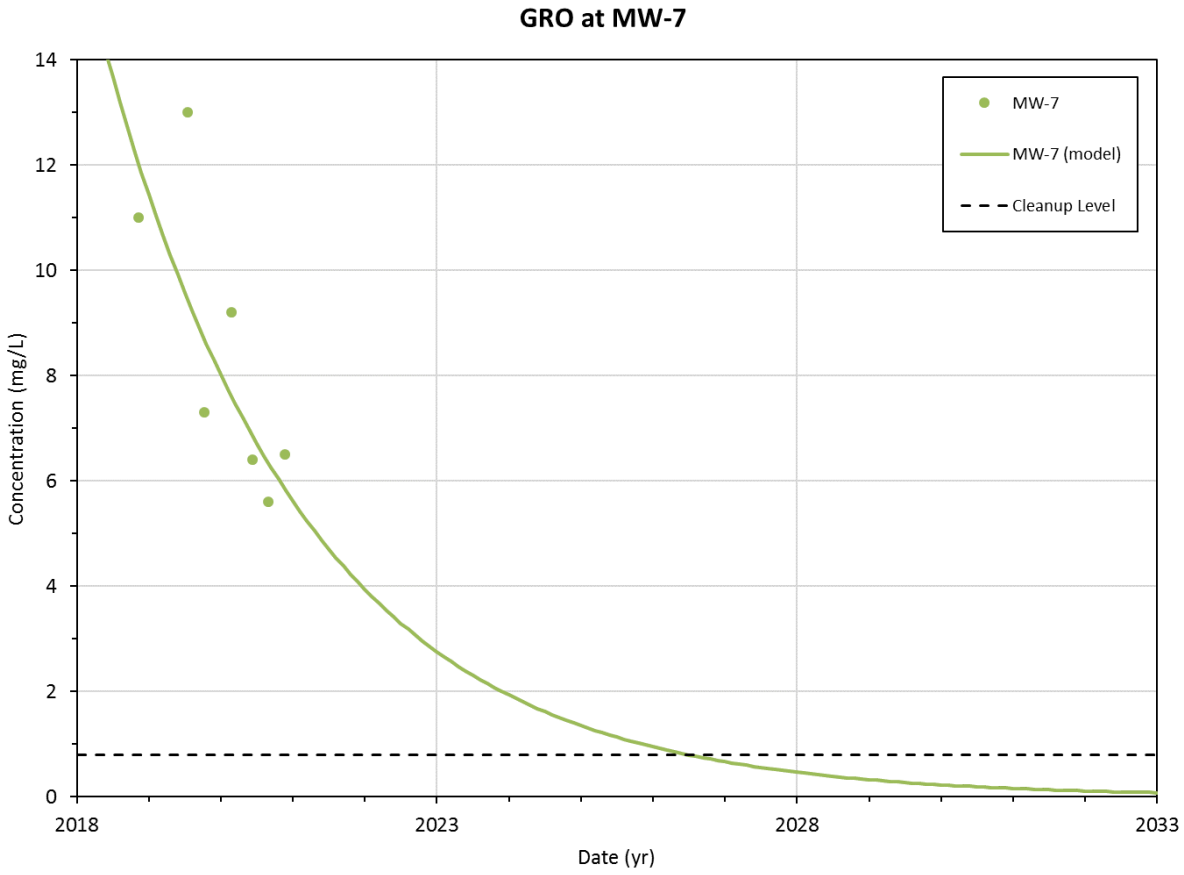
$$C = e^{(-0.3555t + 729.22)}$$

The t values can be set to any value. The typical process is to pick a small time interval (Δt) and calculate t starting at 0. In this case, 0 was set as the date of baseline sampling. This resulted in:

$$t_{i+1} = t_i + \Delta t$$

Date (Decimal)	GRO (nmol/L)	GRO (mg/L)
2018.0	136080	16.33
2018.1	131328	15.76
2018.2	126741	15.21
2018.3	122314	14.68
2018.4	118042	14.17
2018.5	113920	13.67
2018.6	109941	13.19
2018.7	106101	12.73
2018.8	102396	12.29
2018.9	98819	11.86
2019.0	95368	11.44
2019.1	92037	11.04
2019.2	88823	10.66
2019.3	85721	10.29
2019.4	82727	9.93
2019.5	79838	9.58
2019.6	77049	9.25
2019.7	74358	8.92
2019.8	71761	8.61
2019.9	69255	8.31
2020.0	66836	8.02
2020.1	64502	7.74
2020.2	62249	7.47
⋮	⋮	⋮

The model data for GRO concentrations in mg/L and the raw data for GRO concentrations in mg/L were then plotted against date (decimal) values. The CUL value was also plotted to visualize when GRO concentrations will decrease below the CUL:



The regression data for DRO and GRO for each of the wells evaluated is summarized in Table 1.

Results

Results of the analysis indicate restoration timeframe predictions for individual wells ranging from 1 to 5 years. The average restoration timeframe is estimated at 3.1 years with a standard deviation of 1.4 years and a 95 percent confidence interval of 1.3 years (Table 2). The longest restoration interval predicted was 5 years for well MW-7, where contaminant concentrations have persisted and where spot treatments were targeted in 2021 to increase the degradation rate of the contaminants.

In general, these results appear to provide a conservative assessment of restoration time. For example, the results for wells MW-5 and MW-14 indicate up to 4 years will be needed for restoration in these areas; however, both of these wells exhibited concentrations below the CULs at the end of 2021. Continued monitoring of these wells will be useful in evaluating potential for rebound.

Attachments

Table 1: Regression Summary of Calculated Restoration Timeframes
Table 2: Statistical Summary of Calculated Restoration Timeframes
Attachment 1: Monitoring Well Regression Data and Plots

Table 1
Regression Summary of Calculated Restoration Timeframes
Blaine Marina, Inc.
Blaine, Washington

TPH Regression Summary

Well		Slope (1/yr)	Y-intercept	R2	ln(CUL)	X-intercept	Restoration Timeframe (yrs)
MW-7	1	-0.3310	679.93	0.669	8.25	2029	11
MW-12	2	-0.2172	447.74	0.4597	8.25	2023	5
MW-13	3	-0.8290	1683.2	0.7327	8.25	2020	2
MW-14	4	-0.2769	568.37	0.1537	8.25	2023	5
Sample Size		4	4				
Minimum		-0.2172	1683				
Maximum		-0.8290	448				
Median		-0.3040	624	---------->	8.25	2026	8
Average		-0.4135	845	---------->	8.25	2023	5
Standard Deviation		0.2432	491				
95% Confidence Interval		0.3870	781				

Table 1
Regression Summary of Calculated Restoration Timeframes
Blaine Marina, Inc.
Blaine, Washington

GRO Regression Summary

Well		Slope (1/yr)	Y-intercept	R2	ln(CUL)	X-intercept	Restoration Timeframe (yrs)
MW-7	1	-0.4325	884.71	0.8571	8.72	2025	7
MW-12	2	-0.2517	516.95	0.368	8.72	2019	1
MW-13	3	-0.6429	1305.7	0.5744	8.72	2017	-1
MW-14	4	-0.4633	943.14	0.5239	8.72	2017	-1
Sample Size		4	4				
Maximum		-0.2517	1306				
Minimum		-0.6429	517				
Median		-0.4479	914				
Average		-0.4476	913	---------->	8.72	2019	1
Standard Deviation		0.1387	280				
95% Confidence Interval		0.2208	445				

Table 1
Regression Summary of Calculated Restoration Timeframes
Blaine Marina, Inc.
Blaine, Washington

DRO Regression Summary

Well		Slope (1/yr)	Y-intercept	R2	ln(CUL)	X-intercept	Restoration Timeframe (yrs)
MW-5[1]	1	-2.2898	4637.8	0.5900	8.25	2021.8	4
MW-7[2]	2	-0.9262	1881.9	0.3472	8.25	2022.9	5
MW-8	3	-0.6050	1230.1	0.7258	8.25	2019.6	2
MW-9	4	-9.7847	19796	1.0000	9.25	2022.2	4
MW-12	5	-0.3121	638.43	0.4354	8.25	2019.1	1
MW-13	6	-0.8658	1757	0.6538	8.25	2019.8	2
MW-14	7	-0.2808	576.12	0.1558	8.25	2022.3	4
Sample Size		7	7	7		7	7
Maximum		-0.2808	19796.0	1.0000		2022.9	4.9
Minimum		-9.7847	576.1	0.1558		2019.1	1.1
Median		-0.8658	1757.0	0.5900		2021.8	3.8
Average		-2.1521	4359.6	0.5583		2021.1	3.1
Standard Deviation		3.1784	6428	0		1.4	1.4
95% Confidence Interval		2.9395	5945	0		1.3	1.3

Notes:

[1] The data outlier related to the August 2020 LNAPL observation was removed from the dataset.

[2] Some 2020 data points removed; outside excavation.

Abbreviations and Acronyms:

DRO = diesel-range organics
GRO = gasoline-range organics
TPH = total petroleum hydrocarbons
yrs = years

Table 2
Statistical Summary of Calculated Restoration Timeframes
Blaine Marina, Inc.
Blaine, Washington

	Rate (1/yr)			Y-intercept			X-intercept (yr)			Restoration Timeframe (yrs)*		
	GRO	DRO	All TPH	GRO	DRO	All TPH	GRO	DRO	All TPH	GRO	DRO	All TPH
Sample Size	4	6	4	4	6	4						
Maximum	-0.2517	0.4516	-0.2172	1306	1757	1683						
Minimum	-0.6429	-0.8658	-0.8290	517	-904	448						
Median	-0.4479	-0.2261	-0.3040	914	466	624	2021	2024	2026	3	6	8
Average	-0.4476	-0.2627	-0.4135	913	539	845	2019	2020	2023	1	2	5
Standard Deviation	0.1387	0.4133	0.2432	280	835	491						
95% Confidence Interval	0.2208	0.4337	0.3870	445	876	781						

*Calculated based on start of treatment (2018)

Abbreviations and Acronyms:

DRO = diesel-range organics
GRO = gasoline-range organics
TPH = total petroleum hydrocarbons
yrs = years

ATTACHMENT 1

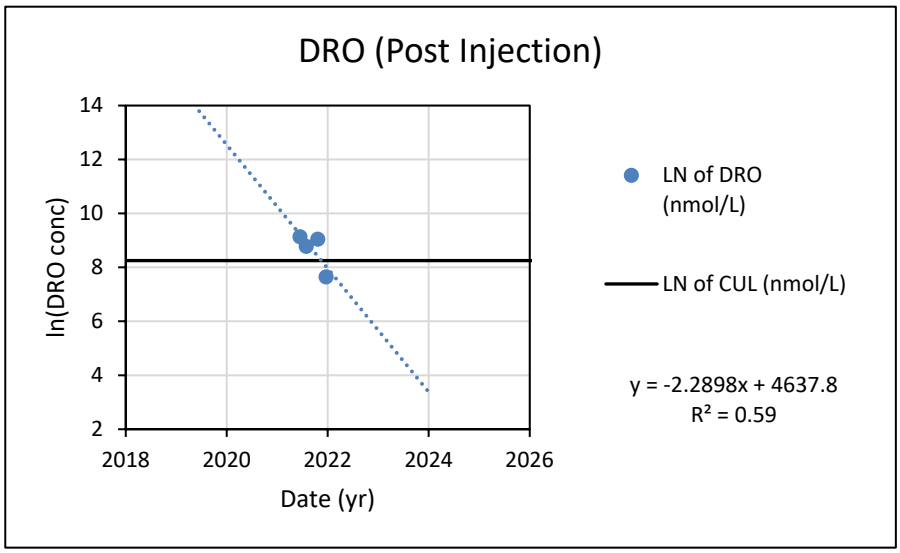
Monitoring Well Regression Data and Plots

Blaine Marina, Inc.

MW-5

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)	
MW-5	11/8/2018	2018.8566	0.35	2692.30769	7.898153983	
MW-5	7/15/2019	2019.5373	0.22	1692.30769	7.433848375	
MW-5	10/7/2019	2019.76728	0.15	1153.84615	7.050856123	
MW-5	2/25/2020	2020.15332	0.13	1000	6.907755279	
MW-5	8/26/2020	2020.65435	13	100000	11.51292546	LNAPL
MW-5	6/14/2021	2021.4538	1.2	9230.76923	9.130297664	
MW-5	7/29/2021	2021.577	0.84	6461.53846	8.77362272	
MW-5	10/20/2021	2021.80424	1.1	8461.53846	9.043286287	
MW-5	12/20/2021	2021.97125	0.27	2076.92308	7.638642788	

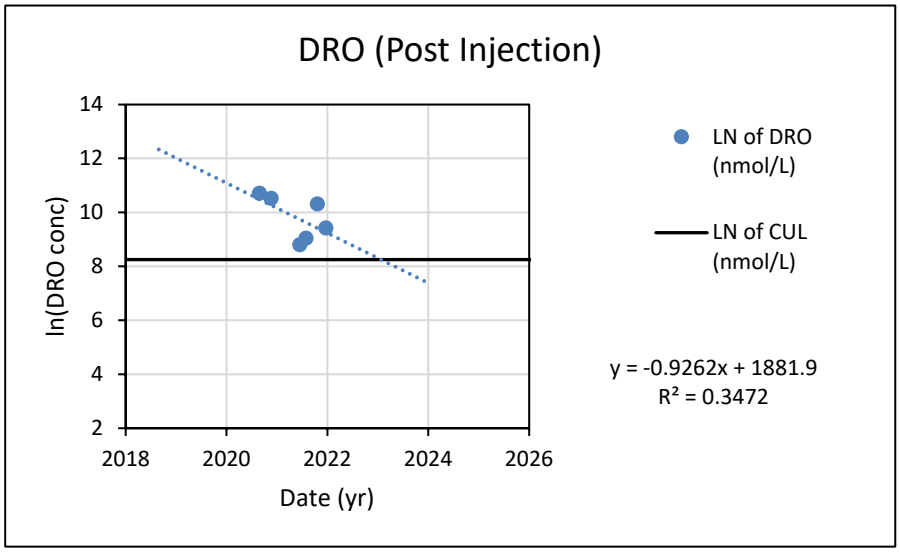


Blaine Marina, Inc.

MW-7

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-7	11/8/2018	2018.85717	3.3	25384.6154	10.14189858
MW-7	7/15/2019	2019.5373	2.2	16923.0769	9.736433468
MW-7	10/7/2019	2019.76728	2.4	18461.5385	9.823444845
MW-7	2/25/2020	2020.15332	1.7	13076.9231	9.478604359
MW-7	6/9/2020	2020.44079	1	7692.30769	8.947976108
MW-7	8/26/2020	2020.65435	5.8	44615.3846	10.70583403
MW-7	11/19/2020	2020.88706	4.8	36923.0769	10.51659203
MW-7	6/14/2021	2021.4538	0.86	6615.38462	8.797153218
MW-7	7/29/2021	2021.577	1.1	8461.53846	9.043286287
MW-7	10/20/2021	2021.80424	3.9	30000	10.30895266
MW-7	12/20/2021	2021.97125	1.6	12307.6923	9.417979737

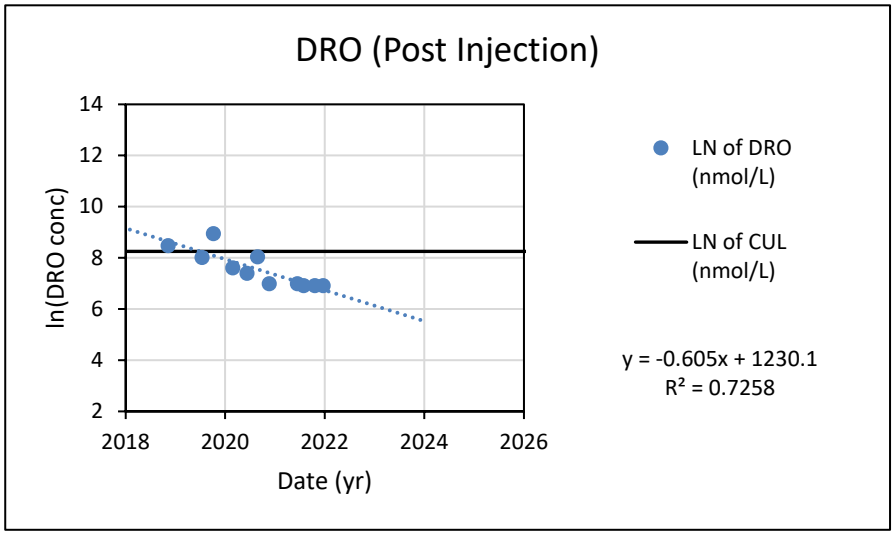


Blaine Marina, Inc.

MW-8

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-8	11/8/2018	2018.85742	0.62	4769.23077	8.469940307
MW-8	7/15/2019	2019.5373	0.39	3000	8.006367568
MW-8	10/7/2019	2019.76728	0.99	7615.38462	8.937925772
MW-8	2/25/2020	2020.15332	0.26	2000	7.60090246
MW-8	6/9/2020	2020.44079	0.21	1615.38462	7.387328359
MW-8	8/26/2020	2020.65435	0.4	3076.92308	8.031685376
MW-8	11/19/2020	2020.88706	0.14	1076.92308	6.981863251
MW-8	6/14/2021	2021.4538	0.14	1076.92308	6.981863251
MW-8	7/29/2021	2021.577	0.13	1000	6.907755279
MW-8	10/20/2021	2021.80424	0.13	1000	6.907755279
MW-8	12/20/2021	2021.97125	0.13	1000	6.907755279

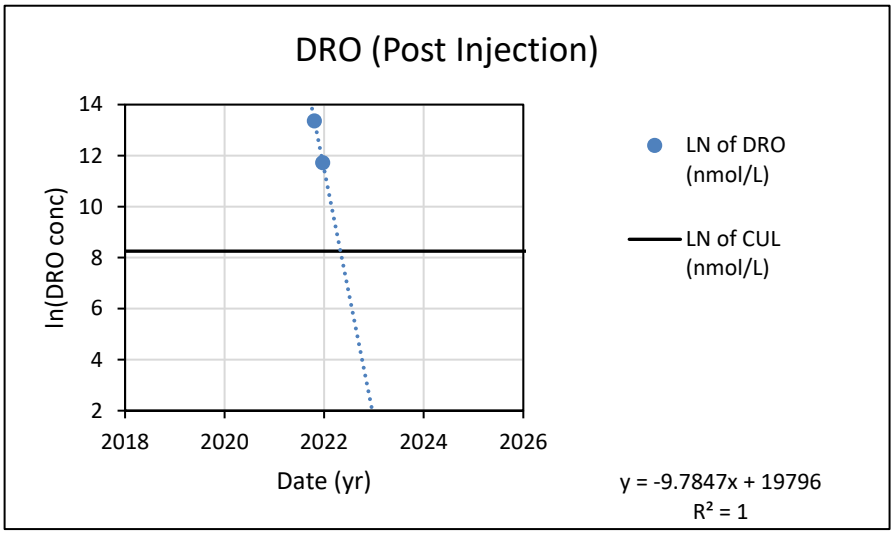


Blaine Marina, Inc.

MW-9

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-9	6/14/2021	2021.4538	6	46153.8462	10.73973558
MW-9	7/29/2021	2021.577	4.8	36923.0769	10.51659203
MW-9	10/20/2021	2021.80424	82	630769.231	13.35469535
MW-9	12/20/2021	2021.97125	16	123076.923	11.72056483

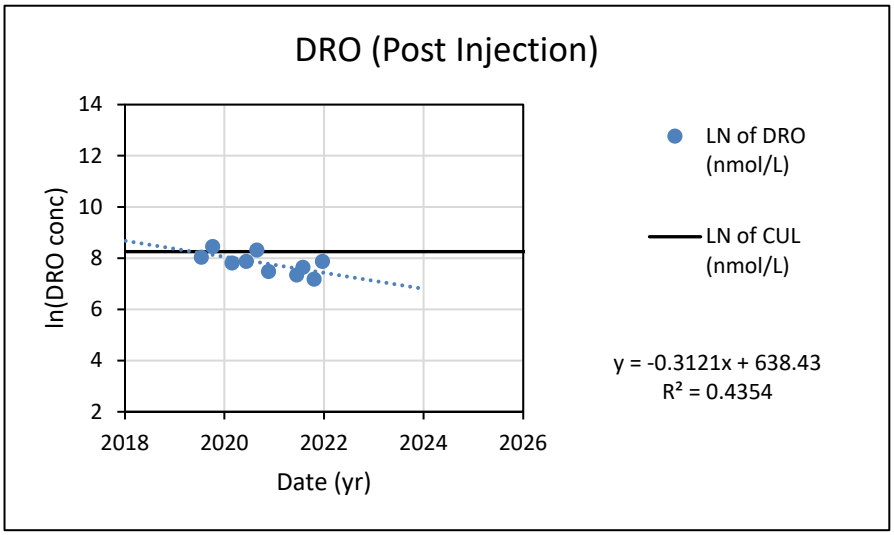


Blaine Marina, Inc.

MW-12

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-12	11/8/2018	2018.85698	0.18	1384.61538	7.233177679
MW-12	7/15/2019	2019.5373	0.4	3076.92308	8.031685376
MW-12	10/7/2019	2019.76728	0.61	4692.30769	8.453679786
MW-12	2/25/2020	2020.15332	0.32	2461.53846	7.808541824
MW-12	6/9/2020	2020.44079	0.34	2615.38462	7.869166446
MW-12	8/26/2020	2020.65435	0.53	4076.92308	8.313097835
MW-12	11/19/2020	2020.88706	0.23	1769.23077	7.478300137
MW-12	6/14/2021	2021.4538	0.2	1538.46154	7.338538195
MW-12	7/29/2021	2021.577	0.27	2076.92308	7.638642788
MW-12	10/20/2021	2021.80424	0.17	1307.69231	7.176019266
MW-12	12/20/2021	2021.97125	0.34	2615.38462	7.869166446

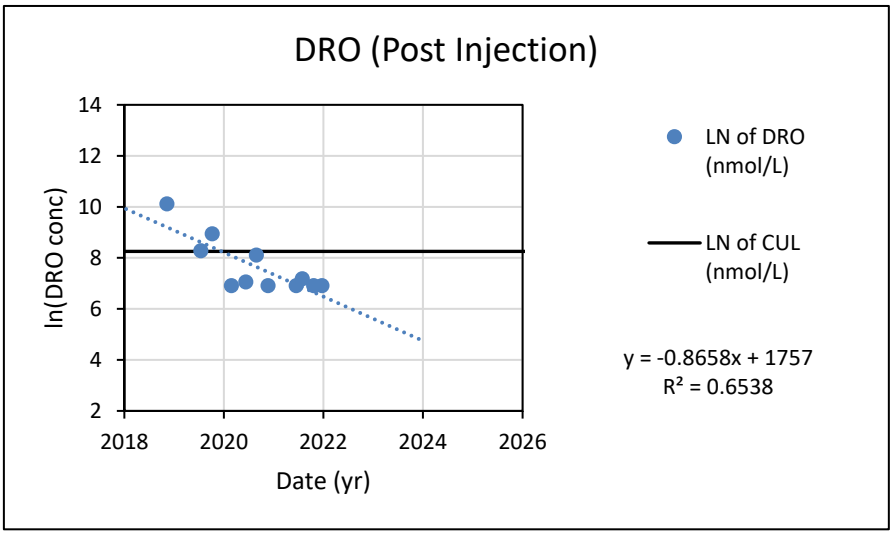


Blaine Marina, Inc.

MW-13

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-13	11/8/2018	2018.8569	3.2	24615.3846	10.11112692
MW-13	7/15/2019	2019.5373	0.51	3923.07692	8.274631554
MW-13	10/7/2019	2019.76728	0.99	7615.38462	8.937925772
MW-13	2/25/2020	2020.15332	0.13	1000	6.907755279
MW-13	6/9/2020	2020.44079	0.15	1153.84615	7.050856123
MW-13	8/26/2020	2020.65435	0.43	3307.69231	8.104006037
MW-13	11/19/2020	2020.88706	0.13	1000	6.907755279
MW-13	6/14/2021	2021.4538	0.13	1000	6.907755279
MW-13	7/29/2021	2021.577	0.17	1307.69231	7.176019266
MW-13	10/20/2021	2021.80424	0.13	1000	6.907755279
MW-13	12/20/2021	2021.97125	0.13	1000	6.907755279

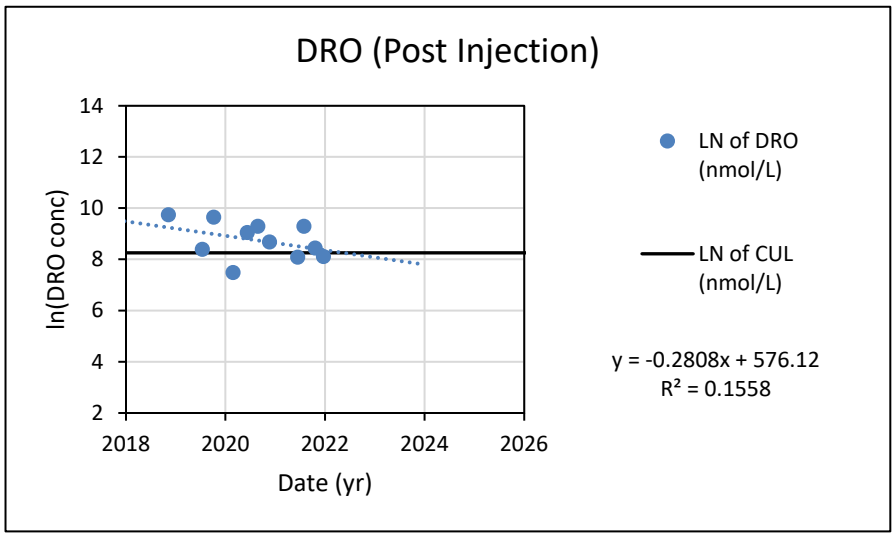


Blaine Marina, Inc.

MW-14

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	DRO (mg/L)	DRO (nmol/L)	LN of DRO (nmol/L)
MW-14	11/8/2018	2018.85683	2.2	16923.0769	9.736433468
MW-14	7/15/2019	2019.5373	0.57	4384.61538	8.385857189
MW-14	10/7/2019	2019.76728	2	15384.6154	9.641123288
MW-14	2/25/2020	2020.15332	0.23	1769.23077	7.478300137
MW-14	6/9/2020	2020.44079	1.1	8461.53846	9.043286287
MW-14	8/26/2020	2020.65435	1.4	10769.2308	9.284448344
MW-14	11/19/2020	2020.88706	0.76	5846.15385	8.673539262
MW-14	6/14/2021	2021.4538	0.42	3230.76923	8.08047554
MW-14	7/29/2021	2021.577	1.4	10769.2308	9.284448344
MW-14	10/20/2021	2021.80424	0.6	4615.38462	8.437150484
MW-14	12/20/2021	2021.97125	0.43	3307.69231	8.104006037

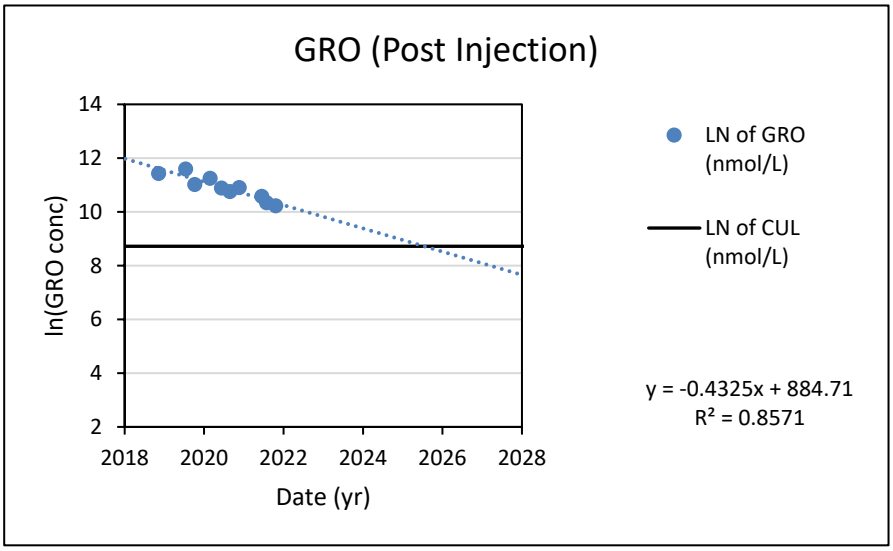


Blaine Marina, Inc.

MW-7

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	LN of GRO (nmol/L)
MW-7	11/8/2018	2018.85717	11	91666.6667	11.42591409
MW-7	7/15/2019	2019.5373	13	108333.333	11.59296817
MW-7	10/7/2019	2019.76728	7.3	60833.3333	11.01589316
MW-7	2/25/2020	2020.15332	9.2	76666.6667	11.2472223
MW-7	6/9/2020	2020.44079	6.4	53333.3333	10.88431681
MW-7	8/26/2020	2020.65435	5.6	46666.6667	10.75078541
MW-7	11/19/2020	2020.88706	6.5	54166.6667	10.89982099
MW-7	6/14/2021	2021.4538	4.7	39166.6667	10.57558132
MW-7	7/29/2021	2021.577	3.7	30833.3333	10.33635163
MW-7	10/20/2021	2021.80424	3.3	27500	10.22194128

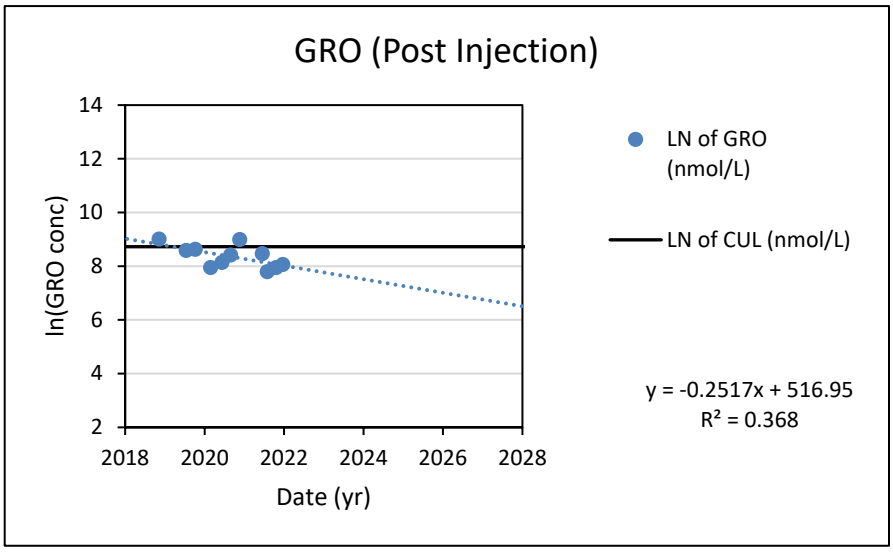


Blaine Marina, Inc.

MW-12

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	LN of GRO (nmol/L)
MW-12	11/8/2018	2018.85698	0.98	8166.66667	9.007816108
MW-12	7/15/2019	2019.5373	0.64	5333.33333	8.581731713
MW-12	10/7/2019	2019.76728	0.67	5583.33333	8.627541249
MW-12	2/25/2020	2020.15332	0.34	2833.33333	7.949209154
MW-12	6/9/2020	2020.44079	0.41	3416.66667	8.136420696
MW-12	8/26/2020	2020.65435	0.54	4500	8.411832676
MW-12	11/19/2020	2020.88706	0.96	8000	8.987196821
MW-12	6/14/2021	2021.4538	0.57	4750	8.465899897
MW-12	7/29/2021	2021.577	0.29	2416.66667	7.790144459
MW-12	10/20/2021	2021.80424	0.34	2833.33333	7.949209154
MW-12	12/20/2021	2021.97125	0.38	3166.66667	8.060434789

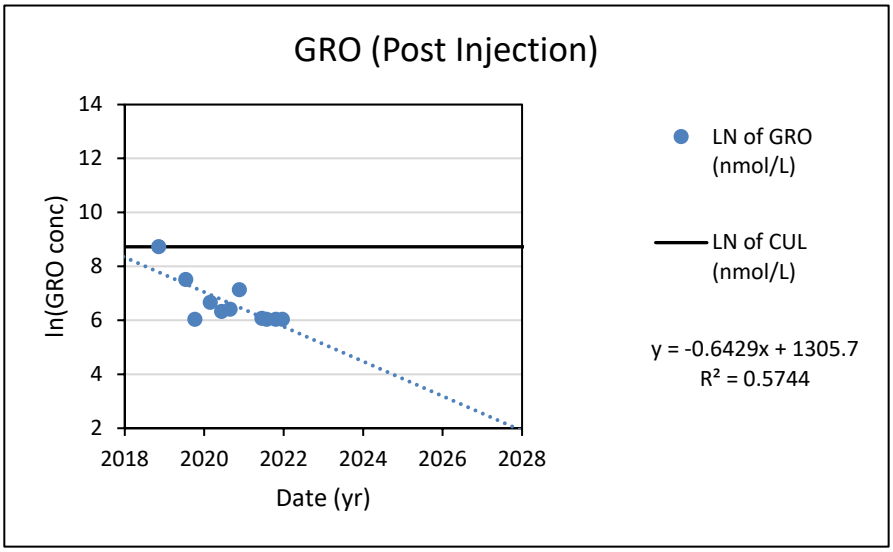


Blaine Marina, Inc.

MW-13

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	LN of GRO (nmol/L)
MW-13	11/8/2018	2018.8569	0.74	6166.66667	8.726913722
MW-13	7/15/2019	2019.5373	0.22	1833.33333	7.513891083
MW-13	10/7/2019	2019.76728	0.05	416.666667	6.032286542
MW-13	2/25/2020	2020.15332	0.094	783.333333	6.663558318
MW-13	6/9/2020	2020.44079	0.067	558.333333	6.324956156
MW-13	8/26/2020	2020.65435	0.073	608.333333	6.410722977
MW-13	11/19/2020	2020.88706	0.15	1250	7.13089883
MW-13	6/14/2021	2021.4538	0.052	433.333333	6.071507255
MW-13	7/29/2021	2021.577	0.05	416.666667	6.032286542
MW-13	10/20/2021	2021.80424	0.05	416.666667	6.032286542
MW-13	12/20/2021	2021.97125	0.05	416.666667	6.032286542

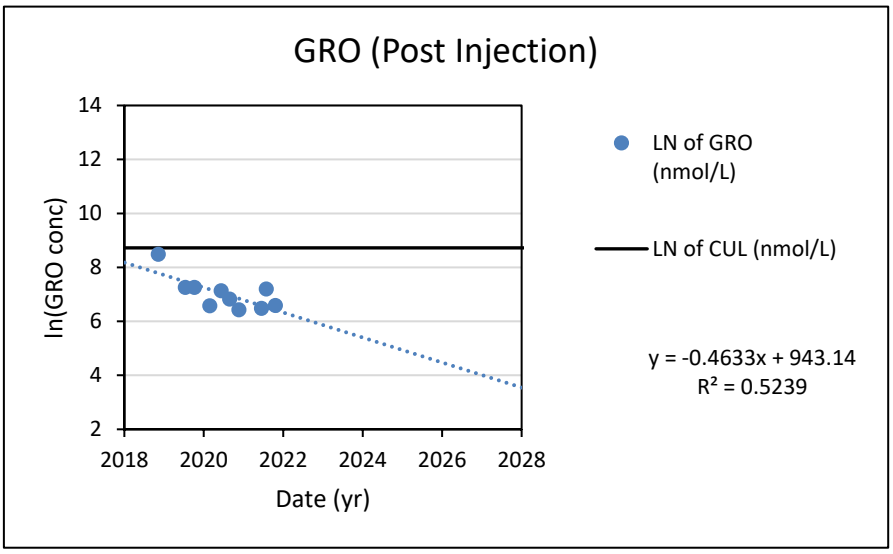


Blaine Marina, Inc.

MW-14

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	LN of GRO (nmol/L)
MW-14	11/8/2018	2018.85683	0.58	4833.33333	8.48329164
MW-14	7/15/2019	2019.5373	0.17	1416.66667	7.256061973
MW-14	10/7/2019	2019.76728	0.17	1416.66667	7.256061973
MW-14	2/25/2020	2020.15332	0.086	716.666667	6.574610832
MW-14	6/9/2020	2020.44079	0.15	1250	7.13089883
MW-14	8/26/2020	2020.65435	0.11	916.666667	6.820743902
MW-14	11/19/2020	2020.88706	0.074	616.666667	6.424328629
MW-14	6/14/2021	2021.4538	0.078	650	6.476972363
MW-14	7/29/2021	2021.577	0.16	1333.33333	7.195437351
MW-14	10/20/2021	2021.80424	0.087	725	6.586171655

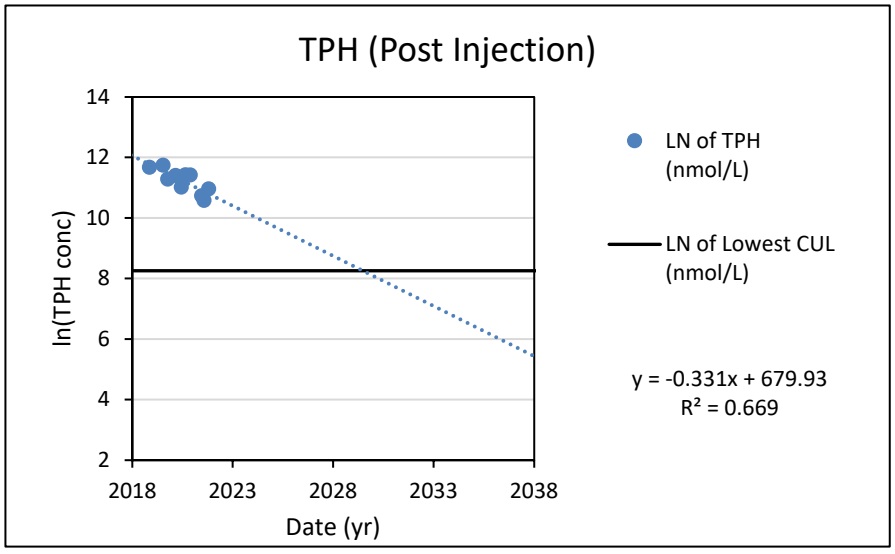


Blaine Marina, Inc.

MW-7

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	DRO (mg/L)	DRO (nmol/L)	TPH (nmol/L)	LN of TPH (nmol/L)
MW-7	11/8/2018	2018.85717	11	91666.6667	3.3	25384.6154	117051.282	11.67036743
MW-7	7/15/2019	2019.5373	13	108333.333	2.2	16923.0769	125256.41	11.7381182
MW-7	10/7/2019	2019.76728	7.3	60833.3333	2.4	18461.5385	79294.8718	11.28092874
MW-7	2/25/2020	2020.15332	9.2	76666.6667	1.7	13076.9231	89743.5897	11.40471188
MW-7	6/9/2020	2020.44079	6.4	53333.3333	1	7692.30769	61025.641	11.0190494
MW-7	8/26/2020	2020.65435	5.6	46666.6667	5.8	44615.3846	91282.0513	11.42170946
MW-7	11/19/2020	2020.88706	6.5	54166.6667	4.8	36923.0769	91089.7436	11.41960049
MW-7	6/14/2021	2021.4538	4.7	39166.6667	0.86	6615.38462	45782.0513	10.7316474
MW-7	7/29/2021	2021.577	3.7	30833.3333	1.1	8461.53846	39294.8718	10.5788493
MW-7	10/20/2021	2021.80424	3.3	27500	3.9	30000	57500	10.95954023

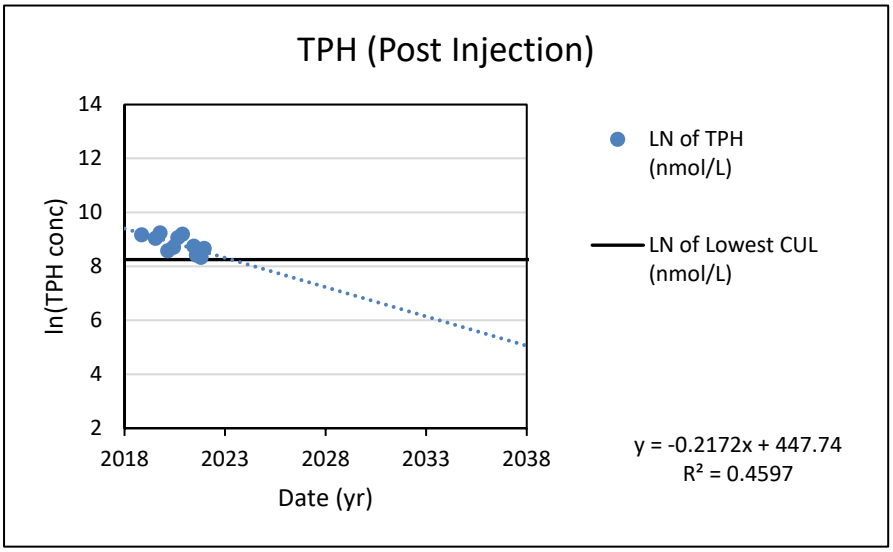


Blaine Marina, Inc.

MW-12

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	DRO (mg/L)	DRO (nmol/L)	TPH (nmol/L)	LN of TPH (nmol/L)
MW-12	11/8/2018	2018.85698	0.98	8166.66667	0.18	1384.61538	9551.28205	9.164430671
MW-12	7/15/2019	2019.5373	0.64	5333.33333	0.4	3076.92308	8410.25641	9.037207241
MW-12	10/7/2019	2019.76728	0.67	5583.33333	0.61	4692.30769	10275.641	9.237531424
MW-12	2/25/2020	2020.15332	0.34	2833.33333	0.32	2461.53846	5294.87179	8.574494045
MW-12	6/9/2020	2020.44079	0.41	3416.66667	0.34	2615.38462	6032.05128	8.704842411
MW-12	8/26/2020	2020.65435	0.54	4500	0.53	4076.92308	8576.92308	9.056830512
MW-12	11/19/2020	2020.88706	0.96	8000	0.23	1769.23077	9769.23077	9.186993008
MW-12	6/14/2021	2021.4538	0.57	4750	0.2	1538.46154	6288.46154	8.746471731
MW-12	7/29/2021	2021.577	0.29	2416.66667	0.27	2076.92308	4493.58974	8.410407159
MW-12	10/20/2021	2021.80424	0.34	2833.33333	0.17	1307.69231	4141.02564	8.328698776
MW-12	12/20/2021	2021.97125	0.38	3166.66667	0.34	2615.38462	5782.05128	8.662513792

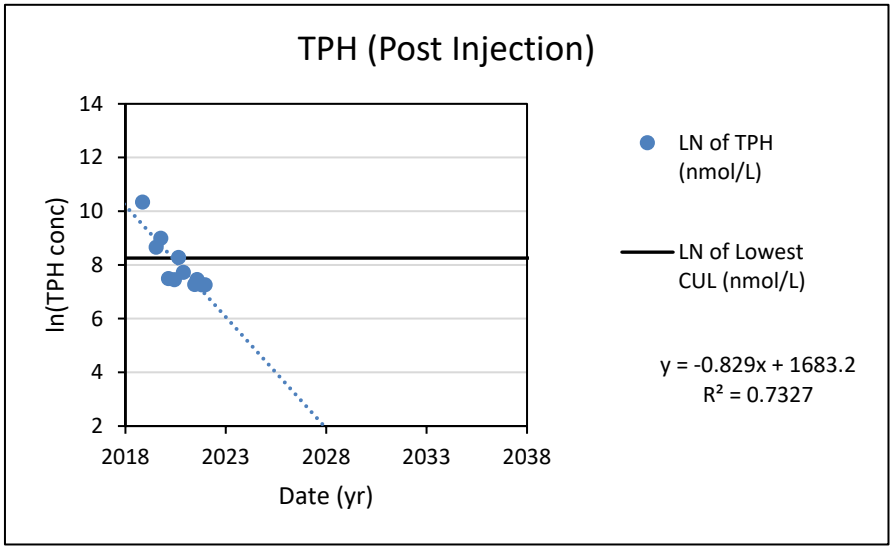


Blaine Marina, Inc.

MW-13

MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	DRO (mg/L)	DRO (nmol/L)	TPH (nmol/L)	LN of TPH (nmol/L)
MW-13	11/8/2018	2018.8569	0.74	6166.66667	3.2	24615.3846	30782.0513	10.33468705
MW-13	7/15/2019	2019.5373	0.22	1833.33333	0.51	3923.07692	5756.41026	8.65806934
MW-13	10/7/2019	2019.76728	0.05	416.666667	0.99	7615.38462	8032.05128	8.991195227
MW-13	2/25/2020	2020.15332	0.094	783.333333	0.13	1000	1783.33333	7.486239551
MW-13	6/9/2020	2020.44079	0.067	558.333333	0.15	1153.84615	1712.17949	7.445522392
MW-13	8/26/2020	2020.65435	0.073	608.333333	0.43	3307.69231	3916.02564	8.272832551
MW-13	11/19/2020	2020.88706	0.15	1250	0.13	1000	2250	7.718685495
MW-13	6/14/2021	2021.4538	0.052	433.333333	0.13	1000	1433.33333	7.267758013
MW-13	7/29/2021	2021.577	0.05	416.666667	0.17	1307.69231	1724.35897	7.452610651
MW-13	10/20/2021	2021.80424	0.05	416.666667	0.13	1000	1416.66667	7.256061973
MW-13	12/20/2021	2021.97125	0.05	416.666667	0.13	1000	1416.66667	7.256061973

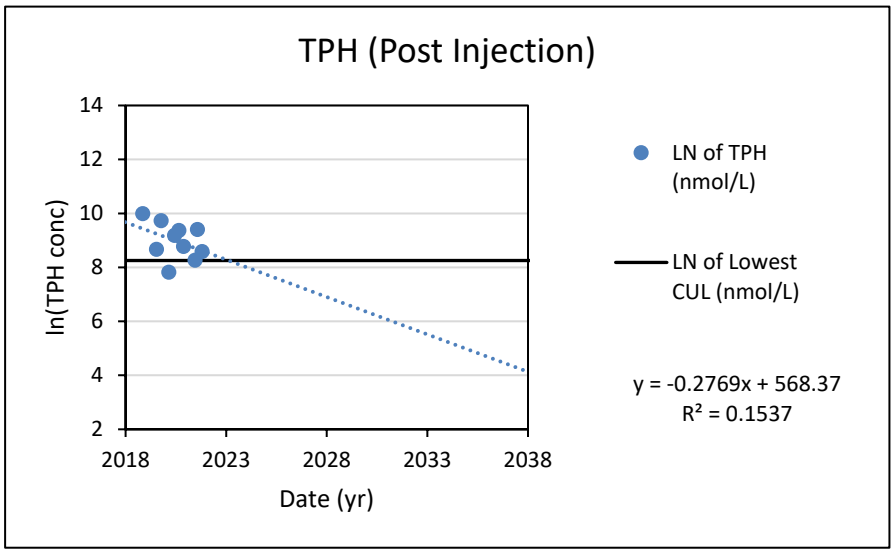


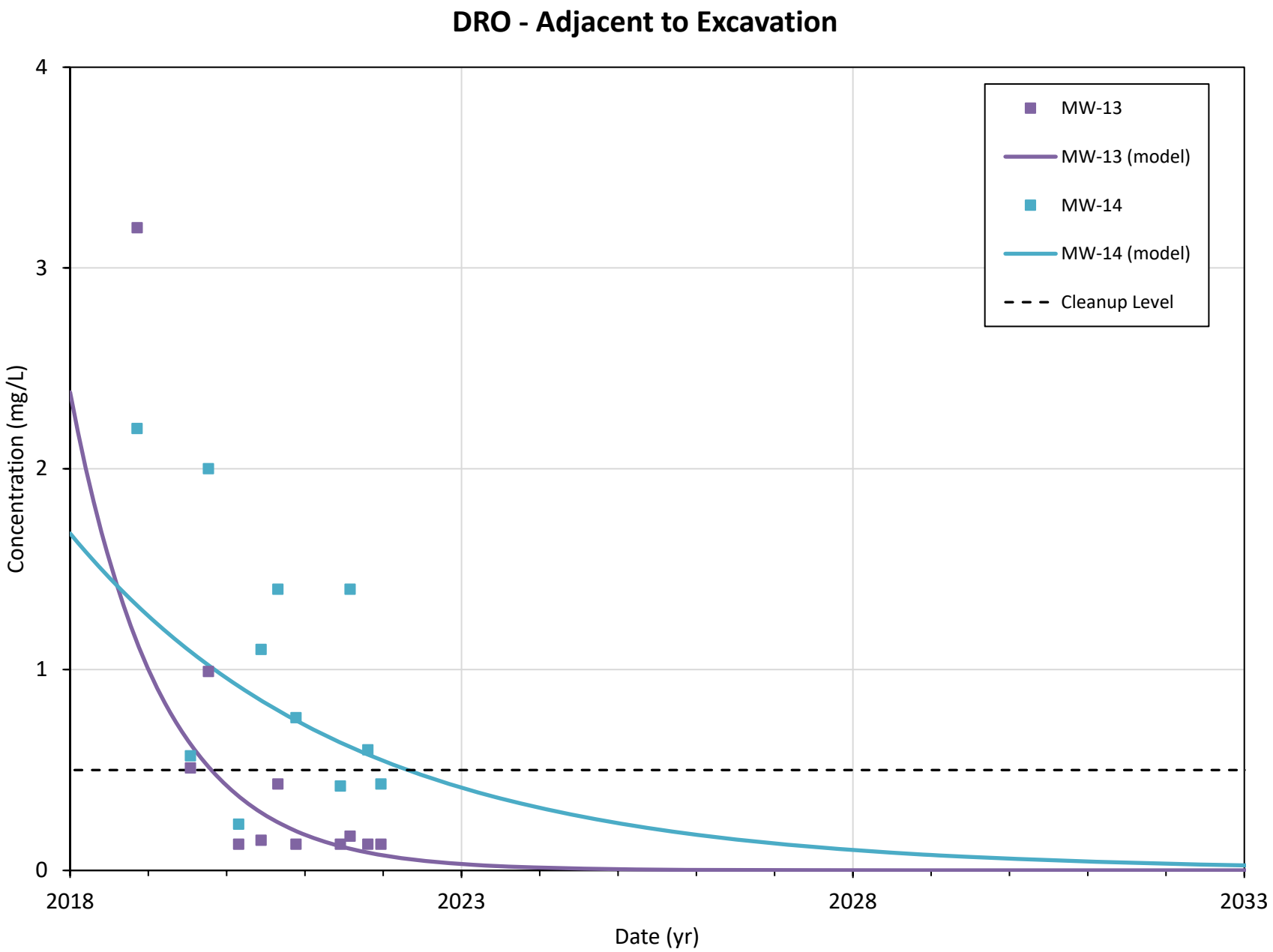
Blaine Marina, Inc.

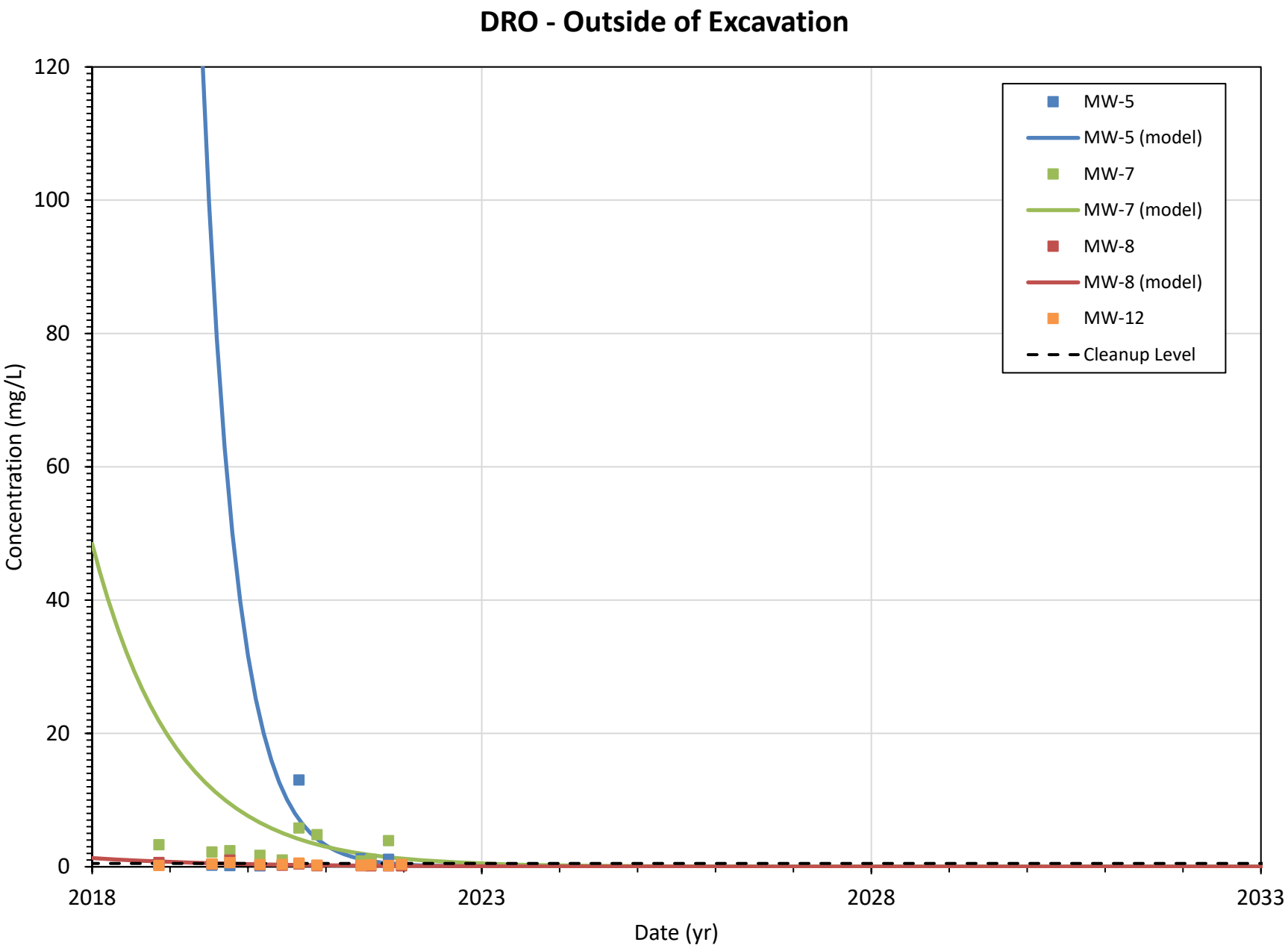
MW-14

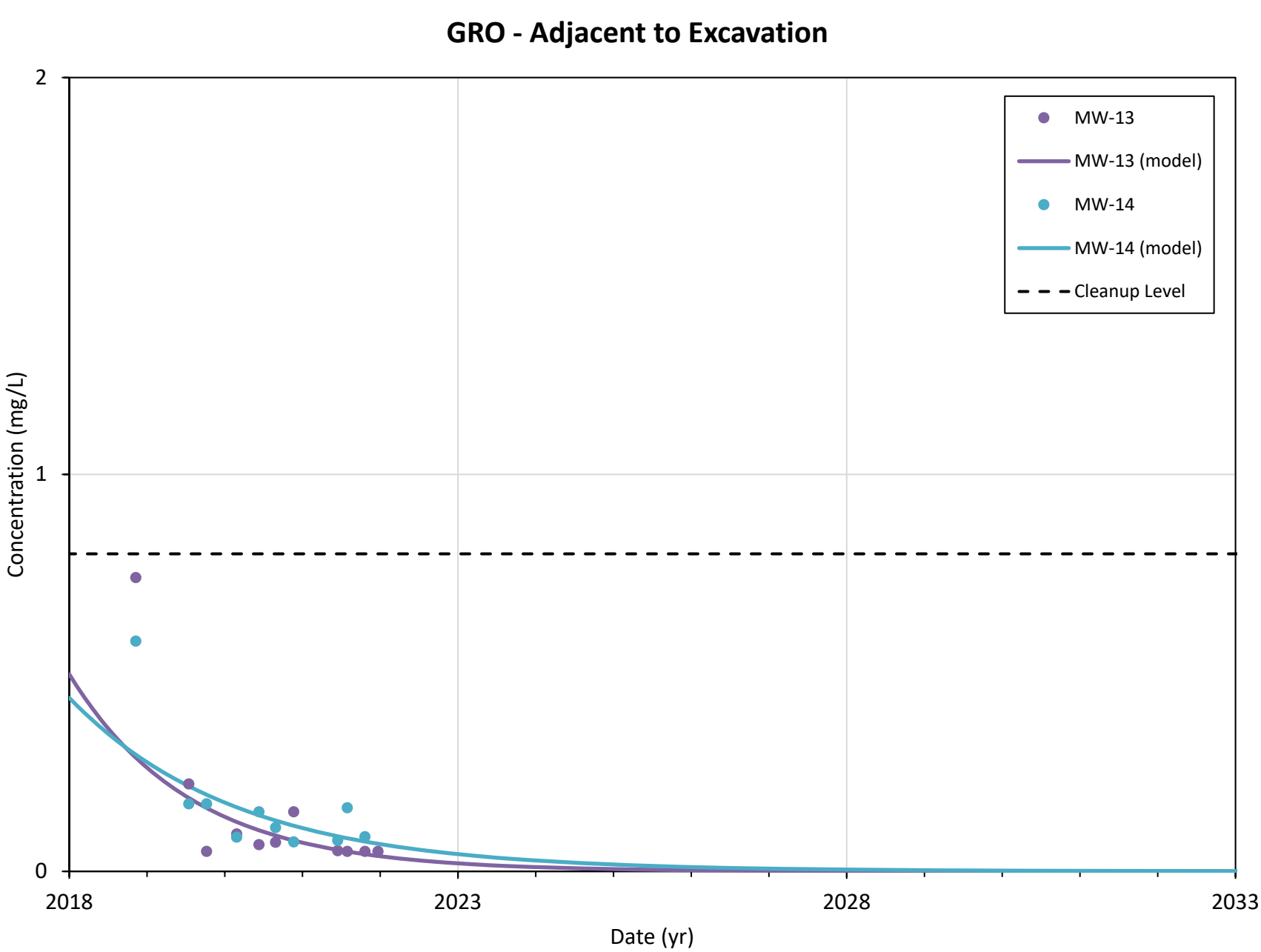
MANN-KENDALL ANALYSIS PRE-INJECTION: NO PRE-INJECTION DATA
MANN-KENDALL ANALYSIS POST-INJECTION: DECREASING
DATE OF FIRST INJECTION: JUNE 2019

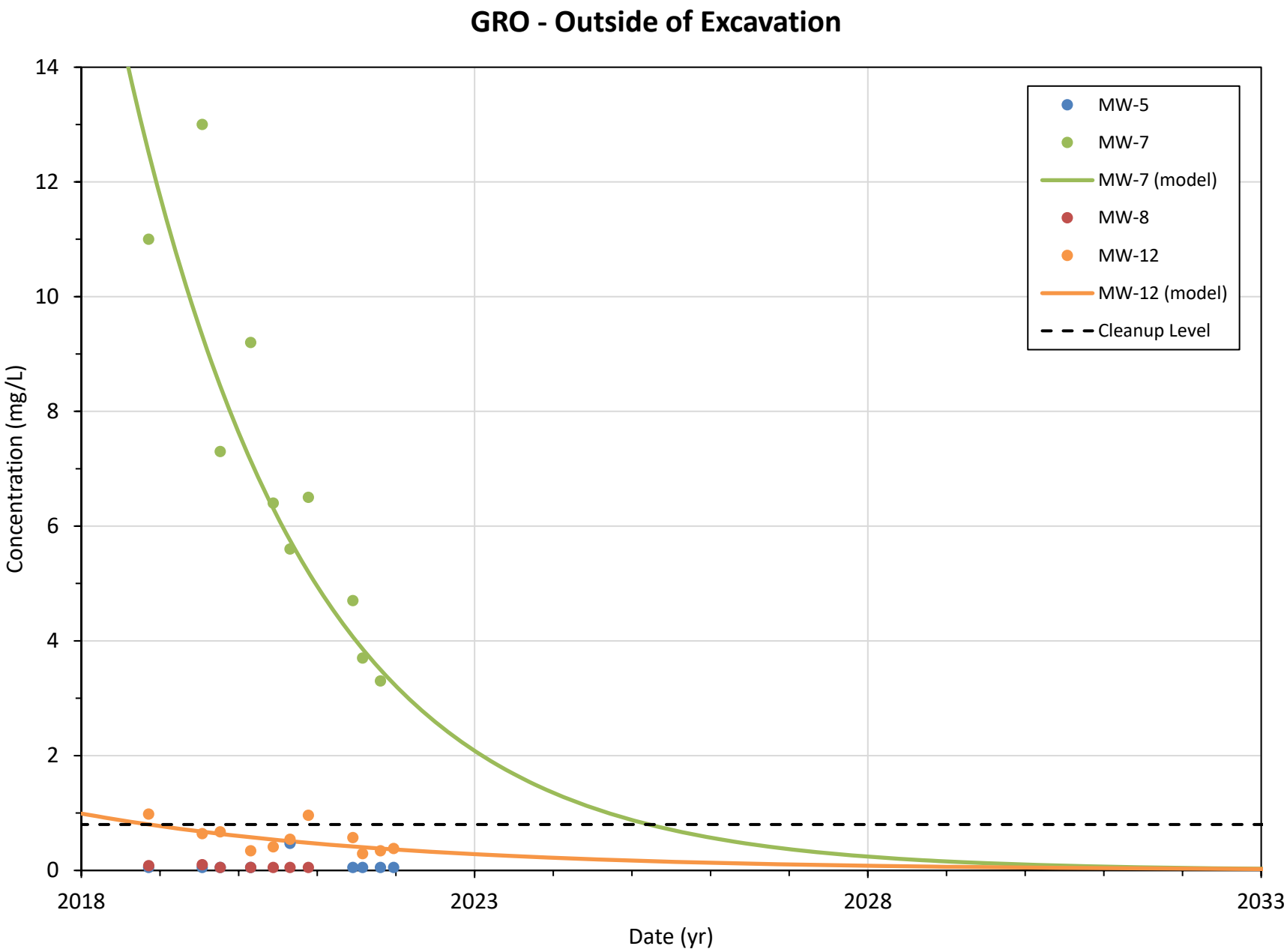
Well	Date	Date (Decimal)	GRO (mg/L)	GRO (nmol/L)	DRO (mg/L)	DRO (nmol/L)	TPH (nmol/L)	LN of TPH (nmol/L)
MW-14	11/8/2018	2018.85683	0.58	4833.33333	2.2	16923.0769	21756.4103	9.987663718
MW-14	7/15/2019	2019.5373	0.17	1416.66667	0.57	4384.61538	5801.28205	8.665834215
MW-14	10/7/2019	2019.76728	0.17	1416.66667	2	15384.6154	16801.2821	9.729210475
MW-14	2/25/2020	2020.15332	0.086	716.666667	0.23	1769.23077	2485.89744	7.818389015
MW-14	6/9/2020	2020.44079	0.15	1250	1.1	8461.53846	9711.53846	9.18106999
MW-14	8/26/2020	2020.65435	0.11	916.666667	1.4	10769.2308	11685.8974	9.366138046
MW-14	11/19/2020	2020.88706	0.074	616.666667	0.76	5846.15385	6462.82051	8.773821113
MW-14	6/14/2021	2021.4538	0.078	650	0.42	3230.76923	3880.76923	8.263788668
MW-14	7/29/2021	2021.577	0.16	1333.33333	1.4	10769.2308	12102.5641	9.401172618
MW-14	10/20/2021	2021.80424	0.087	725	0.6	4615.38462	5340.38462	8.583052955




DRO - Adjacent to Excavation
Concentration (mg/L)
Date (yr)
0
1
2
3
4
2018
2023
2028
2033
MW-13
MW-13 (model)
MW-14
MW-14 (model)
Cleanup Level


DRO - Outside of Excavation
120
100
80
60
40
20
0
Concentration (mg/L)
2018
2023
2028
2033
Date (yr)
MW-5
MW-5 (model)
MW-7
MW-7 (model)
MW-8
MW-8 (model)
MW-12
Cleanup Level


GRO - Adjacent to Excavation
2
1
0
Concentration (mg/L)
2018
2023
2028
2033
Date (yr)
MW-13
MW-13 (model)
MW-14
MW-14 (model)
Cleanup Level


GRO - Outside of Excavation
14
12
10
8
6
4
2
0
Concentration (mg/L)
2018
2023
2028
2033
Date (yr)
MW-5
MW-7
MW-7 (model)
MW-8
MW-12
MW-12 (model)
Cleanup Level