Annual Groundwater Quality Report
2020 Bioremediation Program
Blaine Marina, Inc. Cleanup Site
Blaine, Washington

September 20, 2021

Prepared for

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LIST OF ABBREVIATIONS AND ACRONYMS

ALS	Analytical Laboratory Services
AN	ammonium nitrate
CAP	cleanup action plan
Ecology	Washington State Department of Ecology
EDR	engineering design report
IHS	indicator hazardous substance
LAI	Landau Associates, Inc.
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
mg-N/L	milligrams nitrogen per liter
On Site	On Site Environmental
OP	observation point
Port	Port of Bellingham
redox	oxidation-reduction
Site	Blaine Marina, Inc. cleanup site
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. (LAI) 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 injection and groundwater quality sampling activities conducted in 2020, and provides recommendations, when warranted, for proposed changes in the bioremediation approach.

1.1 Background

The Site is located in 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 (LAI 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; LAI 2018).

1.2 Cleanup Activities

The Port completed a majority of the required cleanup activities in 2018 that were described in the cleanup action plan (CAP; Ecology 2017), and detailed in the EDR (LAI 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 liquids (LNAPL) recovered from the excavation. Additional demolition and Site restoration activities were required to accomplish the removal, since buildings were located above the source area where contamination levels were highest. The contaminated materials were removed from the Site and disposed of at an offsite 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 (LAI 2019a). The ongoing cleanup activities discussed herein relate to addressing the residual contamination left in place outside of the source area.

1.3 Summary of Bioremediation Program

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

bioremediation work plan (Work Plan; LAI 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 infiltrating a nitrate solution into the groundwater. The nitrate solution is introduced into the subsurface using infiltration components that were installed in 2018 during source removal efforts. The infiltration components were designed to allow large quantities of nitrate solution to infiltrate into the source area, where the contaminated soil was excavated and replaced. Infiltration components consist of clean sand and gravel backfill material to enhance groundwater flow, and four infiltration trenches installed within and outside of the boundary of the excavation to promote distribution of nitrate solution.

The Port will continue implementing cleanup activities in cooperation with Ecology until concentrations of the indicator hazardous substances (IHSs) are reduced sufficiently to meet the cleanup requirements detailed in the CAP. These activities are summarized in annual reports to document and share updates on the cleanup progress. If it is determined during the implementation of bioremediation that additional nitrate solution is not required, a period of monitored natural attenuation would be conducted to continue tracking remedial progress and confirm that cleanup levels are achieved and maintained. When it becomes evident that 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. This determination would be made in coordination with Ecology if sufficient evidence indicates a reasonable restoration timeframe is expected without nitrate solution infiltration.

2.0 ANAEROBIC BIOREMEDIATION

As summarized above, nitrate solution is introduced into the 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. The process is presented in detail in the Work Plan (LAI 2019b) and summarized below.

2.1 The Anaerobic Bioremediation Process

Biodegradation of petroleum hydrocarbons occurs through microbially-mediated redox reactions between electron donors (i.e., food) and electron acceptors (i.e., something to respire/breathe) (Cunningham et al. 2001; Wiedemeier et al. 1999). At this Site, petroleum hydrocarbons act as the electron donors while a number of compounds can serve as the electron acceptors (oxygen, nitrate, manganese [IV], ferric iron, sulfate, and/or carbon dioxide).

The electron acceptors occur naturally but are supplemented to accelerate the cleanup process. Oxygen is an excellent electron acceptor, but nitrate is preferred at this Site for several reasons. Nitrate is much more soluble in groundwater than oxygen, which allows for a higher initial concentration of electron acceptor at the point of infiltration, more treatment longevity, and a larger downgradient extent of treatment. In addition, there is a lower demand for nitrate in the aquifer resulting in less of the electron acceptor being consumed by side-reactions, which allows for greater treatment longevity and a larger portion of the added electron acceptor used directly for contaminant reduction. This is particularly important in aquifers with naturally reducing depositional environments, such as estuaries and tideflat deposits.

Multiple injection or infiltration events are typically required to complete a course of treatment to address petroleum hydrocarbons present in groundwater and sorbed onto soil surfaces. Petroleum hydrocarbon concentrations in groundwater will likely fluctuate during treatment until the non-aqueous mass is depleted. Upon reduction of the aqueous-phase petroleum hydrocarbons and depletion of the nitrate, contaminants will desorb from soil surfaces and enter the groundwater, where petroleum hydrocarbon concentrations may rebound until more nitrate is added, or until the contaminant is depleted from the Site. Fluctuations in petroleum hydrocarbon concentrations also occur as groundwater levels rise and fall due to seasonal changes in rainfall, or tidal influence causes the groundwater to contact additional contamination that may be adsorbed to soil surfaces in the vadose zone.

Nitrate solution is introduced into four pairs of infiltration ports. These are shown on Figure 2 and 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.

[1] OP = Observation point.

The perforations in the piping allow the injected solution to infiltrate throughout granular backfill material (sand and gravel) surrounding the perforated piping, then into the surrounding formation. Distribution of the solution throughout the Site is further enhanced by the hydraulic gradient created by the mounding of the groundwater table at the infiltration locations. The groundwater table is intentionally mounded during infiltration events and appears to remain elevated as the solution infiltrates throughout the Site, promoting nitrate distribution to the areas of need. During the infiltration events, LAI personnel monitor nearby groundwater monitoring wells, utility corridors, catch basins, and surface water to observe for potential impacts to surface water and/or ammonium nitrate (AN) solution loss to utilities as a preferential pathway. During the first infiltration event in 2019, pressure transducers were installed in nearby groundwater monitoring wells to observe for mounding and dissipation. Active monitoring observations and transducer data collected during the first event confirmed that an induced groundwater mounding effect is present at the Site during infiltration events. Monitoring has also confirmed that nitrate solution is not entering utilities or flowing to the surface water during the infiltration events.

Two of the infiltration port pairs (OP-3/OP-4 and OP-5/OP-6) were installed within the area excavated during the contaminant source removal. Since the entire excavation was backfilled with sand and gravel, the nitrate solution can move freely throughout the extent of the historical source area and should infiltrate slowly out of the excavated area and into the surrounding aquifer through lenses of permeable soils. Outside of the source area, two additional pairs of infiltration ports (OP-1/OP-2 and OP-7/OP-8) were installed to target the highest levels of petroleum hydrocarbon contamination remaining on Site after the source-area excavation. Like the ports installed within the previous source area, these infiltration ports were constructed with gravel and perforated piping. However, since OP-1/OP-2 and OP-7/OP-8 were installed by trenching into areas composed of finer-grain soils (silt and clay), a smaller volume of nitrate solution is added to these areas.

The AN solution is partially prepared off site by Cascade Columbia Distribution Company and delivered to the Site in highly concentrated batches. Tap water is used on site to dilute the AN solution to the desired concentrations in a 4,000 or 6,500-gallon mixing tank. Yeast extract is added to provide additional macro- and micro-nutrients for cellular growth and reproduction. Once the desired concentration is prepared and mixed with the yeast, the solution is pumped to one of the four pairs of infiltration ports described above. Due to the large volume of relatively high hydraulic conductivity excavation backfill in the historical source area, flow rates in the infiltration galleries are much higher than in the infiltration trenches. AN solution is introduced simultaneously into risers on either end of each infiltration gallery/trench for even distribution of solution within the gallery or trench.

Based on the desired distribution and estimated pore volumes, remediation at this Site is generally carried out by adding a total of approximately 40,000 gallons of nitrate solution during each infiltration event. Approximately 36,000 gallons are infiltrated into OP-3/OP-4 and OP-5/OP-6, and up to approximately 4,000 gallons into OP-1/OP-2 and OP-7/OP-8. Due apparently to clayey soil in the vicinity of OP-7/OP-8, only a limited volume of nitrate solution can be applied at this location. To

accommodate for this condition, smaller batch volumes with greater concentrations of nitrate were infiltrated at this location during 2020.

2.2 Implementation Event Details – 2020

This section describes the overall approach to nitrate infiltration and water quality performance assessments conducted in 2020. In general, nitrate treatment events occur twice per year, and assessment of groundwater quality is currently conducted on a quarterly basis from the 11 groundwater monitoring wells shown on Figure 2. The 2020 timeline of nitrate solution infiltration and monitoring events is summarized below.

- February 2020: 1st Quarter performance assessment
- April 2020: Nitrate solution infiltration
- June 2020: 2nd Quarter performance assessment
- August 2020: 3rd Quarter performance assessment
- October 2020: Nitrate solution infiltration
- November 2020: 4th Quarter performance assessment.

2.2.1 Nitrate Infiltration

Two infiltration events were conducted in 2020, with the timing, infiltration volumes, and concentrations selected based on LAI's interpretation of groundwater trends (primarily IHS and nitrate concentrations). The two events in 2020 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.

The events were conducted in April and October of 2020. Injection trench pairs OP-1/OP-2, OP-3/4, and OP-5/6 were treated as planned for both events. However, the OP-7/OP-8 trench was not treated in April 2020 to allow for assessment of nitrate distribution and longevity in that area, as a result of the clayey soils. During the subsequent monitoring events in June and August 2020, the analytical results from downgradient monitoring well MW-12 showed a steady depletion of nitrate to below the laboratory reporting limit. Treatment resumed at this trench in October 2020 to keep nitrate concentrations high enough to enhance biodegradation in that area even though the treatment volume (800 gallons) was smaller than the original design volume (2,000 gallons). Table 1 provides a summary of nitrate volumes and solution concentrations for all four injection events.

2.2.2 Water Quality

In addition to the monitoring conducted during the infiltration events, LAI personnel return to the Site quarterly to evaluate the performance of the bioremediation program. The assessments are 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 table elevation to understand groundwater flow and confirm that groundwater mounding is present, and analysis of groundwater samples to assess IHS concentrations and to evaluate the proper distribution of nitrate solution throughout the area where residual contamination persists. Additionally, surface water samples are collected and analyzed for nitrate, to confirm that the nitrate solution is not negatively impacting surface water. Cumulative groundwater elevations through 2020 are 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 analyses from that location. This assumes that 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. Groundwater samples are routinely collected from wells with LNAPL and analyzed for nitrate to confirm that the infiltration solution is reaching the targeted areas.

Nitrate is not a Site IHS but is monitored during the quarterly events to evaluate distribution of nitrate solution from the infiltrations, and to evaluate the longevity of the nitrate as it is being consumed in the bioremediation process. All IHS parameter samples were submitted to Analytical Laboratory Services (ALS) in Everett, Washington. In 1st quarter 2020, the nitrate analysis was switched from ALS to On Site Environmental (On Site) because On Site can achieve significantly lower reporting limits for both nitrate and nitrite. Prior to 2020, nitrate and nitrite groundwater and surface water data were frequently flagged as estimates and/or had raised laboratory reporting limits due to interference from elevated salinity in the samples. None of the groundwater nitrate samples were flagged as estimates due to salinity interference in 2020.

For efficiency, the analytical program was partially reduced in 2020 to include only those parameters needed to understand bioremediation progress. Benzene and naphthalenes were not analyzed during 2020. The Port plans to resume IHS parameter monitoring when treatment performance data suggest that the Site groundwater data are comparable to established cleanup levels. Table 3 presents the IHS and performance assessment parameters for the Site, along with the analytical methods used by the Ecology-accredited laboratories.

3.0 BIOREMEDIATION PERFORMANCE ASSESSMENT

This section summarizes the analytical results used in assessing the performance and progress of the bioremediation program in 2020. The cumulative laboratory analytical results for groundwater are summarized in Table 4 with comparisons to the cleanup levels established in the CAP. Table 5 provides a summary of the analytical data that are used for evaluating changes in IHS concentrations and other indicator parameters related to bioremediation performance assessment. 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 pertinent results for tracking remedial progress are presented in plan view on Figures 3 through 5. The subsections below summarize Site groundwater quality with respect to IHS parameters.

3.1.1 Gasoline-Range Total Petroleum Hydrocarbons

In 2020, gasoline-range total petroleum hydrocarbon (TPH-G) concentrations were within compliance (less than the established cleanup level) at more than half of the monitoring wells (MW-4, MW-6, MW-8, MW-11, MW-13, MW-14). TPH-G was detected at concentrations below the cleanup level (0.8 milligrams per liter [mg/L]) at monitoring wells MW-8 and MW-11 during previous events, but TPH-G concentrations have remained below the laboratory reporting limit (0.05 mg/L) since October 2019 and July 2019, respectively. These rapid concentration decreases followed by the consecutive quarters of TPH-G below the laboratory reporting limit at wells MW-8 and MW-11 are good indications that treatment events are successfully addressing the residual contamination in this area. TPH-G concentrations have not been detected above the reporting limit at MW-4 and MW-6; including the baseline event in November 2018. Cumulative TPH-G concentration results for each well are shown on Figure 3.

TPH-G was detected at MW-12 at a concentration (0.96 mg/L) greater than the cleanup level during the 4th quarter 2020 event. The last time TPH-G was detected above the cleanup level at this well was during the baseline event (0.98 mg/L) in November 2018. Fluctuations in IHS concentrations were anticipated and expected to initially increase as desorption was enhanced through injection disturbance and biological treatment of aqueous-phase contamination.

TPH-G concentrations have exceeded the cleanup level at MW-7 for all the sampling events, including the baseline event. The cumulative results indicate a slow, but steady decrease of TPH-G concentrations within the vicinity of MW-7, but a more targeted treatment approach is warranted to accelerate hydrocarbon degradation in this area. The Port plans to implement a targeted treatment approach in this area throughout 2021.

3.1.2 Diesel-Range Total Petroleum Hydrocarbons

In 2020, diesel-range total petroleum hydrocarbon (TPH-D) concentrations decreased to below the baseline concentrations at monitoring wells MW-8, MW-13, and MW-14. Concentrations fluctuated at a few wells (MW-7, MW-12, MW-13, and MW-14), and TPH-D was detected at concentrations exceeding the cleanup level (0.5 mg/L) for the first time at MW-6. In addition to MW-6, TPH-D was detected at concentrations greater than the cleanup level at MW-7, MW-12, and MW-14. While MW-5 data show there was a cleanup level exceedance in August 2020, that sample was collected to characterize the LNAPL observed at that well, and not for performance assessment purposes. TPH-D concentration results and LNAPL thickness measurements for MW-5 are shown on Figure 4.

As LAI has observed at similar cleanup sites, increased TPH-D concentrations in early stages of bioremediation treatments are due to desorption and/or mobilization of contaminants that were previously trapped within soil pore spaces. LAI has also observed that the laboratory analytical method reports a range of organics, and the results can be affected by breakdown products (i.e., polar metabolites) during the anaerobic degradation of other petroleum hydrocarbon contaminants. The existing data set for the Site is relatively small to speculate on trends. Continued monitoring in 2021 and beyond will provide additional data to determine cleanup progress.

3.1.3 Nitrate Distribution

Nitrate was detected throughout the cleanup Site, indicating that the injection program is successfully providing electron acceptor to the areas of residual contamination. Concentrations in 2020 ranged from 0.23 milligrams nitrogen per liter (mg-N/L) (4th quarter; MW-8) to 480 mg-N/L (2nd quarter; MW-13). Elevated concentrations of nitrate at MW-4, MW-9, and MW-10 provide additional evidence that the nitrate solution is being delivered to the areas of the Site that are considered to have the highest residual IHS concentrations. The cumulative nitrate results are shown on Figure 4.

Nitrate has not been detected at one location (MW-7) since bioremediation began, potentially a result of the nitrate being consumed near MW-12 before it reaches MW-7. The Port plans to implement a more targeted (i.e., “hot spot”) treatment approach in 2021 to improve nitrate distribution and longevity near MW-7.

Concentrations of nitrate decreased significantly from what was observed at wells MW-12, MW-13, and MW-14 (approximately 35 to 40 feet from the shoreline) to wells MW-5, MW-6, and MW-7 (immediately adjacent to the shoreline). This reduction shows that the nitrate is being used for bioremediation as desired, and not being lost to the surface water. It also indicates that the infiltration program is providing an appropriate quantity of nitrate to protect surface water from nitrate impacts. While this nitrate concentration decrease is beneficial in protecting surface water quality, it also presents a limitation to effectively treat the area around MW-7 where contaminant concentrations persist. The targeted treatment proposed for 2021 will include an increase in nitrate

concentrations and frequency at OP-7/OP-8 to focus on addressing the persistent contamination at MW-7.

3.1.4 Light Non-Aqueous Phase Liquid Occurrence

Based on the presence of LNAPL at monitoring wells MW-9 and MW-10, TPH-G concentrations at these locations were presumed to be greater than the cleanup level during the 2020 monitoring events. However, at MW-9, the LNAPL thickness dropped, and was maintained at about zero feet through 2020; IHS monitoring will resume at that location in 2021 to determine IHS concentrations. At MW-10, a slight increase in LNAPL thickness was observed in August and November 2020 (approximately 0.15 feet greater than baseline).

LNAPL was observed (0.08 feet thickness) at MW-5 for the first time during the 2nd quarter event and was still present during the 3rd quarter event, but the overall thickness decreased and was not observed in the 4th quarter. A sample of the LNAPL was collected from MW-5 during the 3rd quarter event to help characterize the LNAPL at that location. The analytical result indicated that both TPH-G and TPH-D were present in the LNAPL, consistent with observations in other areas of the Site. The TPH-G result (estimated at 0.47 mg/L) was below the cleanup level of 0.8 mg/L but TPH-D was elevated at 13 mg/L. The LNAPL thicknesses measured during performance monitoring events are shown on Figures 3 and 4.

The persistent LNAPL accumulation and slight increase in thickness observed at MW-10 through November 2020 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 2020, LNAPL was managed at MW-10 using hydrocarbon sorbent socks that were removed prior to each sampling event, and a clean sock was installed at the end of each event. In order to fully assess the accumulation of LNAPL at MW-10, the use of hydrocarbon soak socks will be suspended at this well in 2021, and the results will be evaluated and incorporated into the 2021 annual report.

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 there are no marine surface water criteria 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 are compared to a Site-specific benchmark value of 20 mg-N/L nitrate + nitrite. The combined nitrate + nitrite surface water

sample results ranged from 0.23 to 0.45 mg-N/L, and there was no detected nitrate or nitrite in the 3rd quarter samples. The cumulative surface water data collected since bioremediation began continue to indicate that the program is being conducted in a manner protective of surface water quality.

3.3 Conclusions and Next Steps

Overall, the Site is responding well to the bioremediation treatment program and IHS concentrations continue to decrease. The Port plans to continue treatment through 2021 to keep nitrate levels elevated and promote biodegradation of the residual hydrocarbon contaminants remaining in the soil and groundwater. The cumulative data (November 2018 through November 2020) included in this report show that TPH-G concentrations have decreased to below the cleanup level throughout most of the Site, but TPH-G persists in the southwest corner near MW-7. Starting in March 2021, the Port will implement a targeted treatment approach to promote more rapid hydrocarbon degradation in this area. This will generally involve increasing the treatment frequency and concentration of nitrate solution.

Cumulative TPH-D data through November 2020 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. The Port will continue to monitor the Site for changes in LNAPL thicknesses and/or locations, and quarterly performance monitoring will be ongoing through 2021.

The IHS concentrations are decreasing significantly in Site groundwater, and meet cleanup standards in most areas of the Site. In areas near the 2018 excavation, IHS concentrations are above cleanup levels but predictably declining and expected to be within standards in the coming years. In areas of the Site near monitoring wells MW-7 and MW-10, IHS concentrations remain elevated and additional injection efforts will be required to achieve cleanup standards at a schedule similar to the rest of the Site. In 2021, the Port plans to start implementing targeted treatments to reduce persistent contaminant concentrations near MW-7 and assess LNAPL accumulation at MW-10. An evaluation of targeted treatment performance and LNAPL accumulation results will be reported in the 2021 annual groundwater quality report, along with the recommended next steps to expand the targeted treatment to the MW-10 area, or use of an alternative approach, such as direct-push injection or installation of additional injection ports near MW-10 and/or MW-7.

The Port anticipates bioremediation will continue to reduce IHS concentrations throughout 2021, and will continue to review and assess the data to determine trends and make adjustments to the bioremediation program as needed to achieve cleanup standards in a timely manner.

4.0 UPCOMING SCHEDULE – 2021

The schedule below summarizes plans for continued bioremediation in 2021. 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. As noted, four additional treatment events have been scheduled to provide ongoing treatment near MW-7, where only smaller batches of nitrate solution are possible.

- March 2021: Targeted treatment event (near MW-7)
- May 2021: Site-wide treatment event #5
- June 2021: 1st quarter performance assessment and targeted treatment event
- July 2021: Targeted treatment event (near MW-7)
- August 2021: 2nd quarter performance assessment and targeted treatment event
- September 2021: Targeted treatment event (near MW-7)
- October 2021: Site-wide treatment event #6
- November 2021: 3rd quarter performance assessment and targeted treatment event
- December 2021: Target treatment event (near MW-7)
- December 2021: 4th quarter performance assessment and targeted treatment event.

5.0 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 LAI. 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 LAI, shall be at the user's sole risk. LAI 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. LAI makes no other warranty, either express or implied.

6.0 REFERENCES

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Data Source: Esri 2012

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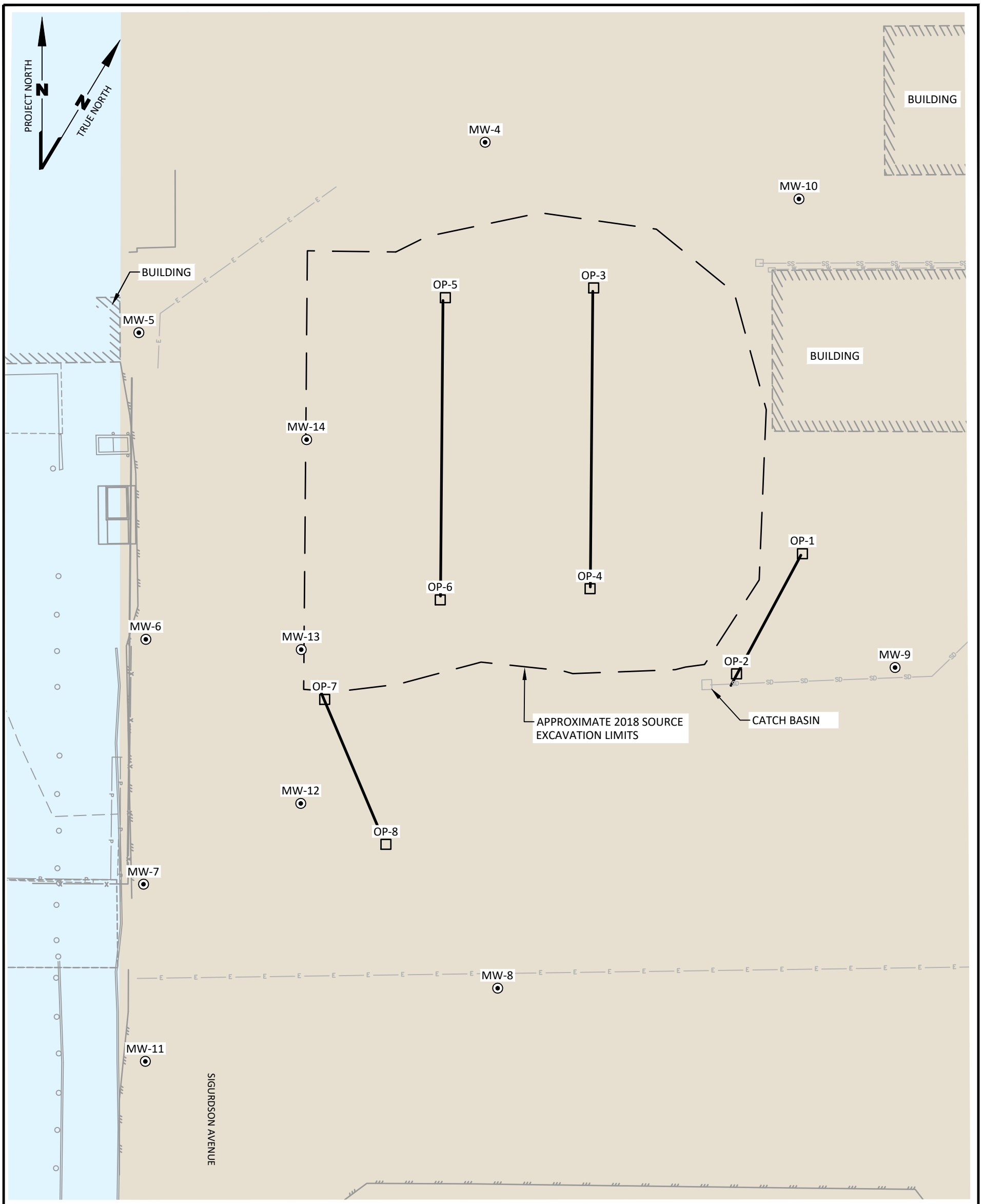
Blaine Marina, Inc. Site Blaine, Washington	**Vicinity Map**	Figure 1



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

PROJECT NORTH

TRUE NORTH

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

BUILDING

BUILDING

BUILDING

OP-5

OP-3

OP-6

OP-4

OP-1

OP-2

OP-7

OP-8

APPROXIMATE 2018 SOURCE EXCAVATION LIMITS

CATCH BASIN

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

MW-5 LNAPL Thickness (ft)	
6/9/2020	0.08
8/26/2020	0.02
11/19/2020	0

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	0.074J

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

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

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	0.54J
11/19/2020	0.96

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

MW-7	
11/8/2018	11
7/15/2019	13 J
10/7/2019	7.3
2/25/2020	11
6/9/2020	6.4
8/26/2020	5.6
11/19/2020	6.6

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

SIGURDSON AVENUE

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

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.

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

Cleanup level for TPH-G = 0.8 mg/L

Treatment Completion Dates
6/14/2019
11/25/2019
4/16/2020
10/16/2020

Sampling Location	
Date	Result

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

LANDAU ASSOCIATES

0 20 40
Scale in Feet

Blaine Marina, Inc. Site
Blaine, Washington

TPH-G Concentrations in Groundwater

Figure 3

PROJECT NORTH

TRUE NORTH

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

BUILDING

BUILDING

BUILDING

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

MW-5 LNAPL Thickness (ft)	
6/9/2020	0.08
8/26/2020	0.02
11/19/2020	0.00

MW-14	
11/8/2018	2.2
7/15/2019	0.57
10/7/2019	2.0
2/25/2020	0.23
6/9/2020	1.1
8/26/2020	1.4
11/19/2020	0.76

OP-5

OP-3

OP-6

OP-4

OP-1

OP-2

OP-7

OP-8

APPROXIMATE 2018 SOURCE EXCAVATION LIMITS

CATCH BASIN

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

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

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

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

MW-7	
11/8/2018	3.7 J
7/15/2019	2.2 J
10/7/2019	2.4 J
2/25/2020	2 J
6/9/2020	1.1 J
8/26/2020	6.6 J
11/19/2020	4.8 J

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

SIGURDSON AVENUE

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	0.40
11/19/2020	0.14

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

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.

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
6/14/2019
11/25/2019
4/16/2020
10/16/2020

Sampling Location	
Date	Result

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

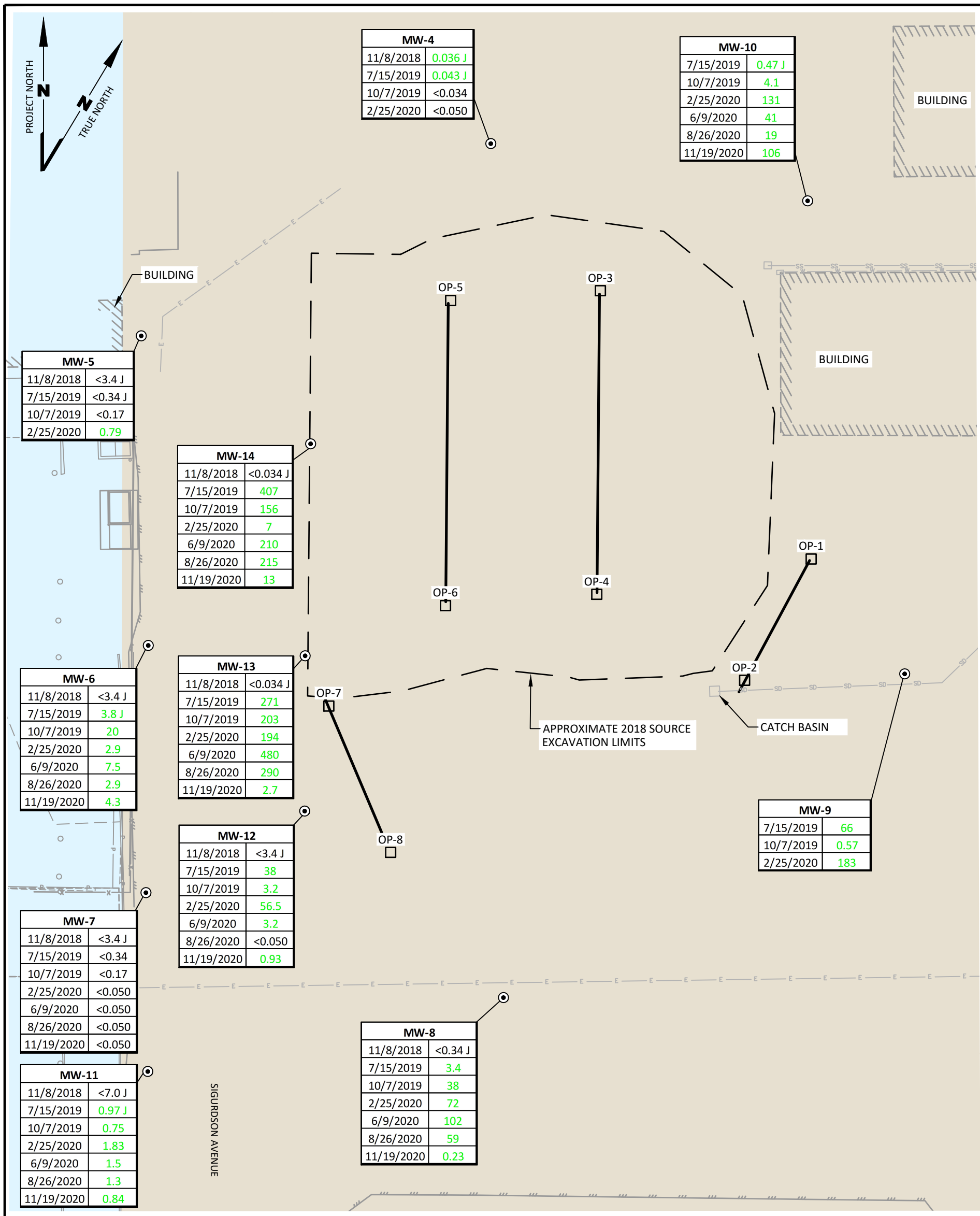
LANDAU ASSOCIATES

0 20 40
Scale in Feet

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-10	
7/15/2019	0.47 J
10/7/2019	4.1
2/25/2020	131
6/9/2020	41
8/26/2020	19
11/19/2020	106

MW-5	
11/8/2018	<3.4 J
7/15/2019	<0.34 J
10/7/2019	<0.17
2/25/2020	0.79

MW-14	
11/8/2018	<0.034 J
7/15/2019	407
10/7/2019	156
2/25/2020	7
6/9/2020	210
8/26/2020	215
11/19/2020	13

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

MW-13	
11/8/2018	<0.034 J
7/15/2019	271
10/7/2019	203
2/25/2020	194
6/9/2020	480
8/26/2020	290
11/19/2020	2.7

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

MW-9	
7/15/2019	66
10/7/2019	0.57
2/25/2020	183

MW-7	
11/8/2018	<3.4 J
7/15/2019	<0.34
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

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

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

Legend

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

Notes

1. All results are reported in milligrams 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
6/14/2019
11/25/2019
4/16/2020
10/16/2020

Sampling Location	
Date	Result

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

LANDAU ASSOCIATES

0 20 40
Scale in Feet

Blaine Marina, Inc. Site
Blaine, Washington

Nitrate Distribution

Figure 5

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	N/A	0	0	0	0	0	5x	5,000	1,129	800	17	2
Totals:				**38,000**	**750**	**38**				**40,000**	**750**	**40**

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
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
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
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
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
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
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

Table 2
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-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
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
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
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
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
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

Table 2
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-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
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
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
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
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
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

Table 2
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-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

Abbreviations/Acronyms:

ft = feet

LNAPL = light non-aqueous phase liquid

TOC = top of casing

Table 3
Bioremediation and Indicator Hazardous Substance Parameters
Blaine Marina, Inc.
Blaine, Washington

Field Parameters	Data Collection Method	Units	Information Provided
DO	Field Meter[a]	mg/L	Aquifer is considered anaerobic at DO concentrations less than 1.0 mg/L
ORP	Field Meter[a]	mV	Negative values indicate reducing conditions.
pH	Field Meter[a]	SU	Optimal for biodegradation in the 6-8 range
Ferrous Iron	Hach® Kit	mg/L	Detections indicate iron-reducing conditions

Laboratory Analyses	Analytical Method	Bottles	Allowable Holding Time	Information Provided
TPH-G and Benzene	NWTPH-Gx/ EPA Method 8260C	3x 40-mL glass, HCL	14 days	Changes in contaminant concentrations are indicative of treatment progress.
TPH-D/O	NWTPH-Dx	1x 2-Liter amber glass	7 days to extract; 40 days to analysis	Changes in contaminant concentrations are indicative of treatment progress.
Naphthalene	EPA Method 8260C	3x 40 mL glass	14 days	Changes in contaminant concentrations are indicative of treatment progress.
Nitrate/ Sulfate	EPA Method 300.0	2x 40-mL VOA unpreserved	Nitrate: 48 hours Sulfate: 28 days	Nitrate concentrations below background indicate nitrate-reducing conditions. Sulfate concentrations below background indicate sulfate-reducing conditions.

Notes:

[a] Measured using a flow-through cell.

Abbreviations and Acronyms:

DO = dissolved oxygen
EPA = US Environmental Protection Agency
HCl = hydrochloric acid
mg/L = milligrams per liter
mL = milliliter
mV = millivolts
NWTPH-Dx = Northwest total petroleum hydrocarbon extended-range diesel analytical method
NWTPH-Gx = Northwest total petroleum hydrocarbon extended-range gasoline analytical method
ORP = oxidation-reduction potential
SU = standard unit
TPH-D = diesel-range total petroleum hydrocarbons
TPH-G = gasoline-range total petroleum hydrocarbons
TPH-O = oil-range total petroleum hydrocarbons

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-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-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
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	**0.47 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	**0.35**	**0.22**	**0.15**	0.13 U	**13**	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	**0.16**
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	1.2 U	0.25 U	0.25 U	0.25 U	**0.29**	0.25 U	**0.31**
Combined TPH[b]	0.5	0.25 U	0.25 U	**0.16**	0.25 U	**0.35**	**0.22**	**0.15**	0.25 U	**13**	0.25 U	0.25 U	0.25 U	**0.29**	0.25 U	**0.47**
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	0.0020 U	0.0020 U	0.0020 U	--	--
Naphthalene	0.083[c]	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	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	15 UJ	1.5 UJ	0.76 U	**3.5**	--	15 UJ	**17 J**	**88**	**13**	**33**	**13**
Nitrate (mg-N/L; calc.)	N/A	**0.036 J**	**0.043 J**	0.034 U	0.050 U	3.4 UJ	0.34 UJ	0.17 U	**0.79**	--	3.4 UJ	**3.8 J**	**20**	**2.9**	**7.5**	**2.9**
Sulfate	N/A	**130**	**110**	**120**	**100**	**2,300**	**2,000**	**1,900**	**2,000**	--	**1,700**	**1,300**	**530**	**840**	**310**	**1,100**
Total Organic Carbon	N/A	**1.8**	**--**	**--**	**--**	1.0 U	**--**	**--**	**--**	**--**	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-6 EV20110126-01 11/19/2020 N	MW-7 EV18110065-08 11/8/2018 N	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
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/DxSG)																
Gasoline Range C5-C12	0.8	--	**11**	**10**	**13 J**	**10 J**	**7.3**	**7.2**	**9.2**	**11**	**6.4**	**6.3**	**5.6**	**5.5**	**6.5**	**6.6**
Diesel Range C12-C24	0.5	0.20 U	**3.3 J**	**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**
Motor Oil Range C24-C40	0.5	**0.67**	**0.4**	**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
Combined TPH[b]	0.5	**0.67**	**3.7 J**	**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**
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	0.0020 UJ	0.0020 UJ	--	--	--	--	--	--
Naphthalene	0.083[c]	--	**0.047**	**0.043**	**0.03**	**0.032**	**0.038 J**	**0.027 J**	**0.018 J**	**0.018 J**	--	--	--	--	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)																
Nitrate (mg/L)	N/A	**19**	15 UJ	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
Nitrate (mg-N/L; calc.)	N/A	**4.3**	3.4 UJ	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
Sulfate	N/A	**640**	**1,500**	**1,500**	**960**	**980**	**740**	**700**	**1,100**	**1,100**	**1,200**	**1,300**	**1,200**	**1,200**	**1,400**	**1,300**
Total Organic Carbon	N/A	**--**	**3.0**	**3.7**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

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

Analyte	Cleanup Level[a]	Sampling Location, Laboratory Sample ID, Sampling Date, Sample Type														
		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	MW-8 EV20110126-03 11/19/2020 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-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
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/DxSG)																
Gasoline Range C5-C12	0.8	**0.082**	**0.097**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	--	--	--	--	--	--	--	--
Diesel Range C12-C24	0.5	**0.62**	**0.39**	**0.99**	**0.26**	**0.210**	**0.4**	**0.14**	--	--	--	--	--	--	--	--
Motor Oil Range C24-C40	0.5	0.25 U	0.25 U	0.25 U	**0.7**	0.25 U	0.25 U	0.25 U	--	--	--	--	--	--	--	--
Combined TPH[b]	0.5	**0.62**	**0.39**	**0.99**	**0.96**	**0.210**	**0.4**	**0.14**	--	--	--	--	--	--	--	--
Volatiles (mg/L; SW-846 8260C)																
Benzene	0.0024	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	0.083[c]	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	1.5 UJ	**15**	**170**	**320**	**450**	**260**	**1.0**	**290**	**2.5**	**810**	**2.1 J**	**18**	**580**	**180**	**83**
Nitrate (mg-N/L; calc.)	N/A	0.34 UJ	**3.4**	**38**	**72**	**102**	**59**	**0.23**	**66**	**0.57**	**180**	**0.47 J**	**4.1**	**130**	**41**	**19**
Sulfate	N/A	**190**	**25**	**170**	**400**	**360**	**400**	**220**	**84**	**76**	**220**	**32**	**90**	**220**	**190**	**180**
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-10 EV20110126-09 11/19/2020 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	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-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/DxSG)																
Gasoline Range C5-C12	0.8	--	**0.079**	0.05 U	0.05 U	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	0.13 U	0.13 U	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	0.25 U	0.25 U	0.25 U	**0.46**	0.25 U
Combined TPH[b]	0.5	--	0.25 U	0.25 U	0.25 U	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	0.0020 U	0.0020 U	--	--	--	0.0020 U	0.0020 U	**0.0023 J**	**0.0022**	--	--	--
Naphthalene	0.083[c]	--	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--	--	--	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	**470**	31 UJ	**4.3 J**	**3.3**	**8.1**	**6.7**	**5.8**	**3.7**	15 UJ	**170**	**14**	**250**	**14**	0.22 U	**4.1**
Nitrate (mg-N/L; calc.)	N/A	**106**	7.0 UJ	**0.97 J**	**0.75**	**1.8**	**1.5**	**1.3**	**0.84**	3.4 UJ	**38**	**3.2**	**57**	**3.2**	0.050 U	**0.93**
Sulfate	N/A	**170**	**2,400**	**2,000**	**1,800**	**1,600**	**1,500**	**1,600**	**2,600**	**1,700**	**620**	**360**	**420**	**430**	**860**	**1,800**
Total Organic Carbon	N/A	--	1.0 U	--	--	--	--	--	--	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-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-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
Total Petroleum Hydrocarbons (mg/L; NWTPH-Gx/DxSG)															
Gasoline Range C5-C12	0.8	**0.74**	**0.22**	0.05 U	**0.094**	**0.067**	**0.073**	**0.15**	**0.58**	**0.17**	**0.17**	**0.086**	**0.150**	**0.11**	**0.074 J**
Diesel Range C12-C24	0.5	**3.2**	**0.51**	**0.99**	0.13 U	**0.150**	**0.43 J**	0.13 U	**2.2**	**0.57**	**2**	**0.23**	**1.1**	**1.4**	**0.76**
Motor Oil Range C24-C40	0.5	**0.41 J**	0.25 U	0.25 U	0.25 U	0.25 U	**0.9**	0.25 U	**0.37 J**	0.25 U	0.25 U	0.25 U	**0.52**	**0.5**	0.25 U
Combined TPH[b]	0.5	**3.61 J**	**0.51**	**0.99**	0.25 U	**0.150**	**1.33 J**	0.25 U	**2.57 J**	**0.57**	**2**	**0.23**	**1.62**	**1.9**	**0.76**
Volatiles (mg/L; SW-846 8260C)															
Benzene	0.0024	**0.0029**	0.0020 U	**0.018**	0.0020 U	--	--	--	**0.042**	**0.021**	**0.023**	0.0020 U	--	--	--
Naphthalene	0.083[c]	**0.0048**	**0.0024**	0.0020 U	**0.0021**	--	--	--	**0.0069**	**0.0025**	**0.0032**	**0.0021**	--	--	--
General Chemistry (mg/L; EPA 300.0/SM 5310C)															
Nitrate (mg/L)	N/A	0.15 UJ	**1,200**	**900**	**860**	**2,100**	**1,300**	**12**	0.15 UJ	**1,800**	**690**	**30**	**940**	**950**	**59**
Nitrate (mg-N/L; calc.)	N/A	0.034 UJ	**270**	**200**	**190**	**480**	**290**	**2.7**	0.034 UJ	**410**	**160**	**7**	**210**	**210**	**13**
Sulfate	N/A	**98**	**69**	**330**	**130**	**120**	**280**	**87**	**55**	**35**	**46**	**31**	**31**	**22**	**52**
Total Organic Carbon	N/A	**8.8**	--	--	--	--	--	--	**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 of 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.

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] 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 (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	33	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	117	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	258	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	
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	33	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	117	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	258	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	2000	30,271	8.1	2.30	--	7.53	
	8/26/2020	441	0.47 J	**13**	1.2 U	--	--	0.88	-301.5	--	--	1.2	--	31,795	19.2	16.01	--	7.50	
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	33	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	117	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	258	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	363	--	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	441	--	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	526	--	0.20 U	**0.67**	--	--	4.69	76.2	19	4.3	0.0	640	5,177	11.8	1.53	--	7.08	
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	33	**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	117	**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	258	**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	363	**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	441	**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	526	**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	
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	33	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	117	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	258	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	363	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	441	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	526	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	
MW-9	11/8/2018	Baseline	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not sampled due to NAPL
	7/15/2019	33	--	--	--	--	--	0.62	-13.5	290	66	0.0	84	3,216	19.2	4.66	--	7.42	
	10/7/2019	117	--	--	--	--	--	5.65	96.4	2.5	0.57	1.6	76	1,545	16.9	--	--	7.03	
	2/25/2020	258	--	--	--	--	--	0.23	0.3	810	180	0.5	220	2,878	11.9	6.05	--	7.07	
MW-10	11/8/2018	Baseline	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not sampled due to NAPL
	7/15/2019	33	--	--	--	--	--	0.74	-34.7	2.1 J	0.47 J	0.0	32	883	16.8	11.75	--	7.52	
	10/7/2019	117	--	--	--	--	--	2.96	160.4	18	4.1	0.0	90	825	14.6	--	--	7.38	
	2/25/2020	258	--	--	--	--	--	0.20	-12.6	580	130	1.0	220	1,618	11.2	6.26	--	7.63	
	6/9/2020	363	--	--	--	--	--	1.51	-46.0	180	41	0.0	190	1,140	13.0	--	--	7.98	

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

Well Location	Sampling Date	Elapsed Time from Injection (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-10	8/26/2020	441	--	--	--	--	--	0.80	-36.7	83	19	0.5	180	1,164	17.8	6.99	--	7.70	
	11/19/2020	526	--	--	--	--	--	1.53	-115.4	470	106	0.0	170	1,300	14.1	32.11	--	7.64	
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	33	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	117	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	258	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	363	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	441	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	526	0.05 U	--	--	--	--	2.81	-114.6	3.7	0.84	0.5	2,600	31,839	12.8	1.20	--	7.64	
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	33	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	117	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	258	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	363	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	441	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	526	**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	
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	33	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	117	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	258	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	363	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	441	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	526	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	
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	33	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	117	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	258	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	363	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	441	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	526	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	

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.

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.

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	0.020 U	0.45	--
SW-3	02-259-02	2/25/2020	1.8	0.41	0.066 U	0.020 U	0.41	--
SW-2	06-111-01	6/9/2020	1.0	0.23	0.066 U	0.020 U	0.23	--
SW-3	06-111-02	6/9/2020	1.1	0.25	0.066 U	0.020 U	0.25	--
SW-2	08-266-01	8/26/2020	0.22 U	0.050 U	0.066 U	0.020 U	0.050 U	--
SW-3	08-266-02	8/26/2020	0.22 U	0.050 U	0.066 U	0.020 U	0.050 U	--
SW-2	11-209-01	11/19/2020	2.0	0.45	0.066 U	0.020 U	0.45	--
SW-3	11-209-02	11/19/2020	2.0	0.45	0.066 U	0.020 U	0.45	--

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