

# TECHNICAL MEMO

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*To:* City of Lakewood  
6000 Main Street SW  
Lakewood, WA

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*From:* Tetra Tech, Inc.  
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*Date:* February 7, 2024

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*Subject:* Final 2023 Annual Summary Data Memo

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## 1.0 Introduction

The City implemented lake management activities at Waughop Lake to limit internal phosphorus loading in order to reduce excessive phytoplankton production. The City decided in 2020 to treat the lake with aluminum sulfate (alum) to provide aluminum to inactivate sediment phosphorus and reduce phosphorus in the lake water column. The first alum application, at 40 mg Al/L, occurred in late March 2020 and was followed by another application, at 40 mg Al/L in the middle of July 2020. A third alum application, at a dose of 20 mg Al/L, was completed in June 2023. This technical memo provides an assessment of in-lake activities and monitoring data collected in 2023, as well as recommended activities for future years.

Waughop Lake is a small lake (33 acres) located in the City of Lakewood, Washington, approximately 42 miles south of Seattle, WA (Figure 1). Waughop Lake is the centerpiece of the popular Fort Steilacoom Park and is used for fishing, model boat racing, kayaking, canoeing, and bird watching. The shoreline area is heavily used by hikers, joggers, and dog walkers.

Waughop Lake has a mean depth of 7 feet (2.1 m) and an approximate volume of 271,365 m<sup>3</sup>. Waughop Lake sits in a basin surrounded by slopes to the north, south,

**Figure 1. Map of Waughop Lake and surrounding area**



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and west, with open flat meadows to the east. The lake's catchment area is approximately 497 acres with contributing surface drainage area of about 217 acres. The Pierce College campus covers about 66 acres. A residential area of approximately 130 acres which is served by septic systems lies southwest of the lake.

No creeks or other natural surface water channels flow into the lake. Stormwater runoff from a portion of Pierce College campus is conveyed through a pipeline to the lake. There are no natural or man-made outlets to the lake and water leaves the lake via seepage and evaporation. Waughop Lake is a glacial kettle lake that appears to be in direct contact with the shallow groundwater-flow system.

Waughop Lake has a long history of toxic cyanobacteria blooms. Health advisories issued by the Tacoma-Pierce County Health Department have been common for Waughop Lake during the past 13 years. In June 2010, the health department issued an advisory not to eat fish from the lake and for a short period of time in 2011, cyanobacteria toxin concentrations were so high that the lake was closed to all uses. Since 2007, toxicity data have been collected and maintained by Ecology on its Washington State Toxic Algae website. Of the 195 water samples collected from Waughop Lake from July 2007 to September 2018, 141 exceeded the state recreation guideline value for microcystin (6 µg/L). More recent toxicity samples collected in July and August 2022 were below the state recreation guidelines for both microcystin and anatoxin-a (1 µg/L). No samples for analysis of cyanobacteria toxins were collected from Waughop Lake following the alum treatments in 2020 or in 2021 or following the alum treatment in 2023.

The City of Lakewood decided to treat the lake with aluminum sulfate (alum) to inactivate sediment phosphorus and reduce phosphorus concentrations in the lake. The 2020 and 2023 alum treatments inactivated a significant amount of sediment phosphorus, stripped phosphorus from the water column, and thereby reduced cyanobacteria while increasing water clarity, improving recreational use of the lake.

## 2.0 2023 Alum Treatment for Phosphorus Control

One alum treatment, buffered with sodium aluminate, was conducted in 2023 to remove phosphorus from the water column and to inactivate the release of phosphorus from the lake sediments to reduce algal production. The treatment was conducted on June 28<sup>th</sup> and 29<sup>th</sup>, 2023. Photos during the treatment are shown in Figures 2 and 3. Photos of increased clarity in the water column are shown in Figure 4. Samples for water quality analysis were collected by Tetra Tech staff before and after the treatment, and in-situ monitoring of dissolved oxygen (DO), conductivity, temperature, and pH were conducted prior to, during, and after treatment.

The alum treatment in June 2023 had a dose of 20 mg Al/L applied to the whole lake. The alum treatments in March and July of 2020 had relatively high doses of 40 mg Al/L each, for a total dose of 80 mg Al/L. The targeted doses were determined based on available phosphorus loading and sediment phosphorus data and were designed to inactivate sediment phosphorus and strip the water column of phosphorus. Based on available data, the total aluminum dose for Waughop Lake was determined to be 120 mg Al/L. Given lake and sediment conditions prior to treatment in 2020, it was recommended that the total alum dose (120 mg Al/L) be applied to the lake in separate applications. The original plan was to applied alum at a dose of 40 mg Al/L three times over the course of a year. The full dose of 120 mg Al/L was based on inactivating the average phosphorus concentration in the top 45 cm of sediment that is most likely to be available for internal loading and subsequent cyanobacteria growth. Mobile sediment phosphorus concentrations in the lake are relatively high due to past practices of discharging manure and other agricultural wastes into the lake (Brown and Caldwell, 2017).

Two of the planned 40 mg Al/L doses were applied in 2020. This strategy of phased application was recommended to allow the lake sediments to consolidate from their very fluid state and maximize the effectiveness of the treatment. This strategy also allows for adaptive management based on results from on-going water quality monitoring efforts. Based on water quality data collected in 2021 and 2022, the dose of the third treatment was reduced to 20 mg Al/L and applied in June 2023.

Immediately following each alum treatment in 2020, there was a substantial increase in water clarity due to the stripping of algae and particulate matter from the water column. Water clarity remained clear throughout the summer of 2020 due to the reduction in phosphorus concentrations and subsequent algal production. Vaughop Lake did not experience a cyanobacteria bloom in 2020. The Washington State Toxic Algae monitoring program indicates that reoccurring toxic algae blooms were observed every year on record from 2007-2018 (King County, 2018).

A similar increase in water clarity was observed immediately following the June 2023 alum treatment. As in 2020, the increase in water clarity was due to the stripping of algae and particulate matter from the water column. Water clarity remained high through the summer (September 2023) before decreasing with increased algae production in October 2023.

The 2023 alum treatment was planned to reduce available phosphorus and reduce the potential for HAB (Harmful Algal Blooms) event occurrences and intensity for 1 to 2 years, depending upon phosphorus cycling and loading as well as climatic impacts. However, treatment effectiveness at reducing lake phosphorus concentrations in 2023 was hindered by extreme low water levels and climatic conditions. These conditions enhanced water column mixing and phosphorus migration from lake sediments making both the phosphorus concentration and bio-availability greater, as seen with increased phosphorus concentrations in the fall and winter of 2023. Future alum treatments or phosphorus stripping/inactivation treatments may need to be implemented within 2 to 3 years to ensure HAB prevention. Additional treatments are necessary to address the phosphorus reserve that exists within the deeper lake sediments and the groundwater phosphorus load that does not leave the lake due to the total lack of flushing via a surface outflow. With continued climate variability the frequency of phosphorus inactivation may have to be considered on a more frequent basis. Also, the use of tri-chloride aluminate, poly-aluminum chloride or other phosphorus inactivation product versus alum may also have to be considered to reduce the potential retention of sulfate in the lake due to the lack of flushing and sediment organic content.



**Figure 2. Chemical distribution system for 2023 alum treatment in June**





**Figure 3. Alum barge during application on second day of treatment in June 2023**



**Figure 4. Water clarity to the lake bottom on June 29th during alum treatment**

### 3.0 Lake Monitoring

A water quality monitoring program was implemented in order to evaluate the short-term and long-term effects of the Waughop Lake alum treatments conducted in 2020 and 2023. The data obtained from this monitoring program was used to assess management progress relative to the water quality goals set for Waughop Lake and to inform future lake management actions.

Tetra Tech staff conducted monthly in-situ monitoring from May through October 2023 and one quarterly monitoring event in December 2023. Additional in-situ monitoring was conducted before, during, and after the alum treatment in June. All monitoring in 2023 included measurements of DO, conductivity, temperature, and pH at either one or two established monitoring station(s) (Figure 5). At the lake sites, these parameters were measured at 0.5-meter intervals within the water column. Tetra Tech staff also recorded secchi disk depth, or transparency, and lake water level during each monitoring event, and made notes on the weather and water conditions, as well as waterfowl and aquatic life observed at the time of sampling.

Water samples were typically collected for laboratory analysis at 1 m depth at the mid-lake station. Samples were collected for laboratory analysis at a depth of 0.5 m above the bottom during the sampling events immediately before and after the alum treatment. A schedule of all Tetra Tech sample collection events in 2023 is provided in Table 1. Water samples were analyzed to determine total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), nitrate+nitrite as nitrogen (NO<sub>3</sub>+NO<sub>2</sub>), alkalinity, sulfate, total aluminum (TA), dissolved organic carbon (DOC), hardness and chlorophyll-*a* (chl) concentrations. Select samples were also analyzed for dissolved aluminum. The Washington State Department of Ecology (Ecology) requested additional analyses for chloride, calcium, magnesium, potassium, sodium, bicarbonate, carbonate, and total sulfides. All laboratory data reports are included in the appendix.

The Pierce Conservation District (PCD) also conducted monthly monitoring events at Waughop Lake from May through October. The PCD measured water column temperature, DO, and shallow pH each month and also collected water samples at 1 m depth for analysis of TP, SRP, TN, chl<sub>a</sub>, sulfate, alkalinity, and total aluminum. The lab data from PCD's monitoring events are included in the figures in this memo.



**Figure 5. Waughop Lake Monitoring Locations**

**Table 1. 2023 Tetra Tech Sampling Schedule**

Date	Sample Depth(s)	Sampling Station(s)	Notes
5/23/2023	0.5 m	Mid-Lake	Monthly
6/27/2023	1 m, 1.8 m	Mid-Lake	Pre-Treatment
6/29/2023	0.5 m, 1 m, 1.8 m	Mid-Lake, West Shore	Post-Treatment (aluminum only)
6/30/2023	1 m, 1.8 m	Mid-Lake	Post-Treatment
7/13/2023	1 m, 1.8 m	Mid-Lake	Post-Treatment & Monthly
8/15/2023	1 m	Mid-Lake	Monthly
9/14/2023	1 m	Mid-Lake	Monthly
8/7/2020	1 m	Mid-Lake	Monthly
10/11/2023	1 m	Mid-Lake	Monthly
12/12/2023	1 m	Mid-Lake	Quarterly

## 4.0 Monitoring Results

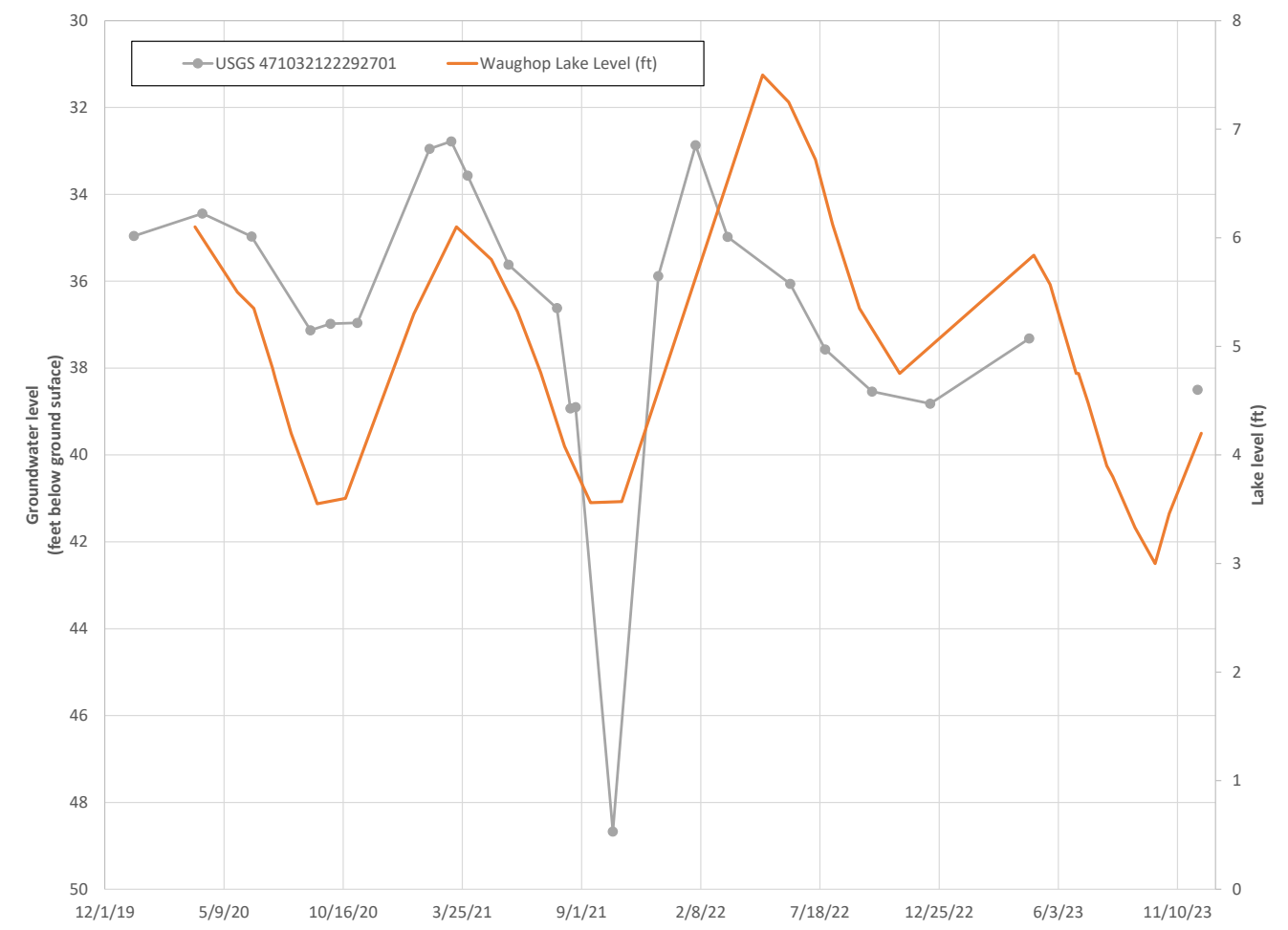
### 4.1.1 Water Level

Water level in Waughop Lake was recorded during each monitoring event based on the installed gage. In 2023, the lake gage showed a steady decline of water level during the summer months as the lake level decreased from around 5.8 feet in early May to a low of 3.0 feet in October (Figure 6). The first monitoring event in 2023 was not until May so water level during spring of 2023 is unknown. The water level in Waughop Lake usually increases steadily during the winter months before declining during the summer months. However, during the summer of 2023 water level was much lower than recorded in previous years (Figure 6). Minimum water levels in 2020, 2021, and 2022 were 3.55 ft, 3.56 ft, and 4.75 ft, respectively, 0.5 to 1.75 ft higher than in 2023.

A USGS groundwater monitoring test hole (site 471032122292701) is located approximately 4 miles east of Waughop Lake and has a record of field measurements of groundwater level in 2020 – 2023. A comparison of lake level in Waughop Lake and groundwater level at the USGS monitoring site indicates that there is a strong correlation between water level in Waughop Lake and local groundwater levels, as shown in Figure 6. The ground elevation at the USGS groundwater monitoring test hole is 272.76 ft NAVD88. Groundwater measurements at the test hole ranged from about 32.8 ft to 48.7 ft below ground surface during 2020 through 2023, or approximately 224.1 to 240 ft NAVD88. The elevation of the gage at Waughop Lake is unknown; however, based on LiDAR, the shoreline elevation is approximately 228 ft NAVD88. The difference in water level elevation at the two locations reflects the local groundwater flow patterns, with higher ground surface and groundwater elevations at the test hole site to the east (USGS, 2010). Unfortunately, there were only two field measurements of groundwater level at the test hole in 2023, during April and December, so we do not know how low the groundwater level in the test hole could have



been during the summer of 2023. Based on measurements collected in 2021, we can expect that groundwater levels during the summer of 2023 were low. Continued monitoring of lake water level is recommended.



**Figure 6. Water level in Waughop Lake and local groundwater level in 2020 - 2023**

### 4.1.2 Total and Soluble Phosphorus

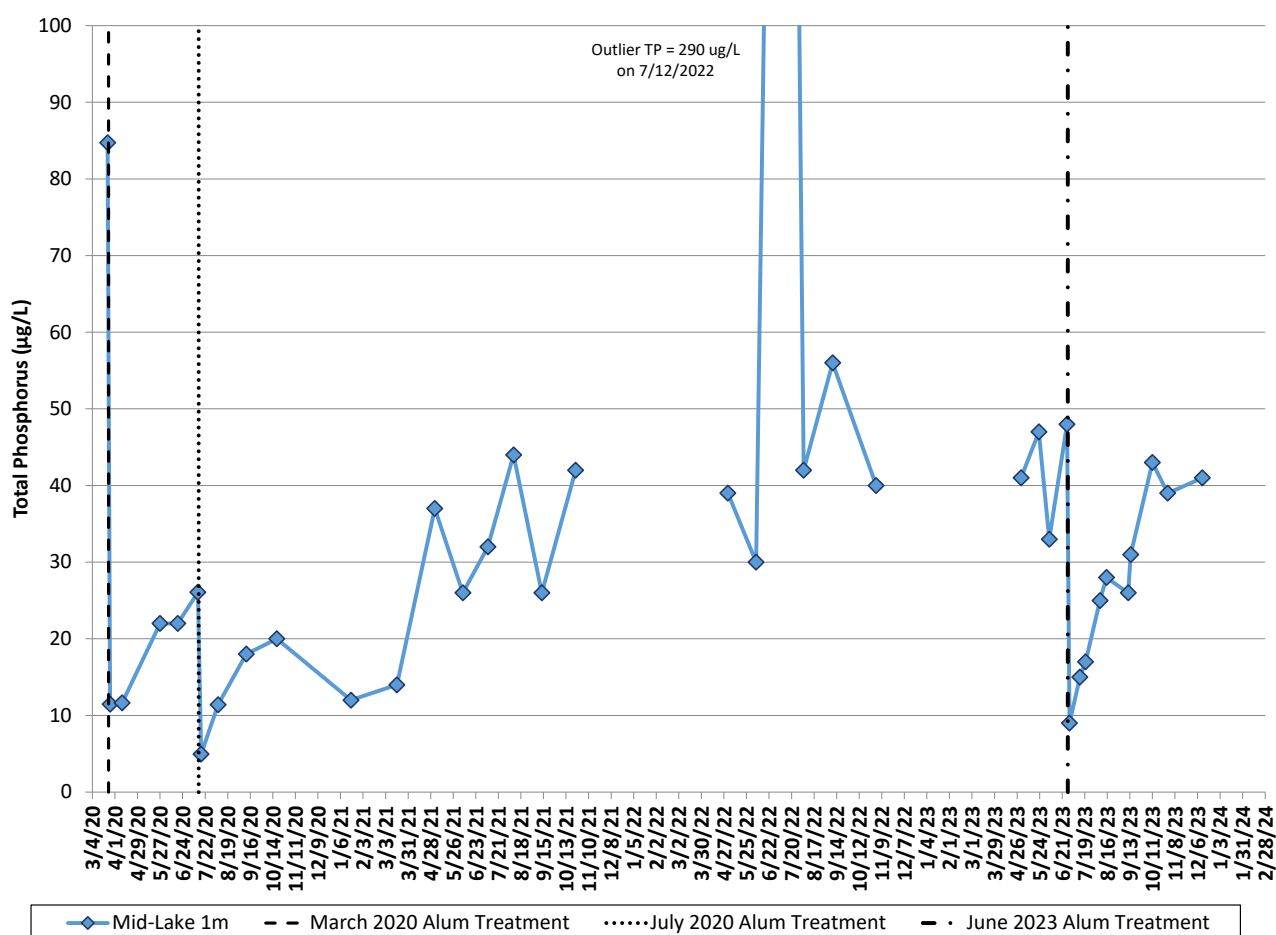
In May and June 2023, prior to the alum treatment, the average TP concentration in Waughop Lake was 42 µg/L (Figure 7). Immediately after the June alum treatment, water column TP was reduced by 79% to 9 µg/L. A gradual increase in TP was observed from July to October corresponding to warmer weather and the lowering of water level in the lake which has a concentrating effect on TP due to lower lake volumes. This general trend of increasing TP throughout the summer was also evident in 2020, 2021 and 2022 (Figure 7). However, despite these effects, water column TP concentrations remained in the target range of less than 35 µg/L for most of the summer and early fall. Although TP had increased to around 40 µg/L in October and December 2023, concentrations during the growing period in 2023 (July through September) were lower than in 2022 and much lower than TP observed in March 2020 prior to any alum treatments. Total phosphorus concentrations measured at 1 m depth in Waughop Lake are shown in Figure 7.

To help further evaluate phosphorus in Waughop Lake, even with decreasing water levels which had a concentrating effect on TP concentration, the mass of TP in the whole lake was calculated for each sampling event using estimated lake volumes and TP concentrations. To calculate TP mass, the concentration of TP on each

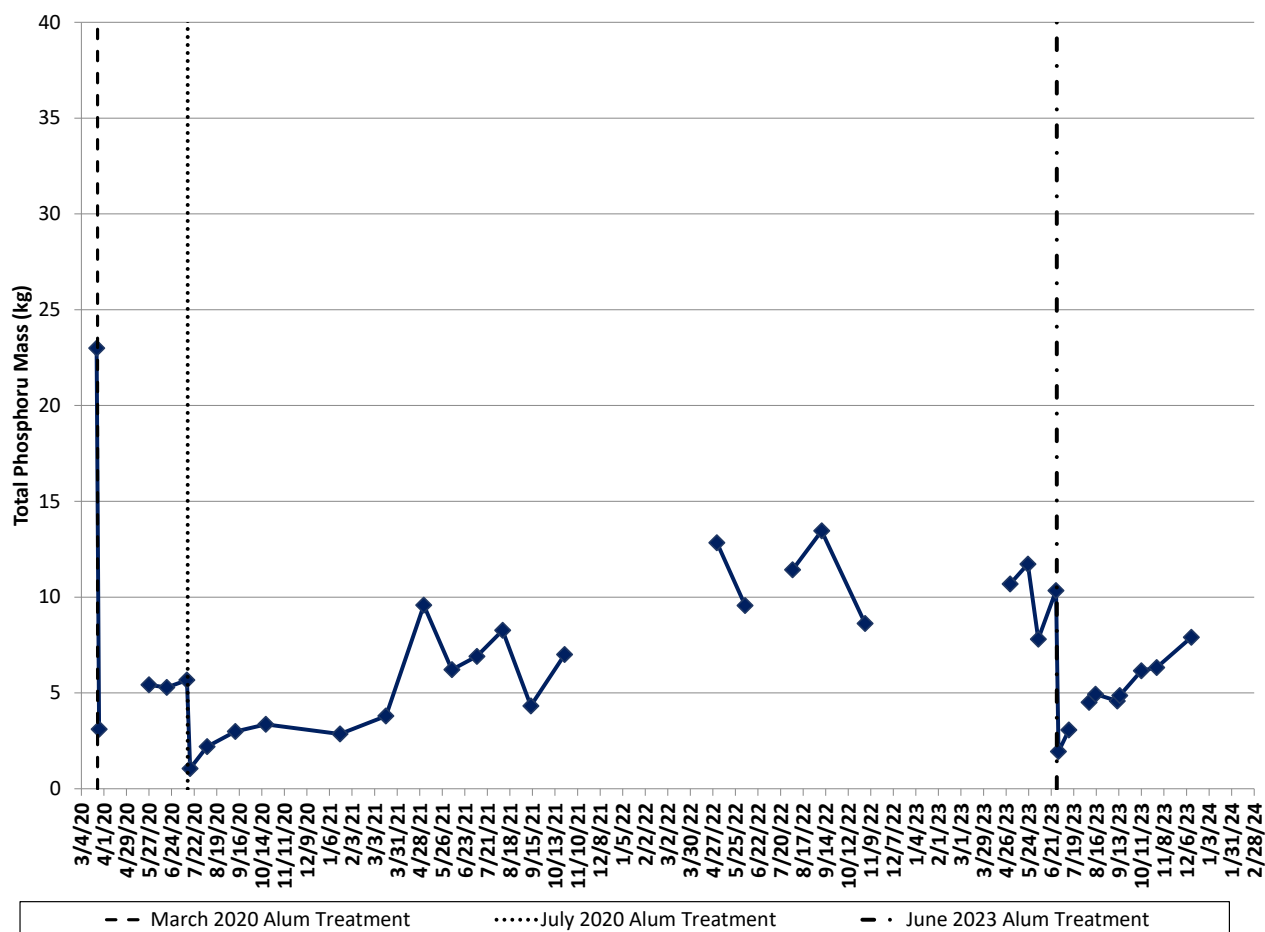


sampling day was multiplied by the estimated lake volume for that day and then converted to kilograms (kg). Figure 8 shows the mass of TP in Waughop Lake for sampling events that had water level recorded to estimate lake volume. TP mass was not calculated for the sampling event in July 2022 that had a very high TP concentration as it is believed to be an outlier. TP mass in Waughop Lake decreased dramatically following the first alum treatment in March 2020 as well as the alum treatment in July 2020. The mass of TP in the lake remained low through most of 2021 then increased to above 10 kg during 2022 and 2023. Following the June 2023 alum treatment, TP mass in the lake was dramatically reduced and remained at 5 kg or below until October 2023. Since October 2023 there has been a small increasing trend in TP mass in the lake. This is most likely due to increasing inflows and external or groundwater loading of phosphorus into the lake.

Soluble reactive phosphorus was relatively low prior to treatment, ranging from below detection (< 1) to 2 µg/L due to algal uptake and organic compounds. There was an immediate increase in SRP, up to 3 µg/L, the day following the June 2023 alum treatment but for the remainder of the year SRP concentrations were consistently less than or at 1 µg/L throughout the summer and fall. Continued monitoring of TP and SRP in the lake is recommended.



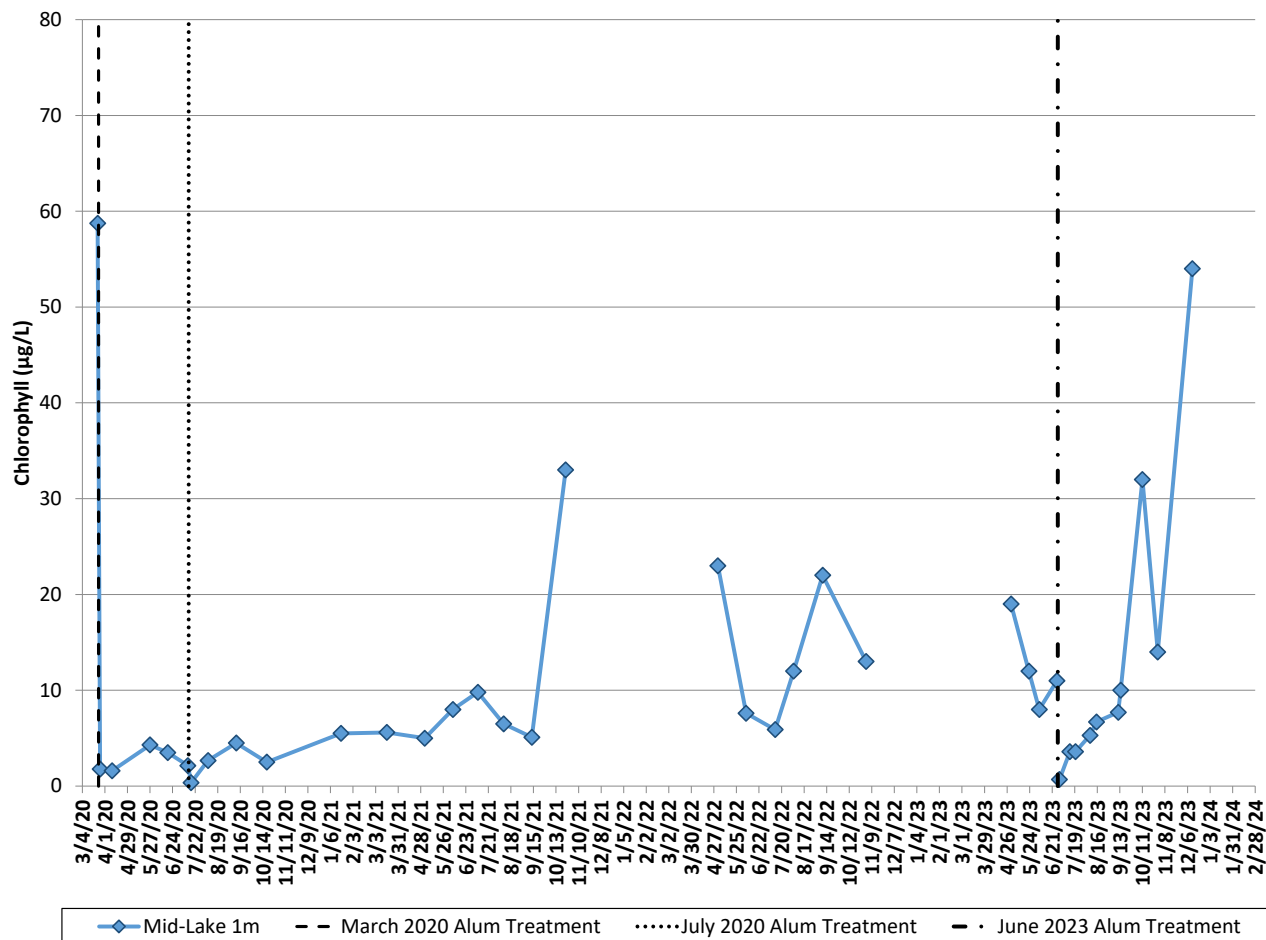
**Figure 7. Total Phosphorus concentrations in Waughop Lake in 2020 - 2023**



**Figure 8. Total Phosphorus Mass in Waughop Lake in 2020-2023**

#### 4.1.3 Chlorophyll-a

The average chl concentration in Waughop Lake in May and June 2023, prior to the alum treatment, was 12.5 µg/L (Figure 9). Immediately after the June alum treatment, the chl concentration was dramatically reduced to 0.7 µg/L. This reduction in chl in the water column reflects the physical removal of algae from the water column as a result of the alum treatment and represents a shift from a eutrophic state to a borderline oligotrophic-mesotrophic state (Welch & Jacoby, 2004). Chl concentrations remained low, averaging 5.4 µg/L for the remainder of the summer, July through September (Figure 9). These chl concentrations indicate the lake remained in a mesotrophic state (moderately productive) through the summer. There was an increase in chl in October, which may have been the result of the concentrating effect of lowering water level of the lake, but chl was also high in December, when water level had started to increase. Precipitation and groundwater recharge also increased in December which may have aided in phosphorus and nitrogen bioavailability. The chl concentration in December was 54 µg/L, which was very high compared to concentrations measured since the 2020 alum treatment. The lake was green in color in December 2023, but field crews did not observe a scum or any indication that the algae present was cyanobacteria. The algae observed in December 2023 appeared to be green algae. Chl concentrations in Waughop Lake are shown in 9. Continued monitoring of chl in the lake is recommended.

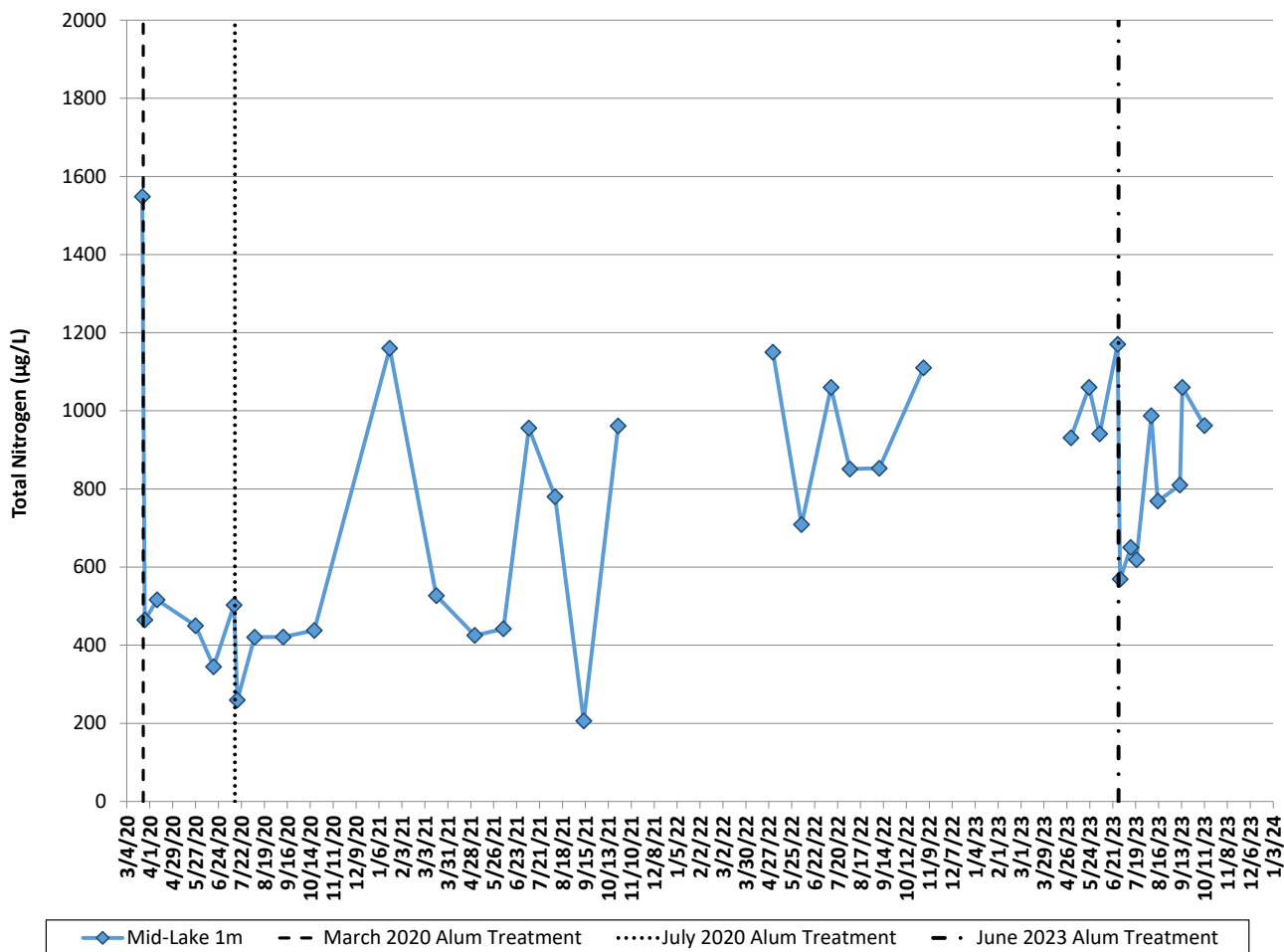


**Figure 9. Chlorophyll concentrations in Waughop Lake in 2020-2023**

#### 4.1.4 Nitrogen, Alkalinity, Sulfate and Total Sulfides

##### Nitrogen

After the 2023 alum treatment, TN was reduced by 46% from a pre-treatment average concentration of 1,060 µg/L to an immediate post-treatment average concentration of 545 µg/L. This reduction was due to its tie to organic compounds in the water column. TN concentrations remained reduced through July then started to increase to near pre-treatment concentrations in August. In December, TN had returned to pre-treatment levels at 1,040 µg/L (Figure 10). Nitrate and nitrite concentrations were at or near detection limits (10 µg/L) prior to the 2023 treatment and remained stable throughout the monitoring period with the exception of a slight increase to 17-19 µg/L, measured the day after treatment. Seasonal fluctuation of TN is anticipated based on plant and algal productivity, as well as external nitrogen loading from groundwater and direct precipitation. Continued monitoring of TN is recommended.

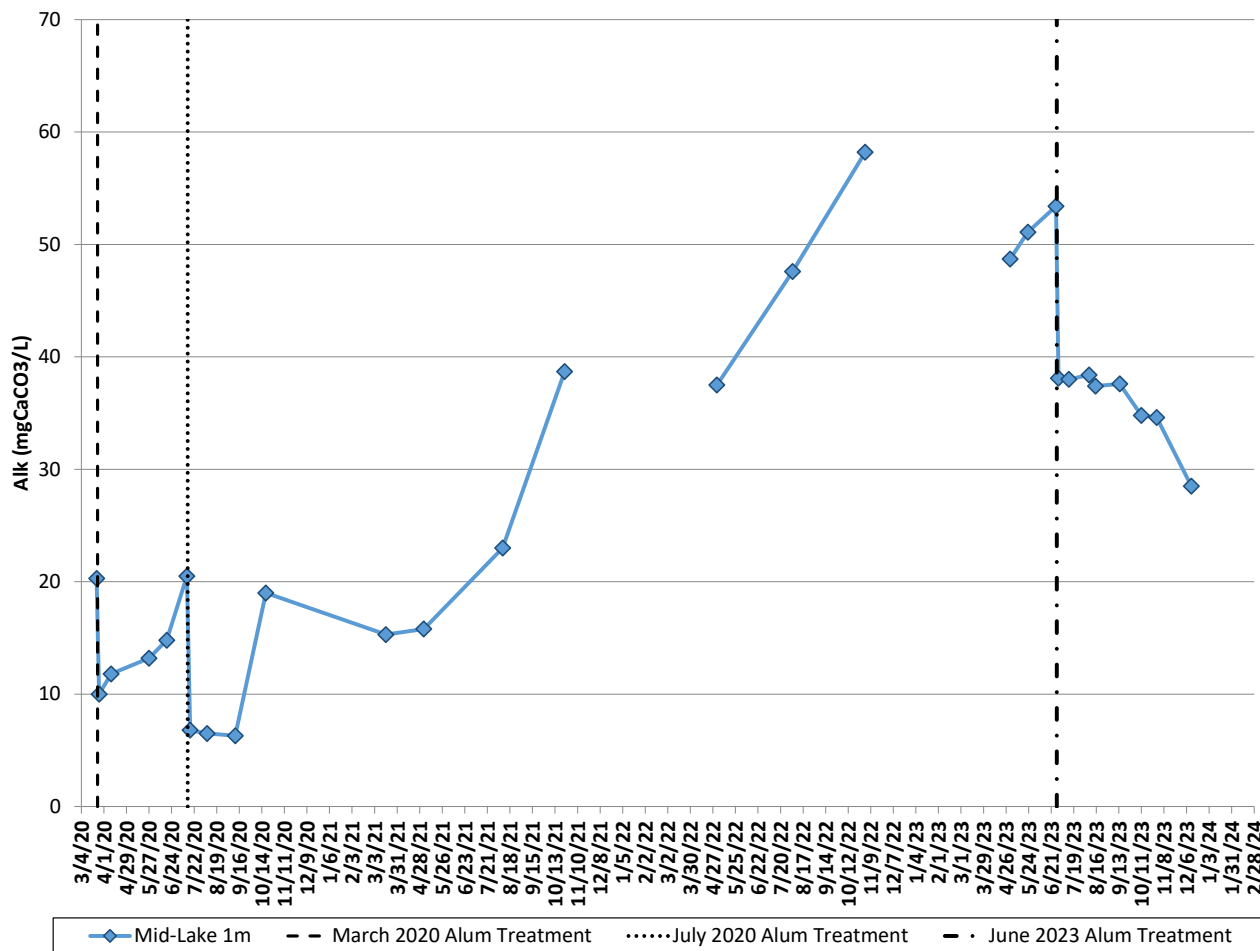


**Figure 10. Total nitrogen concentrations in Waughop Lake in 2020-2023**

## Alkalinity

As previously observed with the 2020 treatments, lake alkalinity (as calcium carbonate) was significantly reduced following the June 2023 alum treatment. This was expected given that alum is an acidic compound. Alkalinity decreased by about 27 percent following the June treatment, to around an average of 36 mg CaCO<sub>3</sub>/L. Alkalinity in the lake prior to the 2023 treatment was higher than previously observed pre-treatment concentrations in 2020 (Figure 11). Towards the end of 2021 and during 2022, alkalinity in the lake increased dramatically from pre-treatment concentrations in 2020 of around 20 mg CaCO<sub>3</sub>/L. Maximum alkalinity in 2022 and 2023 prior to alum was 58.2 mg CaCO<sub>3</sub>/L. It is unknown what caused the increase in alkalinity at the end of 2021 and during 2022 but it could be the result of higher-than-normal inflows from groundwater and precipitation. Water levels during the end of 2021 and 2022 were also higher than typical indicating increased inflows. The monitoring results from 2023 indicate that lake alkalinity has returned to near 2020 pre-treatment levels (Figure 11). It is recommended that monitoring of the lake's alkalinity continue.

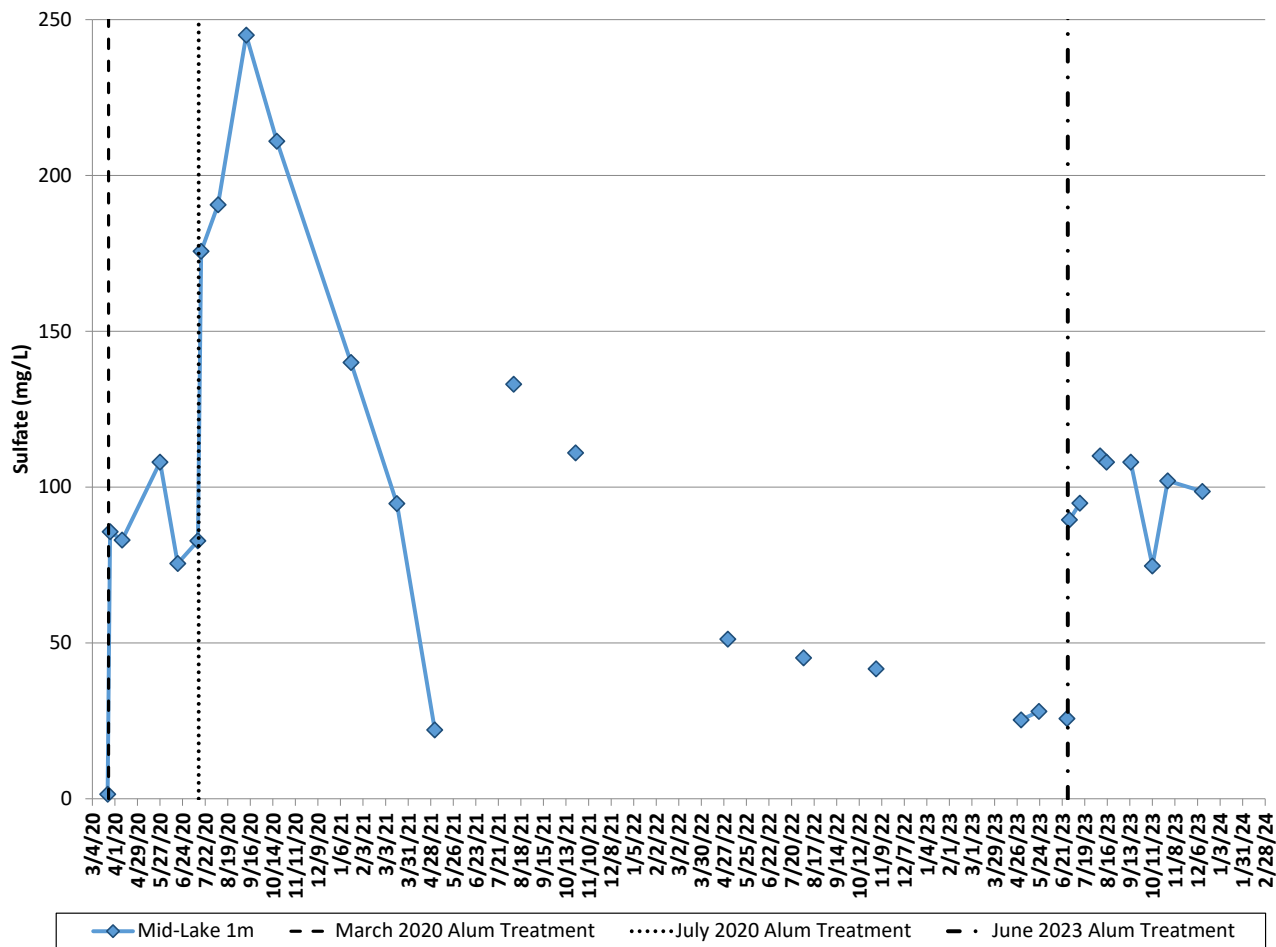




**Figure 11. Alkalinity in Waughop Lake in 2020-2023**

## Sulfate

Sulfate concentrations in Waughop Lake increased following the June 2023 alum treatment. Sulfate concentrations prior to the 2023 treatment averaged 26 mg/L. Following the 2023 treatment, sulfate increased to around 92 mg/L (2). Due to the lack of inflow and outflow from the lake, a temporary increase in sulfate was expected and was also seen following the 2020 alum treatments. The normal settling of the sulfate following alum treatments was observed to be slower given that there is no outlet and no flushing. In addition, the high levels of sulfate in the sediment contributed to the observed increase as sulfate was likely entering the water column to replace the loss of negative carbonate ions with the reduction in alkalinity. Sulfate has remained elevated in the lake through December 2023, however, as groundwater flow increases over the winter, a reduction of sulfate is expected. Seasonal fluctuation in sulfate concentrations may also continue due to the concentrating or diluting effect of the varying water level and lake volume. Continued monitoring of sulfate concentrations in the lake is recommended.



**Figure 12. Sulfate concentrations in Waughop Lake in 2020-2023**

## Total Sulfides

Prior to the June alum treatment, Ecology requested that the City of Lakewood collect samples as part of their required permit monitoring in Waughop Lake for analysis of total sulfides. Samples were collected by Tetra Tech for total sulfides analysis beginning the day before treatment, on June 27<sup>th</sup>, 2023. Samples were collected at a depth of 1 m and at a depth of 0.5 m off the bottom, if water depths allowed. Samples were analyzed by Fremont Analytical using method SM 4500-S2-D which quantifies total sulfides in the water including dissolved hydrogen sulfide, hydrosulfide, and metallic sulfides (which are common in suspended particulates). Table 2 summarizes total sulfides results from samples collected at Waughop Lake before and after the June alum treatment.

Total sulfides concentrations were 1.6 and 2.8 mg/L in surface and bottom samples respectively, prior to the June alum treatment. Following the treatment, surface total sulfides concentrations increased but bottom concentrations decreased (Table 2). Two weeks post treatment, the surface total sulfides concentration had decreased substantially while the bottom concentration increased back to near pre-treatment levels. Starting in August, two months post-treatment, total sulfides in Waughop Lake decreased even further to concentrations near or at the detection limit or below the reporting limit. Concentrations in red italicized font in Table 2 indicate samples that were reported below the detection limit and the concentration in the table is the detection limit for that sample. Total sulfides concentrations in the lake remained low through December 2023 and were detected at levels just above the detection limits but below the reporting limits (Table 2).

**Table 2. Waughop Lake Total Sulfides Concentrations, 2023.**

Date	Time Period	Total Sulfides (mg/L)	
		1 m	0.5 m off bottom
6/27/2023	Day before Treatment	1.6	2.8
6/30/2023	Day after Treatment	4	1.2
7/13/2023	2 Weeks Post Treatment	0.8	2.4
8/15/2023	Two Months After	0.6	0.128 (ND)
9/14/2023	Three Months After	0.0138 (ND)	0.0139 (J)
10/11/2023	Four Months After	0.0138 (ND)	--
12/12/2023	Six Months After	0.0336 (J)	0.0383 (J)

#### 4.1.5 Aluminum

Immediately following the June alum treatment (1 hour after treatment completion), TA increased due to the aluminum addition and temporarily exceeded the EPA aluminum acute and chronic criterion (Table 3; Figure 13). Total aluminum concentrations from samples collected the day after treatment were substantially lower and below both the acute and chronic EPA criterion concentrations (Table 3). The EPA aluminum criteria were calculated using an EPA published aluminum criteria spreadsheet and are based on concentrations of DOC, hardness, and pH. The EPA aluminum criteria are for total recoverable aluminum.

Total aluminum concentrations remained below the EPA acute and chronic criterion through the rest of 2023. However, there was a slight increase in TA in July, two-weeks post treatment and again in September, before concentrations decreased to less than pre-treatment concentrations in December (Table 3). Under the somewhat alkaline conditions at Waughop Lake (average pH above 8.0), the solubility of aluminum is enhanced, and may form complexes with DOC. The complexing of aluminum and DOC has been observed in other lakes (Long Lake, Kitsap County; Cooke et al. 2005) because of humic substances in the water column and could be a likely cause of increased aluminum concentrations later in the summer. Aluminum concentrations were also impacted by the lowering of water level in the lake which has a concentrating effect due to lower lake volumes.

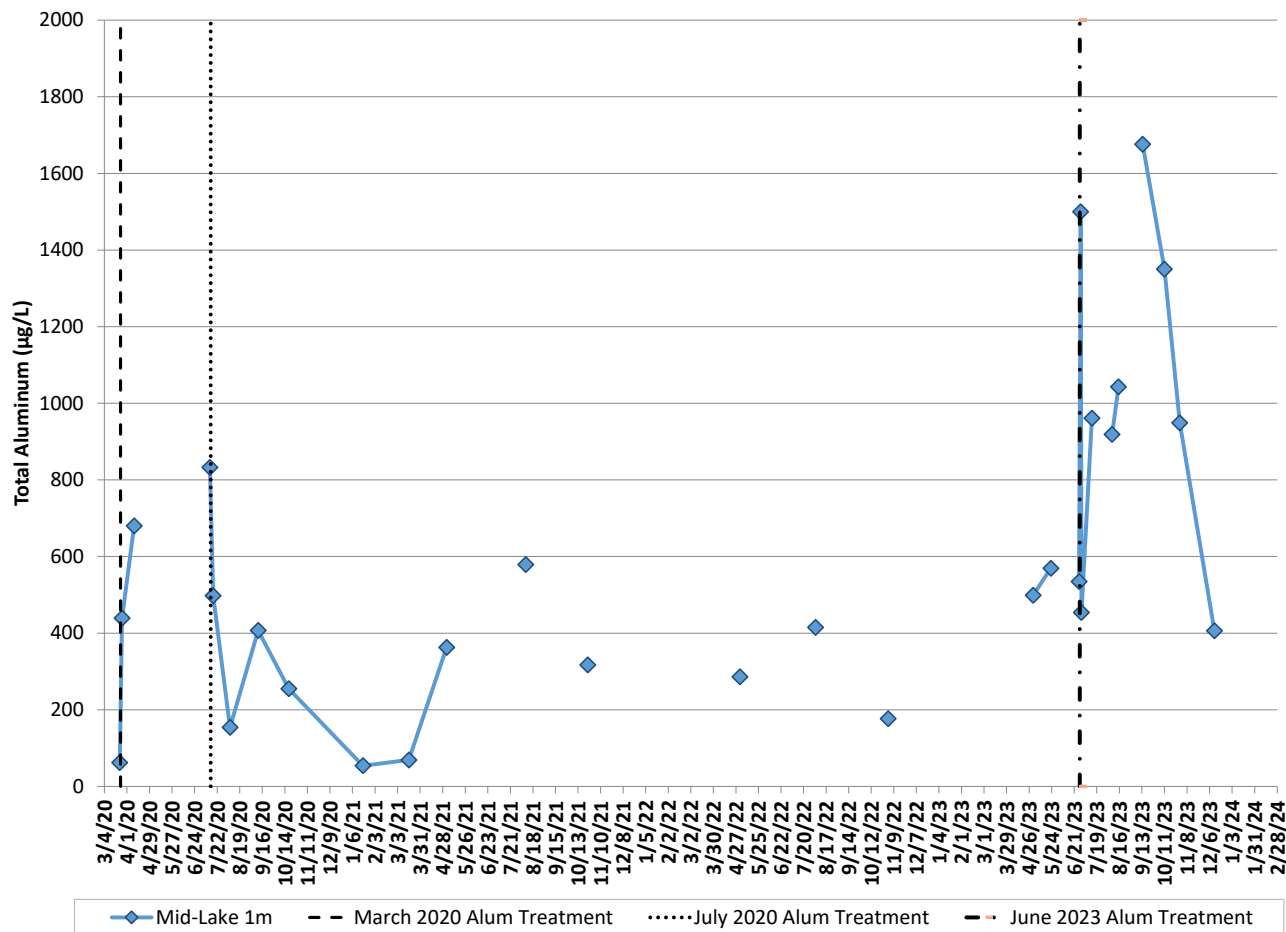
Dissolved aluminum (DA) was higher than expected in June prior to the alum treatment. There was an immediate decrease in DA following the treatment (Table 3). A similar effect was observed when DA decreased following an alum treatment in Long Lake, Kitsap County and the decrease was thought to have been the result of natural levels of aluminum complexed with humic materials by the alum floc in the relatively brown-water lake (Cooke et al. 2005). Concentrations of DA increased two weeks post treatment and remained at concentrations higher than pre-treatment through August. Samples for DA were not collected after two months post treatment (Table 3). Following the high concentration of DA in July, Tetra Tech reached out to the contract laboratory, IEH Analytical, to see if samples could be re-analyzed for confirmation. IEH Analytical confirmed the DA concentrations from July. DOC concentrations increased steadily back to pre-treatment levels or higher throughout the summer. Samples for total organic carbon (TOC) analysis were not collected in 2023 but based on previous data, all of the organic carbon in Waughop Lake is typically in the dissolved fraction. The increased DA concentrations are most likely due to the complexing of aluminum and DOC in the water column. Continued monitoring of TA concentration in the lake is recommended.

**Table 3. Waughop Lake Aluminum Concentrations, 2023.**

Date	Time Period	Depth (m)	Total Aluminum (µg/L)	Dissolved Aluminum (µg/L)	DOC (mg/L)	Hardness (mg CaCO <sub>3</sub> /L)	pH	EPA Aluminum Criteria	
								Total Aluminum (ug/L)	
								Acute	Chronic
5/23/2023	Month Before	1	569	--	8.4	23.8	8.25	3900	1600
6/27/2023	Day Before	1	535	408.3	9.43	19.6	8.49	4400	2100
6/27/2023	Day Before	1.8	503	428.4	8.98	18.3	8.43	4200	2000
6/29/2023	1 hr Post	1	<b>1500</b>	41.4	--	--	6.99	<b>1300*</b>	<b>500*</b>
6/29/2023	1 hr Post	1.8	<b>1850</b>	39.2	--	--	6.95	<b>1200*</b>	<b>480*</b>
6/30/2023	Day After	1	454	61.4	5.94	17.9	7.21	1600	590
6/30/2023	Day After	1.8	484	50.7	6.01	17.9	7.22	1600	600
7/13/2023	2-weeks Post	1	961	845.8	6.21	19.5	8.21	3500	1600
7/13/2023	2-weeks Post	1.8	969	821.9	5.97	19.8	8.20	3400	1600
8/15/2023	Two Months After	1	1043	995.3	7.7	20.9	8.30	3900	1700
9/14/2023	Three Months After	1	1676	--	9.7	21.8	8.60	4500	2200
10/11/2023	Four Months After	1	1350	--	11.6	20.3	8.72	4900	2400
12/12/2023	Six Months After	1	406	--	10.7	18.2	8.21	4000	1500

\*EPA criterion calculated based on an estimated DOC of 6 mg/L and an estimated hardness of 18 mg CaCO<sub>3</sub>/L





**Figure 13. Total aluminum concentrations in Waughop Lake in 2020-2023**

#### 4.1.6 Additional Parameters Requested by Ecology (Chloride, Calcium, Magnesium, Potassium, Sodium, Carbonate, Bicarbonate)

Prior to the June alum treatment, Ecology requested that the City of Lakewood collect additional samples for analysis of chloride, calcium, magnesium, potassium, sodium, carbonate ( $\text{CO}_3$ ), and bicarbonate ( $\text{HCO}_3$ ) as part of the APAM permit required monitoring. Tetra Tech collected samples for the above analyses starting the day before treatment through December 2023. Samples were collected at a depth of 1 m and on occasion at 0.5 m off the bottom. Table 4 summarizes the data results for these additional requested parameters.

For most parameters, there was little difference between concentrations prior to the alum treatment and concentrations post treatment (Table 4). Sodium concentrations in the lake increased following the alum treatment, from an average of 28.3 mg/L to an average of 52.6 mg/L post treatment. This increase was expected given that sodium is a main component of the buffer applied during treatment, sodium aluminate. The increase in sodium could have also been partially due to the concentrating effect of lowering lake water levels. All parameters with the exception of chloride, decreased slightly from October to December, which corresponded to an increase in lake water levels and volume.

Bicarbonate and alkalinity concentrations were very similar throughout the monitoring period and decreased following the treatment as expected. As stated previously, alum is an acidic compound and alkalinity/bicarbonate would be expected to decrease as alum is added. Prior to the alum treatment, bicarbonate averaged 51.1 mg

CaCO<sub>3</sub>/L and alkalinity averaged 53.1 mg CaCO<sub>3</sub>/L. Post treatment bicarbonate concentrations averaged 33.8 mg CaCO<sub>3</sub>/L and alkalinity averaged 36.4 mg CaCO<sub>3</sub>/L. This indicates that the majority of the alkalinity in Waughop Lake is due to the presence of bicarbonate in the water. Carbonate concentrations measured before and after the alum treatment were consistently below the detection limit of 1 mg CaCO<sub>3</sub>/L. This was also expected given that carbonate becomes dominant in waters at pH values greater than 10.3. Bicarbonate is typically the dominant form of the carbonate cycle in surface waters with pH between 6.3 and 10.3.

### 4.1.7 Water Clarity

Water clarity, or transparency, was measured with a secchi disk during each monitoring event and numerous times during the alum treatment. Prior to June alum treatment, water clarity at Waughop Lake was less than 1 meter at the mid-lake station (Figure 14). After the first day of treatment with alum, water clarity had increased to 2.2 meters, and after completion of the treatment, water clarity had increased such that the secchi disk was visible at the bottom of the lake at around 2.5 meters depth (Figure 14). The high level of clarity was maintained throughout most of the summer and the secchi disk continued to be visible at the bottom or near the bottom of the lake through September. Water clarity decreased substantially in October and December back to less than 1 m.

Higher levels of water clarity corresponded with lower observed chl concentrations and a reduction in algal production due to alum treatment. The decrease in water clarity starting in October corresponded with increased chl concentrations and algal production. Decreased water clarity in October also corresponded with the lowest lake levels recorded and sediment resuspension, given the very shallow water depth, could also have contributed to decreased clarity.

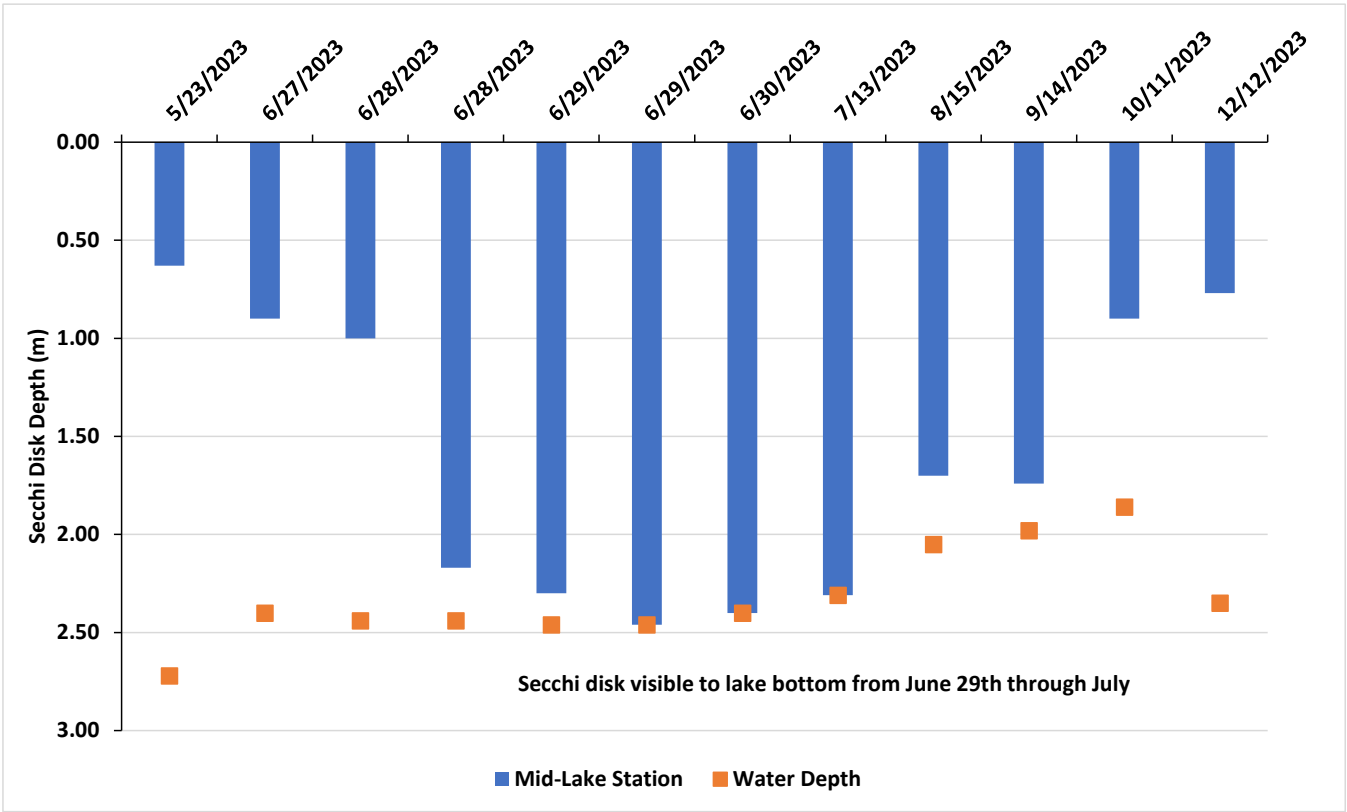


Figure 14. Secchi disk depth (water transparency) in Waughop Lake during 2023

**Table 4. Waughop Lake Cations and Anions Concentrations, 2023.**

Date	Time Period	Depth (m)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	HCO <sub>3</sub> (mg CaCO <sub>3</sub> /L)	CO <sub>3</sub> (mg CaCO <sub>3</sub> /L)
6/27/2023	Day Before Treatment	1	4.62	5.99	1.12	3.37	28.5	51	<1.00
		1.8	4.94	5.81	0.913	2.92	28	51.1	<1.00
6/30/2023	Day After Treatment	1	4.73	5.84	0.804	2.73	48.8	32.3	<1.00
		1.8	4.41	5.82	0.816	2.71	48.5	30.6	<1.00
7/13/2023	2 Weeks Post	1	3.99	6.36	0.876	3.05	50.5	36.9	<1.00
		1.8	3.99	6.47	0.896	2.98	50.8	38	<1.00
8/15/2023	Two Months After	1	4.52	6.74	0.998	4.81	56.6	36.3	<1.00
9/14/2023	Three Months After	1	5.15	6.98	1.06	3.46	62.8	36.7	<1.00
10/11/2023	Four Months After	1	4.62	6.43	1.03	3.51	58.1	32.9	<1.00
12/12/2023	Six Months After	1	4.62	5.74	0.94	3.07	45	26.5	<1.00
Pre-Treatment Average			4.78	5.9	1.02	3.15	28.3	51.1	<1.00
Post-Treatment Average			4.50	6.3	0.93	3.29	52.6	33.8	<1.00

#### 4.1.8 Water Temperature, Dissolved Oxygen, Conductivity, and pH

Profiles of water temperature, DO, conductivity, and pH were measured at 0.5-meter intervals at each station, starting at 0.5 m below the water surface and ending at 0.5 m above the bottom. Profile depths ranged from 1.5 to 2.5 meters deep at the mid-lake station depending on water level conditions. Due to the similarity in data across stations, profiles at the mid-lake station are considered representative of 2023 conditions at Waughop Lake and are discussed in detail below.

##### Water Temperature

Water temperatures in May through December 2023 ranged from 7.2°C to 25.7°C at the mid-lake station. The warmest temperatures were observed in August while the coldest temperatures were observed in December. During the summer months (June through September), temperatures ranged from 20.3°C to 25.7°. As shown in Figure 15, temperature does not vary significantly throughout the water column, as Waughop Lake is a shallow lake that mixes frequently throughout the year.

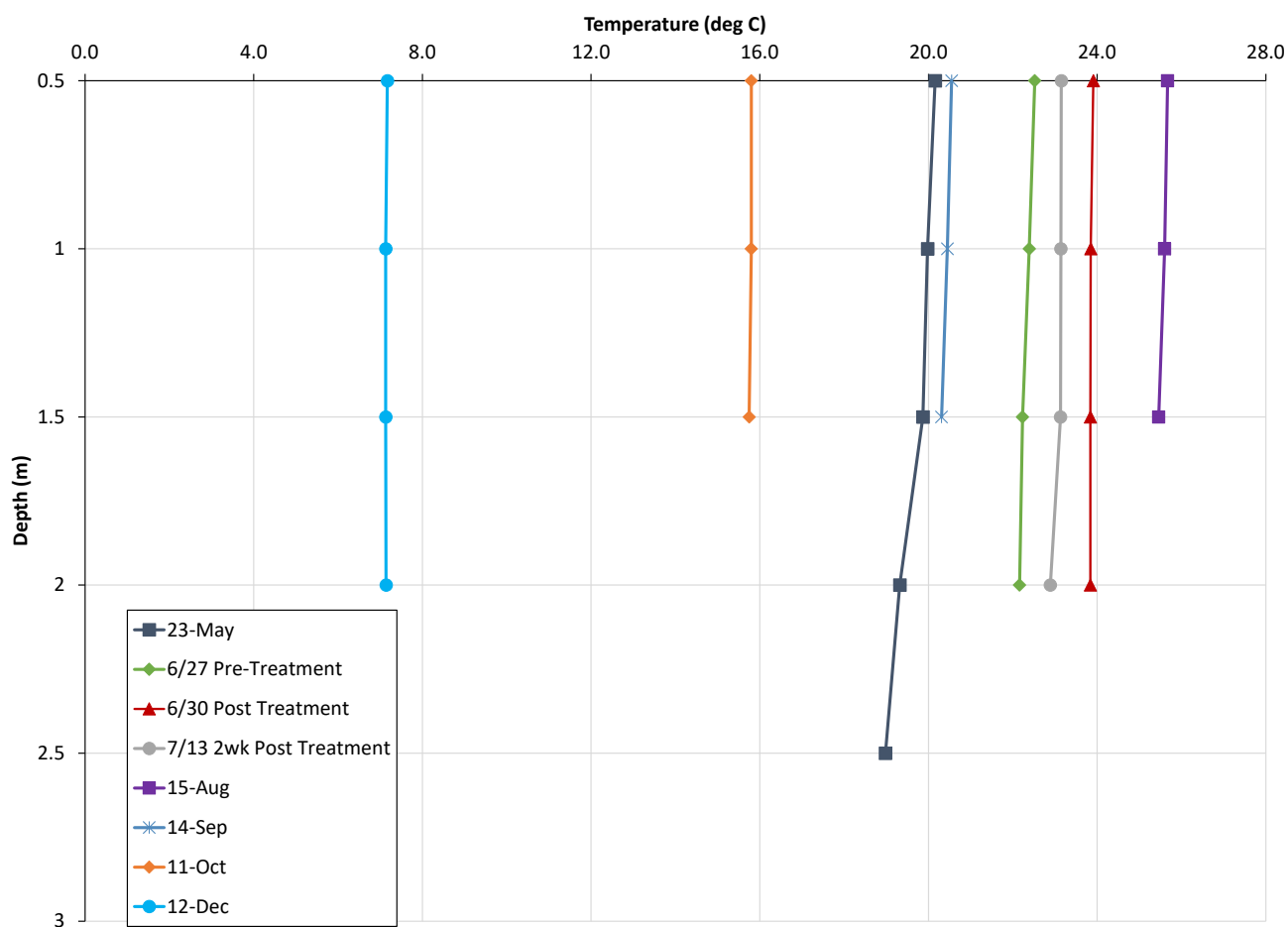


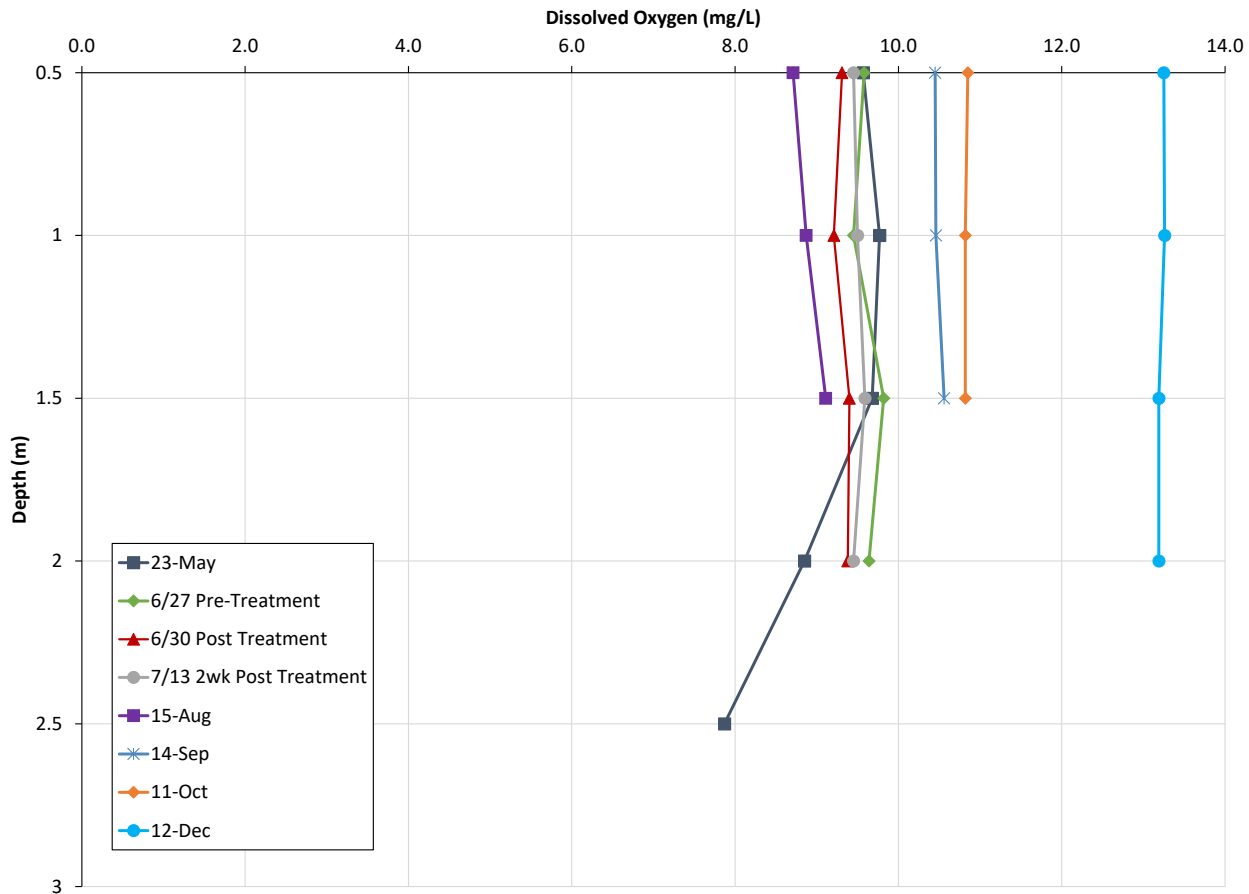
Figure 15. Water temperature profiles at Waughop Lake in 2023

##### Dissolved Oxygen

Dissolved oxygen concentrations ranged from 7.87 (0.5 m from the bottom) to 13.3 mg/L at the mid-lake station. DO measurements were not collected near or within the sediment at the lake bottom in order to protect the



monitoring equipment. DO averaged 10.1 mg/L and did not vary significantly throughout the water column (Figure 16). The highest DO concentrations were observed in December and corresponded to maximum chl concentrations and high productivity. Higher DO concentrations in December could also be due to colder water temperatures, which increases the DO saturation level. A decrease in DO was observed immediately following the alum treatment but rebounded back to pre-treatment concentrations within 2 weeks post treatment.



**Figure 16. Dissolved oxygen profiles in Waughop Lake, 2023**

## pH

pH varied slightly throughout the water column and was generally higher at the surface and lower at deeper locations. At the mid-lake station, pH ranged from 7.2 to 8.7 across all 2023 monitoring dates (Figure 17). The highest pH values were observed in October, and a decrease in pH was observed due to treatment in June. The pH was most likely influenced by photosynthesis from phytoplankton in the water column. pH was also monitored continuously during the June alum treatment and for 24 hours post treatment (Figure 18). pH prior to the start of the treatment was high, around 8.5. pH decreased initially after the alum treatment started the morning of June 28<sup>th</sup>, then stabilized overnight. There was another slight decrease in pH after the start of the treatment the second morning on June 29<sup>th</sup>, but then pH stabilized at around 7.1 and continued to remain stable for 24 hours following treatment (Figure 18).

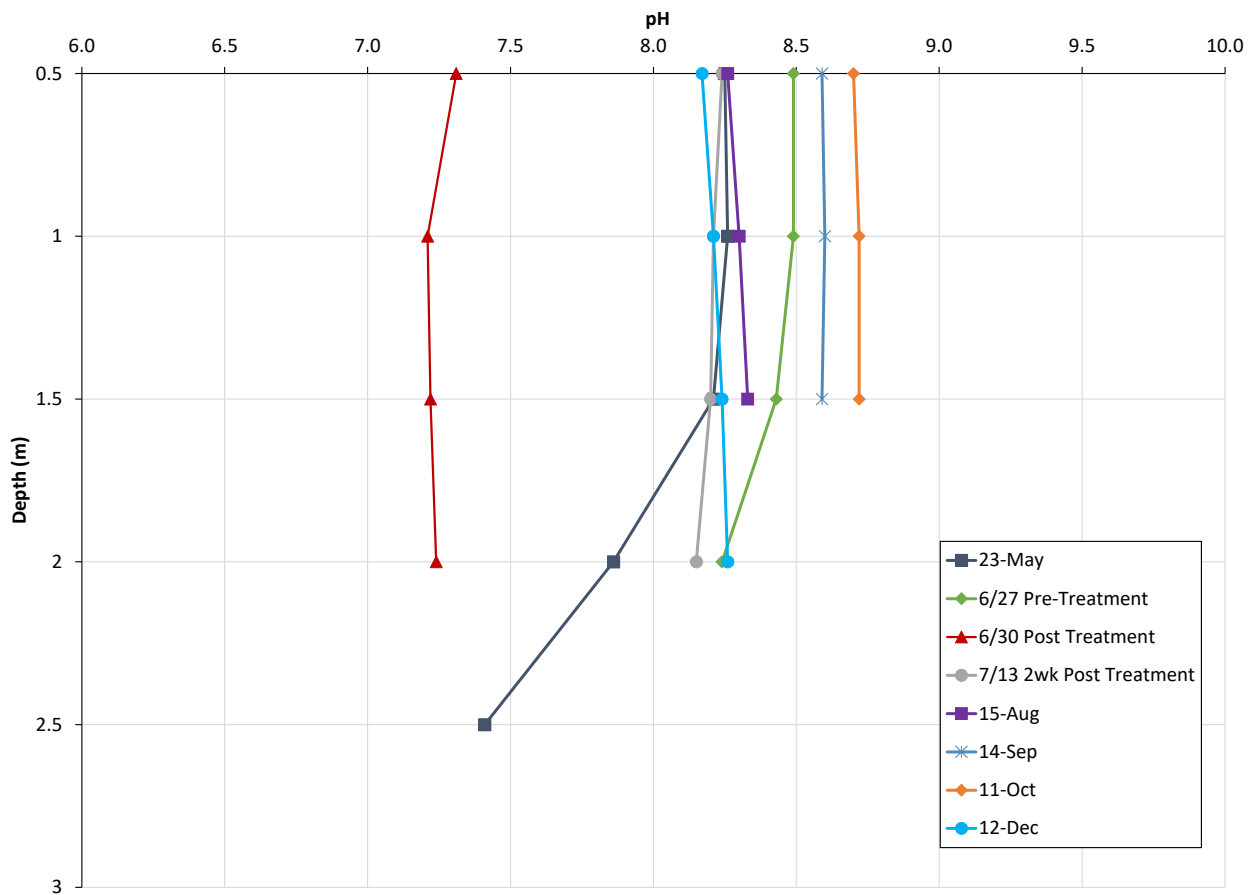


Figure 17. pH profiles in Waughop Lake in 2023

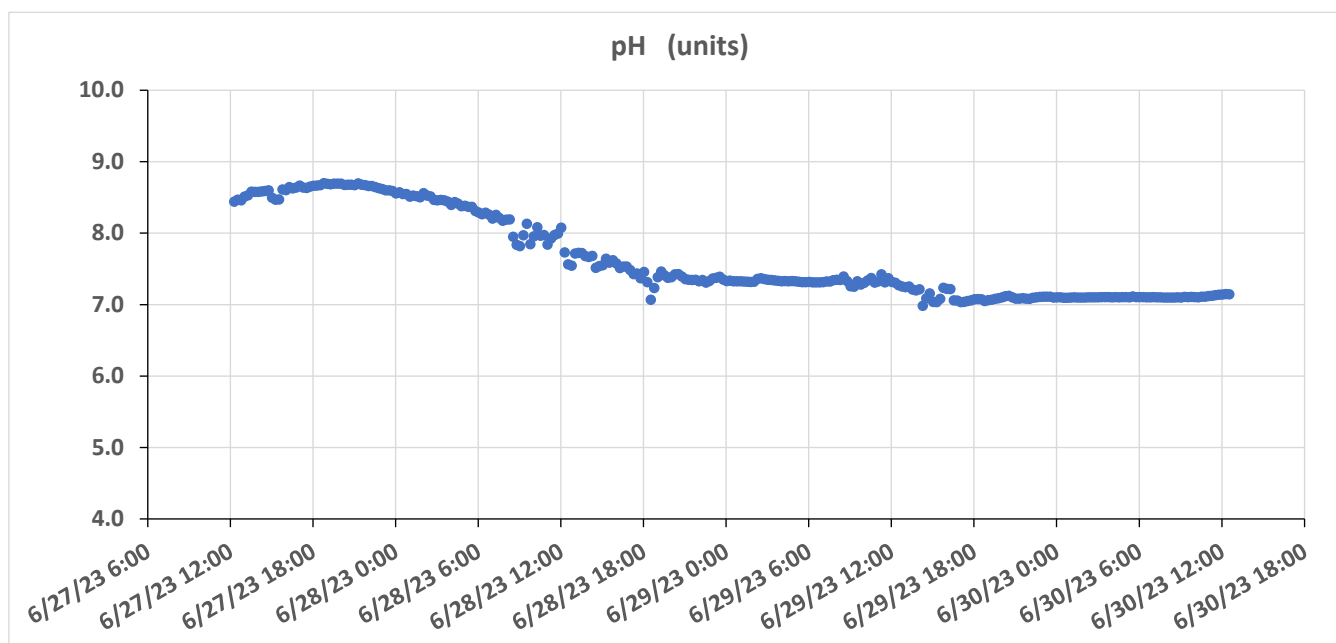


Figure 18. Continuous pH measurements in Waughop Lake during June 2023 Alum Treatment

# Conductivity

Specific conductivity was uniform throughout the water column. Specific conductivity varied over the course of the monitoring period and generally increased as a result of alum treatments (Figure 19).

Prior to the June alum treatment, conductivity in Waughop Lake had an average value of 153  $\mu\text{S}/\text{cm}$ . One day after treatment, the average conductivity had increased to an average of 286  $\mu\text{S}/\text{cm}$ . Conductivity remained higher than pre-treatment levels through December 2023. Maximum conductivity was measured in August 2023.

An increase in specific conductivity was anticipated as a direct result of alum treatments. However, the effect was prolonged due to the lack of flushing in Waughop Lake and the lowering of the water level during the summer months. As groundwater flow increases over the winter, a reduction of specific conductivity is expected and has already been shown with December measurements.

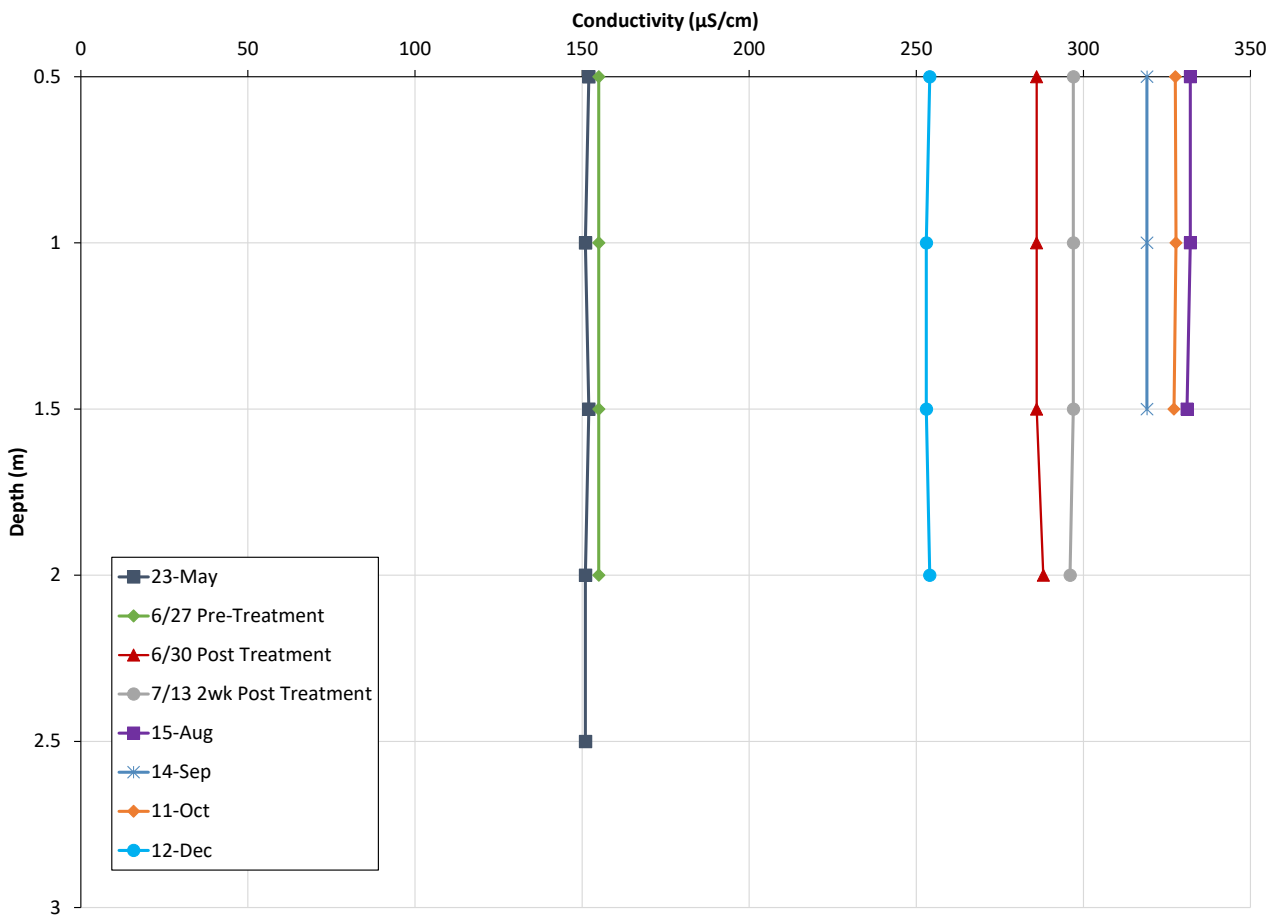


Figure 19. Conductivity profiles in Waughop Lake in 2023

## 5.0 Water Quality Summary Discussion

Similar to conditions following the 2020 alum treatments, Waughop Lake did not experience a toxic algae bloom during 2023. The growth of toxic algae was reduced by the two whole-lake buffered alum treatments conducted in March and July 2020 and the whole-lake buffered alum treatment conducted in June 2023. The alum treatments were designed to remove phosphorus from the water column and to inactivate the release of phosphorus from the lake sediments to reduce algal production. In-situ water quality monitoring was conducted before, during, and after the alum treatment, with water samples collected for laboratory analysis before and after treatment. In addition, Tetra Tech staff performed in-situ monitoring and collected water samples for analysis monthly from May through October. Below is a summary of noteworthy findings from the 2023 monitoring season.

- Water level in Waughop Lake decreased substantially throughout the summer due to limited recharge
  - Water level decreased by 2.8 feet between May and October.
  - Water level minimum of 3.0 feet much lower than recorded in previous years.
  - Water level in Waughop Lake is apparently correlated with groundwater levels and reflects direct contact with the shallow groundwater-flow system.
- Alum treatment reduced phosphorus concentrations and internal loading in Waughop Lake during the summer of 2023
  - Waughop Lake did not experience a toxic bloom in 2023, even with more than favorable climatic and hydrologic conditions.
  - Despite the concentrating effects of lowering water levels, water column TP after the alum treatment remained well below the target range of less than 35 µg/L for the duration of the summer.
  - Increased water clarity was observed throughout the summer of 2023 due to the decrease in algae.
- Alum treatment temporarily impacted lake chemical composition
  - Concentrations of aluminum and sulfate were temporarily increased.
  - Nitrogen and alkalinity were temporarily reduced.
  - Concentrations of total sulfides varied after treatment but eventually were well below pre-treatment concentrations at the end of the monitoring period.
  - Concentrations of chloride, calcium, magnesium, potassium, and carbonate were unchanged following the alum treatment.
  - Sodium was temporarily increased.
- Temperature, pH, DO, and conductivity do not vary significantly throughout the water column
  - Waughop Lake is a shallow lake that mixes frequently throughout the year.
  - Higher values of pH and DO were mostly likely due to higher photosynthetic activity prior to treatment and during October and December.
  - Conductivity temporarily increased following the alum treatment.
- Improved water quality in 2023 compared to pre-treatment conditions
  - After June alum treatment, average TP and chl were significantly reduced throughout the remainder of the summer.
  - The mass of phosphorus in Waughop Lake decreased dramatically following the June treatment and remained low through the summer.
  - Water clarity increased and the high level of clarity was maintained throughout most of the summer. The secchi disk continued to be visible at the bottom or near the bottom of the lake through September.



## 6.0 Recommendations for Future Work

The 2020 and 2023 alum treatments dramatically reduced phosphorus availability in the water column and prevented the occurrence of a toxic algae bloom in Waughop Lake in 2020, 2021, and 2023. Water quality improvements resulting from the 2023 alum treatment are expected to continue. However, depending on internal and external loading of phosphorus, additional phosphorus inactivation treatments will be needed in the future to continue to limit HAB events. These future treatments may involve a modification in the buffering and or aluminum trichloride versus alum to accelerate the general water chemistry recovery due to the limited surface water input of calcium, sodium, and flushing of sulfate.

Long-term monitoring in Waughop Lake is recommended to track water quality parameters, observe any changes in the lake, and to continue to monitor the effectiveness and longevity of the alum treatments. Long-term monitoring also will provide the necessary data for adaptive management. In addition to monthly sampling for TP, TN, SRP, and chl, periodic analysis (every other month) for alkalinity, sulfate, TA, DOC, and hardness are recommended. In-situ monitoring to collect profiles of water temperature, DO, pH, and conductivity should also occur monthly. Continued water quality monitoring will allow for adaptive management of the lake and help inform management decisions, such as aquatic plant management and the potential use of other phosphorus inactivation products instead of alum for possible future phosphorus inactivation treatments, if needed. A high degree of water clarity paired with abundant solar energy may allow for an increase in aquatic plant production, so continued monitoring of conditions at Waughop Lake should include observations of changes to aquatic plants such as mapping for density and community structure.

## 7.0 References

- Brown and Caldwell. 2017. Waughop Lake Management Plan. Prepared for City of Lakewood, Washington. Grant #G1400475. Prepared with assistance by University of Washington, Tacoma.
- Cooke, G.D, E.B. Welch, S.A. Peterson, and S.A. Nichols. 2005. Restoration and Management of Lakes and Reservoirs. 3rd edition. Taylor & Francis. Boca Raton, FL.
- King County. 2018. Washington State Toxic Algae: Freshwater algae bloom monitoring program. Accessed at <https://www.nwtoxicalgae.org/>
- USGS. 2010. Hydrogeologic Framework, Groundwater Movement, and Water Budget in the Chambers-Clover Creek Watershed and Vicinity, Pierce County, Washington. Scientific Investigations Report 2010-5055. Accessed at <https://pubs.usgs.gov/sir/2010/5055/>
- Welch, E.B. and J.M. Jacoby. 2004. Pollutant Effects in Freshwater: Applied Limnology. 3<sup>rd</sup> Edition. Taylor & Francis. New York, NY.





# IEH ANALYTICAL LABORATORIES

LABORATORY & CONSULTING SERVICES

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CASE FILE NUMBER: 1740273 PAGE 1  
REPORT DATE: 06/11/23  
DATE SAMPLED: 05/23/23 DATE RECEIVED: 05/23/23  
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER  
SAMPLES FROM TETRA TECH INC.

## CASE NARRATIVE

One water sample was received by the laboratory and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

## SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	TOTAL-N (mg/L)	DOC (mg/L)	ALKALINITY (mgCaCO3/L)
Mid-Lake 0.5ml	0.047	<0.001	0.011	1.06	8.40	51.1

SAMPLE ID	TOTAL ALUMINUM (mg/L)	HARDNESS (mg/CaCO3/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
Mid-Lake 0.5ml	0.5693	23.8	28.0	12	6.2



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REPORT DATE:	06/11/23	
DATE SAMPLED:	05/23/23	DATE RECEIVED: 05/23/23
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM TETRA TECH INC.		

## QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	TOTAL-N (mg/L)	DOC (mg/L)	ALKALINITY (mgCaCO3/L)
METHOD	SM18 4500PF	SM18 4500PF	SM184500N03F	SM204500NC	EPA 415.1	SM18 2320B
DATE ANALYZED	05/27/23	05/25/23	05/24/23	05/31/23	06/09/23	05/25/23
DETECTION LIMIT	0.002	0.001	0.010	0.050	0.250	1.00
DUPLICATE						
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.023	<0.001	<0.010	0.682	1.18	41.0
DUPLICATE	0.024	<0.001	<0.010	0.716	1.24	41.6
RPD	4.01%	NC	NC	4.86%	4.98%	1.45%
SPIKE SAMPLE						
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.023	<0.001	<0.010	0.682	1.18	
SPIKED SAMPLE	0.076	0.020	0.194	1.74	5.52	
SPIKE ADDED	0.050	0.020	0.200	1.00	4.50	
% RECOVERY	106.14%	100.00%	96.78%	106.23%	96.49%	NA
QC CHECK						
FOUND	0.094	0.041	0.404	0.499	3.98	100
TRUE	0.094	0.039	0.408	0.499	4.00	100
% RECOVERY	100.00%	105.13%	99.02%	100.00%	99.50%	100.00%
BLANK	<0.002	<0.001	<0.010	<0.050	<0.250	NA

RPD = RELATIVE PERCENT DIFFERENCE.

NA = NOT APPLICABLE OR NOT AVAILABLE.

NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.

OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



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CASE FILE NUMBER: 1740273 PAGE 3  
REPORT DATE: 06/11/23  
DATE SAMPLED: 05/23/23 DATE RECEIVED: 05/23/23  
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER  
SAMPLES FROM TETRA TECH INC.

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	HARDNESS (mgCaCO3/l)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
METHOD	EPA 200.8	SM18 2340C	EPA 375.4	SM1810200H	SM1810200H
DATE ANALYZED	06/01/23	05/30/23	05/26/23	05/31/23	05/31/23
DETECTION LIMIT	0.0030	2.00	1.00	0.1	0.1
DUPLICATE					
SAMPLE ID	BATCH	BATCH	Mid-Lake 0.5m1	BATCH	BATCH
ORIGINAL	0.0051	17.8	28.0	2.3	3.8
DUPLICATE	0.0050	16.6	27.7	2.1	3.7
RPD	0.40%	6.82%	0.89%	8.00%	1.90%
SPIKE SAMPLE					
SAMPLE ID	BATCH	BATCH	Mid-Lake 0.5m1		
ORIGINAL	0.0051	17.8	28.0		
SPIKED SAMPLE	0.4983	35.6	37.7		
SPIKE ADDED	0.5000	20.0	10.0		
% RECOVERY	98.65%	88.93%	97.21%	NA	NA
QC CHECK					
FOUND	0.5034	36.9	10.2		
TRUE	0.5000	40.0	10.0		
% RECOVERY	100.68%	92.25%	102.00%	NA	NA
BLANK	<0.0030	<2.00	<1.00	NA	NA

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SUBMITTED BY:

*Damien Gadomski*

Damien Gadomski, PhD  
Laboratory Manager



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## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741068 **PAGE 1**  
**REPORT DATE:** 08/08/23  
**DATE SAMPLED:** 06/27/23 **DATE RECEIVED:** 06/27/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### CASE NARRATIVE

Two water samples were received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.048	0.002	<0.010	9.43	1.17	53.4	7.70
Mid-Lake Bottom	0.047	0.002	<0.010	8.98	1.20	52.7	7.91

SAMPLE ID	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
Mid-Lake 1m	0.5345	0.4083	4.62	25.7	11	4.9
Mid-Lake Bottom	0.5026	0.4284	4.94	25.2		

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	5.99	1.12	3.37	28.5	19.6	51.0	<1.00
Mid-Lake Bottom	5.81	0.913	2.92	28.0	18.3	51.1	<1.00





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<b>CASE FILE NUMBER:</b>	<b>1741068</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>08/08/23</b>	
<b>DATE SAMPLED:</b>	<b>06/27/23</b>	<b>DATE RECEIVED: 06/27/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	07/01/23	06/28/23	06/28/23	07/11/23	07/03/23	06/29/23	06/27/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.009	0.002	0.114	<0.250	0.284	74.8	
DUPLICATE	0.008	0.002	0.121	<0.250	0.295	73.8	
RPD	0.47%	5.48%	5.77%	NC	3.80%	1.35%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.009	0.002	0.114	<0.250	0.284		
SPIKED SAMPLE	0.060	0.026	0.326	4.24	1.24		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	102.65%	119.05%	106.22%	94.18%	95.30%	NA	NA
QC CHECK							
FOUND	0.095	0.040	0.421	4.25	0.526	96.8	
TRUE	0.094	0.039	0.408	4.00	0.490	100	
% RECOVERY	101.06%	101.52%	103.09%	106.25%	107.35%	96.80%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

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<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	07/06/23	07/10/23	06/29/23	07/07/23	07/06/23	07/06/23
DETECTION LIMIT	0.0030	0.0030	0.50	1.00	0.1	0.1
DUPLICATE						
SAMPLE ID	BATCH	BATCH	Mid-Lake Bottom	BATCH	BATCH	BATCH
ORIGINAL	0.0272	0.0507	4.94	17.7	36	9.7
DUPLICATE	0.0255	0.0524	4.94	17.9	37	8.5
RPD	6.62%	3.26%	0.00%	1.17%	3.64%	13.65%
SPIKE SAMPLE						
SAMPLE ID	BATCH	BATCH	Mid-Lake Bottom	BATCH		
ORIGINAL	0.0272	0.0507	4.94	17.7		
SPIKED SAMPLE	0.5633	0.5018	14.6	39.4		
SPIKE ADDED	0.5000	0.5000	20.0	20.0		
% RECOVERY	107.20%	90.22%	48.35%	108.34%	NA	NA
QC CHECK						
FOUND	0.5481	0.5220	30.4	9.57		
TRUE	0.5000	0.5000	30.0	10.0		
% RECOVERY	109.62%	104.39%	101.33%	95.70%	NA	NA
BLANK	<0.0030	<0.0030	<0.50	<1.00	NA	NA

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NA = NOT APPLICABLE OR NOT AVAILABLE.

NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.

OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741068 **PAGE 4**  
**REPORT DATE:** 08/08/23  
**DATE SAMPLED:** 06/27/23 **DATE RECEIVED:** 06/27/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	06/30/23	06/30/23	06/30/23	06/30/23	06/30/23	06/29/23	06/29/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	35.8	9.25	2.78	26.4	127		
DUPLICATE	35.8	9.24	2.75	26.5	127		
RPD	0.09%	0.09%	0.81%	0.23%	0.09%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	35.8	9.25	2.78	26.4			
SPIKED SAMPLE	46.4	19.6	13.5	37.5			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	105.80%	103.42%	107.48%	110.76%	NA	NA	NA
QC CHECK							
FOUND	9.79	9.82	10.1	10.2	64.9		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	97.92%	98.16%	101.36%	102.47%	98.07%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



# IEH ANALYTICAL LABORATORIES

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1741118</b>	<b>PAGE 1</b>
<b>REPORT DATE:</b>	<b>08/08/23</b>	
<b>DATE SAMPLED:</b>	<b>06/29/23</b>	<b>DATE RECEIVED:</b> <b>06/29/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

## CASE NARRATIVE

Three water samples were received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

## SAMPLE DATA

SAMPLE ID	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)
Mid-Lake 1m	1.50	0.0414
Mid-Lake 0.5m from bottom	1.85	0.0392
West Shore	1.51	0.0306



# IEH ANALYTICAL LABORATORIES

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: 1741118 PAGE 2  
REPORT DATE: 08/08/23  
DATE SAMPLED: 06/29/23 DATE RECEIVED: 06/29/23  
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER  
SAMPLES FROM TETRA TECH INC.

## QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)
METHOD	EPA 200.8	EPA 200.8
DATE ANALYZED	07/06/23	07/10/23
DETECTION LIMIT	0.0030	0.0030
DUPLICATE		
SAMPLE ID	BATCH	BATCH
ORIGINAL	0.0272	0.0507
DUPLICATE	0.0255	0.0524
RPD	6.62%	3.26%
SPIKE SAMPLE		
SAMPLE ID	BATCH	BATCH
ORIGINAL	0.0272	0.0507
SPIKED SAMPLE	0.5633	0.5018
SPIKE ADDED	0.5000	0.5000
% RECOVERY	107.20%	90.22%
QC CHECK		
FOUND	0.5481	0.5220
TRUE	0.5000	0.5000
% RECOVERY	109.62%	104.39%
BLANK	<0.0030	<0.0030

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1741155</b>	<b>PAGE 1</b>
<b>REPORT DATE:</b>	<b>08/08/23</b>	
<b>DATE SAMPLED:</b>	<b>06/30/23</b>	<b>DATE RECEIVED: 06/30/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### CASE NARRATIVE

Two water samples were received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.009	0.003	0.019	5.94	0.569	38.1	7.10
Mid-Lake Bottom	0.009	0.002	0.017	6.01	0.580	37.2	7.02

SAMPLE ID	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
Mid-Lake 1m	0.4539	0.0614	4.73	89.5	0.7	1.2
Mid-Lake Bottom	0.4839	0.0507	4.41	91.9		

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	5.84	0.804	2.73	48.8	17.9	32.3	<1.00
Mid-Lake Bottom	5.82	0.816	2.71	48.5	17.9	30.6	<1.00



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<b>CASE FILE NUMBER:</b>	<b>1741155</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>08/08/23</b>	
<b>DATE SAMPLED:</b>	<b>06/30/23</b>	<b>DATE RECEIVED: 06/30/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	07/10/23	07/01/23	07/01/23	07/11/23	07/08/23	07/10/23	07/01/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.090	0.017	0.446	<0.250	0.397	166	
DUPLICATE	0.092	0.017	0.449	<0.250	0.444	164	
RPD	2.75%	1.20%	0.56%	NC	11.18%	1.01%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.090	0.017	0.446	<0.250	0.397		
SPIKED SAMPLE	0.135	0.037	0.657	4.24	1.49		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	90.60%	100.50%	105.29%	94.18%	109.10%	NA	NA
QC CHECK							
FOUND	0.094	0.039	0.417	4.25	0.499	96.8	
TRUE	0.094	0.039	0.408	4.00	0.490	100	
% RECOVERY	100.00%	98.98%	102.28%	106.25%	101.84%	96.80%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741155 **PAGE 3**  
**REPORT DATE:** 08/08/23  
**DATE SAMPLED:** 06/30/23 **DATE RECEIVED:** 06/30/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	07/06/23	07/10/23	07/05/23	07/11/23	07/06/23	07/06/23
DETECTION LIMIT	0.0030	0.0030	0.50	1.00	0.1	0.1
DUPLICATE						
SAMPLE ID	BATCH	Mid-Lake Bottom	BATCH	Mid-Lake Bottom	BATCH	BATCH
ORIGINAL	0.0272	0.0507	20.0	91.9	8.5	2.7
DUPLICATE	0.0255	0.0524	19.3	95.0	8.5	2.7
RPD	6.62%	3.26%	3.21%	3.24%	0.00%	0.00%
SPIKE SAMPLE						
SAMPLE ID	BATCH	Mid-Lake Bottom	BATCH	Mid-Lake Bottom		
ORIGINAL	0.0272	0.0507	20.0	91.9		
SPIKED SAMPLE	0.5633	0.5018	38.9	103		
SPIKE ADDED	0.5000	0.5000	20.0	10.0		
% RECOVERY	107.20%	90.22%	94.60%	109.51%	NA	NA
QC CHECK						
FOUND	0.5481	0.5220	30.2	9.98		
TRUE	0.5000	0.5000	30.0	10.0		
% RECOVERY	109.62%	104.39%	100.67%	99.80%	NA	NA
BLANK	<0.0030	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741155 **PAGE 4**  
**REPORT DATE:** 08/08/23  
**DATE SAMPLED:** 06/30/23 **DATE RECEIVED:** 06/30/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	07/06/23	07/06/23	07/06/23	07/06/23	07/06/23	07/10/23	07/10/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	35.3	8.92	2.52	25.2	125		
DUPLICATE	35.3	8.92	2.56	25.1	125		
RPD	0.23%	0.02%	1.54%	0.13%	0.16%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	35.3	8.92	2.52	25.2			
SPIKED SAMPLE	45.5	19.1	12.7	35.8			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	102.06%	101.47%	102.13%	106.36%	NA	NA	NA
QC CHECK							
FOUND	9.93	9.68	9.88	10.2	64.7		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	99.33%	96.85%	98.80%	101.53%	97.78%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

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SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741377 **PAGE 1**  
**REPORT DATE:** 09/14/23  
**DATE SAMPLED:** 07/13/23 **DATE RECEIVED:** 07/13/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### CASE NARRATIVE

Two water samples were received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.015	<0.001	<0.010	6.21	0.650	38.0	7.94
Mid-Lake Bottom	0.016	<0.001	<0.010	5.97	0.620	39.2	7.93

SAMPLE ID	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
Mid-Lake 1m	0.9611	0.8458	3.99	94.8	3.6	1.5
Mid-Lake Bottom	0.9689	0.8219	3.99	97.6		

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	6.36	0.876	3.05	50.5	19.5	36.9	<1.00
Mid-Lake Bottom	6.47	0.896	2.98	50.8	19.8	38.0	<1.00



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1741377</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>09/14/23</b>	
<b>DATE SAMPLED:</b>	<b>07/13/23</b>	<b>DATE RECEIVED: 07/13/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	07/17/23	07/14/23	07/13/23	07/24/23	07/17/23	07/25/23	07/14/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.151	<0.001	<0.010	<0.250	0.545	158	
DUPLICATE	0.151	<0.001	<0.010	<0.250	0.539	158	
RPD	0.04%	NC	NC	NC	1.11%	0.00%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.151	<0.001	<0.010	<0.250	0.545		
SPIKED SAMPLE	0.201	0.020	0.208	4.22	1.54		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	99.31%	100.00%	104.24%	93.84%	99.20%	NA	NA
QC CHECK							
FOUND	0.094	0.039	0.418	4.14	0.528	102	
TRUE	0.094	0.039	0.408	4.00	0.490	100	
% RECOVERY	100.00%	98.98%	102.45%	103.43%	107.76%	102.00%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1741377 **PAGE 3**  
**REPORT DATE:** 09/14/23  
**DATE SAMPLED:** 07/13/23 **DATE RECEIVED:** 07/13/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	08/09/23	08/09/23	07/19/23	07/14/23	07/19/23	07/19/23
DETECTION LIMIT	0.0030	0.0030	0.50	1.00	0.1	0.1
DUPLICATE						
SAMPLE ID	BATCH	Mid-Lake 1m	Mid-Lake Bottom	Mid-Lake Bottom	BATCH	BATCH
ORIGINAL	<0.0030	0.8458	3.99	97.6	4.0	0.9
DUPLICATE	<0.0030	0.8164	4.52	94.8	4.0	0.9
RPD	NC	3.54%	12.35%	2.94%	0.00%	0.00%
SPIKE SAMPLE						
SAMPLE ID	BATCH	Mid-Lake 1m	Mid-Lake Bottom	Mid-Lake Bottom		
ORIGINAL	<0.0030	0.8458	3.99	97.6		
SPIKED SAMPLE	0.4590	1.300	14.8	109		
SPIKE ADDED	0.5000	0.5000	10.0	10.0		
% RECOVERY	91.80%	90.84%	108.26%	115.34%	NA	NA
QC CHECK						
FOUND	0.4760	0.5220	30.5	9.84		
TRUE	0.5000	0.5000	30.0	10.0		
% RECOVERY	95.21%	104.39%	101.67%	98.40%	NA	NA
BLANK	<0.0030	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: 1741377 PAGE 4  
REPORT DATE: 09/14/23  
DATE SAMPLED: 07/13/23 DATE RECEIVED: 07/13/23  
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER  
SAMPLES FROM TETRA TECH INC.

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	07/18/23	07/18/23	07/18/23	07/18/23	07/18/23	07/25/23	07/25/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	34.6	8.67	2.73	24.8	122		
DUPLICATE	34.5	8.65	2.68	25.0	122		
RPD	0.18%	0.29%	1.90%	0.42%	0.21%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	34.6	8.67	2.73	24.8			
SPIKED SAMPLE	44.9	18.5	12.7	35.9			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	103.17%	97.80%	99.85%	110.89%	NA	NA	NA
QC CHECK							
FOUND	9.73	9.49	9.98	10.1	63.4		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	97.26%	94.89%	99.75%	100.86%	95.78%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

NA = NOT APPLICABLE OR NOT AVAILABLE.

NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.

OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1742078</b>	<b>PAGE 1</b>
<b>REPORT DATE:</b>	<b>10/16/23</b>	
<b>DATE SAMPLED:</b>	<b>08/15/23</b>	<b>DATE RECEIVED: 08/15/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### CASE NARRATIVE

One water sample was received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.028	0.001	<0.010	7.70	0.769	37.4	7.94

SAMPLE ID	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
Mid-Lake 1m	1.043	0.9953	4.52	108	6.7	3.4

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	6.74	0.998	4.81	56.6	20.9	36.3	<1.00





# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1742078</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>10/16/23</b>	
<b>DATE SAMPLED:</b>	<b>08/15/23</b>	<b>DATE RECEIVED: 08/15/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	08/25/23	08/16/23	08/17/23	08/17/23	08/22/23	08/21/23	08/15/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.005	<0.001	0.091	<0.250	0.179	79.5	
DUPLICATE	0.005	<0.001	0.091	<0.250	0.191	78.5	
RPD	5.60%	NC	0.60%	NC	6.49%	1.27%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.005	<0.001	0.091	<0.250	0.179		
SPIKED SAMPLE	0.053	0.022	0.298	4.07	1.36		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	96.66%	110.00%	103.44%	90.38%	117.60%	NA	NA
QC CHECK							
FOUND	0.093	0.040	0.414	4.02	0.510	101	
TRUE	0.094	0.039	0.408	4.00	0.490	100	
% RECOVERY	98.94%	101.52%	101.47%	100.50%	104.08%	101.00%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

NA = NOT APPLICABLE OR NOT AVAILABLE.

NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.

OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1742078 **PAGE 3**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 08/15/23 **DATE RECEIVED:** 08/15/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	DISSOLVED ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	08/17/23	08/17/23	08/23/23	08/18/23	08/22/23	08/22/23
DETECTION LIMIT	0.0030	0.0030	0.50	1.00	0.1	0.1
DUPLICATE						
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.1001	0.0148	2.31	23.5	6.4	2.4
DUPLICATE	0.1001	0.0141	2.52	23.3	6.4	2.0
RPD	0.00%	4.70%	8.70%	0.76%	0.00%	17.07%
SPIKE SAMPLE						
SAMPLE ID	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.1001	0.0148	2.31	23.5		
SPIKED SAMPLE	0.6313	0.5418	12.6	33.2		
SPIKE ADDED	0.5000	0.5000	10.0	10.0		
% RECOVERY	106.24%	105.41%	103.01%	97.11%	NA	NA
QC CHECK						
FOUND	0.5373	0.5369	30.9	9.86		
TRUE	0.5000	0.5000	30.0	10.0		
% RECOVERY	107.46%	107.38%	103.00%	98.60%	NA	NA
BLANK	<0.0030	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

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**CASE FILE NUMBER:** 1742078 **PAGE 4**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 08/15/23 **DATE RECEIVED:** 08/15/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	08/21/23	08/21/23	08/21/23	08/21/23	08/21/23	08/21/23	08/21/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	8.47	1.06	0.565	2.39	26		
DUPLICATE	8.54	1.05	0.575	2.40	26		
RPD	0.82%	0.83%	1.76%	0.57%	0.54%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	8.47	1.06	0.565	2.39			
SPIKED SAMPLE	19.0	11.6	11.1	13.4			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	105.37%	105.45%	105.38%	110.56%	NA	NA	NA
QC CHECK							
FOUND	10.3	10.4	10.4	10.9	68.6		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	102.88%	104.21%	104.21%	109.40%	103.71%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

*Damien Gadomski*

Damien Gadomski, PhD

Laboratory Manager



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1742786 **PAGE 1**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 09/14/23 **DATE RECEIVED:** 09/14/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### CASE NARRATIVE

One water sample was received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.031	<0.001	<0.010	9.70	1.06	37.6	8.09

SAMPLE ID	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
Mid-Lake 1m	1.676	5.15	108	10	4.5

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	6.98	1.06	3.46	62.8	21.8	36.7	<1.00



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1742786 **PAGE 2**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 09/14/23 **DATE RECEIVED:** 09/14/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	09/25/23	09/15/23	09/15/23	10/10/23	09/19/23	09/21/23	09/15/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.062	0.002	0.019	1.11	0.565	86.4	
DUPLICATE	0.062	0.002	0.016	1.17	0.540	87.2	
RPD	0.32%	2.40%	12.10%	5.62%	4.52%	0.92%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.062	0.002	0.019	1.11	0.565		
SPIKED SAMPLE	0.110	0.022	0.191	5.40	1.56		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	95.79%	103.46%	86.33%	95.51%	99.70%	NA	NA
QC CHECK							
FOUND	0.095	0.041	0.402	4.26	0.461	98.8	
TRUE	0.094	0.039	0.408	4.00	0.490	100	
% RECOVERY	101.06%	104.06%	98.53%	106.50%	94.08%	98.80%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

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**CASE FILE NUMBER:** 1742786 **PAGE 3**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 09/14/23 **DATE RECEIVED:** 09/14/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	09/25/23	09/21/23	09/22/23	09/29/23	09/29/23
DETECTION LIMIT	0.0030	0.50	1.00	0.1	0.1
DUPLICATE					
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.0241	1.37	21.1	8.0	3.7
DUPLICATE	0.0239	1.37	21.5	7.7	3.5
RPD	0.61%	0.00%	1.59%	4.26%	3.70%
SPIKE SAMPLE					
SAMPLE ID	BATCH	BATCH	BATCH		
ORIGINAL	0.0241	1.37	21.1		
SPIKED SAMPLE	0.5328	11.9	31.5		
SPIKE ADDED	0.5000	10.0	10.0		
% RECOVERY	101.74%	105.11%	104.05%	NA	NA
QC CHECK					
FOUND	0.5276	31.3	9.93		
TRUE	0.5000	30.0	10.0		
% RECOVERY	105.52%	104.33%	99.35%	NA	NA
BLANK	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1742786 **PAGE 4**  
**REPORT DATE:** 10/16/23  
**DATE SAMPLED:** 09/14/23 **DATE RECEIVED:** 09/14/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	09/30/23	09/30/23	09/30/23	09/30/23	09/30/23	09/30/23	09/30/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	35.6	9.60	2.49	27.4	128		
DUPLICATE	35.7	9.62	2.52	27.5	129		
RPD	0.29%	0.15%	1.25%	0.21%	0.25%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	35.6	9.60	2.49	27.4			
SPIKED SAMPLE	45.6	19.9	12.8	37.1			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	99.77%	102.89%	103.58%	96.48%	NA	NA	NA
QC CHECK							
FOUND	9.85	10.1	10.3	10.3	66.3		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	98.50%	101.23%	102.54%	102.58%	100.20%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

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OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager





# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1743346 **PAGE 1**  
**REPORT DATE:** 11/09/23  
**DATE SAMPLED:** 10/11/23 **DATE RECEIVED:** 10/11/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### CASE NARRATIVE

One water sample was received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.043	0.001	0.014	11.6	0.962	34.8	7.60

SAMPLE ID	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
Mid-Lake 1m	1.35	4.62	74.7	32	11

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	6.43	1.03	3.51	58.1	20.3	32.9	<1.00



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1743346</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>11/09/23</b>	
<b>DATE SAMPLED:</b>	<b>10/11/23</b>	<b>DATE RECEIVED: 10/11/23</b>
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	10/16/23	10/12/23	10/13/23	10/12/23	10/17/23	10/18/23	10/11/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.080	0.018	0.012	<0.250	0.391	58.4	
DUPLICATE	0.081	0.017	0.012	<0.250	0.387	58.8	
RPD	0.98%	0.58%	1.70%	NC	1.03%	0.68%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.080	0.018	0.012	<0.250	0.391		
SPIKED SAMPLE	0.130	0.038	0.201	3.89	1.35		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	100.25%	101.06%	94.47%	86.44%	96.30%	NA	NA
QC CHECK							
FOUND	0.094	0.040	0.408	3.91	0.441	102	
TRUE	0.094	0.039	0.408	4.00	0.469	100	
% RECOVERY	100.00%	101.52%	99.88%	97.63%	94.03%	102.00%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

NA = NOT APPLICABLE OR NOT AVAILABLE.

NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.

OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1743346 **PAGE 3**  
**REPORT DATE:** 11/09/23  
**DATE SAMPLED:** 10/11/23 **DATE RECEIVED:** 10/11/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAEO_a (ug/L)
METHOD	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	10/18/23	10/20/23	10/18/23	10/17/23	10/17/23
DETECTION LIMIT	0.0030	0.50	1.00	0.1	0.1
DUPLICATE					
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.0155	31.4	6.29	0.5	1.6
DUPLICATE	0.0160	31.7	6.46	0.5	1.6
RPD	3.60%	1.00%	2.71%	0.00%	0.00%
SPIKE SAMPLE					
SAMPLE ID	BATCH	BATCH	BATCH		
ORIGINAL	0.0155	31.4	6.29		
SPIKED SAMPLE	0.4859	53.6	16.6		
SPIKE ADDED	0.5000	20.0	10.0		
% RECOVERY	94.09%	110.89%	103.18%	NA	NA
QC CHECK					
FOUND	0.4542	31.3	9.86		
TRUE	0.5000	30.0	10.0		
% RECOVERY	90.83%	104.33%	98.62%	NA	NA
BLANK	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1743346 **PAGE 4**  
**REPORT DATE:** 11/09/23  
**DATE SAMPLED:** 10/11/23 **DATE RECEIVED:** 10/11/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	10/26/23	10/26/23	10/26/23	10/26/23	10/26/23	10/26/23	10/26/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	36.1	9.50	2.72	26.9	129		
DUPLICATE	37.9	9.98	2.85	28.2	136		
RPD	4.82%	4.94%	4.70%	4.66%	4.85%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	36.1	9.50	2.72	26.9			
SPIKED SAMPLE	46.5	19.8	13.4	38.2			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	103.75%	103.46%	106.61%	112.72%	NA	NA	NA
QC CHECK							
FOUND	10.1	9.97	10.3	10.2	66.3		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	101.01%	99.69%	102.54%	102.43%	100.19%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

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SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1744586 **PAGE 1**  
**REPORT DATE:** 12/26/23  
**DATE SAMPLED:** 12/12/23 **DATE RECEIVED:** 12/12/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### CASE NARRATIVE

One water sample was received by the laboratory in good condition and analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

### SAMPLE DATA

SAMPLE ID	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
Mid-Lake 1m	0.041	0.002	0.034	10.7	1.04	28.5	7.47

SAMPLE ID	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
Mid-Lake 1m	0.406	4.62	98.6	54	7.4

SAMPLE ID	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO3/l)	HCO3 (mgCaCO3/l)	CO3 (mgCaCO3/l)
Mid-Lake 1m	5.74	0.940	3.07	45.0	18.2	26.5	<1.00



# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

<b>CASE FILE NUMBER:</b>	<b>1744586</b>	<b>PAGE 2</b>
<b>REPORT DATE:</b>	<b>12/26/23</b>	
<b>DATE SAMPLED:</b>	<b>12/12/23</b>	<b>DATE RECEIVED:</b> 12/12/23
<b>FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER</b>		
<b>SAMPLES FROM TETRA TECH INC.</b>		

### QA/QC DATA

QC PARAMETER	TOTAL-P (mg/L)	SRP (mg/L)	N03+N02 (mg/L)	DOC (mg/L)	TOTAL-N (mg/L)	ALKALINITY (mgCaCO3/L)	pH
METHOD	SM20 4500PF	SM20 4500PF	SM204500N03F	EPA 415.1	SM204500NC	SM20 2320B	EPA 150.1
DATE ANALYZED	12/16/23	12/12/23	12/13/23	12/22/23	12/19/23	12/15/23	12/12/23
DETECTION LIMIT	0.002	0.001	0.010	0.250	0.050	1.00	0.10
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	
ORIGINAL	0.038	0.002	0.504	<0.250	0.851	33.2	
DUPLICATE	0.041	0.002	0.488	<0.250	0.827	32.7	
RPD	8.20%	0.42%	3.12%	NC	2.86%	1.52%	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	0.038	0.002	0.504	<0.250	0.851		
SPIKED SAMPLE	0.084	0.021	0.717	3.99	1.81		
SPIKE ADDED	0.050	0.020	0.200	4.50	1.00		
% RECOVERY	93.01%	97.74%	106.54%	88.67%	95.50%	NA	NA
QC CHECK							
FOUND	0.095	0.040	0.432	3.92	0.441	99.3	
TRUE	0.094	0.039	0.408	4.00	0.469	100	
% RECOVERY	101.06%	101.52%	105.88%	98.08%	94.03%	99.30%	NA
BLANK	<0.002	<0.001	<0.010	<0.250	<0.050	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

**CASE FILE NUMBER:** 1744586 **PAGE 3**  
**REPORT DATE:** 12/26/23  
**DATE SAMPLED:** 12/12/23 **DATE RECEIVED:** 12/12/23  
**FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER**  
**SAMPLES FROM TETRA TECH INC.**

### QA/QC DATA

QC PARAMETER	TOTAL ALUMINUM (mg/L)	CHLORIDE (mg/L)	SULFATE (mg/L)	CHLOR_a (ug/L)	PHAE0_a (ug/L)
METHOD	EPA 200.8	EPA 325.3	EPA 375.4	SM2010200H	SM2010200H
DATE ANALYZED	12/14/23	12/13/23	12/13/23	12/19/23	12/19/23
DETECTION LIMIT	0.0030	0.50	1.00	0.1	0.1
DUPLICATE					
SAMPLE ID	BATCH	Mid-Lake 1m	BATCH	BATCH	BATCH
ORIGINAL	0.0166	4.62	30.5	17	3.3
DUPLICATE	0.0184	4.52	31.3	19	3.5
RPD	10.19%	2.30%	2.58%	9.35%	5.88%
SPIKE SAMPLE					
SAMPLE ID	BATCH	Mid-Lake 1m	BATCH		
ORIGINAL	0.0166	4.62	30.5		
SPIKED SAMPLE	0.5563	14.7	41.5		
SPIKE ADDED	0.5000	20.0	10.0		
% RECOVERY	107.94%	50.45%	109.67%	NA	NA
QC CHECK					
FOUND	0.4954	30.9	9.70		
TRUE	0.5000	30.0	10.0		
% RECOVERY	99.08%	103.00%	97.00%	NA	NA
BLANK	<0.0030	<0.50	<1.00	NA	NA

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# IEH ANALYTICAL LABORATORIES

## LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: 1744586 PAGE 4  
REPORT DATE: 12/26/23  
DATE SAMPLED: 12/12/23 DATE RECEIVED: 12/12/23  
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER  
SAMPLES FROM TETRA TECH INC.

### QA/QC DATA

#### QC PARAMETER

	CALCIUM (mg/l)	MAGNESIUM (mg/l)	POTASSIUM (mg/l)	SODIUM (mg/l)	HARDNESS (mgCaCO <sub>3</sub> /l)	HCO <sub>3</sub> (mgCaCO <sub>3</sub> /l)	CO <sub>3</sub> (mgCaCO <sub>3</sub> /l)
METHOD	EPA 200.7	EPA 200.7	EPA 200.7	EPA 200.7	SM18 2340B	EPA 310.1	EPA 310.1
DATE ANALYZED	12/14/23	12/14/23	12/14/23	12/14/23	12/14/23	12/15/23	12/15/23
DETECTION LIMIT	0.100	0.100	0.500	0.500	0.700	1.00	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH		
ORIGINAL	42.1	13.4	1.86	141	160		
DUPLICATE	44.8	12.2	1.93	136	162		
RPD	6.21%	9.21%	3.57%	3.31%	1.17%	NA	NA
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH			
ORIGINAL	42.1	13.4	1.86	141			
SPIKED SAMPLE	50.8	25.0	12.4	151			
SPIKE ADDED	10.0	10.0	10.0	10.0			
% RECOVERY	87.00%	116.20%	105.09%	104.15%	NA	NA	NA
QC CHECK							
FOUND	10.4	10.2	10.3	10.6	68.2		
TRUE	10.0	10.0	10.0	10.0	66.2		
% RECOVERY	103.93%	102.50%	102.68%	105.71%	103.04%	NA	NA
BLANK	<0.100	<0.100	<0.500	<0.500	<0.700	NA	NA

RPD = RELATIVE PERCENT DIFFERENCE.

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SUBMITTED BY:

Damien Gadomski, PhD  
Laboratory Manager



**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2306470**

July 05, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 6/27/2023 for the analyses presented in the following report.

***Sulfide by SM 4500-S2-F***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,



Brianna Barnes  
Project Manager

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2306470

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2306470-001	Mid-Lake 1 m	06/27/2023 12:30 PM	06/27/2023 3:45 PM
2306470-002	Mid-Lake Bottom	06/27/2023 12:40 PM	06/27/2023 3:45 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

**I. SAMPLE RECEIPT:**

Samples receipt information is recorded on the attached Sample Receipt Checklist.

**II. GENERAL REPORTING COMMENTS:**

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

**III. ANALYSES AND EXCEPTIONS:**

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

---

### Qualifiers:

- \* - Flagged value is not within established control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Reporting Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate

Work Order: **2306470**  
 Date Reported: **7/5/2023**

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

**Lab ID:** 2306470-001

**Collection Date:** 6/27/2023 12:30:00 PM

**Client Sample ID:** Mid-Lake 1 m

**Matrix:** Water

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
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**Sulfide by SM 4500-S2-F**

Batch ID: R85056 Analyst: SS

Sulfide	1.60	0.500		mg/L	1	7/3/2023 11:22:17 AM
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**Lab ID:** 2306470-002

**Collection Date:** 6/27/2023 12:40:00 PM

**Client Sample ID:** Mid-Lake Bottom

**Matrix:** Water

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
----------	--------	----	------	-------	----	---------------

**Sulfide by SM 4500-S2-F**

Batch ID: R85056 Analyst: SS

Sulfide	2.80	0.500		mg/L	1	7/3/2023 11:22:17 AM
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**Work Order:** 2306470  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

**Sulfide by SM 4500-S2-F**

Sample ID: <b>MB-R85056</b>	SampType: <b>MBLK</b>	Units: <b>mg/L</b>			Prep Date: <b>7/3/2023</b>				RunNo: <b>85056</b>		
Client ID: <b>MBLKW</b>	Batch ID: <b>R85056</b>	Analysis Date: <b>7/3/2023</b>							SeqNo: <b>1775518</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	ND	0.500									

Sample ID: <b>LCS-R85056</b>		SampType: <b>LCS</b>		Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R85056</b>		Analysis Date: <b>7/3/2023</b>						SeqNo: <b>1775519</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	2.40	0.500	2.000	0	120	45.6	120				

Sample ID: <b>2306470-001ADUP</b>		SampType: <b>DUP</b>		Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>Mid-Lake 1 m</b>		Batch ID: <b>R85056</b>					Analysis Date: <b>7/3/2023</b>			SeqNo: <b>1775521</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	2.40	0.500						1.600	40.0	30	R

**NOTES:**

R - High RPD observed.

Sample ID: <b>2306536-002AMS</b>		SampType: <b>MS</b>			Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>		RunNo: <b>85056</b>		
Client ID: <b>BATCH</b>		Batch ID: <b>R85056</b>			Analysis Date: <b>7/3/2023</b>				SeqNo: <b>1776234</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	4.00	0.500	2.000	1.200	140	21.5	190				

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Clare Griggs

Work Order Number: 2306470  
 Date Received: 6/27/2023 3:45:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown prior to receipt. Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all holding times able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	17.3

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C



3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

## Chain of Custody Record & Laboratory Services Agreement

Date: 6/27/2023 Page: 1 of 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetrattech.com

Laboratory Project No (Internal): 2306470

Special Remarks:

Bill to City of Lakewood

Attn: Weston Ott

wott@cityoflakewood.us

253-983-7725

6000 Main St. SW

Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 6241)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCD)	Diesel/Heavy Oil Range Organics (DO)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)**	EDB (8011)	SULFIDES	Comments
1 Mid-Lake 1 m	6/27/23	1230	W															
2 Mid-Lake Bottom	6/27/23	1240	W															
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

\*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

\*\*Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Tl Ti V Zn

\*\*\*Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide Iodide O-Phosphate Fluoride Nitrate-Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature) *Adam Bryant* Print Name *Adam Bryant* Date/Time *6/27/23 3:40*

Relinquished (Signature) *Ashley Salzman* Print Name *Ashley Salzman* Date/Time *6/27/23 1545*

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify)





**Fremont**  
*Analytical*  
An Alliance Technical Group Company

3600 Fremont Ave. N.

Seattle, WA 98103

T: (206) 352-3790

F: (206) 352-7178

info@fremontanalytical.com

**Tetra Tech, Inc.**

Shannon Brattebo

2003 Western Ave Suite 700

Seattle, WA 98121

**RE: Waughop Lake Alum**

**Work Order Number: 2306536**

July 07, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 6/30/2023 for the analyses presented in the following report.

***Sulfide by SM 4500-S2-F***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Brianna Barnes  
Project Manager

*DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing  
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing  
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910*

Original

[www.fremontanalytical.com](http://www.fremontanalytical.com)

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2306536

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2306536-001	Mid-Lake 1 M	06/30/2023 12:20 PM	06/30/2023 4:12 PM
2306536-002	Mid-Lake Bottom	06/30/2023 12:35 PM	06/30/2023 4:12 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

### I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

### II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

### III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

### Qualifiers:

- \* - Flagged value is not within established control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Reporting Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate

Work Order: **2306536**  
Date Reported: **7/7/2023**

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

**Lab ID:** 2306536-001

**Collection Date:** 6/30/2023 12:20:00 PM

**Client Sample ID:** Mid-Lake 1 M

**Matrix:** Water

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
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**Sulfide by SM 4500-S2-F**

Batch ID: R85056 Analyst: SS

Sulfide	4.00	0.500		mg/L	1	7/3/2023 11:22:17 AM
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**Lab ID:** 2306536-002

**Collection Date:** 6/30/2023 12:35:00 PM

**Client Sample ID:** Mid-Lake Bottom

**Matrix:** Water

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
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**Sulfide by SM 4500-S2-F**

Batch ID: R85056 Analyst: SS

Sulfide	1.20	0.500		mg/L	1	7/3/2023 11:22:17 AM
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**Work Order:** 2306536  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

**Sulfide by SM 4500-S2-F**

Sample ID: <b>MB-R85056</b>		SampType: <b>MBLK</b>			Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>MBLKW</b>		Batch ID: <b>R85056</b>			Analysis Date: <b>7/3/2023</b>					SeqNo: <b>1775518</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide ND 0.500

Sample ID: <b>LCS-R85056</b>		SampType: <b>LCS</b>			Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R85056</b>			Analysis Date: <b>7/3/2023</b>			SeqNo: <b>1775519</b>				
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 2.40 0.500 2.000 0 120 45.6 120

Sample ID: <b>2306470-001ADUP</b>		SampType: <b>DUP</b>			Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>BATCH</b>		Batch ID: <b>R85056</b>			Analysis Date: <b>7/3/2023</b>					SeqNo: <b>1775521</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 2.40 0.500 1.600 40.0 30 R

**NOTES:**

R - High RPD observed.

Sample ID: <b>2306536-002AMS</b>		SampType: <b>MS</b>			Units: <b>mg/L</b>		Prep Date: <b>7/3/2023</b>			RunNo: <b>85056</b>		
Client ID: <b>Mid-Lake Bottom</b>		Batch ID: <b>R85056</b>			Analysis Date: <b>7/3/2023</b>					SeqNo: <b>1776234</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 4.00 0.500 2.000 1.200 140 21.5 190

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Morgan Wilson

Work Order Number: 2306536  
 Date Received: 6/30/2023 4:20:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown prior to receipt. Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all holding times able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	19.8

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C



3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

# Chain of Custody Record & Laboratory Services Agreement

Date: 06/30/23 Page: 1 of 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Collected by:

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Laboratory Project No (Internal): 2306536

Special Remarks:

Bill to City of Lakewood  
Attn: Weston Ott  
wott@cityoflakewood.us  
253-983-7725

6000 Main St. SW  
Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Client: Tetra Tech, Inc.

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetratech.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals ** (EPA 6020 / 200.8)	Total (T)   Dissolved (D)	Anions (IC) ***	EDB (8011)	SULFIDES	Comments
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1 Mid-Lake 1 m

06/30/23

12:20

W

X

2 Mid-Lake Bottom

06/30/23

12:35

W

X

3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

\*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

\*\*Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

\*\*\*Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide Iodide Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify)

Relinquished (Signature)

Print Name

Date/Time

Received (Signature)

Print Name

Date/Time

Relinquished (Signature)

Print Name

Date/Time

Received (Signature)

Print Name

Date/Time



**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2307159**

July 20, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 7/13/2023 for the analyses presented in the following report.

***Sulfide by SM 4500-S2-F***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,



Brianna Barnes  
Project Manager

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2307159

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2307159-001	Mid-Lake 1 M	07/13/2023 11:00 AM	07/13/2023 2:09 PM
2307159-002	Mid-Lake Bottom	07/13/2023 11:15 AM	07/13/2023 2:09 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

**I. SAMPLE RECEIPT:**

Samples receipt information is recorded on the attached Sample Receipt Checklist.

**II. GENERAL REPORTING COMMENTS:**

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

**III. ANALYSES AND EXCEPTIONS:**

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

---

### Qualifiers:

- \* - Associated LCS is outside of control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Method Detection Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate



## Analytical Report

Work Order: 2307159

Date Reported: 7/20/2023

**Client:** Tetra Tech, Inc.

**Collection Date:** 7/13/2023 11:00:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2307159-001

**Matrix:** Water

**Client Sample ID:** Mid-Lake 1 M

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
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**Sulfide by SM 4500-S2-F**

Batch ID: R85352

Analyst: AM

Sulfide	0.800	0.500	0.128		mg/L	1	07/17/23 16:30:46
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**Client:** Tetra Tech, Inc.

**Collection Date:** 7/13/2023 11:15:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2307159-002

**Matrix:** Water

**Client Sample ID:** Mid-Lake Bottom

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
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**Sulfide by SM 4500-S2-F**

Batch ID: R85352

Analyst: AM

Sulfide	2.40	0.500	0.128		mg/L	1	07/17/23 16:30:46
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**Work Order:** 2307159  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

**Sulfide by SM 4500-S2-F**

Sample ID: <b>MB-R85352</b>		SampType: <b>MBLK</b>			Units: <b>mg/L</b>		Prep Date: <b>7/17/2023</b>			RunNo: <b>85352</b>		
Client ID: <b>MBLKW</b>		Batch ID: <b>R85352</b>			Analysis Date: <b>7/17/2023</b>					SeqNo: <b>1780883</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide ND 0.500

Sample ID: <b>LCS-R85352</b>		SampType: <b>LCS</b>			Units: <b>mg/L</b>		Prep Date: <b>7/17/2023</b>			RunNo: <b>85352</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R85352</b>			Analysis Date: <b>7/17/2023</b>			SeqNo: <b>1780884</b>				
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 2.00 0.500 2.000 0 100 45.6 120

Sample ID: <b>2307159-001ADUP</b>		SampType: <b>DUP</b>			Units: <b>mg/L</b>		Prep Date: <b>7/17/2023</b>			RunNo: <b>85352</b>		
Client ID: <b>Mid-Lake 1 M</b>		Batch ID: <b>R85352</b>			Analysis Date: <b>7/17/2023</b>					SeqNo: <b>1780887</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 0.800 0.500 0.8000 0 30

Sample ID: <b>2307159-002AMS</b>		SampType: <b>MS</b>			Units: <b>mg/L</b>		Prep Date: <b>7/17/2023</b>			RunNo: <b>85352</b>		
Client ID: <b>Mid-Lake Bottom</b>		Batch ID: <b>R85352</b>			Analysis Date: <b>7/17/2023</b>					SeqNo: <b>1780889</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 4.80 0.500 2.000 2.400 120 21.5 190

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Morgan Wilson

Work Order Number: 2307159  
 Date Received: 7/13/2023 2:09:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown prior to receipt. Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all holding times able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	21.4

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C





3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

# Chain of Custody Record & Laboratory Services Agreement

Date: 7/3/23 Page: 1 of 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Collected by: Zach Skelton (TT)

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Laboratory Project No (Internal): 2307159  
Special Remarks:  
Bill to City of Lakewood  
Attn: Weston Ott  
wott@cityoflakewood.us  
253-983-7725  
6000 Main St. SW  
Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Client: Tetra Tech, Inc.

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetratech.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270-SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)**	EDB (802.1)	SULFIDES	Comments
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1	Mid-Lake 1 m	7/13/23	1100	W	1													
2	Mid-Lake Bottom	7/13/23	1115	W	1													

3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

\*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

\*\*Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Tl Ti V Zn

\*\*\*Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-phosphate Fluoride Nitrate-Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify)

Relinquished (Signature) *Adam Bryant* Date/Time 7/13/23 1410

Relinquished (Signature) *Adam Bryant* Date/Time 7/13/23 1410



**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2308209**

August 22, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 8/15/2023 for the analyses presented in the following report.

***Sulfide by SM 4500-S2-F***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,



Brianna Barnes  
Project Manager

*DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing  
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing  
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910*

Original

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**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2308209

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2308209-001	Mid-Lake 1 m	08/15/2023 9:45 AM	08/15/2023 1:35 PM
2308209-002	Mid-Lake Bottom	08/15/2023 10:00 AM	08/15/2023 1:35 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

### I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

### II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

### III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

---

### Qualifiers:

- \* - Associated LCS is outside of control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Method Detection Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate



## Analytical Report

Work Order: 2308209

Date Reported: 8/22/2023

**Client:** Tetra Tech, Inc.

**Collection Date:** 8/15/2023 9:45:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2308209-001

**Matrix:** Water

**Client Sample ID:** Mid-Lake 1 m

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
<b><u>Sulfide by SM 4500-S2-F</u></b>					Batch ID: R86063		Analyst: SS
Sulfide	0.600	0.500	0.128		mg/L	1	08/22/23 14:17:17

**Client:** Tetra Tech, Inc.

**Collection Date:** 8/15/2023 10:00:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2308209-002

**Matrix:** Water

**Client Sample ID:** Mid-Lake Bottom

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
<b><u>Sulfide by SM 4500-S2-F</u></b>					Batch ID: R86063		Analyst: SS
Sulfide	ND	0.500	0.128		mg/L	1	08/22/23 14:17:17

**Work Order:** 2308209  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

**Sulfide by SM 4500-S2-F**

Sample ID: <b>MB-R86063</b>	SampType: <b>MBLK</b>	Units: <b>mg/L</b>			Prep Date: <b>8/22/2023</b>			RunNo: <b>86063</b>			
Client ID: <b>MBLKW</b>	Batch ID: <b>R86063</b>				Analysis Date: <b>8/22/2023</b>			SeqNo: <b>1795802</b>			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Sulfide ND 0.500

Sample ID: <b>LCS-R86063</b>		SampType: <b>LCS</b>			Units: <b>mg/L</b>		Prep Date: <b>8/22/2023</b>			RunNo: <b>86063</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R86063</b>			Analysis Date: <b>8/22/2023</b>				SeqNo: <b>1795803</b>			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	

Sulfide 1.40 0.500 2.000 0 70.0 45.6 120

Sample ID: <b>LCSD-R86063</b>	SampType: <b>LCSD</b>	Units: <b>mg/L</b>			Prep Date: <b>8/22/2023</b>			RunNo: <b>86063</b>			
Client ID: <b>LCSW02</b>	Batch ID: <b>R86063</b>				Analysis Date: <b>8/22/2023</b>			SeqNo: <b>1795804</b>			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Sulfide 1.40 0.500 2.000 0 70.0 45.6 120 1.400 0 20

Sample ID: 2308209-001ADUP		SampType: DUP		Units: mg/L		Prep Date: 8/22/2023			RunNo: 86063		
Client ID: Mid-Lake 1 m		Batch ID: R86063		Analysis Date: 8/22/2023			SeqNo: 1795806				
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Sulfide ND 0.500 0.6000 200 30 R

**NOTES:**

R - High RPD observed.

Sample ID: <b>2308209-002AMS</b>		SampType: <b>MS</b>		Units: <b>mg/L</b>		Prep Date: <b>8/22/2023</b>			RunNo: <b>86063</b>		
Client ID: <b>Mid-Lake Bottom</b>		Batch ID: <b>R86063</b>		Analysis Date: <b>8/22/2023</b>			SeqNo: <b>1795808</b>				
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Sulfide 5.60 0.500 2.000 0 280 21.5 190 S

**NOTES:**

S - Outlying spike recoveries were associated with this sample.

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Clare Griggs

Work Order Number: 2308209  
 Date Received: 8/15/2023 1:35:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all holding times able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	19.4

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C





3600 Fremont Ave. N.  
Seattle, WA 98103  
Tel: 206-352-3790

## Chain of Custody Record & Laboratory Services Agreement

Date: \_\_\_\_\_ Page: 1 of 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Collected by:

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Laboratory Project No (Internal):

Special Remarks:

Bill to City of Lakewood

Attn: Weston Ott

wott@cityoflakewood.us

253-983-7725

6000 Main St. SW

Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Email(s): shannon.brattebo@tetratech.com

Telephone: 206-728-9655

City, State, Zip: Seattle, WA 98121

Address: 2003 Western Ave. Suite 700

Client: Tetra Tech, Inc.

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DO)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	SULFIDES	Comments
1 Mid-Lake 1 m	8/15/23	0945	W	1														
2 Mid-Lake Bottom	8/15/23	1000	W	1														
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide Iodide O-Phosphate Fluoride Nitrate-Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature) *Adam Bryant* Print Name Adam Bryant Date/Time 08/15/23 1335 Received (Signature) *Emma Tuck* Print Name Emma Tuck Date/Time 8/15/23 13:35

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify) \_\_\_\_\_





3600 Fremont Ave. N.  
Seattle, WA 98103  
T: (206) 352-3790  
F: (206) 352-7178  
info@fremontanalytical.com

**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2309168**

September 21, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 9/14/2023 for the analyses presented in the following report.

***Toal Sulfide by SM 4500-S2-D***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Brianna Barnes  
Project Manager

*DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing  
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing  
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910*

Original

[www.fremontanalytical.com](http://www.fremontanalytical.com)

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**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2309168

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## Work Order Sample Summary

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Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2309168-001	Mid-Lake 1 m	09/14/2023 10:27 AM	09/14/2023 3:52 PM
2309168-002	Mid-Lake Bottom	09/14/2023 10:37 AM	09/14/2023 3:52 PM

---

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

### I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

### II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

### III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

### Qualifiers:

- \* - Associated LCS is outside of control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Method Detection Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate



## Analytical Report

Work Order: 2309168  
Date Reported: 9/21/2023

**Client:** Tetra Tech, Inc.

**Collection Date:** 9/14/2023 10:27:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2309168-001

**Matrix:** Water

**Client Sample ID:** Mid-Lake 1 m

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
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**Toal Sulfide by SM 4500-S2-D**

Batch ID: R86639 Analyst: FG

Sulfide	ND	0.0500	0.0138		mg/L	1	09/21/23 9:39:01
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**Client:** Tetra Tech, Inc.

**Collection Date:** 9/14/2023 10:37:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2309168-002

**Matrix:** Water

**Client Sample ID:** Mid-Lake Bottom

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
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**Toal Sulfide by SM 4500-S2-D**

Batch ID: R86639 Analyst: FG

Sulfide	0.0139	0.0500	0.0138	J	mg/L	1	09/21/23 9:39:01
---------	--------	--------	--------	---	------	---	------------------

**Work Order:** 2309168  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

### Total Sulfide by SM 4500-S2-D

Sample ID: <b>LCS-R86639</b>		SampType: <b>LCS</b>			Units: <b>mg/L</b>		Prep Date: <b>9/21/2023</b>			RunNo: <b>86639</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R86639</b>						Analysis Date: <b>9/21/2023</b>			SeqNo: <b>1807644</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Sulfide	0.0997	0.0500	0.1000	0	99.7	80	120					

Sample ID: <b>MB-R86639</b>		SampType: <b>MBLK</b>			Units: <b>mg/L</b>		Prep Date: <b>9/21/2023</b>			RunNo: <b>86639</b>		
Client ID: <b>MBLKW</b>		Batch ID: <b>R86639</b>						Analysis Date: <b>9/21/2023</b>			SeqNo: <b>1807645</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Sulfide	ND	0.0500										

Sample ID: <b>2309168-001ADUP</b>		SampType: <b>DUP</b>			Units: <b>mg/L</b>		Prep Date: <b>9/21/2023</b>			RunNo: <b>86639</b>		
Client ID: <b>Mid-Lake 1 m</b>		Batch ID: <b>R86639</b>						Analysis Date: <b>9/21/2023</b>			SeqNo: <b>1807704</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Sulfide	ND	0.0500						0	0	20		

Sample ID: <b>2309168-001AMS</b>		SampType: <b>MS</b>			Units: <b>mg/L</b>		Prep Date: <b>9/21/2023</b>			RunNo: <b>86639</b>		
Client ID: <b>Mid-Lake 1 m</b>		Batch ID: <b>R86639</b>						Analysis Date: <b>9/21/2023</b>			SeqNo: <b>1807705</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Sulfide	0.103	0.0500	0.1000	0	103	80	120					

Sample ID: <b>2309168-001AMSD</b>		SampType: <b>MSD</b>			Units: <b>mg/L</b>		Prep Date: <b>9/21/2023</b>			RunNo: <b>86639</b>		
Client ID: <b>Mid-Lake 1 m</b>		Batch ID: <b>R86639</b>						Analysis Date: <b>9/21/2023</b>			SeqNo: <b>1807706</b>	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
Sulfide	0.114	0.0500	0.1000	0	114	80	120	0.1030	10.1	20		

## Sample Log-In Check List

Client Name: **TETRAS**  
 Logged by: **Lyann Rivera**

Work Order Number: **2309168**  
 Date Received: **9/14/2023 3:52:00 PM**

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown prior to receipt Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all holding times able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	14.7

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C





3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

# Chain of Custody Record & Laboratory Services Agreement

Date: \_\_\_\_\_ Page: 1 of 1

Laboratory Project No (Internal): **2309168**

Project Name: Waughop Lake Alum

Special Remarks:  
Bill to City of Lakewood  
Attn: Weston Ott  
wott@cityoflakewood.us  
253-983-7725

Project No: 100-RCE-T39045

6000 Main St. SW  
Lakewood, WA 98499-5027

Collected by: *Adam Bryant*

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Client: Tetra Tech, Inc.

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetratech.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HX)	SVOs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)   Dissolved (D)	Anions (IC)***	EDB (8011)	SULFIDES	Comments
1 Mid-Lake 1 m	09/14/23	10:27	W	1													
2 Mid-Lake Bottom	09/14/23	10:37	W	1													
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

\*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

\*\*Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

\*\*\*Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide Iodide Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature) *Adam Bryant* Print Name *Adam Bryant* Date/Time *15:50*

Relinquished (Signature) *Adam Bryant* Print Name *Adam Bryant* Date/Time *15:50*

Received (Signature) *Adam Bryant* Print Name *Adam Bryant* Date/Time *9/14/23 15:52*

Received (Signature) *Adam Bryant* Print Name *Adam Bryant* Date/Time *9/14/23 15:52*

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify) \_\_\_\_\_





**Fremont**  
*Analytical*  
An Alliance Technical Group Company

3600 Fremont Ave. N.  
Seattle, WA 98103  
T: (206) 352-3790  
F: (206) 352-7178  
info@fremontanalytical.com

**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2310163**

October 18, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 1 sample(s) on 10/11/2023 for the analyses presented in the following report.

***Total Sulfide by SM 4500-S2-D***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Brianna Barnes  
Project Manager

*DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing  
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing  
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910*

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Original

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---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2310163

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2310163-001	Mid-Lake 1 m	10/11/2023 12:00 AM	10/11/2023 1:39 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

### I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

### II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

### III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

### Qualifiers:

- \* - Associated LCS is outside of control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Method Detection Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate



# Analytical Report

Work Order: 2310163  
Date Reported: 10/18/2023

**Client:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Lab ID:** 2310163-001  
**Client Sample ID:** Mid-Lake 1 m

**Collection Date:** 10/11/2023

**Matrix:** Water

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
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**Total Sulfide by SM 4500-S2-D**

Batch ID: R87181      Analyst: FG

Sulfide	ND	0.0500	0.0138		mg/L	1	10/17/23 11:00:00
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**Work Order:** 2310163  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

### Total Sulfide by SM 4500-S2-D

Sample ID: <b>MB-R87181</b>	SampType: <b>MBLK</b>	Units: <b>mg/L</b>				Prep Date: <b>10/17/2023</b>			RunNo: <b>87181</b>		
Client ID: <b>MBLKW</b>	Batch ID: <b>R87181</b>					Analysis Date: <b>10/17/2023</b>			SeqNo: <b>1819888</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	ND	0.0500									

Sample ID: <b>LCS-R87181</b>	SampType: <b>LCS</b>	Units: <b>mg/L</b>				Prep Date: <b>10/17/2023</b>			RunNo: <b>87181</b>		
Client ID: <b>LCSW</b>	Batch ID: <b>R87181</b>					Analysis Date: <b>10/17/2023</b>			SeqNo: <b>1819889</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	0.188	0.0500	0.2000	0	93.9	80	120				

Sample ID: <b>2310163-001ADUP</b>	SampType: <b>DUP</b>	Units: <b>mg/L</b>				Prep Date: <b>10/17/2023</b>			RunNo: <b>87181</b>		
Client ID: <b>Mid-Lake 1 m</b>	Batch ID: <b>R87181</b>					Analysis Date: <b>10/17/2023</b>			SeqNo: <b>1819891</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	ND	0.0500						0	0	20	

Sample ID: <b>2310163-001AMS</b>	SampType: <b>MS</b>	Units: <b>mg/L</b>				Prep Date: <b>10/17/2023</b>			RunNo: <b>87181</b>		
Client ID: <b>Mid-Lake 1 m</b>	Batch ID: <b>R87181</b>					Analysis Date: <b>10/17/2023</b>			SeqNo: <b>1819892</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	0.192	0.0500	0.2000	0	96.2	80	120				

Sample ID: <b>2310163-001AMSD</b>	SampType: <b>MSD</b>	Units: <b>mg/L</b>				Prep Date: <b>10/17/2023</b>			RunNo: <b>87181</b>		
Client ID: <b>Mid-Lake 1 m</b>	Batch ID: <b>R87181</b>					Analysis Date: <b>10/17/2023</b>			SeqNo: <b>1819893</b>		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	0.198	0.0500	0.2000	0	99.1	80	120	0.1924	2.97	20	

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Morgan Wilson

Work Order Number: 2310163  
 Date Received: 10/11/2023 1:39:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown prior to receipt. Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all hold times (except field parameters, pH e.g.) able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	14.5

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C





**Fremont**  
AN ALLIANCE TECHNICAL GROUP COMPANY  
Analytical

3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

## Chain of Custody Record & Laboratory Services Agreement

Date:

Page: 1

of: 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Collected by:

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Laboratory Project No (Internal):

2310163

Special Remarks:

Bill to City of Lakewood

Attn: Weston Ott

wott@cityoflakewood.us

253-983-7725

6000 Main St. SW

Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Client: Tetra Tech, Inc.

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetratech.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCD)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)   Dissolved (D)	Anions (IC)***	EDS (8011)	SULFIDES	Comments
1 Mid-Lake 1 m			W															
2 Mid-Lake Bottom	10/11/23		W															
3																		
4																		
5																		
6																		
7																		
8																		
9	10/11/23																	
10																		

\*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

\*\*Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL Individual: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

\*\*\*Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
<i>Adam Bryant</i>	Adam Bryant	10/11/2023 1339	<i>Shannon Brattebo</i>	Shannon Brattebo	10/11/23 1339
Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time

Turn-around Time:  
☒ Standard ☐ Next Day  
☐ 3 Day ☐ Same Day  
☐ 2 Day (specify)





**Fremont**  
*Analytical*  
An Alliance Technical Group Company

3600 Fremont Ave. N.  
Seattle, WA 98103  
T: (206) 352-3790  
F: (206) 352-7178  
info@fremontanalytical.com

**Tetra Tech, Inc.**  
Shannon Brattebo  
2003 Western Ave Suite 700  
Seattle, WA 98121

**RE: Waughop Lake Alum**  
**Work Order Number: 2312294**

December 19, 2023

**Attention Shannon Brattebo:**

Fremont Analytical, Inc. received 2 sample(s) on 12/12/2023 for the analyses presented in the following report.

***Total Sulfide by SM 4500-S2-D***

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Brianna Barnes  
Project Manager

*DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing*  
*ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing*  
*Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910*

---

Original

**[www.fremontanalytical.com](http://www.fremontanalytical.com)**

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**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum  
**Work Order:** 2312294

---

## Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2312294-001	Mid-Lake 1 m	12/12/2023 10:18 AM	12/12/2023 1:56 PM
2312294-002	Mid-Lake Bottom	12/12/2023 10:25 AM	12/12/2023 1:56 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

---

**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

---

### I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

### II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

### III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

---

### Qualifiers:

- \* - Associated LCS is outside of control limits
- B - Analyte detected in the associated Method Blank
- D - Dilution was required
- E - Value above quantitation range
- H - Holding times for preparation or analysis exceeded
- I - Analyte with an internal standard that does not meet established acceptance criteria
- J - Analyte detected below Reporting Limit
- N - Tentatively Identified Compound (TIC)
- Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
- S - Spike recovery outside accepted recovery limits
- ND - Not detected at the Method Detection Limit
- R - High relative percent difference observed

### Acronyms:

- %Rec - Percent Recovery
- CCB - Continued Calibration Blank
- CCV - Continued Calibration Verification
- DF - Dilution Factor
- DUP - Sample Duplicate
- HEM - Hexane Extractable Material
- ICV - Initial Calibration Verification
- LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
- MCL - Maximum Contaminant Level
- MB or MBLANK - Method Blank
- MDL - Method Detection Limit
- MS/MSD - Matrix Spike / Matrix Spike Duplicate
- PDS - Post Digestion Spike
- Ref Val - Reference Value
- REP - Sample Replicate
- RL - Reporting Limit
- RPD - Relative Percent Difference
- SD - Serial Dilution
- SGT - Silica Gel Treatment
- SPK - Spike
- Surr - Surrogate



## Analytical Report

Work Order: 2312294

Date Reported: 12/19/2023

**Client:** Tetra Tech, Inc.

**Collection Date:** 12/12/2023 10:18:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2312294-001

**Matrix:** Water

**Client Sample ID:** Mid-Lake 1 m

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
<b>Total Sulfide by SM 4500-S2-D</b>				Batch ID: R88428		Analyst: AM	
Sulfide	0.0336	0.0500	0.0138	J	mg/L	1	12/19/23 10:01:31

**Client:** Tetra Tech, Inc.

**Collection Date:** 12/12/2023 10:25:00 AM

**Project:** Waughop Lake Alum

**Lab ID:** 2312294-002

**Matrix:** Water

**Client Sample ID:** Mid-Lake Bottom

Analyses	Result	RL	MDL	Qual	Units	DF	Date Analyzed
<b>Total Sulfide by SM 4500-S2-D</b>				Batch ID: R88428		Analyst: AM	
Sulfide	0.0383	0.0500	0.0138	J	mg/L	1	12/19/23 10:01:31

**Work Order:** 2312294  
**CLIENT:** Tetra Tech, Inc.  
**Project:** Waughop Lake Alum

## QC SUMMARY REPORT

**Total Sulfide by SM 4500-S2-D**

Sample ID: <b>CCB-R88428</b>		SampType: <b>CCB</b>			Units: <b>mg/L</b>		Prep Date: <b>12/19/2023</b>			RunNo: <b>88428</b>		
Client ID: <b>CCB</b>		Batch ID: <b>R88428</b>						Analysis Date: <b>12/19/2023</b>			SeqNo: <b>1846585</b>	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide		ND	0.0500									

Sample ID: <b>LCS-R88428</b>		SampType: <b>LCS</b>			Units: <b>mg/L</b>		Prep Date: <b>12/19/2023</b>			RunNo: <b>88428</b>		
Client ID: <b>LCSW</b>		Batch ID: <b>R88428</b>						Analysis Date: <b>12/19/2023</b>			SeqNo: <b>1846586</b>	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide		0.163	0.0500	0.2000	0	81.7	80	120				

Sample ID: <b>2312338-001FDUP</b>		SampType: <b>DUP</b>			Units: <b>mg/L</b>		Prep Date: <b>12/19/2023</b>			RunNo: <b>88428</b>		
Client ID: <b>BATCH</b>		Batch ID: <b>R88428</b>						Analysis Date: <b>12/19/2023</b>			SeqNo: <b>1847024</b>	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide		0.0359	0.0500						0.02900	21.4	20	J

Sample ID: <b>2312338-001FMS</b>		SampType: <b>MS</b>			Units: <b>mg/L</b>		Prep Date: <b>12/19/2023</b>			RunNo: <b>88428</b>		
Client ID: <b>BATCH</b>		Batch ID: <b>R88428</b>						Analysis Date: <b>12/19/2023</b>			SeqNo: <b>1847025</b>	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide		0.210	0.0500	0.2000	0.02900	90.4	80	120				

Sample ID: <b>2312338-001FMSD</b>		SampType: <b>MSD</b>			Units: <b>mg/L</b>		Prep Date: <b>12/19/2023</b>			RunNo: <b>88428</b>		
Client ID: <b>BATCH</b>		Batch ID: <b>R88428</b>						Analysis Date: <b>12/19/2023</b>			SeqNo: <b>1847026</b>	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide		0.205	0.0500	0.2000	0.02900	88.1	80	120	0.2098	2.23	20	

## Sample Log-In Check List

Client Name: TETRAS  
 Logged by: Lyann Rivera

Work Order Number: 2312294  
 Date Received: 12/12/2023 1:56:00 PM

### Chain of Custody

1. Is Chain of Custody complete? Yes ☒ No ☐ Not Present ☐  
 2. How was the sample delivered? Client

### Log In

3. Custody Seals present on shipping container/cooler?  
 (Refer to comments for Custody Seals not intact) Yes ☐ No ☐ Not Present ☒  
 4. Was an attempt made to cool the samples? Yes ☐ No ☒ NA ☐  
 5. Were all items received at a temperature of >2°C to 6°C \* Unknown Prior to Receipt Yes ☐ No ☐ NA ☒  
 6. Sample(s) in proper container(s)? Yes ☒ No ☐  
 7. Sufficient sample volume for indicated test(s)? Yes ☒ No ☐  
 8. Are samples properly preserved? Yes ☒ No ☐  
 9. Was preservative added to bottles? Yes ☐ No ☒ NA ☐  
 10. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☒  
 11. Did all samples containers arrive in good condition(unbroken)? Yes ☒ No ☐  
 12. Does paperwork match bottle labels? Yes ☒ No ☐  
 13. Are matrices correctly identified on Chain of Custody? Yes ☒ No ☐  
 14. Is it clear what analyses were requested? Yes ☒ No ☐  
 15. Were all hold times (except field parameters, pH e.g.) able to be met? Yes ☒ No ☐

### Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☒

Person Notified:	<input type="text"/>	Date:	<input type="text"/>
By Whom:	<input type="text"/>	Via:	<input type="checkbox"/> eMail <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> In Person
Regarding:	<input type="text"/>		
Client Instructions:	<input type="text"/>		

17. Additional remarks:

### Item Information

Item #	Temp °C
Sample	10.5

\* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C





**Fremont**  
Analytical  
An Alliance Technical Group Company

3600 Fremont Ave N.  
Seattle, WA 98103  
Tel: 206-352-3790

## Chain of Custody Record & Laboratory Services Agreement

Date: \_\_\_\_\_ Page: 1 of 1

Project Name: Waughop Lake Alum

Project No: 100-RCE-T39045

Collected by:

Location: Waughop Lake, Lakewood, WA

Report To (PM): Shannon Brattebo, Tetra Tech

Laboratory Project No (Internal): 2312294

Special Remarks:  
Bill to City of Lakewood  
Attn: Weston Ott  
wott@cityoflakewood.us  
253-983-7725  
6000 Main St. SW  
Lakewood, WA 98499-5027

Disposal: Samples will be disposed in 30 days unless otherwise requested.  
☐ Retain volume (specify above) ☐ Return to client

Client: Tetra Tech, Inc.

Address: 2003 Western Ave. Suite 700

City, State, Zip: Seattle, WA 98121

Telephone: 206-728-9655

Email(s): shannon.brattebo@tetratech.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCS (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DO)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)   Dissolved (D)	Antens (IC)***	EDB (8011)	SULFIDES	Comments
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1 Mid-Lake 1 m

2 Mid-Lake Bottom

12/12/23 1018 W

12/12/23 1025 W

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