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MEMORANDUM

To:	Darwin Green and Allegra Cairns, Constantine Mining LLC
From:	Alice Conovitz, Integral Consulting Inc.
Date:	October 15, 2018
Subject:	Palmer Project Baseline Groundwater Quality
Project No.:	C708

The Palmer exploration project is a copper-zinc-gold-silver mineral exploration project located in southeastern Alaska approximately 35 miles northwest of the town of Haines, at the northern limit of the Alaska Marine Highway (Figure 1-1). Constantine North Inc. (Constantine), a wholly owned U.S. subsidiary of Constantine Metal Resources Ltd., is Operator of the Constantine Mining LLC Palmer Joint Venture. In 2006, Constantine began exploratory drilling to delineate resource extent and quality. The exploration drill program is seasonal, with helicopter-supported drill activity typically extending from late May until early October in each calendar year. The project area is primarily underlain by basaltic rocks interbedded with siltstone and volcanic tuff, which hosts volcanogenic massive sulfide mineralization. This memorandum has been prepared to summarize baseline conditions in support of planning and permitting for underground exploration. The information and water quality data discussed here are for groundwater stations expected to be relevant to potential future exploration activities.

Glacier Creek and its tributaries provide the primary drainage with in the project boundary, ultimately flowing into the Klehini River (Figure 1-2). Individual flow measurements on Glacier Creek from 2015 and 2018 ranged from 4 cfs to 470 cfs, depending on location and time of year, with peak flows occurring during freshet (snow melt) in late spring and summer. The Klehini River runs from west to east along the northern property boundary, flowing approximately 40 miles from its glacial headwaters in British Columbia to the confluence with the Chilkat River at the town of Klukwan, which is approximately 25 miles south of the Palmer project area. Flow in this large, braided river varies seasonally; average monthly flows measured above the confluence with the Chilkat River from 1983 to 1991 ranged from 220 cfs in winter months (January through March) to over 4,100 cfs in the summer (June through August). The Sarah Creek and the Jarvis Creek/Little

Jarvis Creek systems add considerable flow to the Klehini River upstream of the Palmer project mineral resource area. Based on long-term weather records from the nearby Pleasant Camp, British Columbia, meteorological station, total annual precipitation from both snowfall and rainfall is 56 inches. Normal annual rainfall is 28 inches, with highest rainfall in September and October. Average daily temperature is typically above freezing from the months of April through October.

In 2014, SRK Consulting (SRK) compiled groundwater level measurements from open drillholes at multiple locations across the project area to develop a preliminary evaluation of the general shape of the water table (SRK 2014a). SRK found that groundwater generally follows topography, with relatively deeper groundwater (150 m to 200 m below ground surface [bgs]) at high elevations and relatively shallow and near the ground surface on the hill sites. SRK determined that this pattern indicates that the fractured rock groundwater system is transmissive and the groundwater drains rapidly to lower elevations. Flowing artesian conditions may occur at the site due to confining layers.

Baseline monitoring of surface water expressions of groundwater from drillholes and natural springs (herein termed groundwater) began in September 2014 and has continued through May 2018 to determine typical water quality conditions of groundwater in the vicinity of the project area prior to any significant site disturbance from mineral exploration and related activities. Baseline data will define natural conditions for the area.

This memorandum updates the baseline groundwater quality information presented in a previous memorandum prepared by Integral Consulting Inc. (Integral): *Palmer Project Baseline Groundwater Quality* (Integral 2016).

1. WATER QUALITY MONITORING

This memorandum summarizes the baseline groundwater quality monitoring conducted during 16 monitoring events from September 2014 to May 2018 at locations within the Palmer project area. Groundwater results measured at three stations within the Glacier Creek drainage, which flows through the center of the Palmer project, are discussed here. Constantine and its contractors have collected additional opportunistic samples from an additional drillhole location; these additional data are presented in Attachment A. Groundwater quality samples were analyzed for conventional parameters, cations/anions, and trace metals.

1.1. MONITORING LOCATIONS

Monitoring locations are shown on Figure 1-3. Photos of sampling locations are provided in Attachment B. The purpose of each monitoring site is specified in Table 1-1. Three monitoring stations are located in the project area on steep mountainous slopes north of the glacially fed headwaters of Glacier Creek:

- U6 drillhole, station P17—Flowing groundwater from an exploratory geotechnical drillhole referred to as the "U6 drillhole" (hole ID GT14-01) is measured at station P17, located at 2,600 ft above mean sea level (amsl) in an area and elevation range where future underground development may occur. Groundwater expressing from the U6 drillhole can be used to characterize subsurface drainage associated with the hanging wall basaltic rocks of the mineralized South Wall zone. The sub-horizontal GT14-01 hole was drilled in December 2014 at a -5 percent inclination through basalts to a distance of 991 ft to a lower depth elevation of 2,400 ft. During hole construction, flowing water was first observed at 742 ft distance. The rocks encountered during drilling were highly fractured with numerous faults. These faults and fractures are expected to have high hydraulic conductivity, and groundwater recharge is expected to be from the immediate ground surface above (SRK 2014b). These discontinuous geologic features readily transmit water but have little storage capacity; the groundwater expressing from the U6 drillhole is expected to have a relatively short retention time underground compared to non-fractured systems. Water samples have been collected from the U6 drillhole during 15 separate sampling events from 2014 to 2018, covering spring, summer, and fall periods: September 2014, April and August 2015; June, July, August, and October 2016; July and August 2017; and May 2018.
- Hari drillhole, station P29—Flowing groundwater from the geotechnical drillhole referred to as "Hari drillhole" (hole ID GT17-05) is measured at station P29. The

Hari drillhole is in an area and elevation range where the majority of future underground development is anticipated to occur. Groundwater expressing from the Hari drillhole can be used to characterize subsurface drainage associated with the Jasper Mountain basalts. The drill collar was constructed at an elevation of 2,945 ft amsl; the hole dips moderately at -15.5 percent over a total length of 960 ft. In contrast to station P17, this drillhole is upgradient of the project's South Wall mineralized zone in an area expected to have less influence from mineralized intrusions. Due to its steeper dip and location along a nearly sheer mountain face, the Hari drillhole is expected to intercept somewhat deeper groundwater than the U6 drillhole. Water samples were collected from the Hari drillhole on 3 days from late July to late August 2017.

- Unnamed spring, station P19—In upper Glacier Creek, monitoring station P19 is located at an intermittent unnamed artesian spring at an elevation of approximately 1,700 ft amsl. The intermittent flows and observation of suspended particles in spring water during or following rain events indicate that the spring is influenced by surface conditions (rainfall and snowmelt) and may capture subsurface drainage from neighboring drilling activity. When flowing, water from this spring drains to Glacier Creek. Water samples were collected from the natural spring during 7 separate summer time sampling events: August 2015; June and August 2016; and July and August 2017.

1.2. SAMPLING METHODOLOGY

All groundwater samples were collected as individual grab (not composite) samples from the surface expression of free-flowing water. Unfiltered water samples were collected as grabs from the drillhole or spring discharge using non-reactive collection containers. For the drillhole locations (P17 and P29), well caps were removed and water was allowed to flow from the hole for a minimum of three-times the well volume to remove stagnant water prior to collecting each sample. Filtered groundwater samples were collected using a peristaltic pump with a 0.45-µm filter placed in-line at the tubing outlet to filter samples immediately before the water was discharged into the sample bottle. The pump inlet was placed in the flowing water portion of the discharge stream at the outlet and elevated as needed to avoid uptake of streambed sediments at spring sites. Alternatively, if an in-line filter and peristaltic pump was not available or practical for the sample collection, samples were filtered manually through a 0.45-µm syringe filter. Immediately after filling, the sample containers are capped, labeled, and placed inside a cooler. Detailed sample collection, handling, and analysis information is presented in the Palmer project quality assurance project plan (QAPP; Integral 2015).

Measurements of field parameters were taken by placing the field probe in a clean, non-reactive container. A peristaltic pump was used to supply a continuous flow of water from the drillhole or spring discharge into the container. Measurements of general water quality characteristics, including conductivity, dissolved oxygen (DO), pH, temperature, and turbidity, were collected in the field at all sampling stations in accordance with the QAPP (Integral 2015). Measurements were recorded when the field instrumentation readings stabilized. Field instruments were maintained, cleaned, and calibrated with standard reference solutions per the manufacturer's specifications. Field instrument standard operating procedures (SOPs), manuals, and calibration log forms are presented in the Palmer project QAPP (Integral 2015).

1.3. ANALYTICAL METHODOLOGY

Sample analysis was performed by the ALS Environmental laboratory group. Analysis for some parameters (chloride, fluoride, and sulfate) was regularly performed at the ALS laboratory in Whitehorse, Yukon Territory. ALS Whitehorse transferred the samples to its laboratory in Vancouver, British Columbia, for the remaining analyses. ALS Vancouver performed all analysis in 2017 and 2018. Laboratory methods used for the Palmer project by ALS are based on Standard Methods (SM) and U.S. Environmental Protection Agency (EPA) methods, and follow accreditation by the Canadian Association for Laboratory Accreditation.

The project parameter list, analytical methods, and measurement quality objectives are presented in Table 1-2. For each parameter, the table lists method detection limits (MDLs; the smallest amount of a substance that can be reported with at least 99 percent certainty that the concentration is greater than zero) and practical quantitation limits (PQLs; the minimum concentration that is measured with a high degree of confidence that the analyte is present at or above that concentration). Where applicable, Alaska water quality standards for freshwater aquatic life and for human health consumption of water plus aquatic organisms are presented for comparison. For all parameters, the MDL and PQL levels for the analytical method are below the water quality standards.

The following parameters were typically measured in baseline groundwater samples:

- Field parameters—Field measurements of general water quality characteristics, including conductivity, DO, oxygen-reduction potential (ORP), pH, temperature, and turbidity, were taken at all sampling stations, in accordance with the QAPP (Integral 2015). A multiprobe was used for DO, pH, temperature, and conductivity measurements. A turbidity meter was used for turbidity measurements. If these instruments were not available, equivalent instruments that meet method requirements were used and calibrated per the manufacturer instructions.

- Conventional parameters—Conventional analyses performed by the ALS laboratory included acidity, hardness as $CaCO_3$, total dissolved solids (TDS), and total suspended solids (TSS). ALS used methods based on SM as shown in Table 1-2.
- Anions and nutrients—Major cations and nutrients typically analyzed included alkalinity as $CaCO_3$, bromide, chloride, fluoride, nitrate, combined nitrate/nitrite, sulfate, and ammonia. These parameters were determined by ALS using the SM and EPA methods listed in Table 1-2.
- Total/Dissolved Metals—Thirty-three metals were analyzed for both the total and dissolved fraction following the methods listed in Table 1-2.

Settleable solids were measured occasionally for groundwater samples and are presented with conventional parameters. The settleable solids samples were collected in the field and analyzed following SM 2540F (SM 1997). The settleable solids analysis was performed as soon as possible following the sampling event. Settleable solids concentrations were determined using the Imhoff cone volumetric technique to measure the mass of solids that settle from 1 L of water in a 60-minute period. The settleable solids measurement SOPs are presented in the Palmer project QAPP (Integral 2015).

1.4. DATA QUALITY EVALUATION

The primary data quality objective (DQO) for groundwater quality baseline sampling is to collect data of sufficient quantity and quality to characterize typical water quality conditions in the absence of significant site disturbance from mineral exploration and related activities (Integral 2015). Quality control samples were prepared in the field and at the laboratories to assess the bias and precision of the sample collection and analysis procedures. All quality assurance and quality control (QA/QC) procedures are documented in the project QAPP (Integral 2015).

Field QC samples included field replicates to assess the variability at the sampling site and field blanks to ensure sample containers and laboratory water do not contain analytes of interest at concentrations that impact the project samples. Laboratory QC procedures included laboratory control samples, matrix spike samples, matrix spike duplicates or laboratory duplicates, and method blanks, and were used to ensure that measurement uncertainty was within an acceptable range to meet the DQO.

Quality assurance reviews were conducted on all data reported by the laboratory to verify that the laboratory implemented the QA/QC procedures of the referenced methods and to evaluate quality control results reported by the laboratory. Integral provides data validation reports to Constantine to document quality assurance reviews.

Data were validated according to the procedures in the EPA data validation guidance documents for inorganic data (USEPA 2002). Data that did not meet the applicable laboratory or data validation quality control limits were qualified during the quality assurance review. Qualifiers applied to this data set are defined in the notes on Tables 3-1a–c. Any sample results flagged as rejected (R-qualified) by the analytical laboratory or data validator are documented in Tables 3-1a–c and the project Microsoft® Access database, but are not included in the water quality analysis presented below. For groundwater samples collected from 2014 to 2018, 8 nitrate, 14 nitrite, and 8 phosphorus results were rejected because the samples were analyzed after more than twice the method-recommended holding time.[1] Five turbidity results were rejected because laboratory turbidity analysis was not requested for these samples and the laboratory used the results for screening purposes only. Thirteen total zinc results collected in July and August 2016 were also rejected because the laboratory reported duplicate results.

Field Replicate Precision

The results of paired normal and field replicate samples collected at station P19 on August 3, 2016, are presented in Table 1-3. The comparability of the field replicate results was assessed by calculating the relative percent difference (RPD) of the results, as presented in Table 4. Results for normal/replicate sample pairs were evaluated against a RPD goal of 30 percent. Greater variability is expected for results near or below the reporting limit because the background signal variations (i.e., "noise") are greater relative to the analyte levels. For all conventional parameters, anions and nutrients, and dissolved metals, the RPD was less than ±10 percent. RPD above 30 percent was observed for 8 metals in total (unfiltered) sample fraction. The observation of these higher RPDs in the unfiltered sample, without similar differences in the filtered sample, indicates that solids entrained in the normal sample may have produced relatively higher total metal concentrations; however, field measured turbidity and TSS were slightly lower in the normal sample.

Comparison to Water Quality Standards

For all metals, the laboratory reported and/or validator-assigned concentration detection limits were below Alaska water quality standards, as shown on Table 3-2. This indicates

[1] Holding time exceedances occurred due to the remoteness of the project location, and were observed only for analyses with short (48 hours) holding times.

that the analytical methods used meet the DQO outlined in the project QAPP (Integral 2015), and that the baseline data set is acceptable for comparison to aquatic life standards.

2. SAMPLING RESULTS

Tables 3-1a–c presents the complete set of groundwater quality results measured during the baseline groundwater sampling from September 2014 through May 2018. Figure 2-1 presents a piper diagram for the characterization of the major cations and anions at each sampling location. Figures 3-1 to 3-61 plot groundwater concentrations over time and are discussed in the next section.

2.1. PIPER DIAGRAM

Piper diagrams present the distribution of major cations and anions measured in the groundwater samples. This visual representation of water chemistry supports comparison of water sources and geologic influences between groundwater stations. Figure 2-1 presents a piper diagram of the distribution of major cations and anions for each groundwater monitoring station, for all sampling events conducted to date.

The piper diagram indicates that all samples from each of the three groundwater monitoring stations contain greater than 80 percent calcium. The monitoring stations show varying levels of sulfate, with the highest fraction of sulfate (over 70 percent) at station P29, sulfate fractions of around 60 percent at station P17, and lower sulfate (generally less than 40 percent) at the P19 spring location. Contributions of magnesium, sodium, and chloride to the overall composition of these water samples were minimal.

The groundwater samples collected from the U6 (P17) and Hari (P29) drillholes were characterized as calcium-sulfate waters (Figure 2-1). The onsite artesian spring location (P19) is a calcium-bicarbonate water, and is closer in nature to the groundwater collected from the proximal U6 drillhole than to the more distant Hari drillhole.

3. TIME SERIES PLOTS AND COMPARISON TO WATER QUALITY STANDARDS

Visual analysis of time series plots provides important insights to the measured magnitude of water quality parameters, as well as patterns and trends observed over time. Time series concentration plots were generated for select conventional parameters (Figures 3-1 through 3-9), anions and nutrients (Figures 3-10 through 3-15), and metals (Figures 3-16 through 3-61). Values qualified as nondetect, by the laboratory or during data validation, are plotted as hollow symbols at half the qualified value. Colored lines, where present, indicate the Alaska water quality criteria freshwater chronic (dashed red line) and acute (solid grey line) aquatic life criteria for metals. Dashed green lines indicate the Alaska human health standards for consumption of water and aquatic organisms. (In some cases, standards are not shown on the plots because they are above the range of the y-axis scale.)

The water quality criteria are applicable to surface water; comparison of the groundwater results to the aquatic life standards provides overall context of groundwater quality but should not be considered as a screening for compliance with standards. Baseline groundwater metals results were screened against the Alaska Department of Environmental Conservation (ADEC) water quality criteria specified in regulation 18 AAC 70 and detailed in the *Alaska Water Quality Manual for Toxic and Deleterious Organic and Inorganic Substance*s (ADEC 2008). Tables 3-1a–c present the complete set of groundwater quality results measured during the baseline groundwater sampling from September 2014 through May 2018. Table 3-2 presents a summary of the comparison of groundwater samples collected from 2014 to 2018 to the chronic and acute aquatic life standards for metals. Human health standards for consumption of fish and aquatic organisms are also presented and compared to groundwater results.

3.1. FIELD AND CONVENTIONAL PARAMETERS

Groundwater temperature (Figure 3-1) was generally somewhat warmer at the U6 (P17) and Hari (P29) drillhole locations relative to the natural spring (P19); this is likely related to the shallow groundwater later and short retention time expected for water expressed from the spring. Average groundwater temperature from the drillholes was 4.6°C, ranging from 3.9°C to 7°C. For the spring, average groundwater temperature was 3.6°C and ranged from 2.7°C to 4.7°C. Measured pH (Figure 3-2) values were generally circumneutral at the U6 drillhole (P17) and the onsite natural spring (P19), with averages of pH 7.6 and pH 8.04, respectively. The three samples from the Hari drillhole (P29) were somewhat higher, with an average of pH 9.1 and all measurements above the aquatic life criteria range for surface water of pH 6.5 to 8.5 (Figure 3-2).[2] Groundwater hardness levels were similar between the U6 and Hari drillholes, with average hardness of 277 mg/L $CaCO_3$ and 251 mg/L $CaCO_3$, respectively. Hardness at the natural spring (P19) averaged 127 mg/L $CaCO_3$ (Figure 3-3).

Conductivity (Figure 3-4) and TDS (Figure 3-5) are related measures of dissolved solids in water; TDS measures the combined total of dissolved solids, while conductivity is the ability of the water to conduct an electrical current due to the presence of charged ions. Similar to hardness, both conductivity and TDS were similar at the U6 and Hari drillholes and were higher than levels measured in the spring. At the U6 drillhole, average TDS was 360 mg/L and average conductivity was 447 μS/cm (ranging from 250 μS/cm to 605 μS/cm). For the three samples collected at the U6 drillhole, average TDS was 355 mg/L and average conductivity was 539 μS/cm (ranging from 535 μS/cm to 541 μS/cm). TDS and conductivity at the spring (P19) were lower; average TDS was 182 mg/L and average conductivity was 243 μS/cm (ranging from 191 μS/cm to 267 μS/cm).

DO measurements indicate whether anoxic (DO < 0.5 mg/L) conditions are present in groundwater. The three measurements at the Hari drillhole (P29) exhibited lower DO than the other groundwater monitoring locations and anaerobic conditions, with DO of 0.7 mg/L to 1.1 mg/ L (Figure 3-6). The U6 drillhole (P17) and spring (P19) stations were highly oxygenated, as expected for shallow groundwater, with levels consistently above the 7 μ/L lower threshold for aquatic life in surface water. The lower DO observed at P29 may be due to the deeper level of groundwater intercepted by this drillhole relative to the shallower groundwater expected to express from the U6 drillhole or the spring.

ORP (Figure 3-7) measures the tendency of the water to oxygenate or reduce dissolved species, and serves as an indicator of changes to water quality. No ORP measurements were made at the Hari drillhole. For the limited ORP measurements at the U6 drillhole (P17) and the onsite spring (P19), levels were comparable, ranging from 29 mV to 108 mV at the U6 drillhole and from 65 mV to 161 mV at the spring.

TSS (Figure 3-8) measurements quantify the mass of suspended sediments that could be removed by filtration or settling; turbidity (Figure 3-9) measurements indicate the clarity of water and levels of suspended and dissolved matter. Turbidity and TSS are generally positively correlated for a water source. With few exceptions, turbidity and TSS were generally low (less than 10 nephelometric turbidity units [NTU] turbidity and less than 20 mg/L TSS) for all groundwater samples, with the exception of the samples collected on

[2] The samples from the Hari drillhole were collected in the weeks following well development. Development included cementing of rods that line the drillhole. This cementing may have influenced the pH of the samples collected in 2017. The results from ongoing sampling efforts may be evaluated to determine if the pH levels presented here were influenced by well development.

August 5, 2015, and August 16, 2016, at the spring (P19). On these dates, turbidity was 55.7 NTU and 48.6*J* NTU, and TSS was 54 mg/L and 86 mg/L, respectively. Rainfall in the days prior to these two sampling events may have driven the relatively higher turbidity and TSS measurements at P19.

3.2. CATIONS/ANIONS

Alkalinity (Figure 3-10) levels indicate the capability of water to neutralize acid; i.e., the buffering capacity of the water. Alkalinity may be positively correlated to hardness in areas with carbonate geology. Average alkalinity at the U6 drillhole (P17) was 116 mg/L $CaCO_3$ (ranging from 109 mg/L $CaCO_3$ to 121 mg/L $CaCO_3$), which was somewhat higher than either the nearby spring (average alkalinity of 82.6 mg/L $CaCO_3$) or the three measurements at the Hari drillhole (average alkalinity of 71.6 mg/L $CaCO_3$).

Bromide and cyanide measurements were below detection at all stations for every sampling event performed to date; time series plots are not presented for these parameters. Chloride (Figure 3-11) measurements were close to or below detection in all samples collected from groundwater monitoring locations, with the highest detected concentration at of 0.92 mg/L at the spring station P19. Chloride was also detected in two samples at the Hari drillhole, with a maximum concentration of 0.83 mg/L. Fluoride (Figure 3-12) was below detection for all samples collected at the spring. At the U6 and Hari drillholes, fluoride was above detection in all samples and averaged 0.039 mg/L and 0.076 mg/L, respectively.

Sulfate levels measured in groundwater from the drillholes were higher than the spring station (Figure 3-14), with sulfate concentrations ranging from 150 to 182 mg/L (average 162 mg/L) at the U6 drillhole (P17) and ranging from 196 mg/L to 199 mg/L (average 197 mg/L) in the three samples collected at the Hari drillhole (P29). Sulfate concentrations at the spring (P19) ranged from 27.4 mg/L to 90.9 mg/L (average 49.4 mg/L).

Ammonia (Figure 3-14) and total nitrate plus nitrite (Figure 3-15) concentrations were generally low at all groundwater stations and across all monitoring events. For ammonia, 20 of the 25 groundwater samples for ammonia were qualified as below the 0.005 mg/L reporting limit and detected values were low. The highest concentration measured to date was 0.193 mg/L at the spring station P19 in August 2015. Total nitrate plus nitrite concentrations ranged from 0.13 mg/L to 0.31 mg/L at the spring (P19). Total nitrate plus nitrite was also generally above detection at the U6 drillhole, with detected concentrations ranging from 0.031 mg/L to 0.057 mg/L. The two samples collected at the Hari drillhole were below the 0.0051 mg/L detection limit.

3.3. METALS

Time series plots of total and dissolved metals in groundwater are presented on Figures 3-16 through 3-61; for general comparison purposes only, chronic and acute aquatic life standards that apply solely to surface water are presented on the plots where relevant.

The time series plots show that, with individual exceptions discussed below, the metals concentrations are generally low in all of the groundwater monitored. Some groundwater concentrations measured at the natural spring were above the chronic and acute water quality standards for metals, as summarized in Table 3-2. Specifically:

- Station P19 (spring) sample results exceeded the chronic and acute aquatic life standard (0.75 mg/L) for total aluminum in August 2015 and August 2016,
- Station P19 (spring) sample results exceeded the chronic standard (1 mg/L) for total iron in August 2015, August 2016, and July 2017, and
- Station P19 (spring) dissolved cadmium concentration was above the hardness-based chronic aquatic life standard for one event. This sample, collected on August 5, 2015, was slightly above the calculated hardness-based standard of 0.35 μg/L, with a measured concentration of 0.64 μg/L.

No exceedances of the chronic or acute aquatic life standards were observed for any of the groundwater samples collected from drillhole locations P17 or P29.

When compared to standards for human health consumption of water and aquatic organisms, concentrations of manganese for all three samples from station P29 (Hari drillhole) and 1 sample from station P19 (spring) were above the consumption standard of 50 μg/L for manganese.

Measured metal concentrations are discussed in more detail below. Table 3-1c presents the complete set of groundwater quality results for metals measured during the baseline groundwater sampling from September 2014 through May 2018. Groundwater concentrations and screening against standards are summarized in Table 3-2.

3.3.1. Metals Results and Observations

Similar to the differences observed in the piper diagrams (Section 2), overall differences are apparent when comparing concentrations of metals in groundwater between sampling stations. In addition to the differences in distribution of major cations and anions noted in Section 2, groundwater from each of the sampling locations contained a unique composition of metals, with certain metals in greater abundance in specific locations relative to the others. For example, groundwater expressing from the natural spring (station P19) generally exhibited higher concentrations of total and dissolved cadmium and zinc concentrations than either the U6 or Hari drillhole locations (stations P17 and P29). The U6 drillhole results were higher in uranium and vanadium than the spring or Hari drillhole results, while the Hari drillhole station exhibited relatively higher manganese, strontium, and thallium. As mentioned above, the three measurements collected from station P29 were collected within the time span of 5 weeks, from July 29, 2017, through August 31, 2017. These samples may not capture the range of conditions possible for groundwater expressing through the Hari drillhole.

Groundwater measured at the spring generally exhibited higher concentrations of total (unfiltered) metals than the drillhole stations. This likely results from the shallow groundwater expressing from the natural spring, and the inflow of groundwater from percolation of rainfall and snowmelt through soils, causing solids to become entrained in the groundwater. Time series plots for unfiltered samples collected at this location indicate a number of elevated analyte concentrations in samples collected on August 5, 2015, and August 16, 2016, relative to spring samples collected on other dates. This increase is likely related to the increased suspended solids (Figure 3-9) that were observed in the August 5, 2015, and August 16, 2016, samples.

Concentrations for the following analytes were below the detection limit or exhibited low concentrations in the majority of groundwater samples collected from both drillhole and spring locations since monitoring began; time series plots are not presented for these parameters and they are not included in the discussion below: beryllium, bismuth, boron, lithium, phosphorus, potassium, silicon, tin, and titanium. The sample results and detection limits for these parameters are presented in Table 3c.

Aluminum

For dissolved aluminum (Figure 3-16), concentrations were low and similar between the spring and drillhole stations. At the spring (P19), the average dissolved aluminum concentration was 3.9 μg/L (ranging from 2.1 μg/L to 12.3 μg/L); this location exhibits low dissolved concentrations relative to total concentrations, indicating the presence of particles with higher aluminum than observed at other stations. The average of dissolved aluminum concentrations above the reporting limit at the U6 drillhole (P17) was 1.2 μg/L (ranging from 1.1 μg/L to 1.4 μg/L). Seven of the 15 dissolved samples collected from this drillhole were below the reporting limit. The average dissolved aluminum concentration at the Hari drillhole (P29) was 4.2 μg/L (ranging from 3.1 μg/L to 5.3 μg/L).

Total aluminum concentrations and aquatic life screening levels are shown on Figure 3-17. At the spring (P19), the average detected total aluminum concentration was 928 μg/L (ranging from 87 µg/L to 3,800 µg/L). The higher total aluminum concentrations relative to dissolved aluminum indicate the presence of aluminum-bearing particles in the unfiltered spring samples. For the drillholes, total aluminum concentrations were similar and were lower than the spring. The average of total aluminum concentrations above the reporting limit at the U6 drillhole (P17) was 4.8 µg/L (ranging from 3 µg/L to 5.7 µg/L). Eleven of the 15 samples collected from this drillhole were below the 3 µg/L reporting limit. For the 3 samples collected at the Hari drillhole, the average total aluminum concentration was 4.6 µg/L (ranging from 3.9 µg/L to 13.8 µg/L).

All total aluminum results for the boreholes were below the chronic and acute aquatic life standards for surface water; 2 samples from the spring at P19 had total aluminum concentrations above the standards. Because the unfiltered sample fraction was compared to the standard, which is based on total recoverable aluminum, concentrations above the standards may be related to suspended particulates included in the concentration measurement.

Antimony

Total and dissolved antimony concentrations were below the 1 µg/L reporting limit for all 15 samples collected to date at the U6 drillhole (P17) and for most of the samples collected from the spring station (P19). Time series plots are not presented for antimony. As with aluminum, the spring station results exhibit low dissolved antimony concentrations relative to total concentrations, indicating the presence of particles entrained in the unfiltered sample. Total antimony was detected in all 3 samples from the Hari drillhole (P29) and in 2 of 3 dissolved samples. The average total concentration at P29 was 0.15 µg/L and the averaged of dissolved concentrations above the reporting limit was 0.16 µg/L. There are no aquatic life criteria for antimony. The water quality standard for human consumption of water and aquatic life is 14 µg/L, which is approximately 100 times higher than the average detected groundwater concentrations.

Arsenic

Dissolved and total arsenic concentrations (Figures 3-18 and 3-19, respectively) were below the 1 µg/L reporting limit for all 15 samples collected to date at the U6 drillhole (P17), and for all of the dissolved samples collected at spring station P19. Three of the 7 unfiltered samples collected at spring were above the 0.1 µg/L reporting limit; these averaged 0.61 µg/L. All total and dissolved measurements were above the reporting limit for the Hari drillhole, with an average value of 0.21 µg/L for both total and dissolved arsenic. All groundwater samples were well below the chronic (150 µg/L) and acute (340 µg/L) aquatic life standards.

Barium

For dissolved barium (Figure 3-20), concentrations were higher at the spring relative to the drillhole stations. At the spring (P19), the average dissolved barium concentration was 75.5 μg/L (ranging from 51.1 μg/L to 190 μg/L). Dissolved barium concentrations were somewhat lower at the drillholes compared to the spring, with average dissolved barium at the U6 drillhole (P17) of 15.8 μg/L (ranging from 15 μg/L to 16.8 μg/L). The average of dissolved barium concentrations at the Hari drillhole (P29) was 31.6 μg/L (ranging from 31 μg/L to 32.4 μg/L).

At the onsite spring (P19), the average total barium concentration was 144 μg/L (ranging from 53.8 μg/L to 317 μg/L). For the drillholes, average total barium at the U6 drillhole (P17) was 16 μg/L (ranging from 14.9 μg/L to 18.6 μg/L); average total barium in the 3 Hari drillhole (P29) samples was 30.8 μg/L (ranging from 29.8 μg/L to 31.3 μg/L). Total barium results are presented on Figure 3-21. At the spring, total barium measurements from August 5, 2015, and August 16, 2016, were higher than concentrations measured on June 30, 2016, and August 3, 2016. For dissolved barium, the dissolved concentration measured on August 5, 2015, was high relative to other measurements, but the dissolved concentration on August 16, 2016, was comparable to other dissolved measurements. This indicates that solids captured in the sample during the August 16, 2016, event likely drove the higher total concentrations, but that barium was present in both total and dissolved fractions during August 2015.

Cadmium

Dissolved (Figure 3-22) and total (Figure 3-23) cadmium concentrations were below reporting limits for all samples from the U6 and Hari drillholes (station P17 and P29). Reporting limits ranged from 0.005 μg/L μg/L to 0.01 μg/L. For the spring (P19), all total and dissolved measurements were above the reporting limits. The average total cadmium was 0.43 μg/L (ranging from 0.16 μg/L to 1.0 μg/L). Average dissolved cadmium at P19 was 0.23 μg/L (ranging from 0.14 μg/L to 0.64 μg/L). The spring dissolved cadmium sample collected on August 5, 2015, was 0.64 μg/L, above the hardness-based chronic criterion of 0.35 μg/L. All other dissolved cadmium concentrations from the groundwater monitoring stations were below the hardness-based chronic and acute aquatic life standards for surface water.

Calcium

Dissolved calcium (Figure 3-24) concentrations were similar to total concentrations (Figure 3-25) at each station, indicating that calcium is present primarily in the dissolved form in groundwater. Calcium concentrations were higher at the drillholes than in the spring samples. Average total and dissolved calcium results at the spring (P19) were 45.2 mg/L and 43.5 mg/L, respectively (ranging from 36.7 mg/L to 63.9 mg/L for total and from 33.3 mg/L to 56.1 mg/L for dissolved). At the U6 drillhole (P17), the average total calcium concentration was 93.2 mg/L (ranging from 85.7 mg/L to 98.9 mg/L), and the average dissolved calcium was 93.2 mg/L (ranging from 82.7 to 99.8 mg/L). Calcium measurements at the Hari drillhole (P29) were similar, with average total calcium of 80.6 mg/L (ranging from 77.9 to 82.3 mg/L) and average dissolved calcium of 79.9 mg/L (ranging from 77.6 mg/L to 82.5 mg/L). There are no aquatic life criteria for calcium; however, calcium is a component of the hardness value, which is used to calculate the hardness-based criteria applicable to some metals.

Chromium

Dissolved chromium (Figure 3-26) concentrations were at or below the 0.1 µg/L reporting limit for all spring and drillhole samples collected to date, with the exception of a single dissolved chromium measurement of 0.23 µg/L at the Hari drillhole (P29). All dissolved chromium concentrations from the groundwater monitoring stations were below the hardness-based chronic and acute aquatic life standards for chromium III in surface water. For total chromium (Figure 3-27), the highest concentrations were measured at the spring (P19), with an average of 3.4 µg/L (ranging from 0.24 µg/L to 14.4 µg/L). The average of total chromium concentrations above the reporting limit measured at the U6 drillhole (P17) was 0.3 µg/L (ranging from 0.11 µg/L to 2.0 µg/L). Only 1 of 3 total chromium samples at the Hari drillhole (P29) was above the reporting limit, with a concentration of 1.2 µg/L.

Cobalt

Dissolved (Figure 3-28) and total (Figure 3-29) cobalt concentrations were at or below the 0.1 µg/L reporting limit for all samples from the U6 and Hari drillholes (P17 and P29). For the spring (P19), the average total cobalt concentration above the reporting limit was 1.2 µg/L (ranging from 0.1 µg/L to 4.6 µg/L). The only dissolved cobalt measurement above the reporting limit at P19 was 0.15 µg/L on August 5, 2015. There are no relevant aquatic life criteria for cobalt.

Copper

Dissolved copper concentrations and aquatic life standards are shown on Figure 3-30. Total copper concentrations are shown on Figure 3-31. Copper concentrations were more variable at the spring compared to the drillholes, with average total copper at the spring of 10.2 µg/L (ranging from 0.75 µg/L to 49.1 µg/L), and average dissolved copper (above the reporting limit) of 0.65 µg/L (ranging from 0.25 µg/L to 1.76 µg/L). At the U6 drillhole, 4 of 15 total copper results were above the reporting limit; the average of these was 0.95 µg/L (ranging from 0.53 µg/L to 2.1 µg/L). Dissolved copper concentrations for the U6 drillhole were all at or near the 0.3 µg/L reporting limit, with an average concentration of 0.34 µg/L (ranging from 0.3 µg/L to 0.4 µg/L). All total and dissolved copper concentrations measured at the Hari drillhole were below the reporting limits (0.5 µg/L for total and 0.2 µg/L for dissolved). All dissolved copper concentrations from the groundwater monitoring stations were below the hardness-based chronic and acute aquatic life standards for surface water. The water quality standard for human consumption of water and aquatic life is 1,300 µg/L, which is orders-of-magnitude above the detected groundwater concentrations.

Iron

Dissolved iron concentrations are plotted on Figure 3-32. Total iron concentrations and the acute aquatic life standards are shown on Figure 3-33. At the spring (P19), the average total iron concentration was 1.7 mg/L (ranging from 0.086 mg/L to 7.9 mg/L). Dissolved iron at P19 was below the 0.01 mg/L reporting limit for 6 of the 7 samples collected, with only the sample collected on August 5, 2015, above the reporting limit, at 0.182 mg/L. For the drillholes, average total iron above the reporting limit at the U6 drillhole (P17) was 0.083 mg/L (ranging from 0.01 mg/L to 0.51 mg/L), and the average dissolved iron concentration was 0.3 mg/L (ranging from 0.01 mg/L to 0.13 mg/L). The average of total iron concentrations at the Hari drillhole (P29) were somewhat higher than the U6 drillhole, at 0.18 mg/L (ranging from 0.17 mg/L to 0.2 mg/L). Dissolved iron concentrations averaged 0.18 mg/L (ranging from 0.15 mg/L to 0.2 mg/L) at P29. Three samples from the onsite spring at P19 had total iron concentrations above the 1 mg/L chronic aquatic life standard for surface water; acute aquatic life standards are not applicable for iron. Because the unfiltered sample fraction was compared to the standard, which is based on total iron, concentrations above the standards may be related to suspended particulates included in the concentration measurement.

Lead

Dissolved (Figure 3-34) and total (Figure 3-35) lead concentrations were below the 0.05 µg/L reporting limit for all drillhole groundwater samples collected to date at station P17 and P29. For the spring (P19), all 7 total lead results were above the reporting limit, with an average of 4.8 µg/L (ranging from 0.35 µg/L to 24 µg/L). Only two dissolved lead samples from the spring were above the reporting limit, both with a concentration of 0.28 µg/L. All dissolved lead concentrations from the groundwater monitoring stations were below the hardness-based chronic and acute aquatic life standards for surface water (Figure 3-35).

Magnesium

Similar to calcium, dissolved magnesium concentrations (Figure 3-36) were similar to total concentrations (Figure 3-37) at each station, and magnesium concentrations were higher at the drillholes than in the spring samples. Average total and dissolved magnesium results at the spring (P19) were 5.4 mg/L and 4.6 mg/L, respectively (ranging from 3.6 mg/L to 7.7 mg/L for total and from 3.1 mg/L to 5.6 mg/L for dissolved). At the U6 drillhole (P17), the average total magnesium concentration was 11 mg/L (ranging from 9.5 mg/L to 13 mg/L), and the average dissolved magnesium concentration was also 11 mg/L (ranging from 10 to 13 mg/L). Concentrations at the Hari drillhole (P29) were similar, with an average of 12 mg/L for both total and dissolved magnesium (ranging from 12 mg/L to 13 mg/L for both total and dissolved). There are no aquatic life criteria for magnesium; however, magnesium is a component of the hardness value, which is used to calculate the hardness-based criteria applicable to some metals.

Manganese

Dissolved manganese concentrations are shown on Figure 3-38; total concentrations are presented on Figure 3-39. At the spring (P19), the average total manganese concentration was 37 μg/L, with a wide concentration range from 2.3 μg/L to 170 μg/L. The average dissolved manganese concentration was 1.5 μg/L (ranging from 0.14 μg/L to 5.3 μg/L) for samples above the reporting limit. For the U6 drillhole (P17), the average of total manganese concentrations above the reporting limit was 1.1 μg/L (ranging from 0.28 μg/L to 4.2 μg/L), and dissolved manganese averaged 0.88 μg/L (ranging from 0.25 μg/L to 2.5 μg/L). Total and dissolved manganese in the 3 samples collected from the Hari drillhole were higher than the U6 drillhole, with total manganese of 69 μg/L (ranging from 61 μg/L to 74 μg/L) and dissolved manganese of 68 μg/L (ranging from 62 μg/L to 73 μg/L). There are no aquatic life criteria for manganese. When compared to the criterion for human health consumption of water and aquatic organisms, concentrations of manganese for all three samples from the Hari drillhole (P29) and 1 sample from station the spring (P19) were above the consumption standard of 50 μg/L for manganese. As noted in EPA guidance, the consumption of water + organism criterion for manganese is not based on toxic effects, but rather is related to preventing undesirable taste and discoloration (USEPA 1993).

Mercury

Dissolved (Figure 3-40) and total (Figure 3-41) mercury concentrations were below the reporting limit for all samples collected to date at the drillhole stations (P17 and P29), for 5 of 7 total mercury samples collected at the spring (P19) and for all 7 dissolved samples collected at the spring. The maximum total mercury concentration at P19 above the reporting limit was 0.025 μg/L. The reporting limit for all sampling events since 2015 was

0.005 µg/L; the reporting limit for the September 2014 sampling event was 0.01 µg/L. All of the reporting limits for dissolved mercury from the groundwater monitoring stations were below the chronic (0.77 µg/L) and acute (1.4 µg/L) aquatic life standards for surface water (Figure 3-41). The water quality criterion for human consumption of water and aquatic life is 0.05 µg/L, which is lower than aquatic life criteria for mercury. All groundwater samples were also below the human consumption criterion.

Molybdenum

Dissolved and total molybdenum concentrations were somewhat higher at the Hari drillhole station (P29) than the U6 drillhole (P17) or the spring (P19), as shown on Figures 3-42 and 3-43. For the spring (P19), average total molybdenum was 1 µg/L (ranging from 0.65 µg/L to 2.6 µg/L), and average dissolved molybdenum was 0.9 µg/L (ranging from 0.55 µg/L to 2.7 µg/L). The U6 drillhole (P17) concentrations were slightly higher than the spring, with average total molybdenum of 1.9 µg/L (ranging from 1.7 µg/L to 2.3 µg/L), and average dissolved molybdenum of 1.8 µg/L (ranging from 1.6 µg/L to 2.2 µg/L). At the Hari drillhole (P29), the average total and dissolved molybdenum concentrations were somewhat higher than both the U6 drillhole and the spring, at 16 µg/L (ranging from 15 µg/L to 16 µg/L) and 14 µg/L (ranging from 14 µg/L to 15 µg/L), respectively. The similarity of total and dissolved concentration ranges measured at each station indicates that molybdenum is present primarily in the dissolved fraction in site groundwater. There are no relevant aquatic life criteria for molybdenum.

Nickel

All dissolved nickel (Figure 3-44) groundwater concentrations were below the 0.5 µg/L reporting limit. For the spring (P19), average total nickel was 3.7 µg/L (ranging from 1.2 µg/L to 7.0 µg/L; Figure 3-45) for the 3 results above the reporting limit. One sample at the U6 drillhole (P17) was above the reporting limit, at 0.7 µg/L. All of the reporting limits for dissolved nickel from the groundwater monitoring stations were below the nickel chronic and acute aquatic life standards for surface water (Figure 3-45). The water quality standard for human consumption of water and aquatic life is 610 µg/L, far above the reporting limit.

Selenium

Dissolved selenium concentrations are presented on Figure 3-46; total selenium concentrations and the chronic aquatic life standard are shown on Figure 3-47. At the spring (P19) the average total selenium concentration was 0.64 µg/L (ranging from 0.50 µg/L to 0.72 µg/L). The average concentration at the U6 drillhole (P17) was 1.1 µg/L (ranging from 0.9 µg/L to 1.2 µg/L). Total selenium at the Hari drillhole (P29) was below the 0.05 µg/L reporting limit for all 3 samples collected. All total selenium concentrations from the groundwater monitoring stations were well below the chronic aquatic life standard of 5 µg/L for surface water; acute aquatic life standards do not apply to selenium. The water quality standard for human consumption of water and aquatic life is 170 µg/L, far above the reporting limit and maximum detected groundwater concentrations.

Dissolved selenium concentrations were similar to total concentrations at each station. At the spring the average dissolved selenium concentration was 0.59 µg/L (ranging from 0.44 µg/L to 0.71 µg/L). The average concentration at the U6 drillhole was 1.1 µg/L (ranging from 0.88 µg/L to 1.2 µg/L). Dissolved selenium at the Hari drillhole was close to or below the 0.05 µg/L reporting limit for all 3 samples collected.

Silver

Dissolved silver concentrations and chronic aquatic life standards are presented on Figure 3-48; total silver concentrations are shown on Figure 3-49. Silver concentrations were below the 0.1 µg/L reporting limit for most total (unfiltered) samples and all dissolved samples measured at the spring and drillhole locations. For the spring (P19), average total silver was 0.16 µg/L (ranging from 0.015 µg/L to 0.33 µg/L) for the 4 results above the reporting limit. All total and dissolved silver sample results at the U6 and Hari drillholes were below the reporting limit. All of the reporting limits for dissolved silver from the groundwater monitoring stations were below the acute aquatic life standards for surface water (Figure 3-49); chronic standards do not apply for silver.

Sodium

Similar to calcium and magnesium, dissolved sodium concentrations (Figure 3-50 were similar to total concentrations (Figure 3-51) and sodium concentrations were higher at the drillholes than in the spring samples, with the exception of the single higher concentration measured at the P19 spring station in August 2015. Average total and dissolved sodium results at the spring (P19) were 2.7 mg/L and 2.8 mg/L, respectively. At the spring, sodium results ranged from 0.6 mg/L to 1.1 mg/L, with the exception of higher values measured in August 2015 at 13.5 mg/L (total) and 14.4 mg/L (dissolved). The cause of these relatively higher sodium measurements at the spring has not been identified. At the U6 drillhole (P17), the average total sodium concentration was 2.4 mg/L (ranging from 2.2 mg/L to 2.7 mg/L), and the average dissolved sodium concentration was also 2.4 mg/L (ranging from 2.2 to 2.6 mg/L). Concentrations at the Hari drillhole (P29) were slightly higher, with an average of 4.5 mg/L (ranging from 4.3 mg/L to 4.7 mg/L) for total sodium and 4.6 mg/L (ranging from 4.4 mg/L to 4.6 mg/L) for dissolved sodium. There are no relevant aquatic life criteria for sodium.

Strontium

Dissolved (Figure 3-52) and total (Figure 3-53) strontium concentrations were similar, indicating that strontium is present primarily as a dissolved constituent. For total strontium, the average concentration at the onsite spring (P19) was 150 μg/L (ranging from 110 μg/L to 252 μg/L). Dissolved concentrations were similar, with average dissolved strontium at the spring of 150 μg/L (ranging from 105 μg/L to 250 μg/L). Total and dissolved strontium concentrations were slightly higher at the drillholes. At the U6 drillhole (P17) average total strontium was 601 μg/L (ranging from 508 μg/L to 780 μg/L), and average dissolved strontium was 590 μg/L (ranging from 510 μg/L to 760 μg/L). For the three samples collected at the Hari drillhole (P29) average total strontium was higher than at the U6 drillhole, at 1,800 μg/L (ranging from 1,700 μg/L to 1,800 μg/L), and average dissolved strontium was 1,700 μg/L (ranging from 1,710 μg/L to 1,730 μg/L). There are no relevant aquatic life criteria for strontium.

Thallium

Dissolved and total thallium concentrations are presented on Figures 3-54 and 3-55, respectively. For the spring (P19), dissolved thallium concentrations were below the 0.1 μg/L reporting limit for all of the samples collected to date; for total thallium, the average of the 3 spring samples above the reporting limit was 0.03 μg/L (ranging from 0.07 μg/L to 0.1 μg/L). For the U6 drillhole, 14 of 15 samples were below the reporting limit for both total and dissolved thallium. The total and dissolved results above the reporting limit were 0.013 μg/L and 0.011 μg/L, respectively. In contrast, all of the total and dissolved results measured in the 3 samples collected at the Hari drillhole (P29) were above the reporting limit. Total thallium at P29 averaged 0.02 μg/L (ranging from 0.014 μg/L to 0.02 μg/L) and dissolved thallium also averaged 0.02 μg/L (ranging from 0.016 μg/L to 0.02 μg/L). There are no relevant aquatic life criteria for thallium. Detected groundwater concentrations were far below the 1.7 μg/L criterion for human health consumption of water and aquatic organisms.

Uranium

Dissolved (Figure 3-56) and total (Figure 3-57) uranium concentrations were higher at the U6 drillhole than the spring or Hari drillhole locations. At the onsite spring (P19) the average total uranium concentration was 0.11 μg/L (ranging from 0.074 μg/L to 0.15 μg/L). Dissolved concentrations at the spring were similar, with average dissolved uranium concentration of 0.099 μg/L (ranging from 0.057 μg/L to 0.14 μg/L). For total uranium, the average concentration at the U6 drillhole (P17) was 0.29 μg/L (ranging from 0.23 μg/L to 0.32 μg/L), and the average concentration at the Hari drillhole was lower at 0.024 μg/L (ranging from 0.023 μg/L to 0.024 μg/L). Average dissolved uranium at the U6 drillhole was 0.28 μg/L (ranging from 0.22 μg/L to 0.31 μg/L), and averaged dissolved uranium at the Hari drillhole was 0.023 μg/L (ranging from 0.021 μg/L to 0.025 μg/L). There are no relevant aquatic life criteria for uranium.

Vanadium

Similar to thallium, dissolved vanadium concentrations were somewhat higher at the U6 drillhole relative to the other groundwater stations (Figure 3-58). Total vanadium (Figure 3-59) was above the 0.5 μg/L reporting limit for 6 of the 7 samples collected at the spring (P19), with an average concentration of 4.4 μg/L (ranging from 0.52 μg/L to 17 μg/L); however, all dissolved vanadium sample concentrations from this spring were below the reporting limit. For the U6 drillhole (P17), the average concentration of total vanadium samples with concentrations above the reporting limit was 0.81 μg/L (ranging from 0.56 μg/L to 2.3 μg/L), and the average of dissolved vanadium samples with concentrations above the reporting limit was also 0.56 μg/L (ranging from 0.52 μg/L to 0.63 μg/L). All total and dissolved vanadium concentrations measured at the Hari drillhole (P29) were below the 0.5 μg/L reporting limit.

Zinc

Dissolved zinc concentrations and aquatic life criteria are shown on Figure 3-60. Total concentrations are presented on Figure 3-61. Zinc concentrations were above reporting limits in all total and dissolved samples collected at the spring (P19) location, with average total zinc of 60 μg/L (ranging from 11 μg/L to 270 μg/L), and average dissolved zinc concentration of 8.4 μg/L (ranging from 6.6 μg/L to 15 μg/L). In contrast, dissolved zinc concentrations were at or below the 1 μg/L to 2 μg/L reporting limits for all samples collected from the U6 (P17) and Hari drillholes (P29). For total zinc, the average concentration of the 5 U6 samples above the reporting limit was 1.1 μg/L (ranging from 0.63 μg/L to 2 μg/L). The average total zinc at the Hari drillhole was 1 mg/L (ranging from 1.1 μg/L to 2 μg/L). All dissolved zinc concentrations from the groundwater monitoring stations were below the hardness-based chronic and acute aquatic life standards for surface water. Detected groundwater concentrations were also far below the 9,100 μg/L criterion for human health consumption of water and aquatic organisms.

4. SUMMARY

This memorandum summarizes baseline groundwater quality data for the Palmer project area collected from September 2014 to May 2018 from two exploratory drillholes and one natural artesian spring. Differences in the groundwater source, local geology, and mineralization are expected to influence water quality and to drive the variations observed in conventional, major ion, and metal concentrations between sampling locations.

The following are key findings of this evaluation of groundwater quality:

- All groundwater stations monitored exhibit generally high water quality.
- No exceedances of aquatic life water quality standards were observed for the U6 or Hari drillhole samples.
- For the natural spring (station P19), some groundwater concentrations were above the chronic and acute water quality standards for metals: total aluminum (two results), total iron (three results), and dissolved cadmium (one result). Both aluminum and iron are common components of soil and suspended sediment particulates in water. Because the unfiltered sample fraction was compared to the standards, which are based on total recoverable aluminum and total recoverable iron, the sample concentrations are influenced by aluminum and iron associated with particulates suspended in the water.
- One sample collected at the spring was above the dissolved cadmium aquatic life standard for surface water; this relatively higher concentration is likely associated with the natural occurrence of some metals due to geochemical interaction of groundwater with the local geologic formations, and is representative of the background groundwater quality conditions of the spring location. Ongoing data collection across seasons will add to the developing understanding of the regional and local groundwater quality conditions in the vicinity of the project area.
- Samples from the Hari drillhole and the spring were above the human health consumption criterion for manganese. The manganese criterion is based on preventing undesirable taste and discoloration and is not indicative of water toxicity.

Both the U6 (P17) and Hari (P29) drillholes are located in areas where future underground development is expected to occur. The groundwater results collected to date for these two stations indicate the high quality of groundwater in these areas. Differences in water quality observed between the two drillhole groundwater stations is likely attributable to drillhole location and local hydrogeology. The U6 drillhole (P17) is adjacent to a primary mineralized area of the project, known as the South Wall zone, while the Hari drillhole

(P29) intercepts drainage associated with the Jasper Mountain area. Sulfate levels were generally lower in samples from the U6 drillhole relative to the three Hari drillhole samples.

The natural spring (P19) exhibited somewhat more variability in water quality relative to the drillhole stations. Increases in turbidity and TSS at this location following periods of precipitation indicate that the onsite spring is fed by a shallow groundwater source that is influenced by precipitation events and suspended sediment particles.

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FIGURES

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Property Boundary

0 10 20
Miles

N

Basemap Source:
National Geographic World Map

Figure 1-1.
Property Location Map Palmer Project
Baseline Groundwater Quality Memorandum

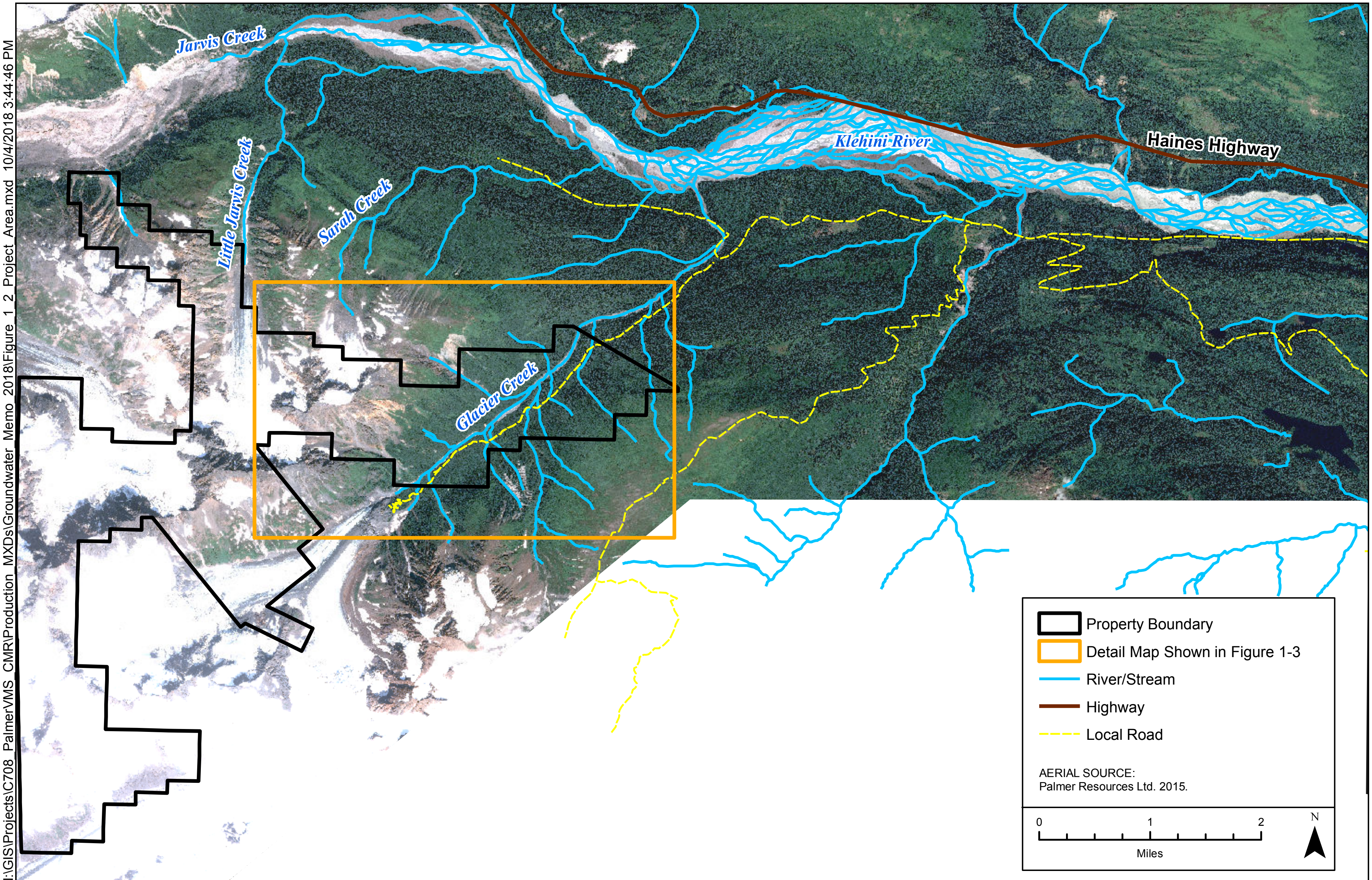

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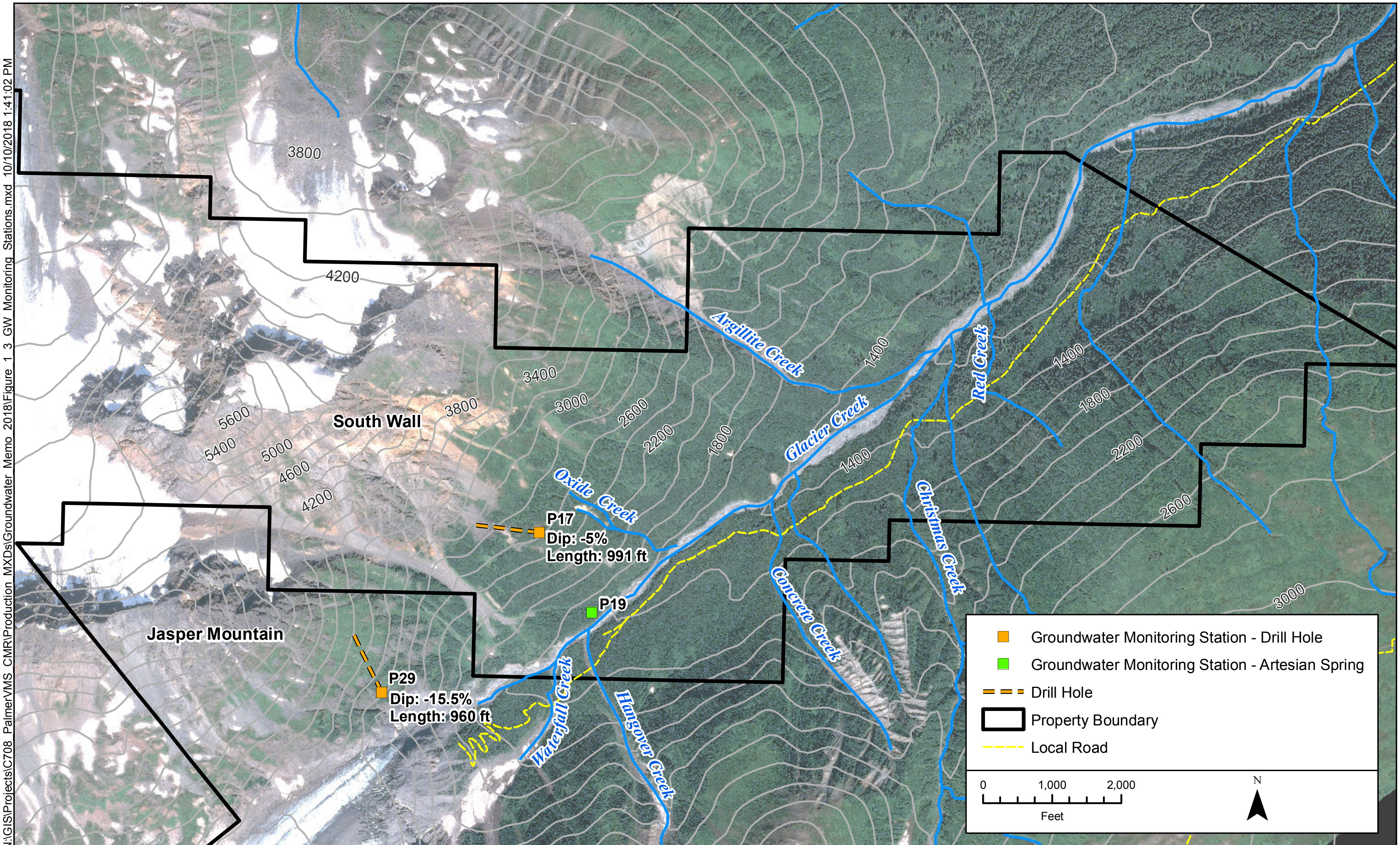
Figure 1-2.
Palmer Project
Project Area and Regional Hydrology
Baseline Groundwater Quality Memorandum



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Aerial Source: Palmer Resources Ltd. 2015
Contour Source: (Unknown) ft AMSL 1999
Hydrography and Resource Area Source: Constantine North 2018

Figure 1-3.
Palmer Project
Groundwater Monitoring Stations
Baseline Groundwater Quality Memorandum

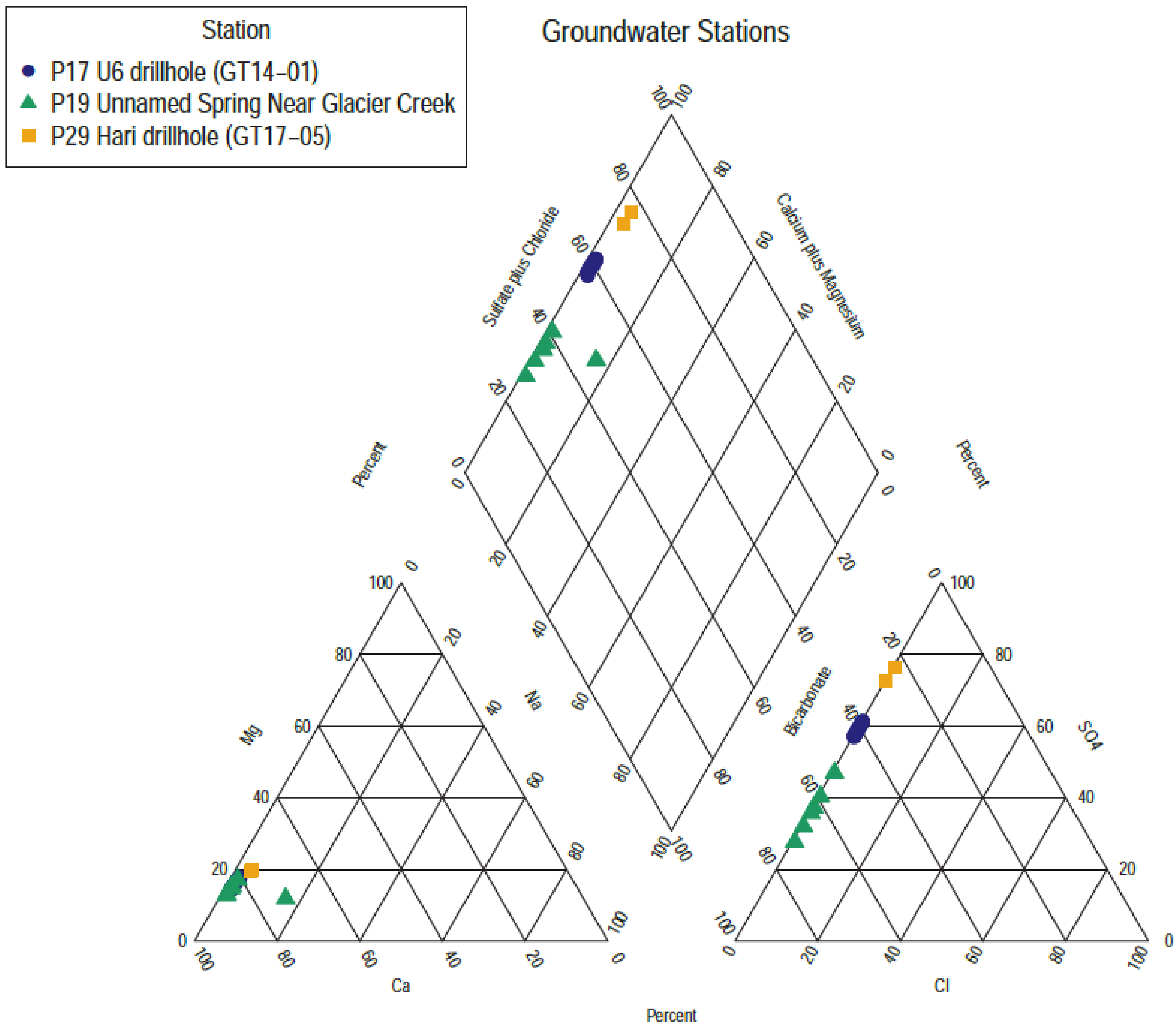
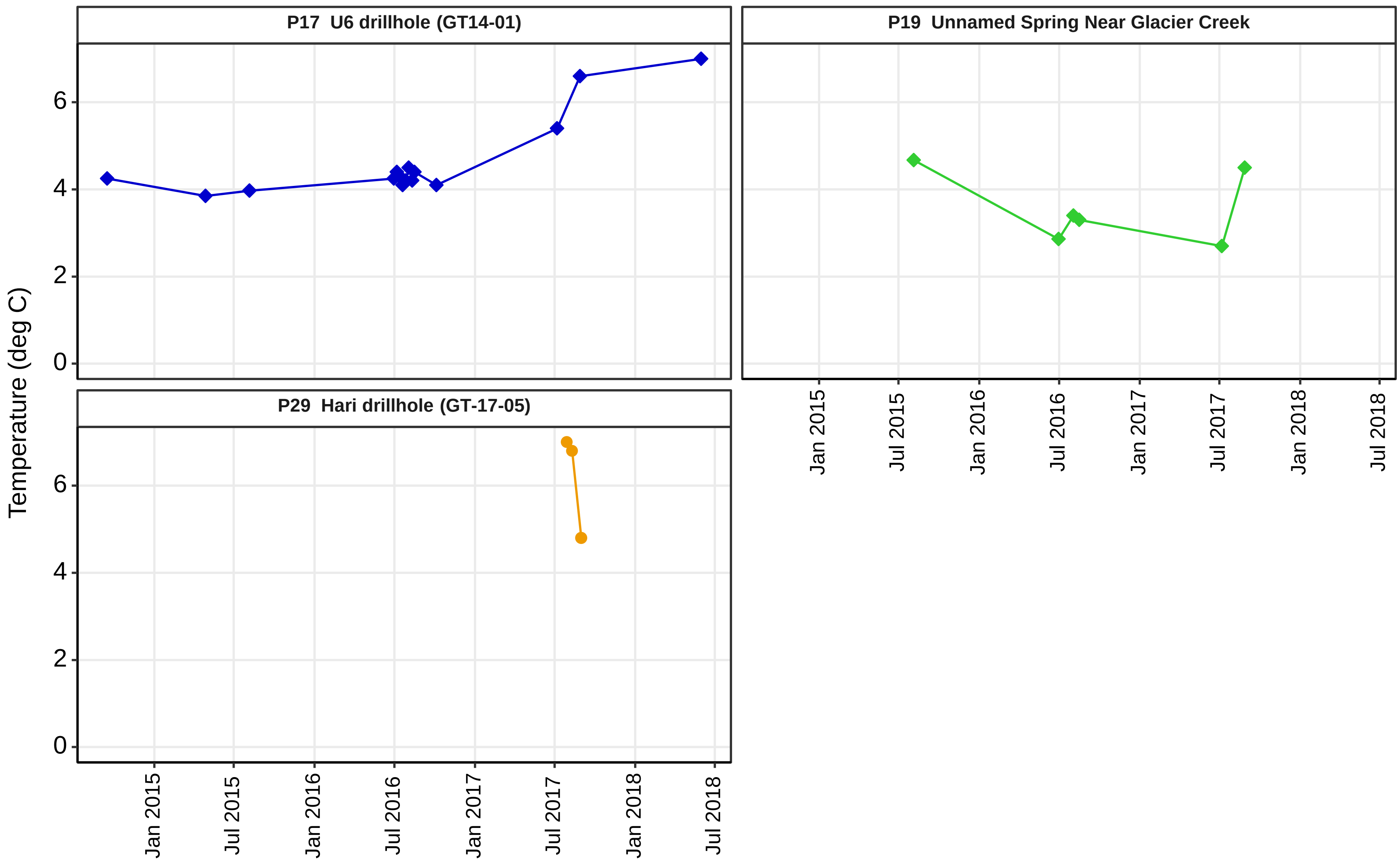


Figure 2-1
Piper Plot: Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



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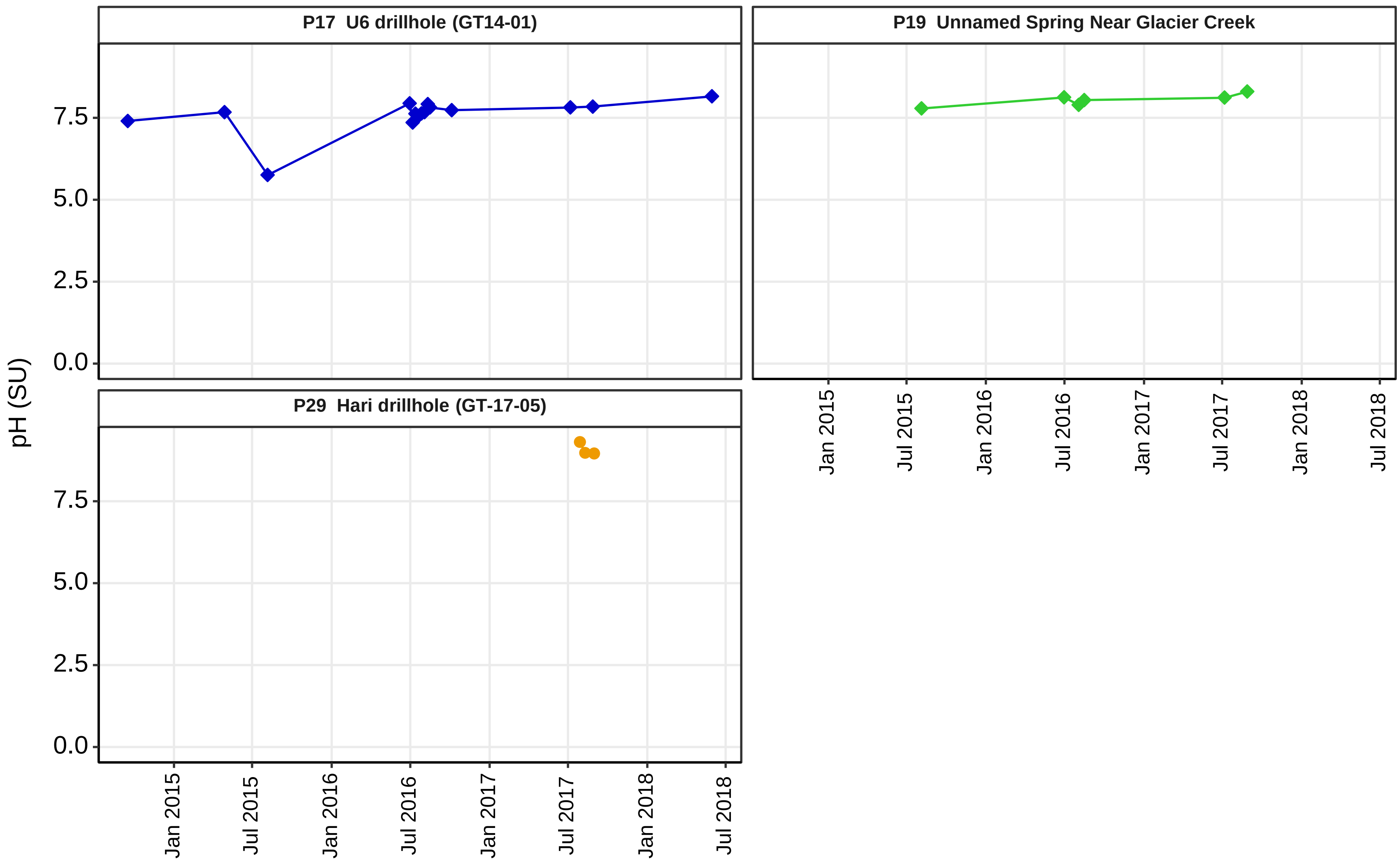
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-1. Time Series Plots: Temperature Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
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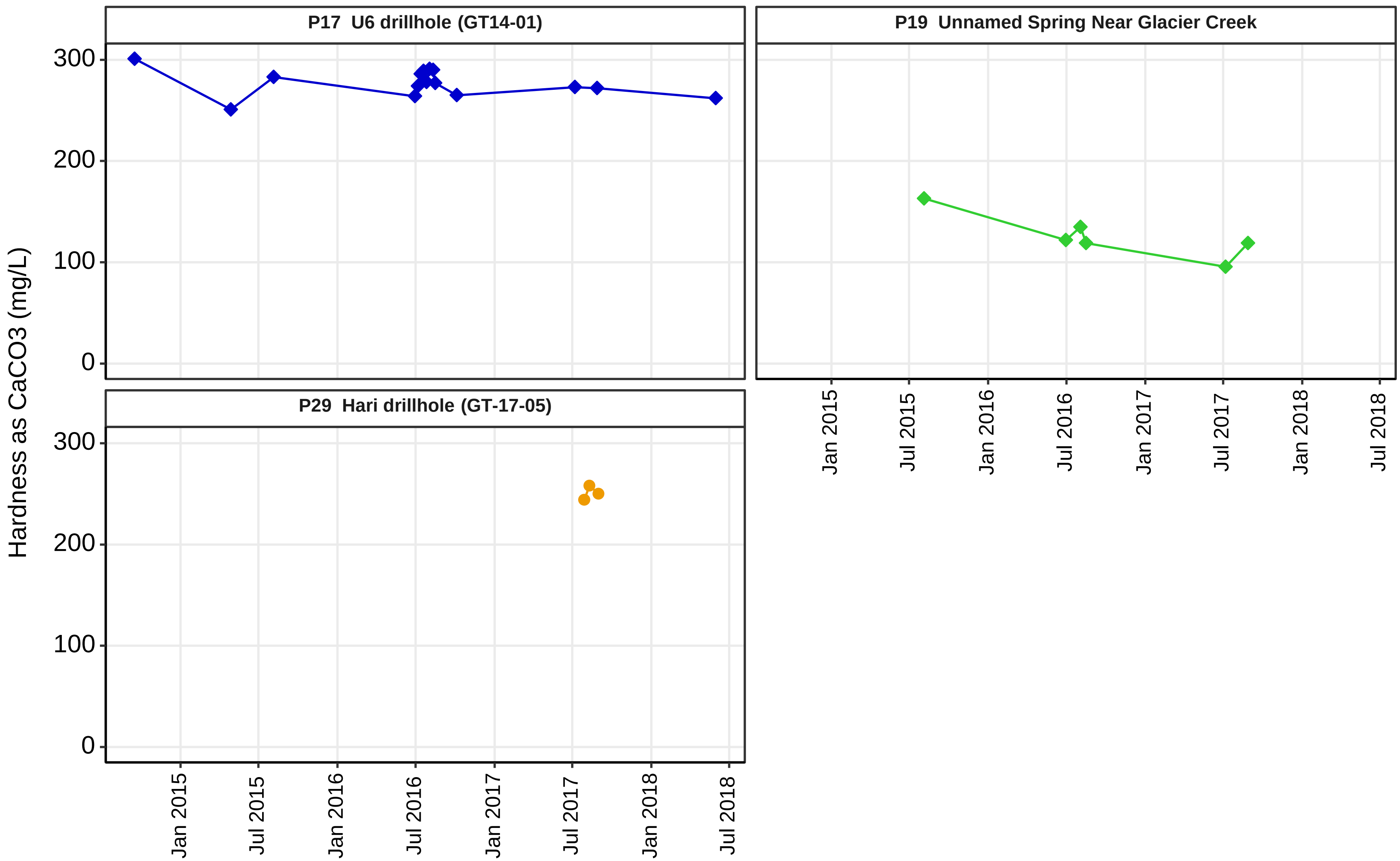
Figure 3-2. Time Series Plots: pH Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



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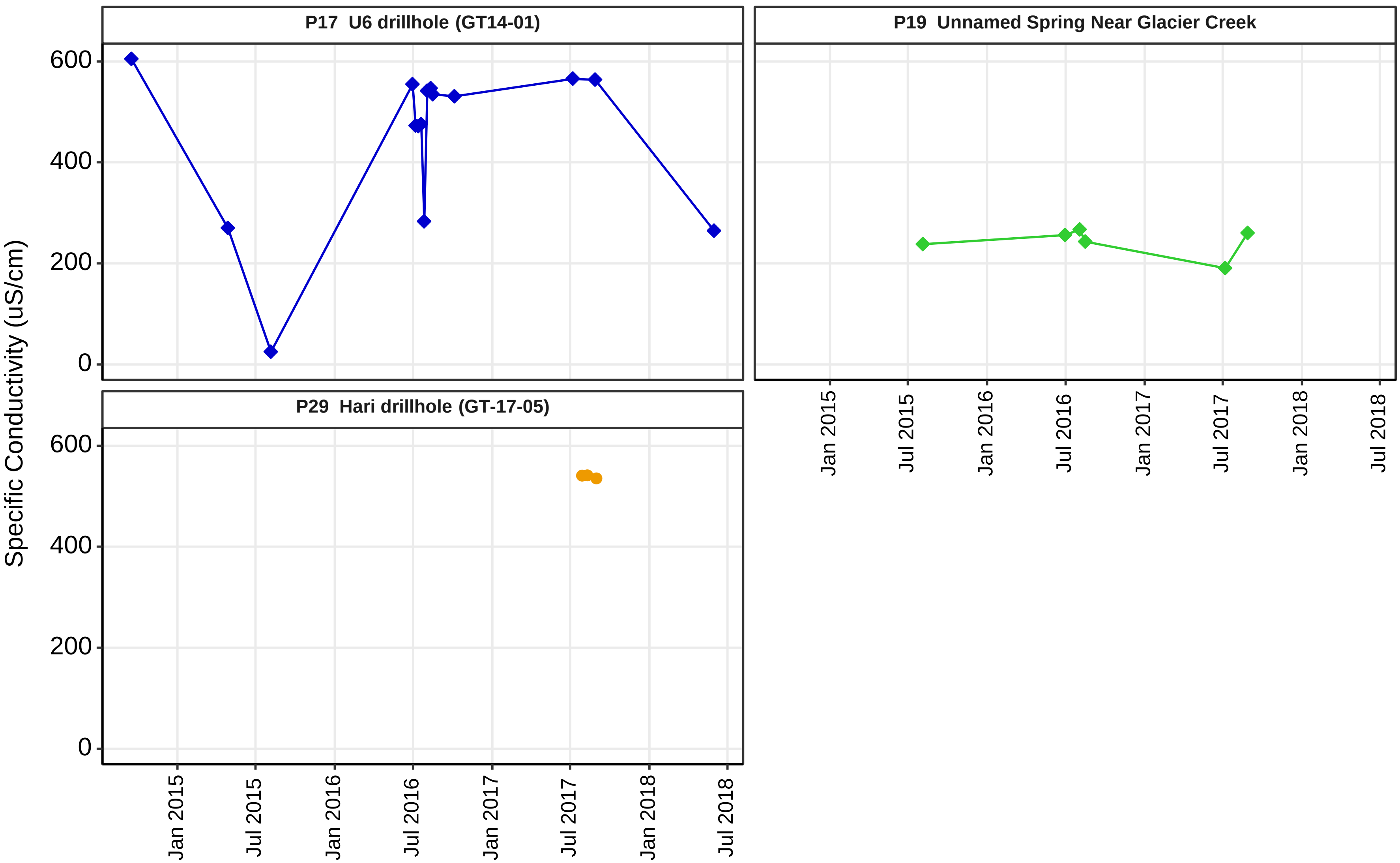
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-3. Time Series Plots: Hardness as CaCO3 Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



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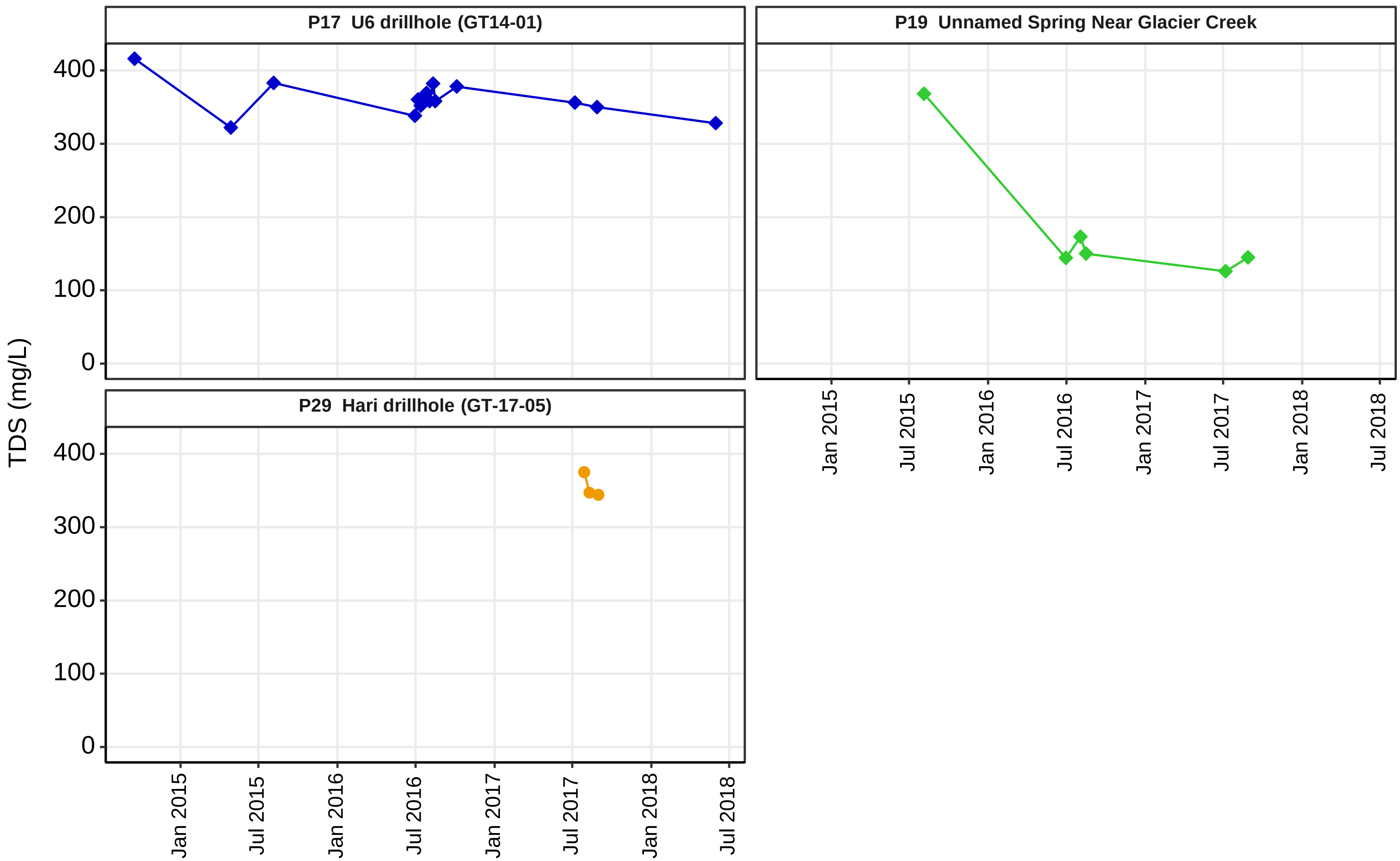
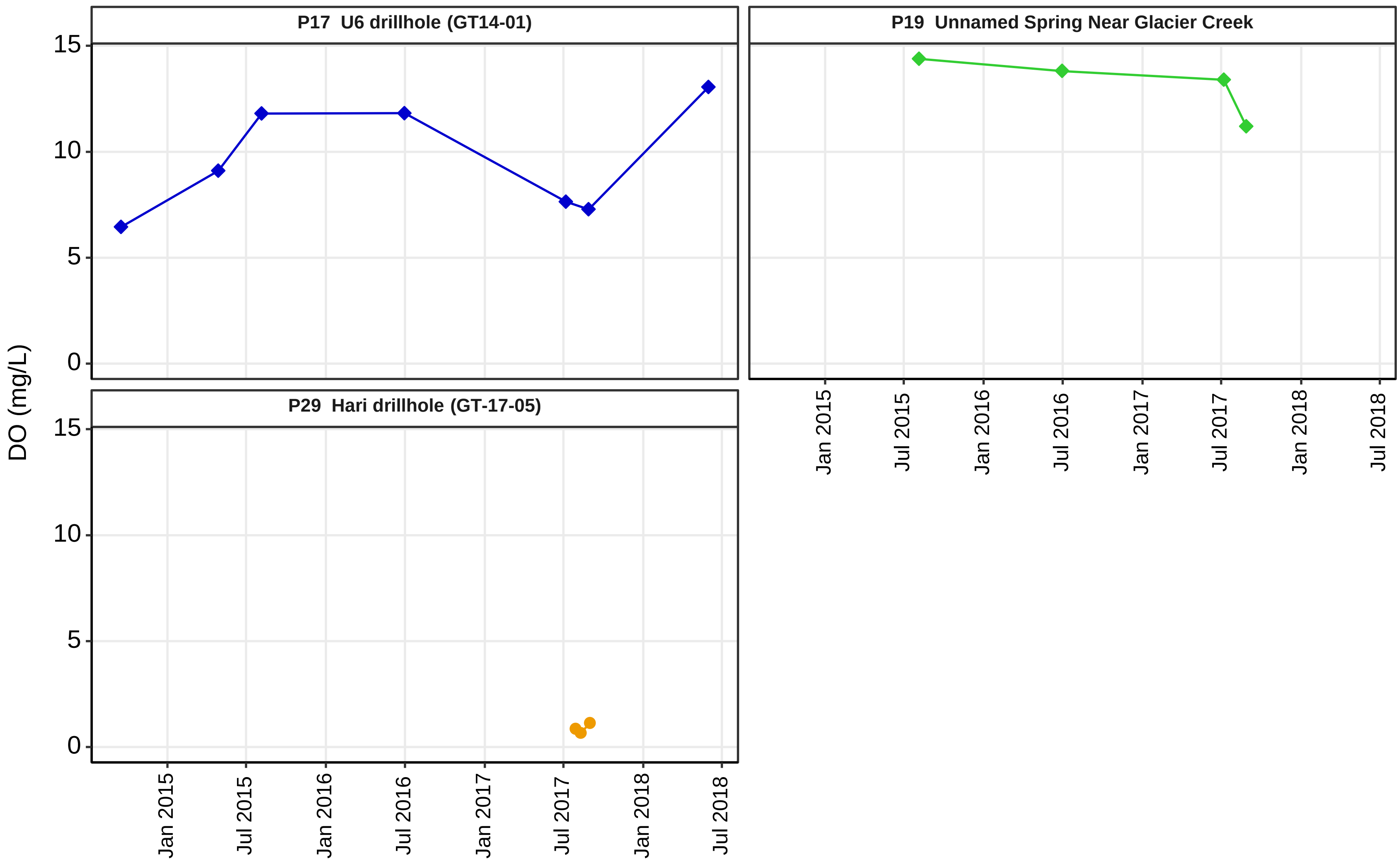
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-4. Time Series Plots: Specific Conductivity Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-5. Time Series Plots: TDS Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



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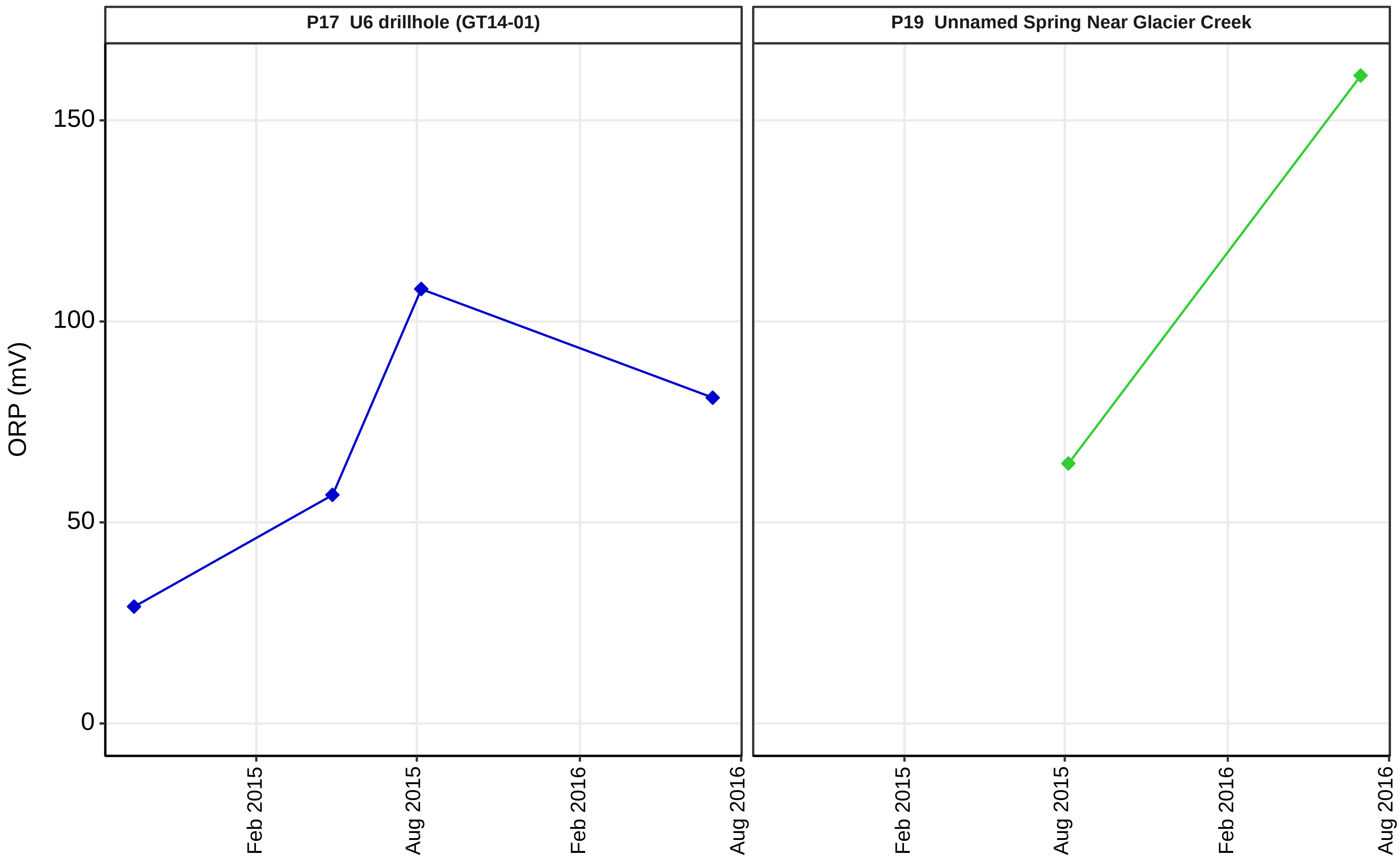
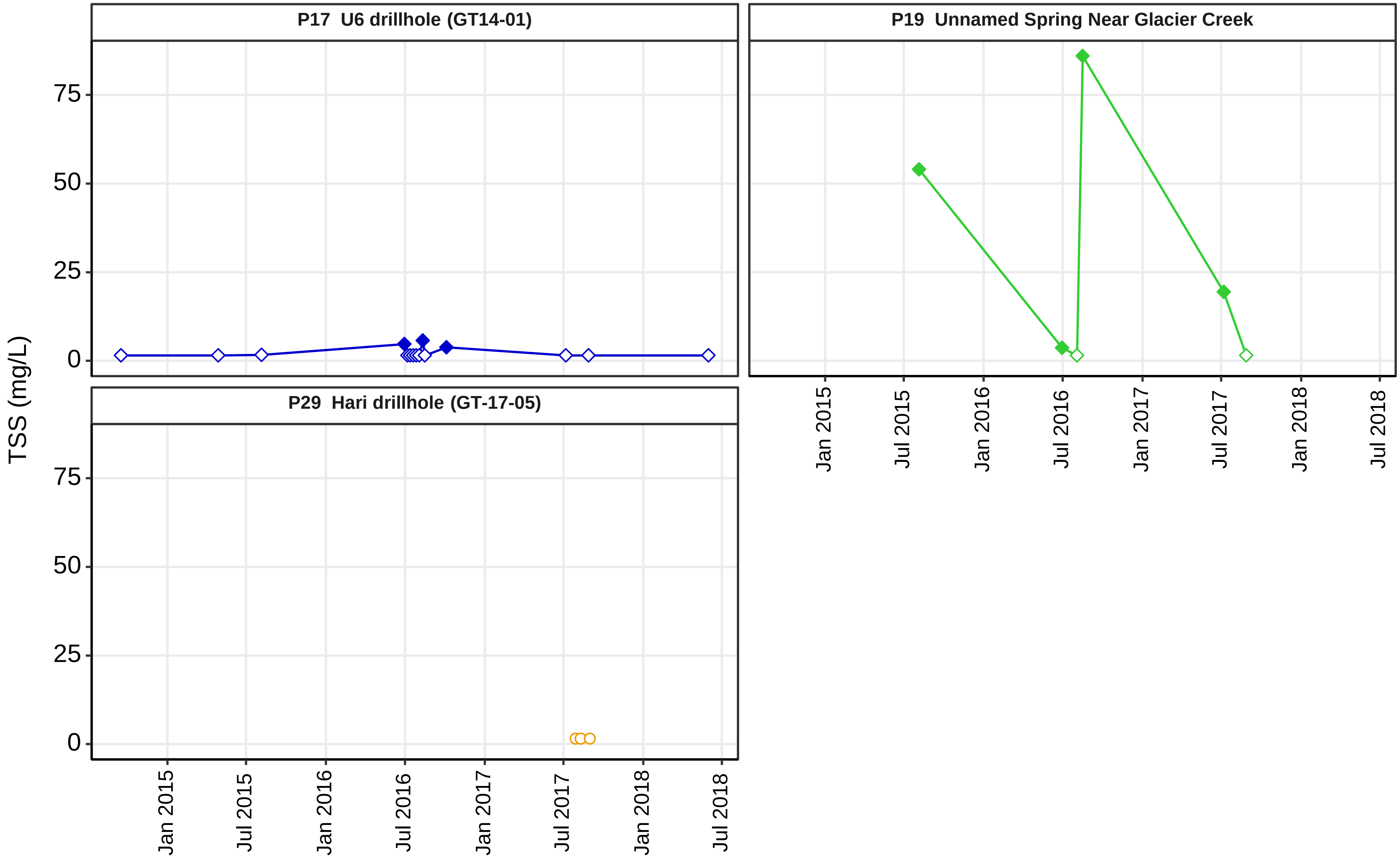
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-6. Time Series Plots: DO Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

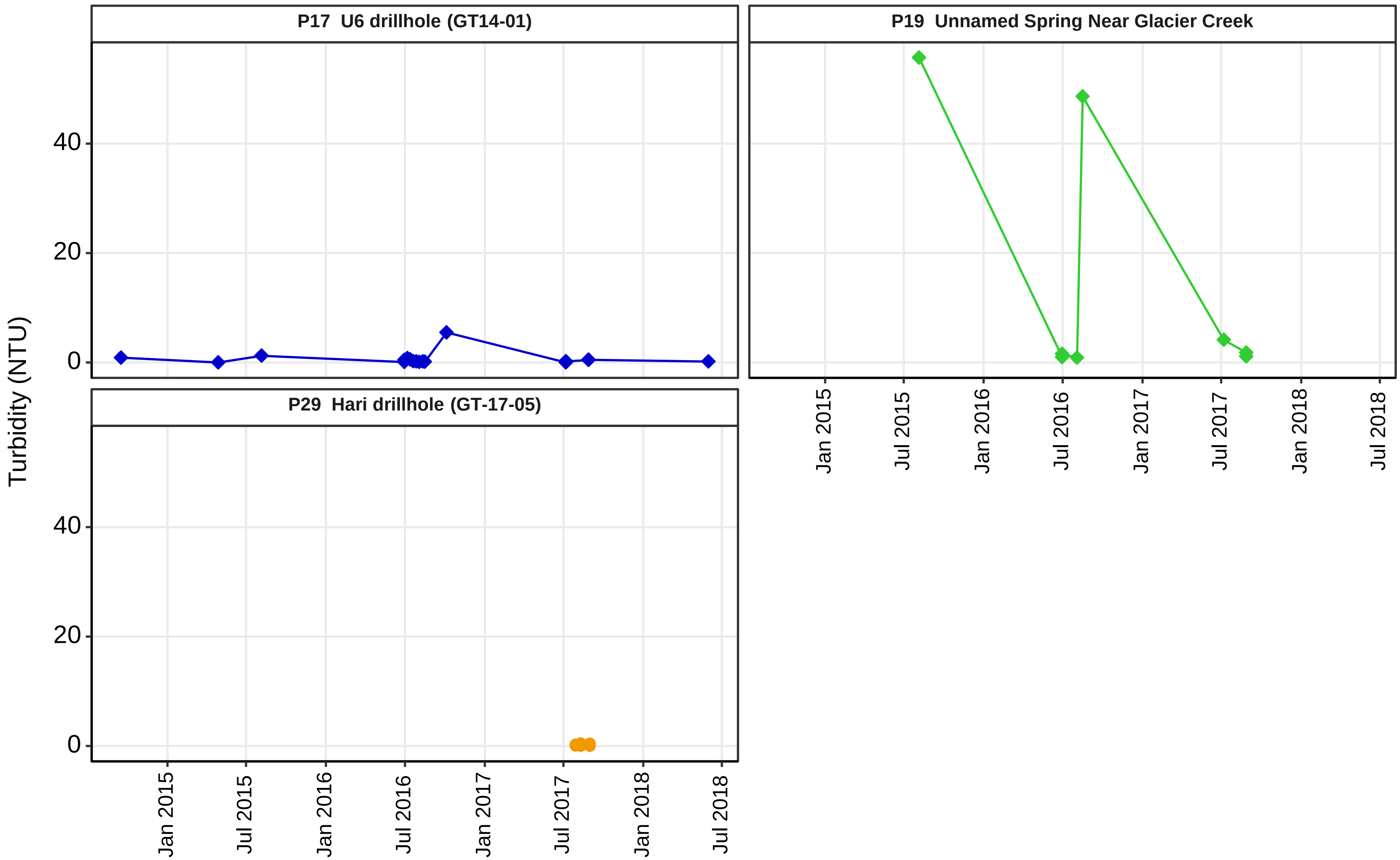
Figure 3-7. Time Series Plots: ORP Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

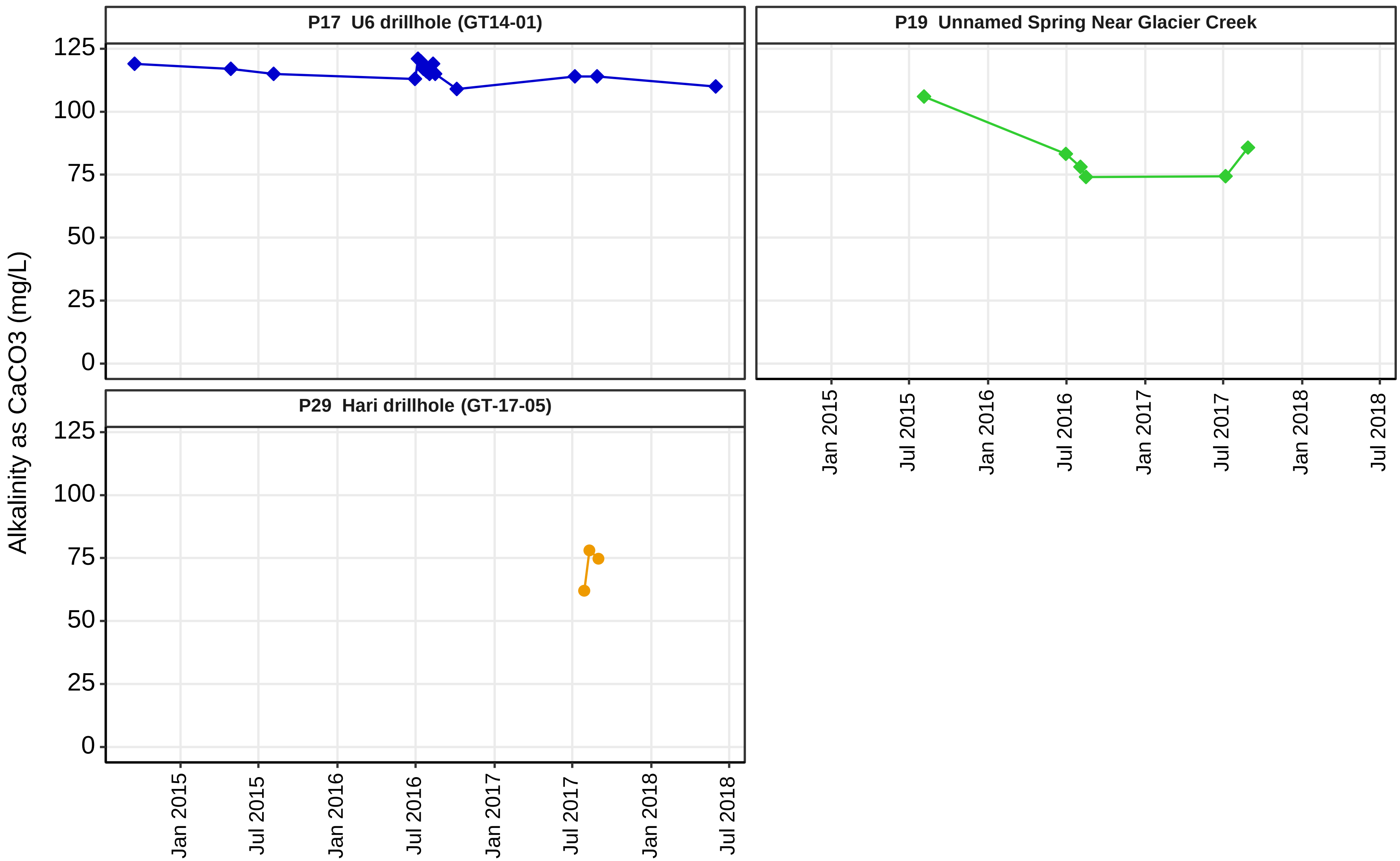
Figure 3-8. Time Series Plots: TSS Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

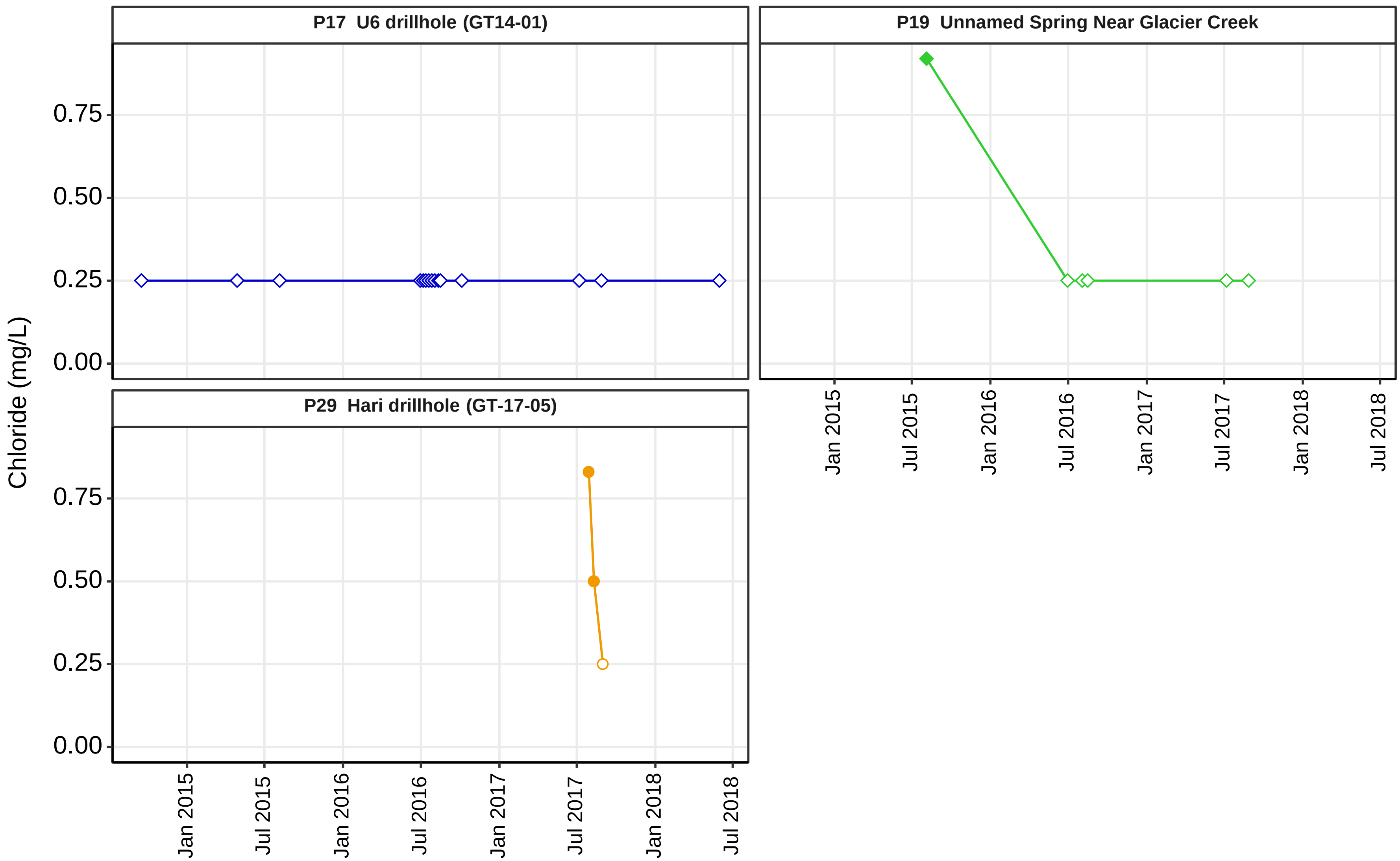
Figure 3-9. Time Series Plots: Turbidity Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

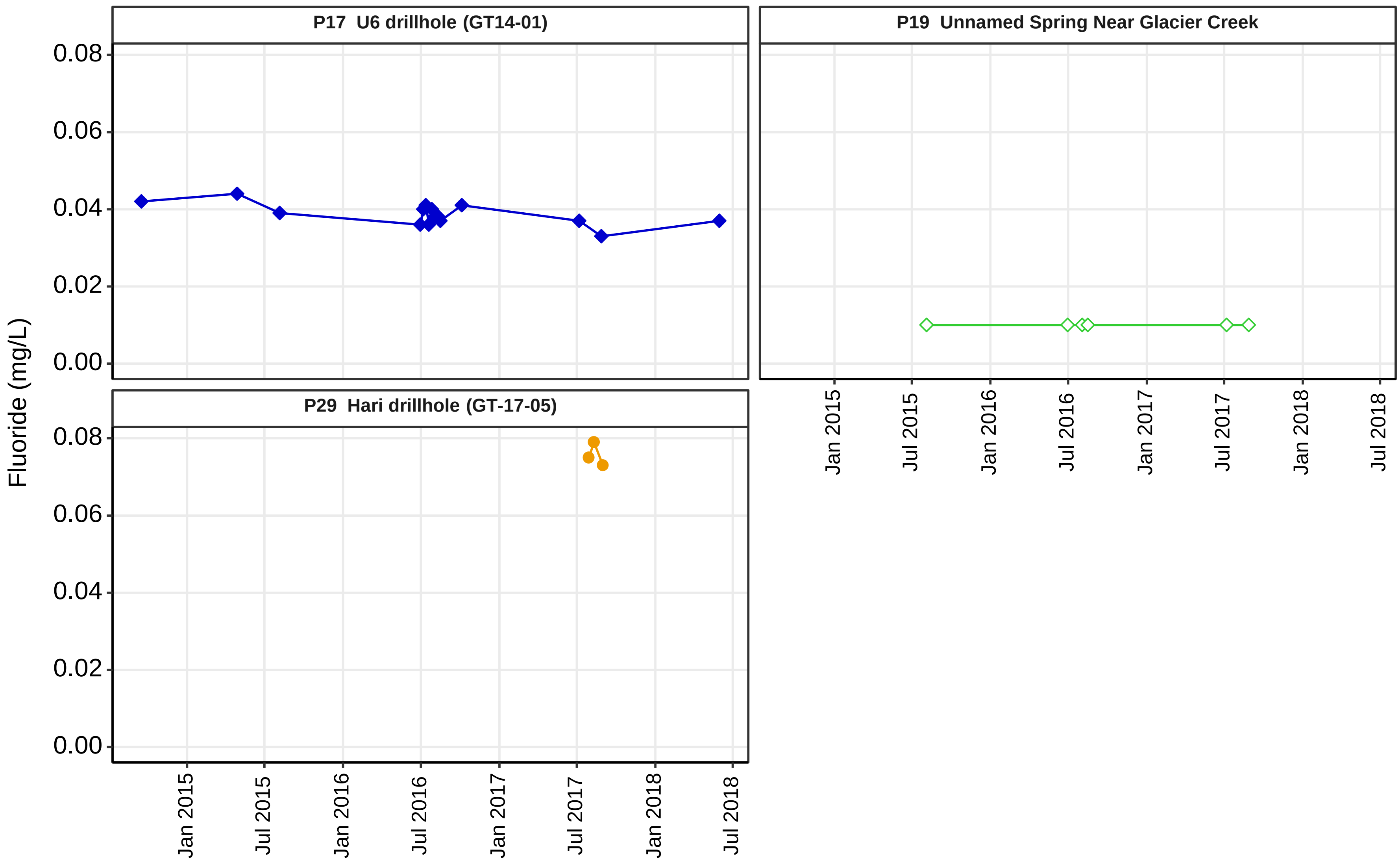
Figure 3-10. Time Series Plots: Alkalinity as CaCO3 Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

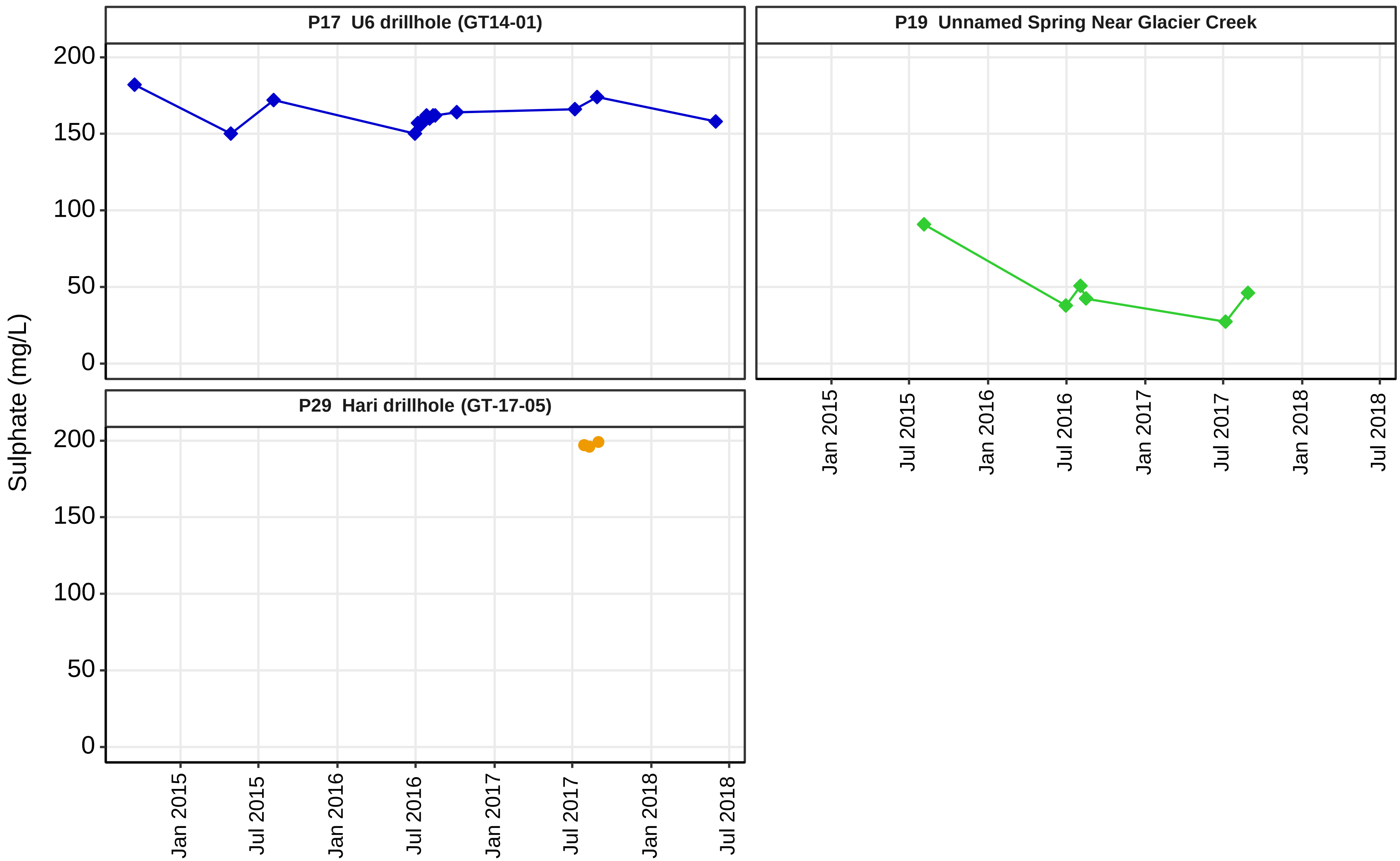
Figure 3-11. Time Series Plots: Chloride Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

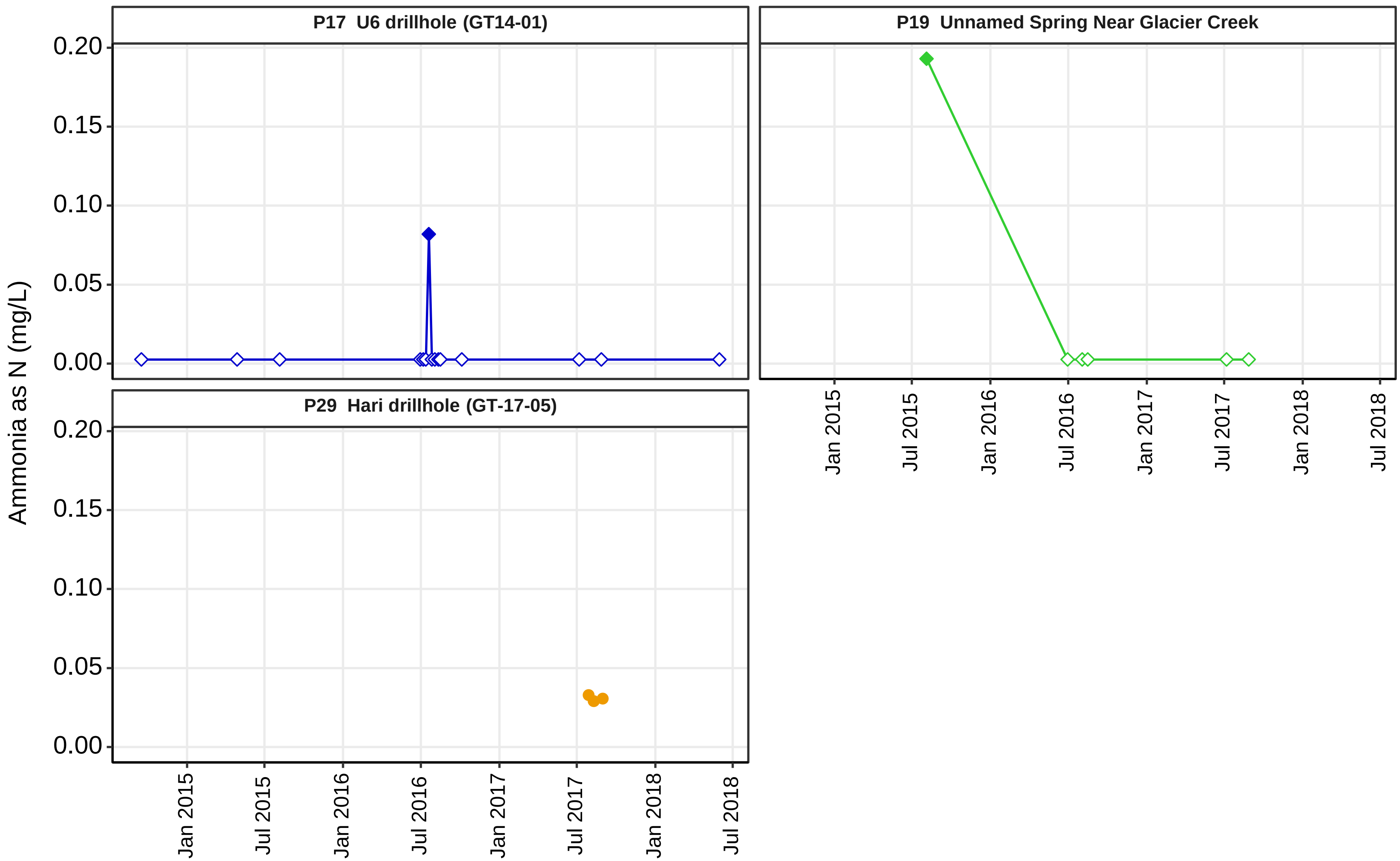
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-12. Time Series Plots: Fluoride Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

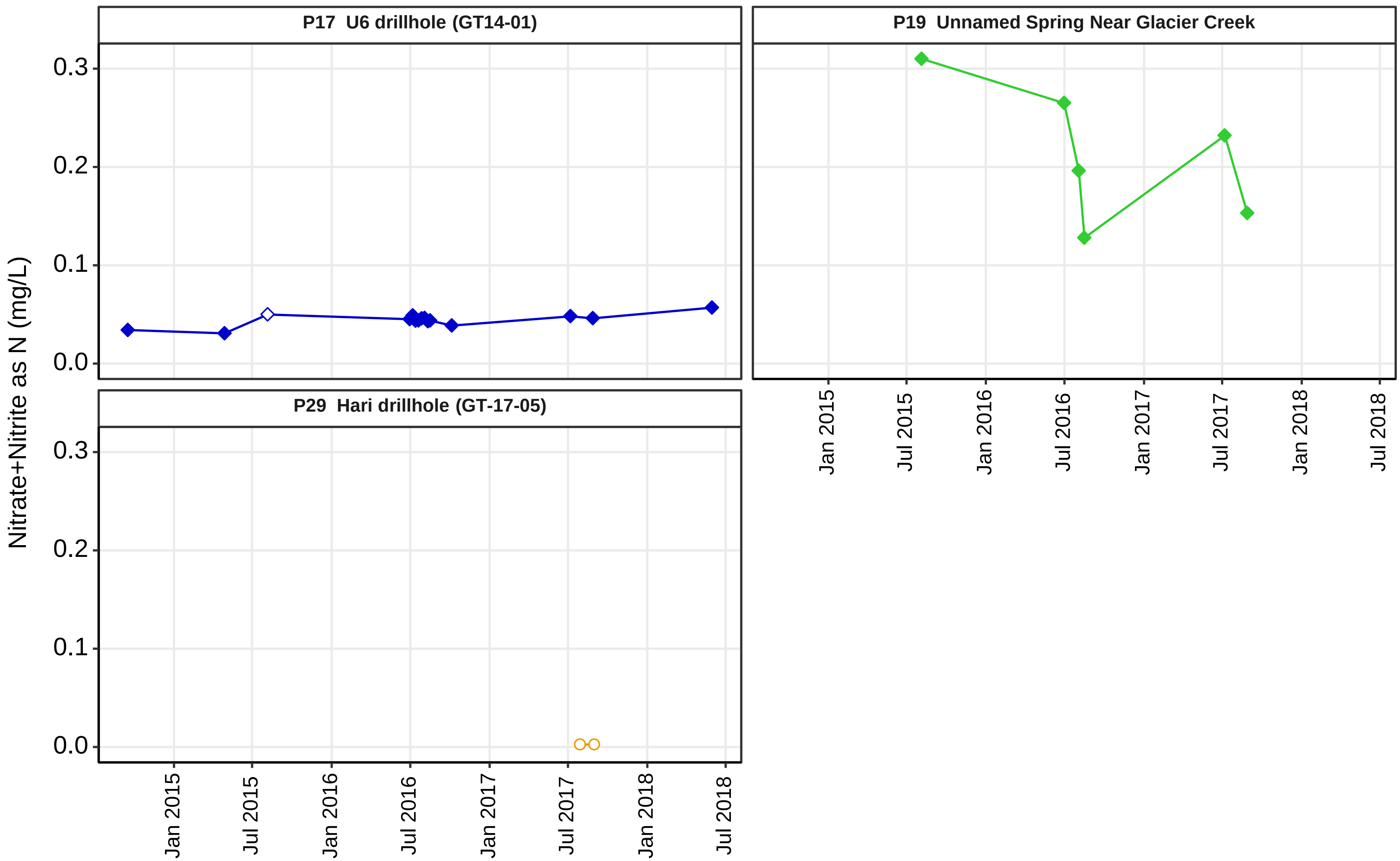
Figure 3-13. Time Series Plots: Sulphate Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

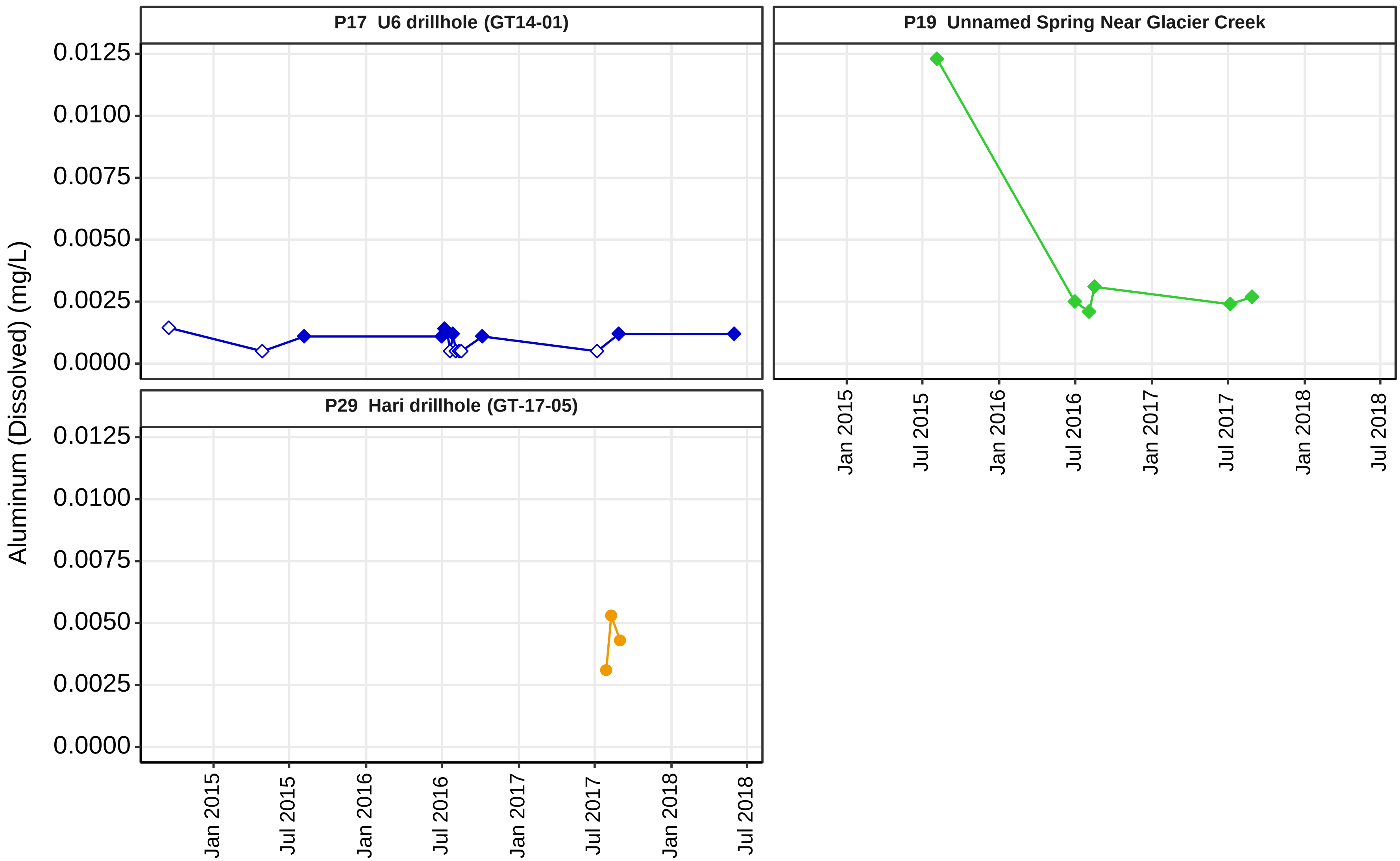
Figure 3-14. Time Series Plots: Ammonia as N Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

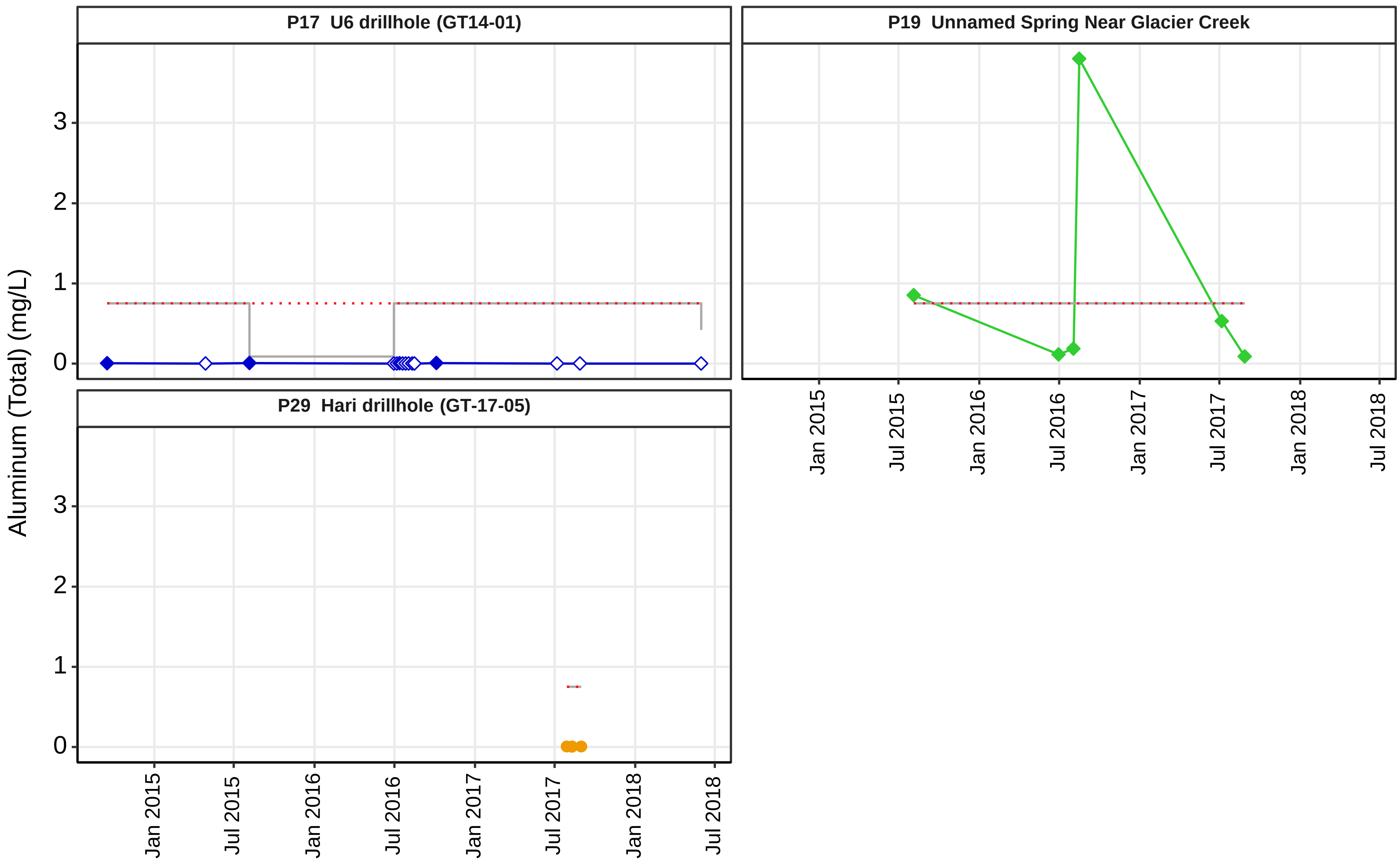
Figure 3-15. Time Series Plots: Nitrate+Nitrite as N Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

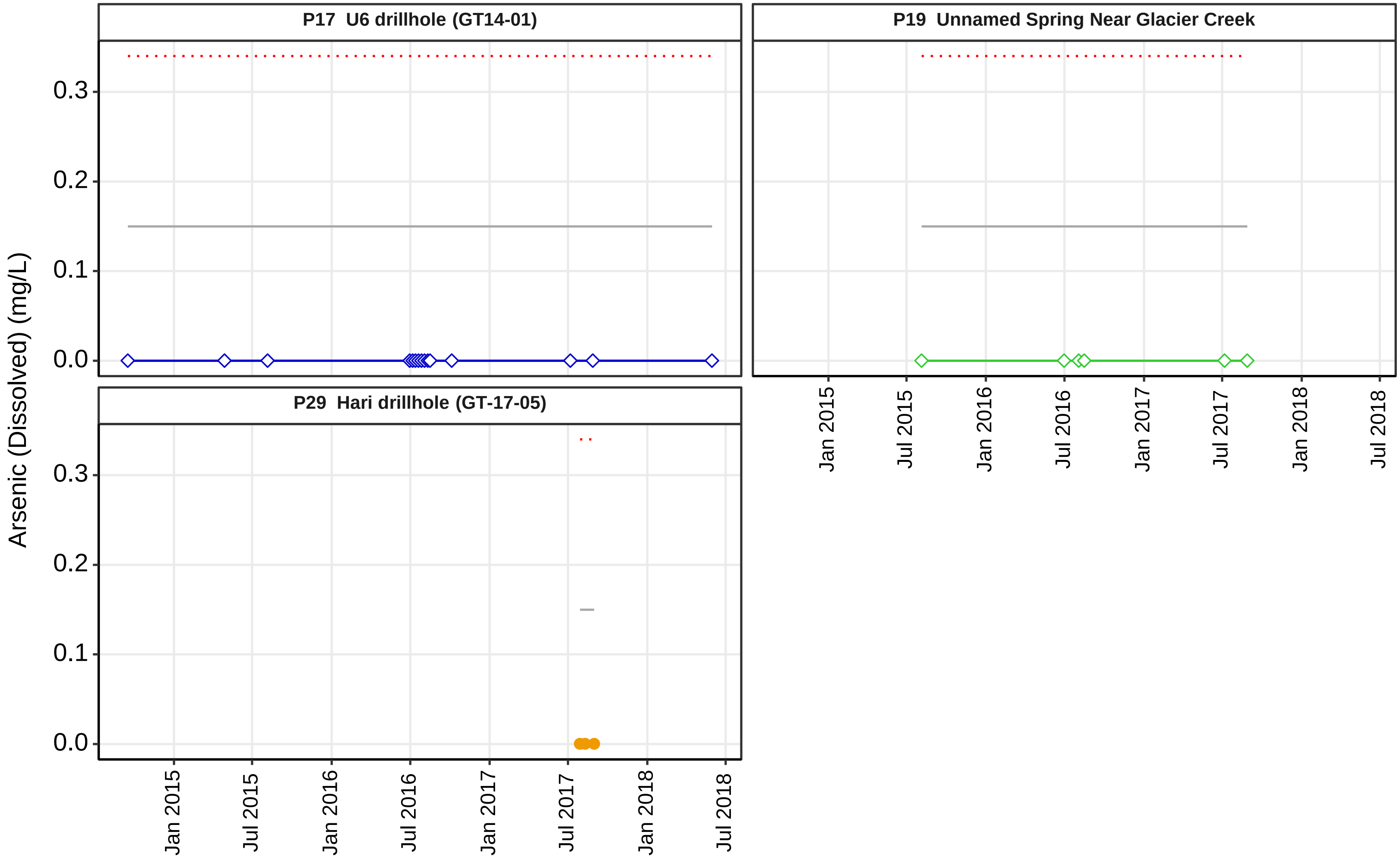
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-16. Time Series Plots: Aluminum (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

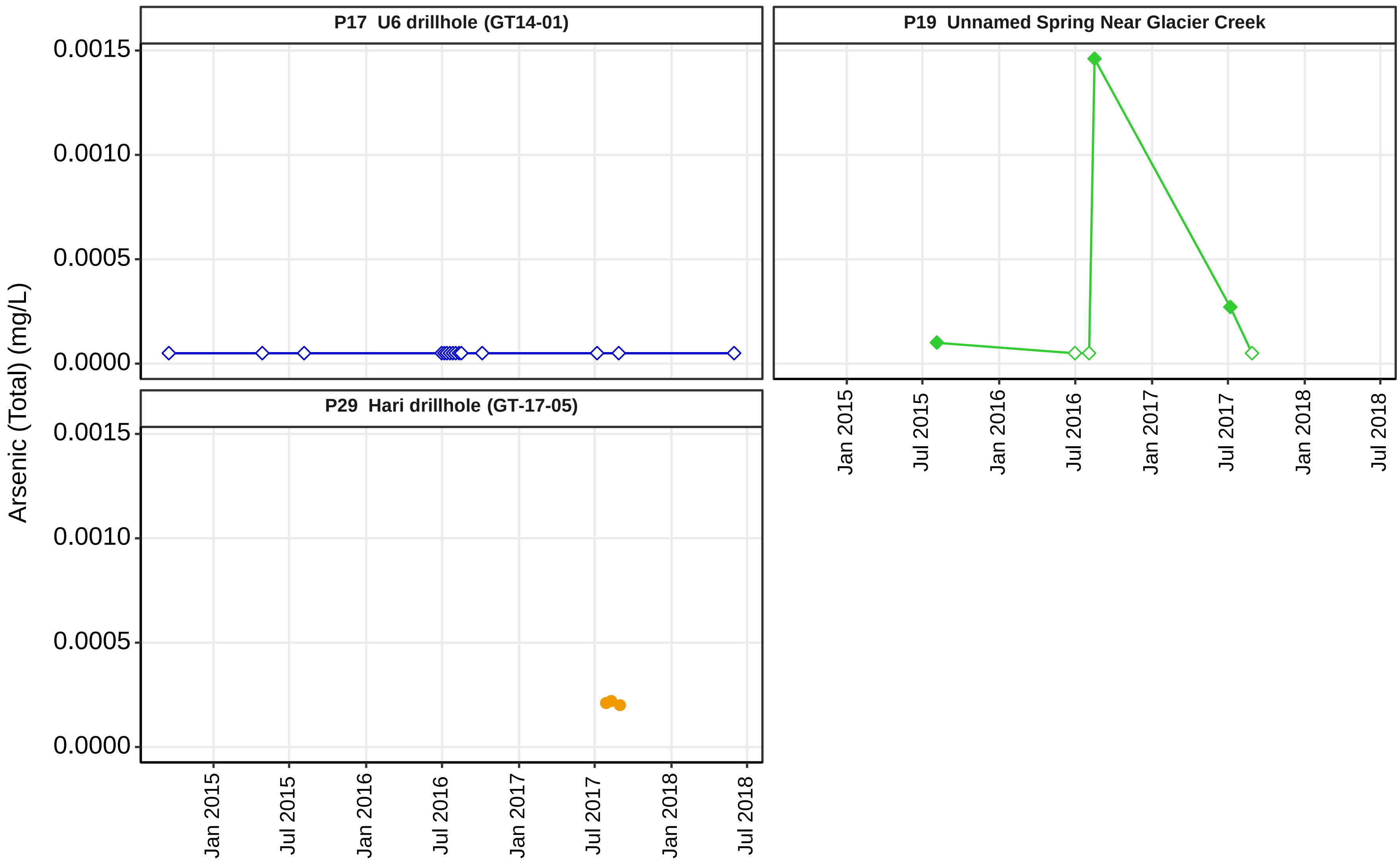
Figure 3-17. Time Series Plots: Aluminum (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

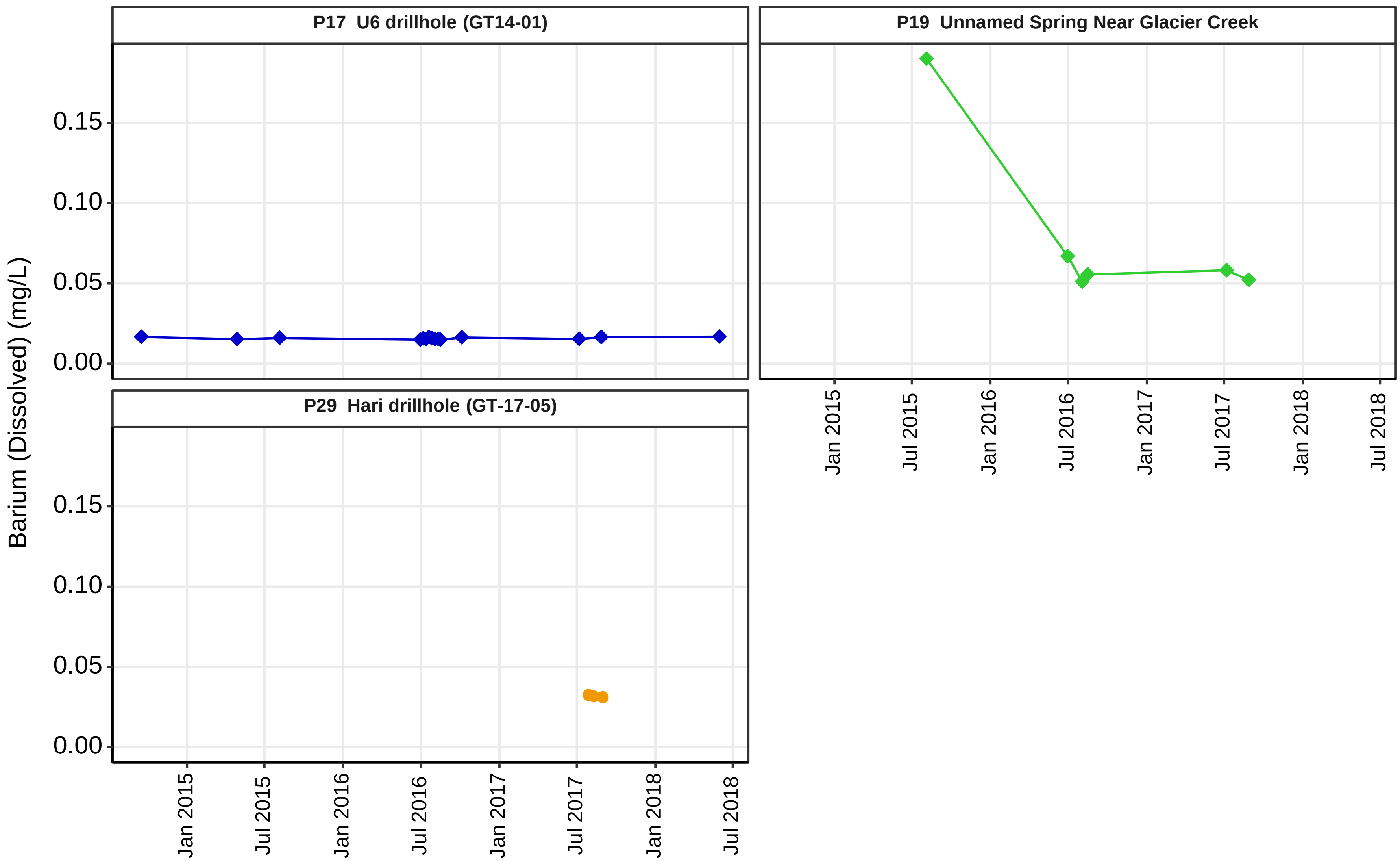
Figure 3-18. Time Series Plots: Arsenic (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

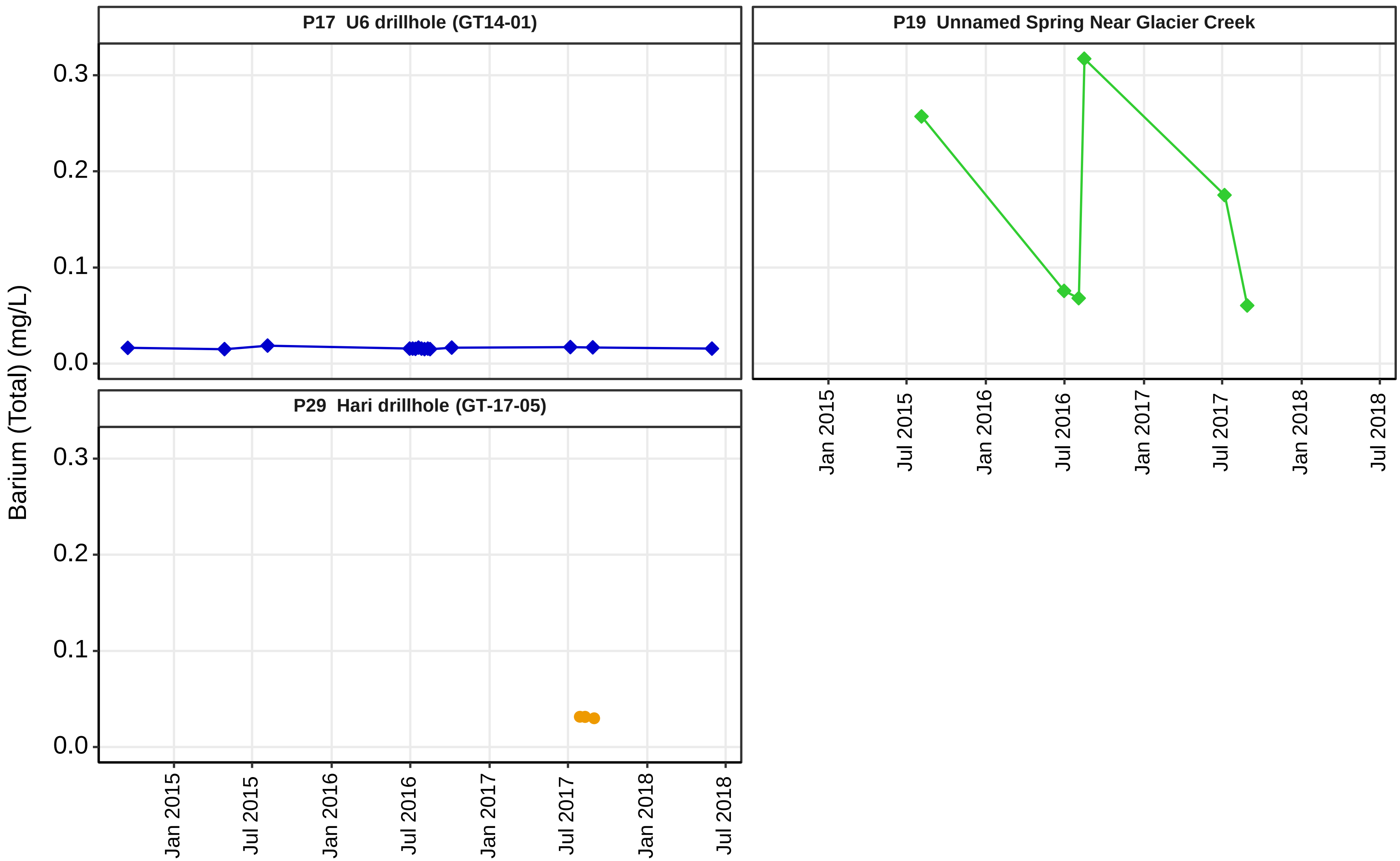
Figure 3-19. Time Series Plots: Arsenic (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

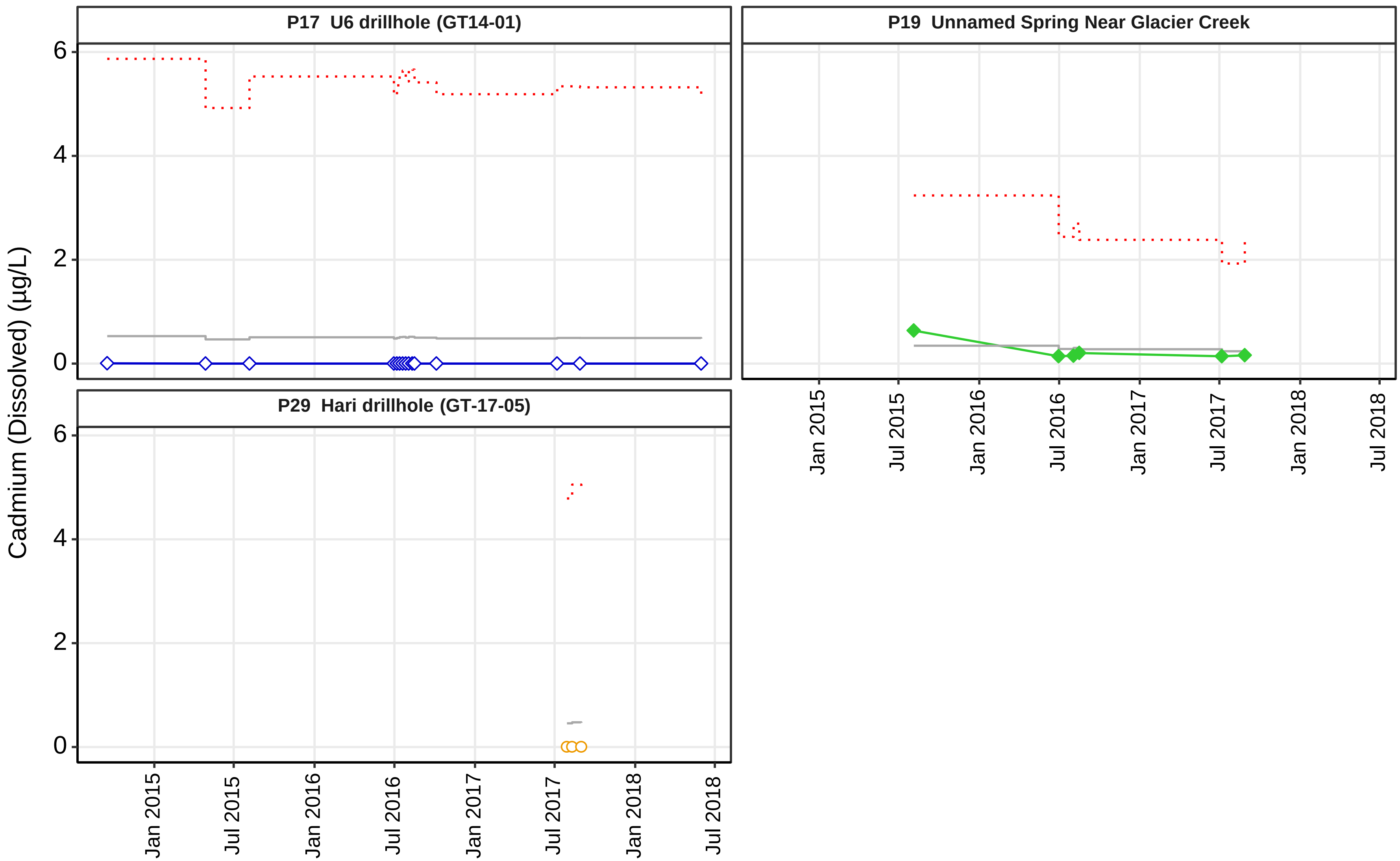
Figure 3-20. Time Series Plots: Barium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

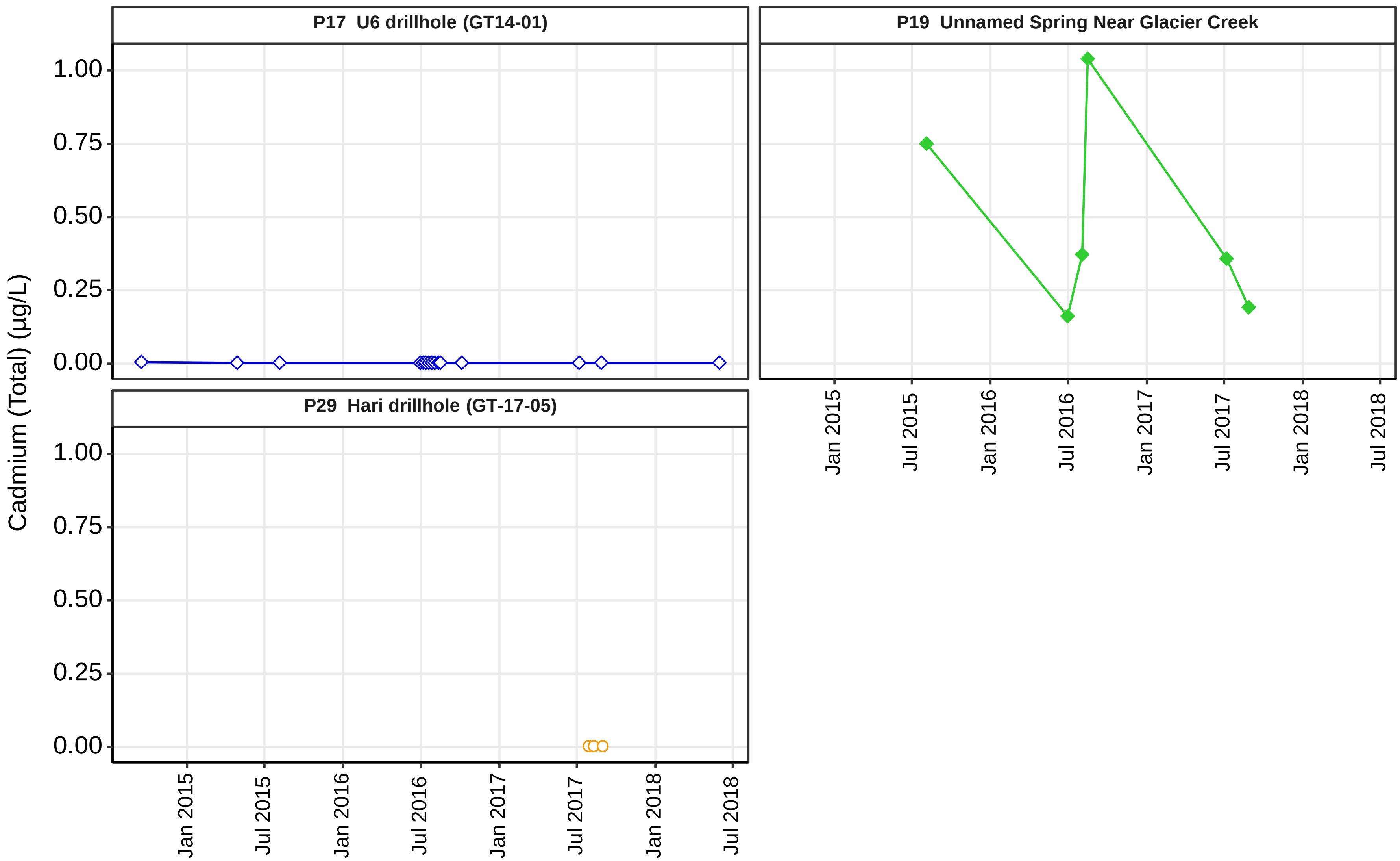
Figure 3-21. Time Series Plots: Barium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

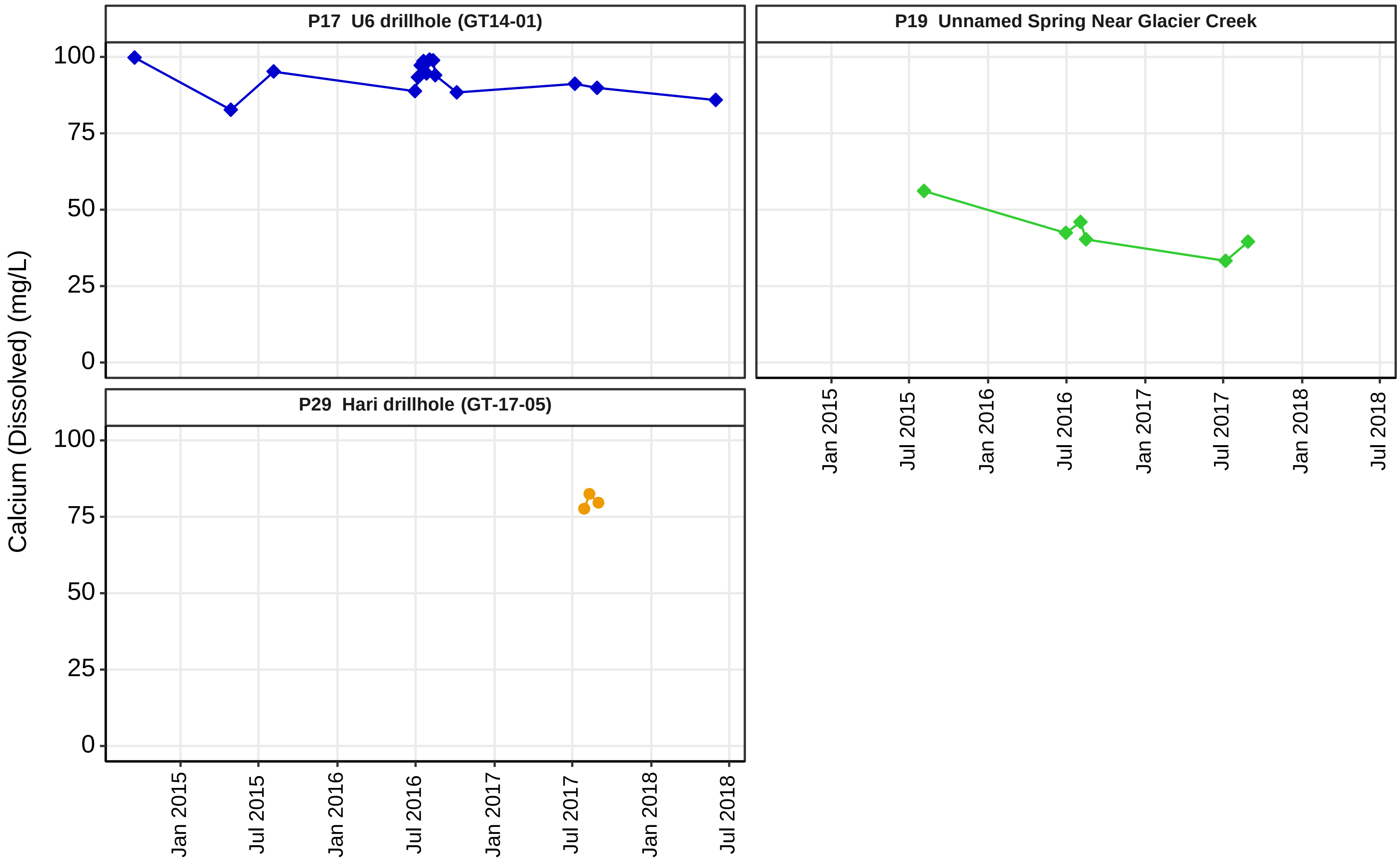
Figure 3-22. Time Series Plots: Cadmium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

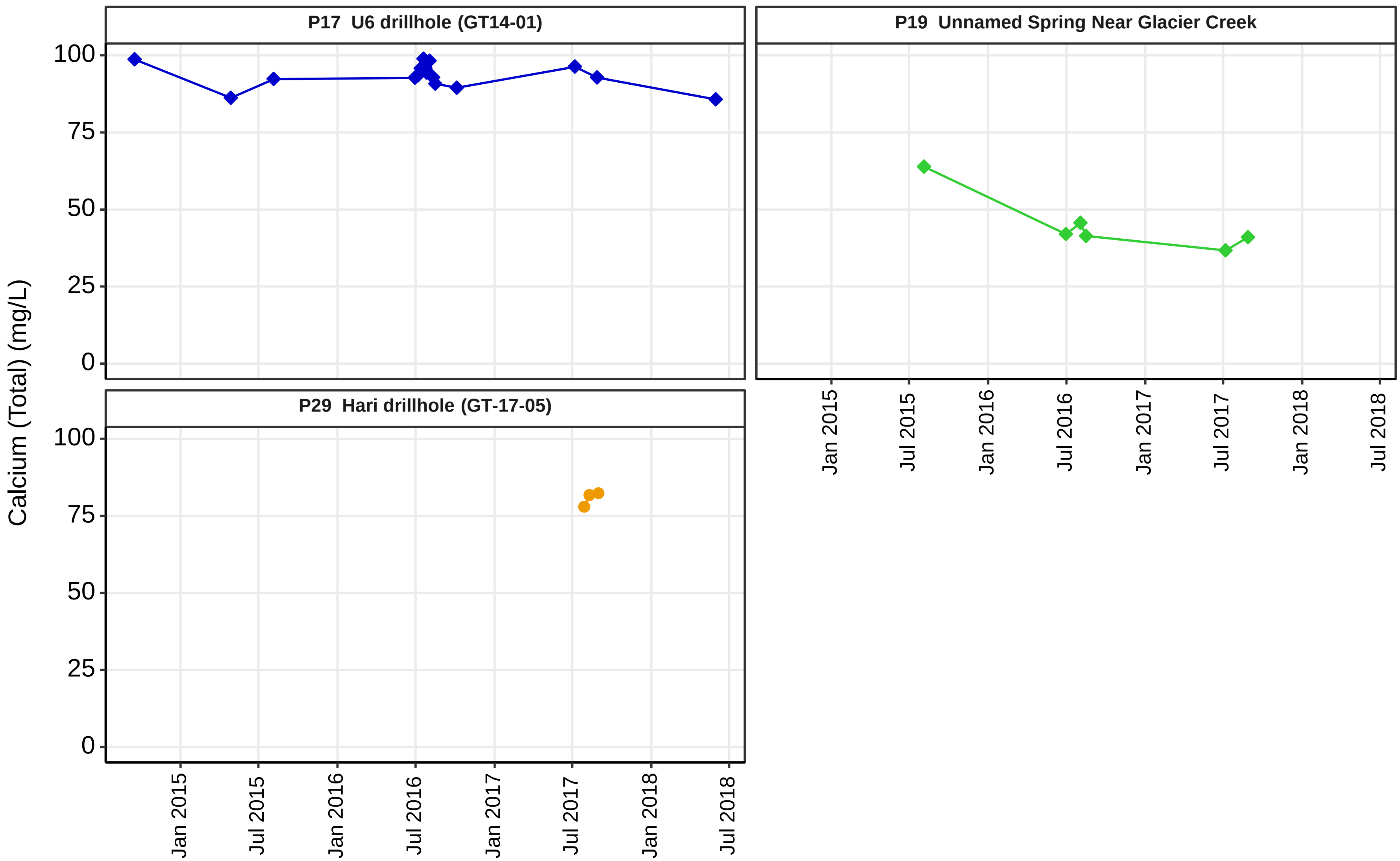
Figure 3-23. Time Series Plots: Cadmium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

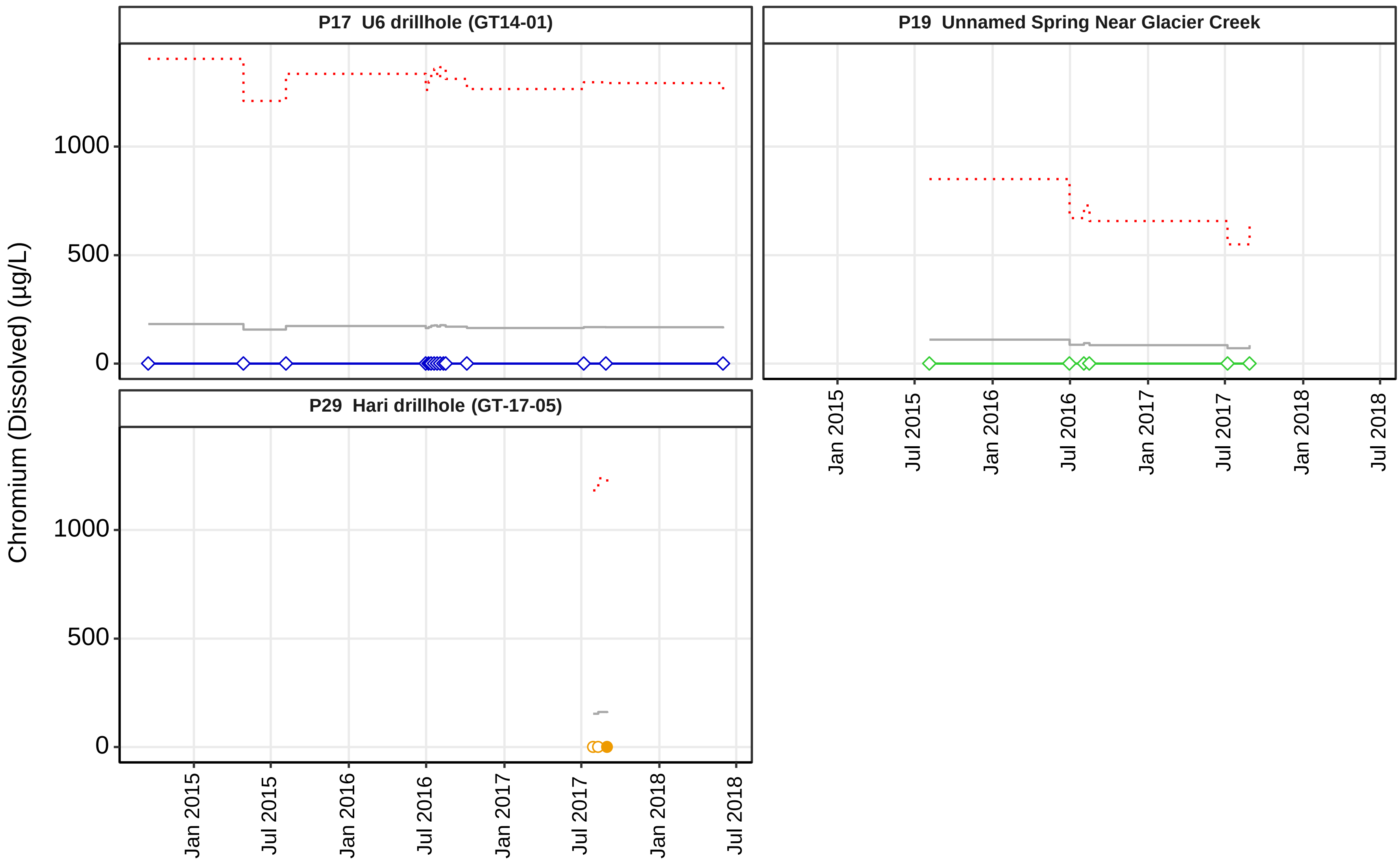
Figure 3-24. Time Series Plots: Calcium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

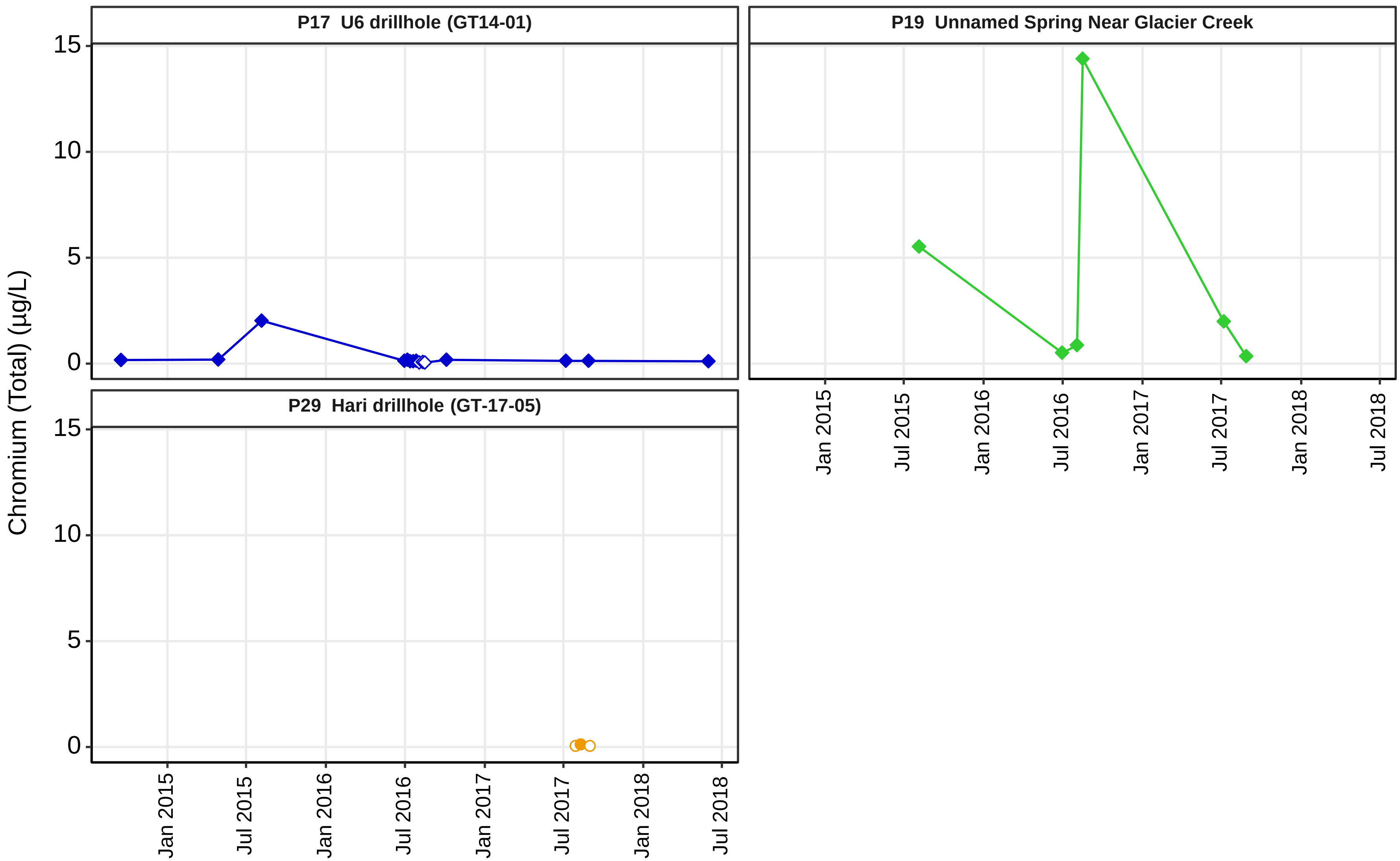
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-25. Time Series Plots: Calcium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



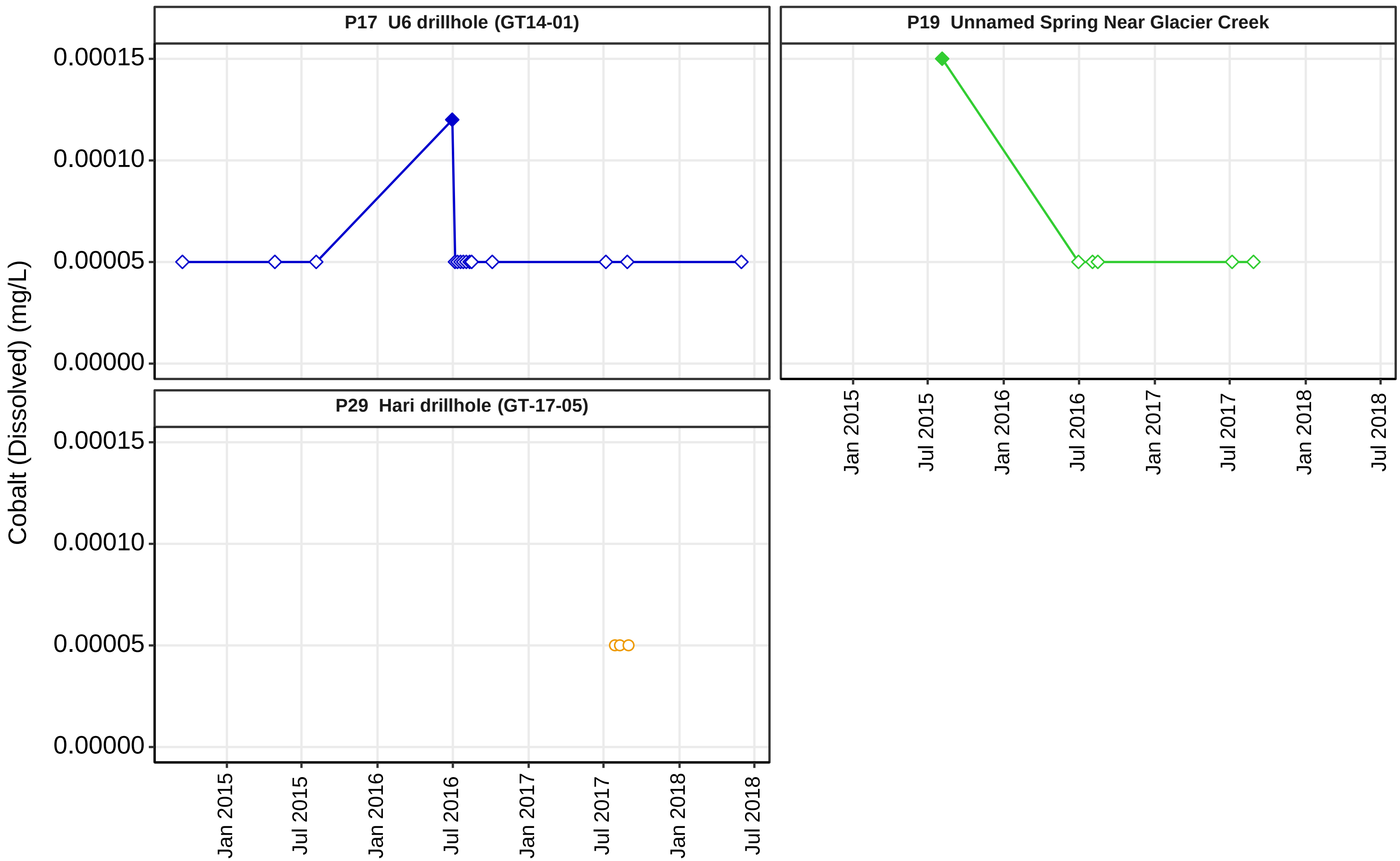
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-26. Time Series Plots: Chromium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

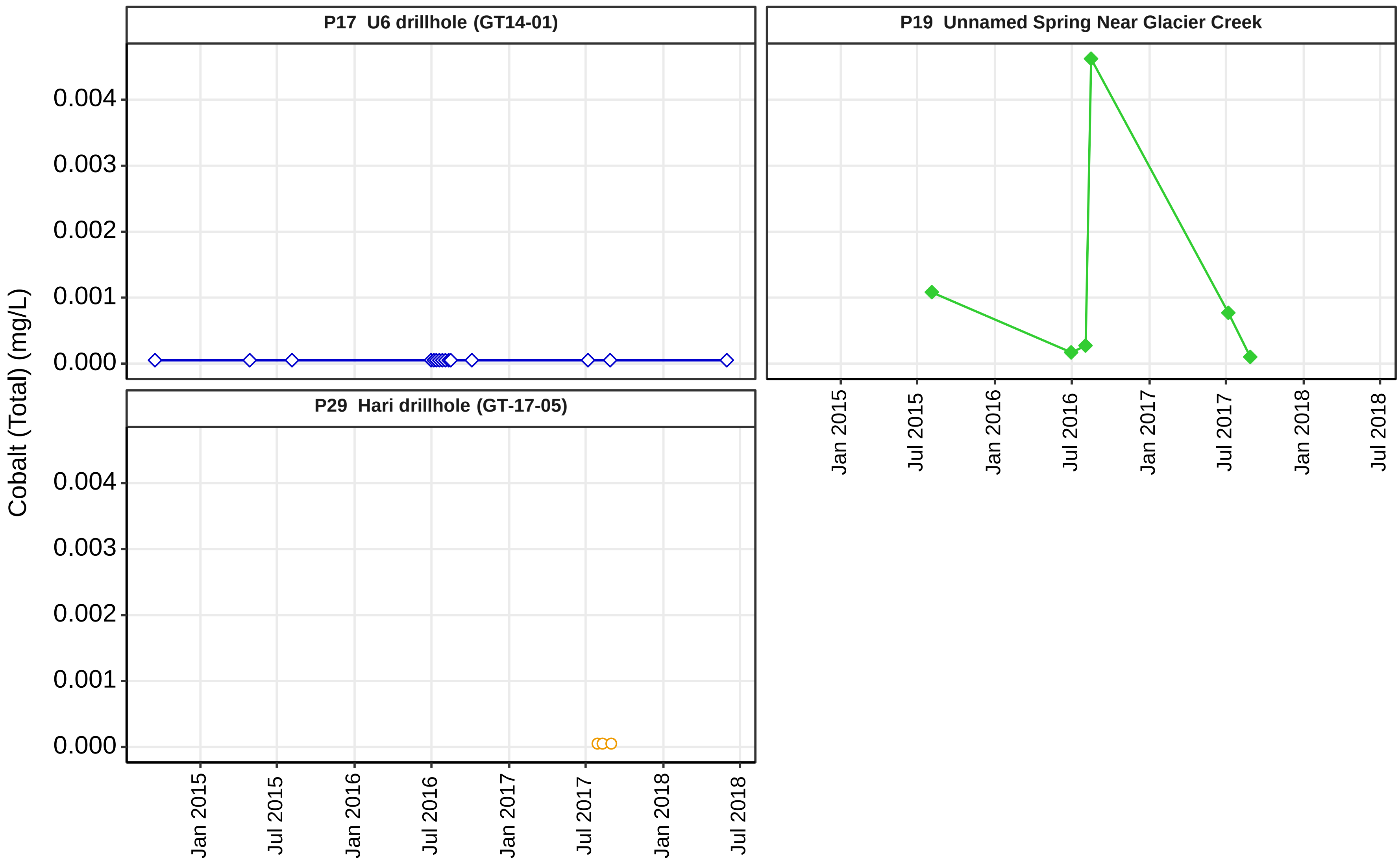
Figure 3-27. Time Series Plots: Chromium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

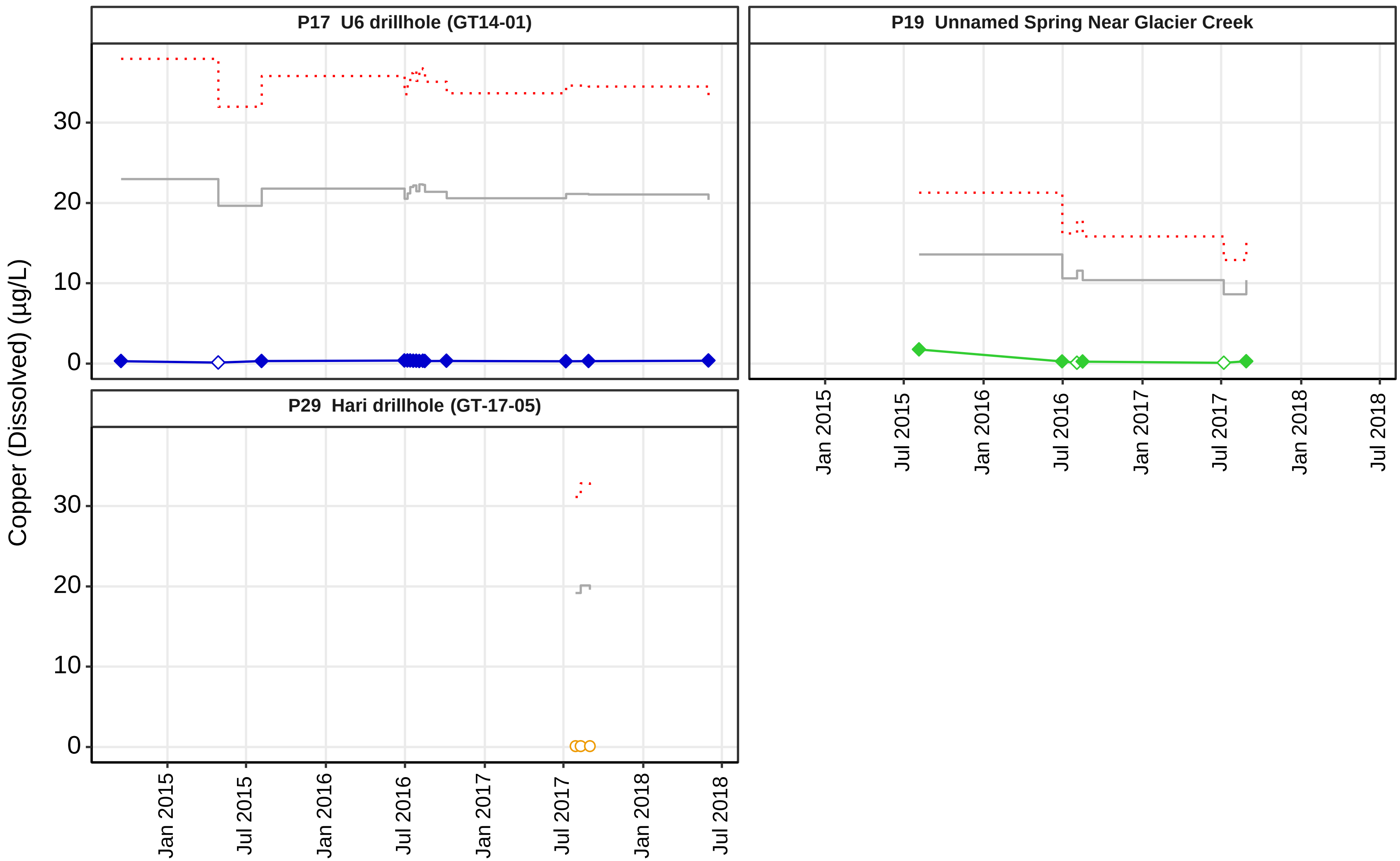
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-28. Time Series Plots: Cobalt (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



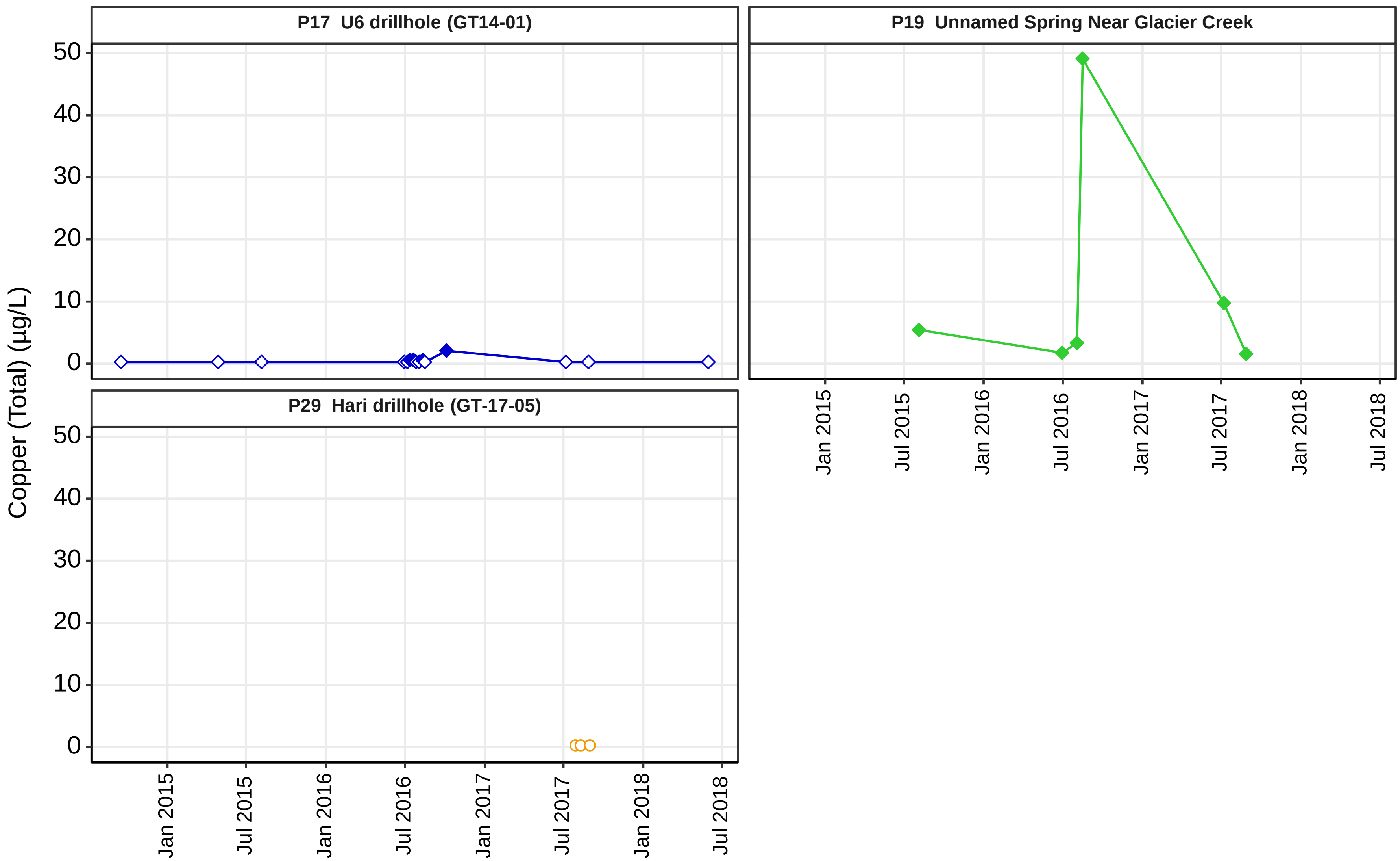
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-29. Time Series Plots: Cobalt (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

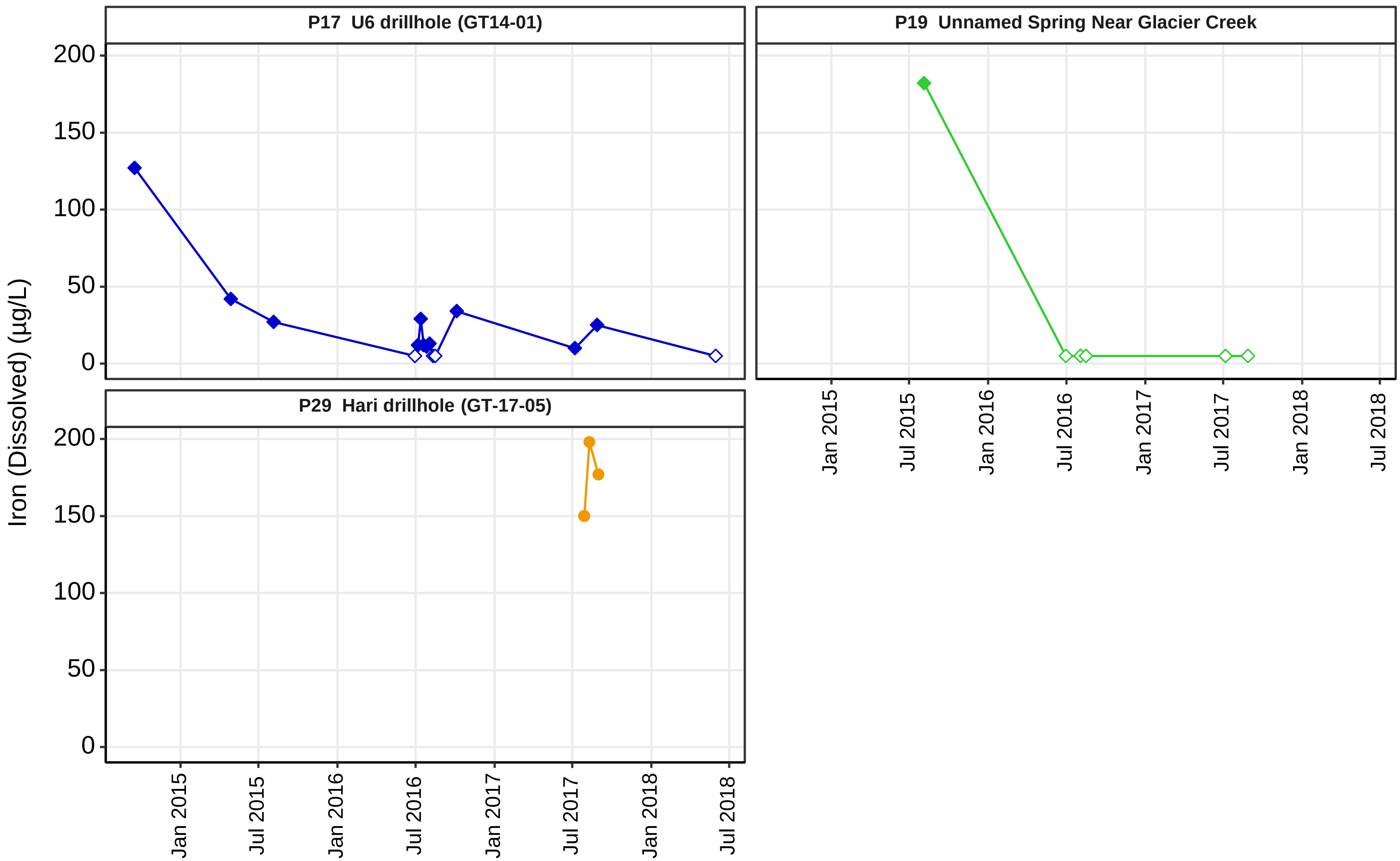
Figure 3-30. Time Series Plots: Copper (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

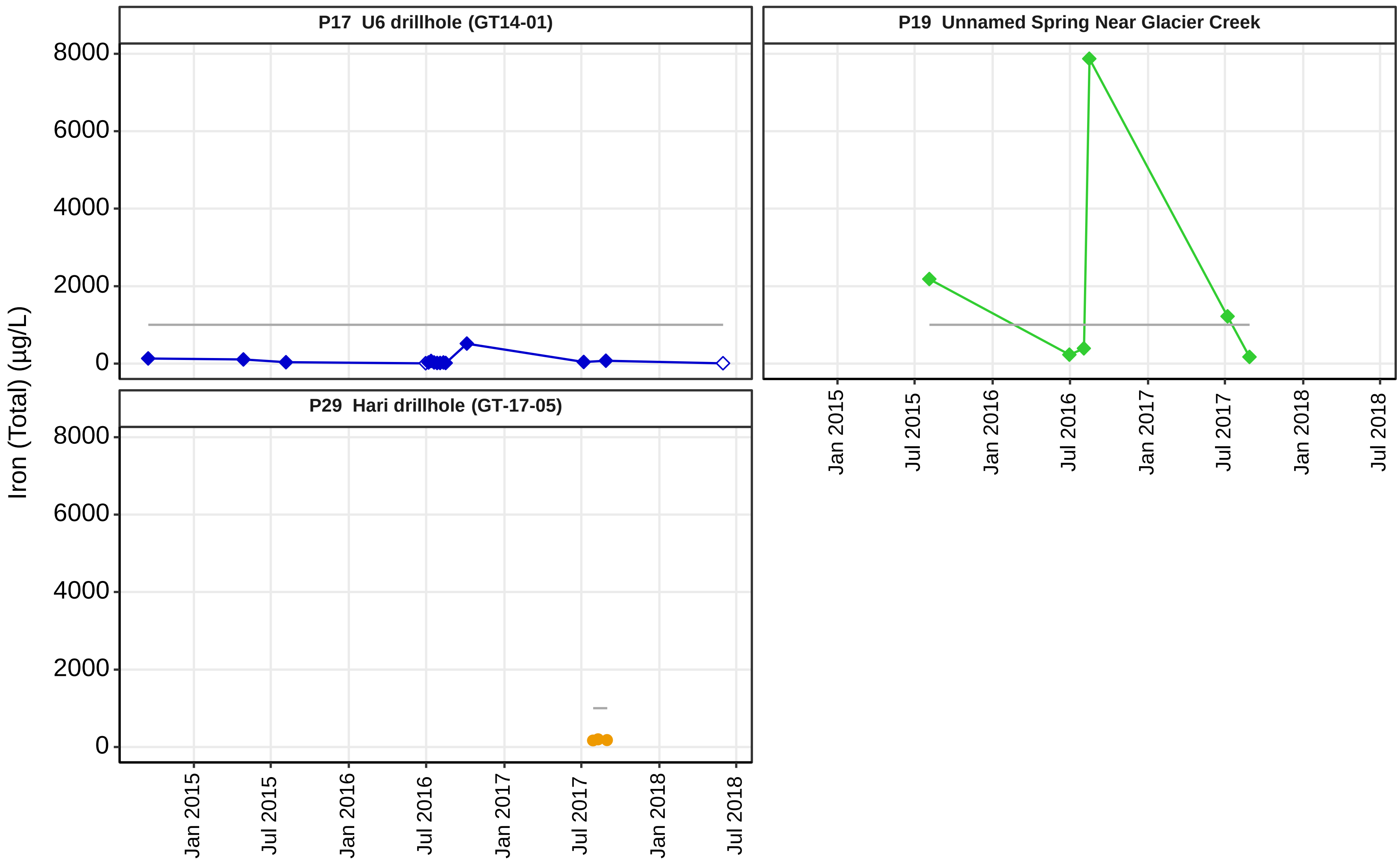
Figure 3-31. Time Series Plots: Copper (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

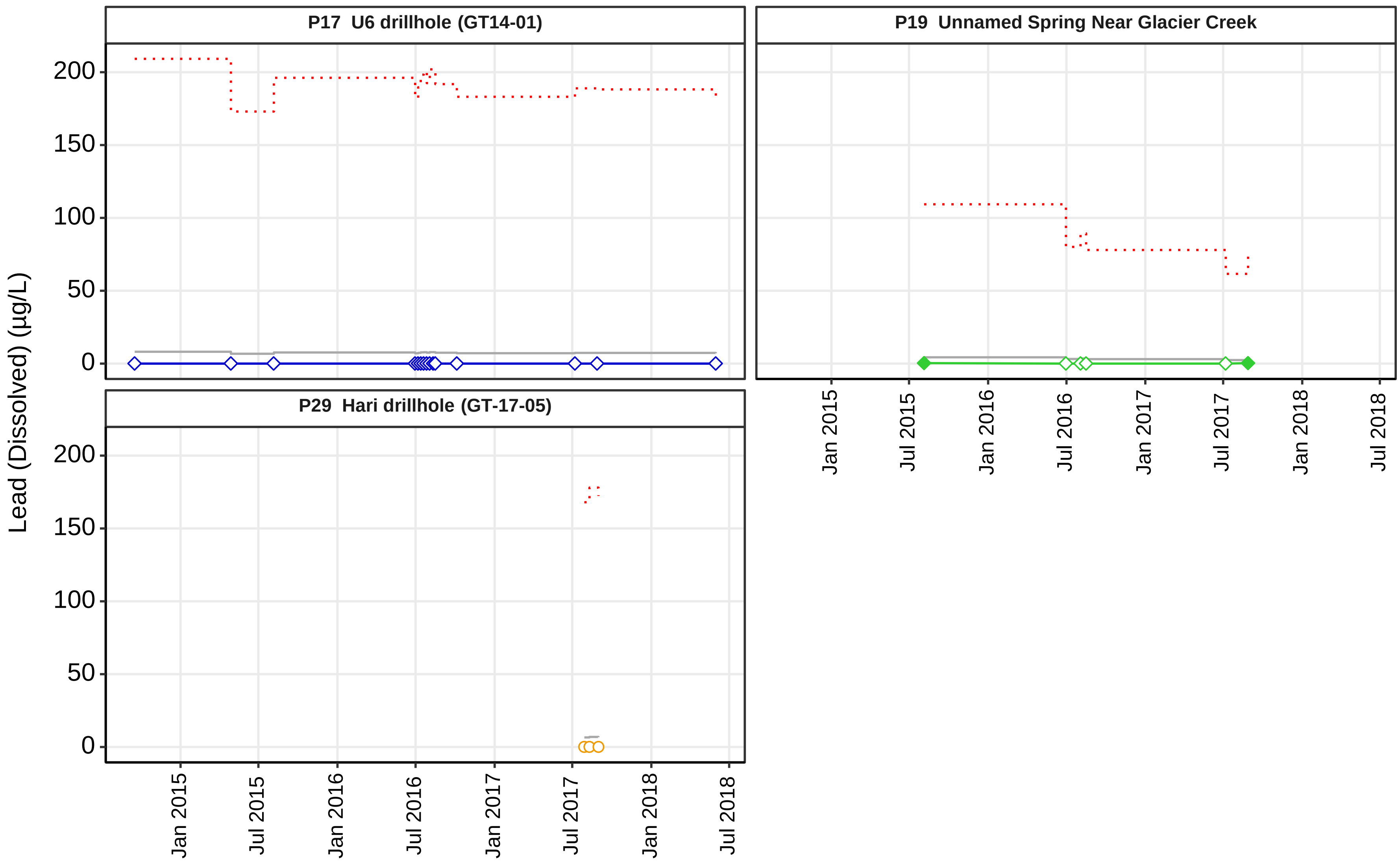
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-32. Time Series Plots: Iron (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



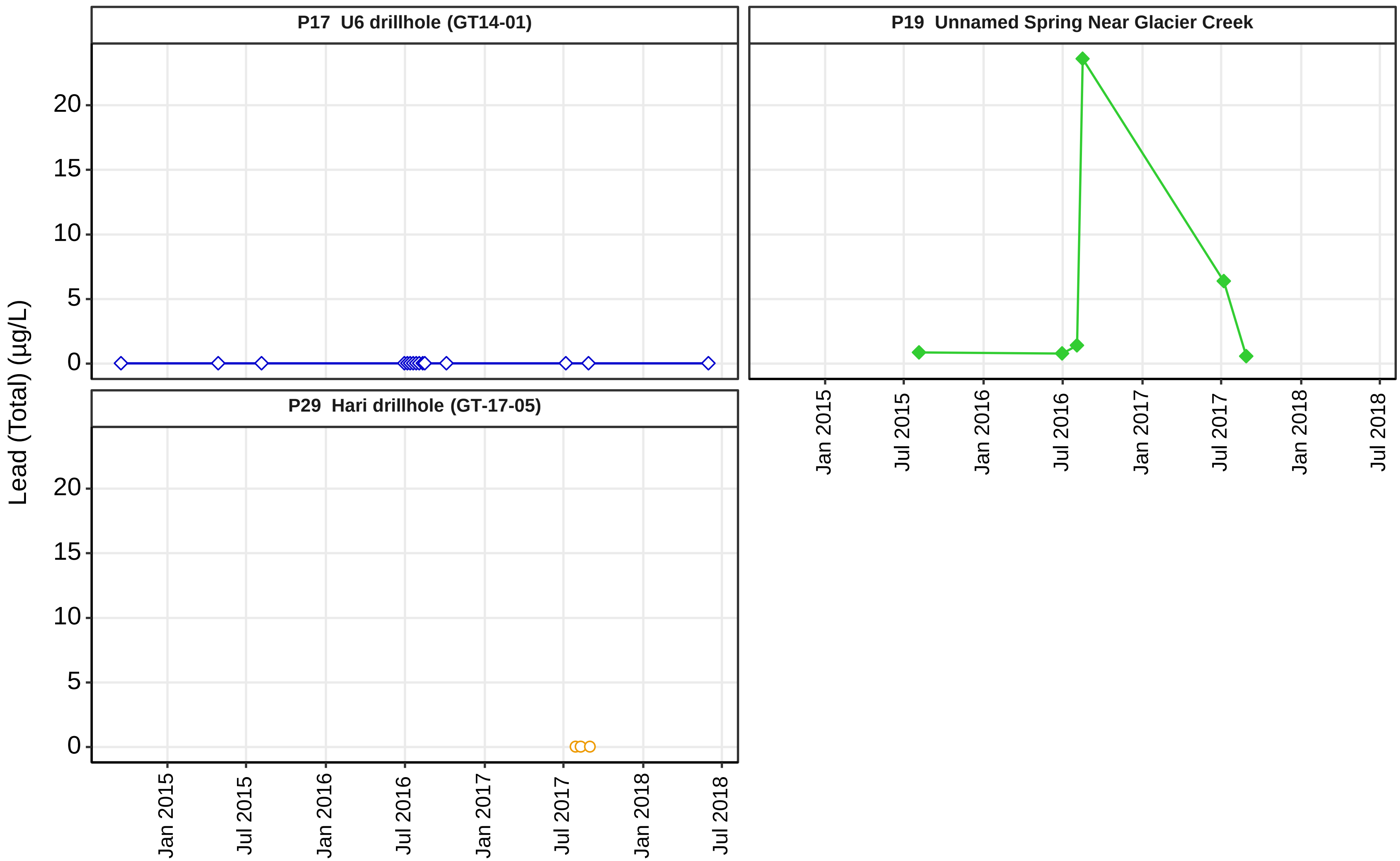
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-33. Time Series Plots: Iron (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

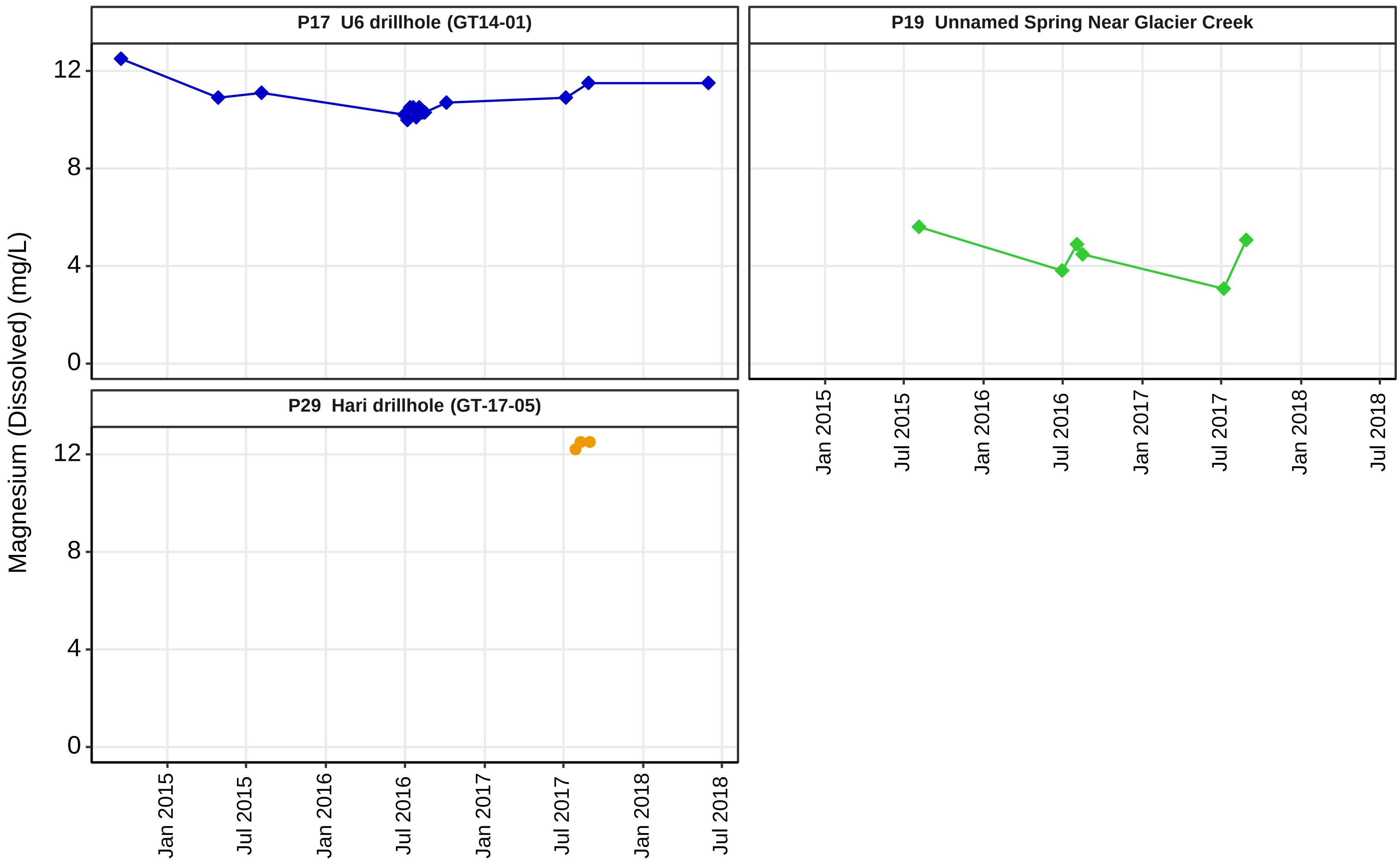
Figure 3-34. Time Series Plots: Lead (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

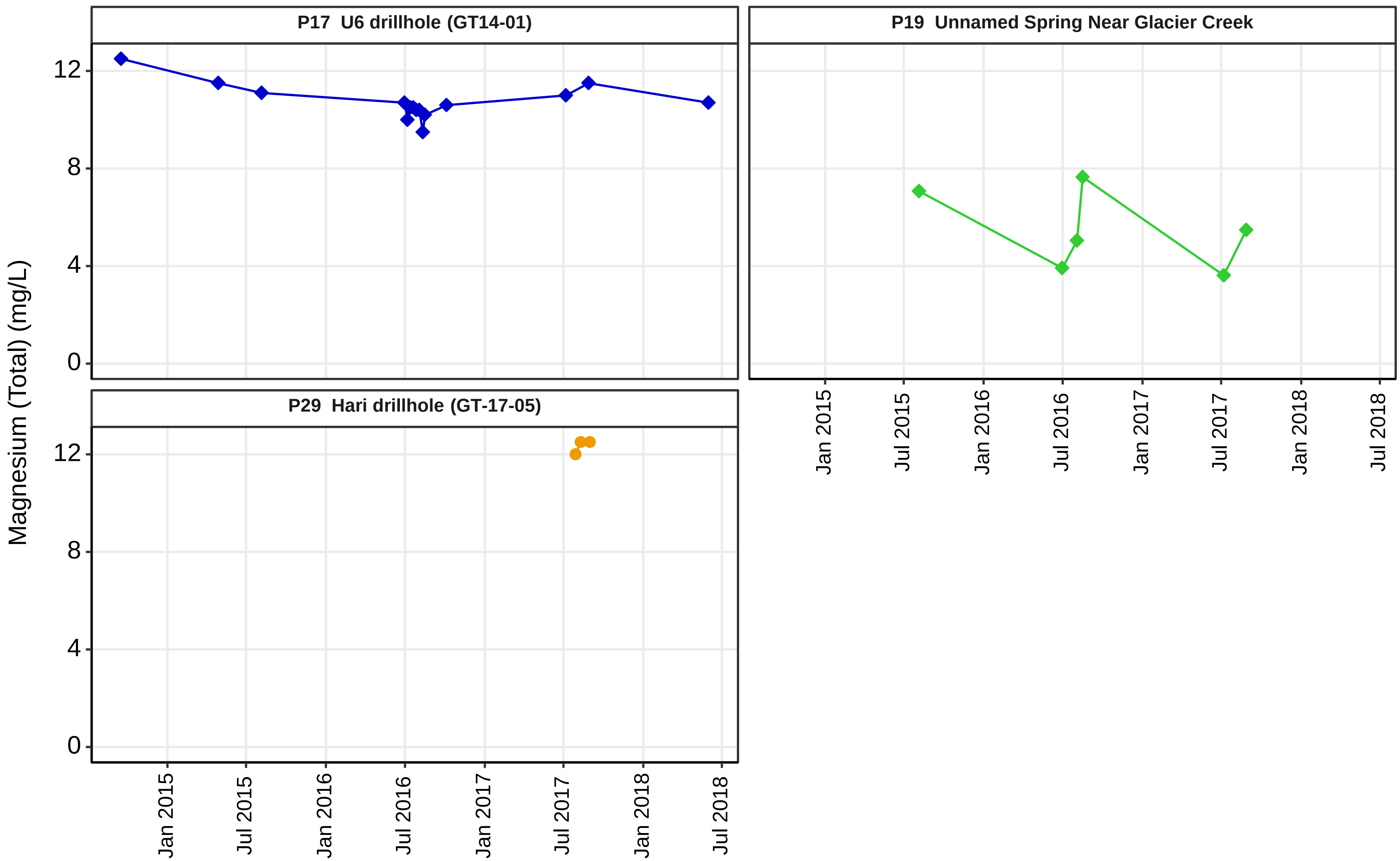
Figure 3-35. Time Series Plots: Lead (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

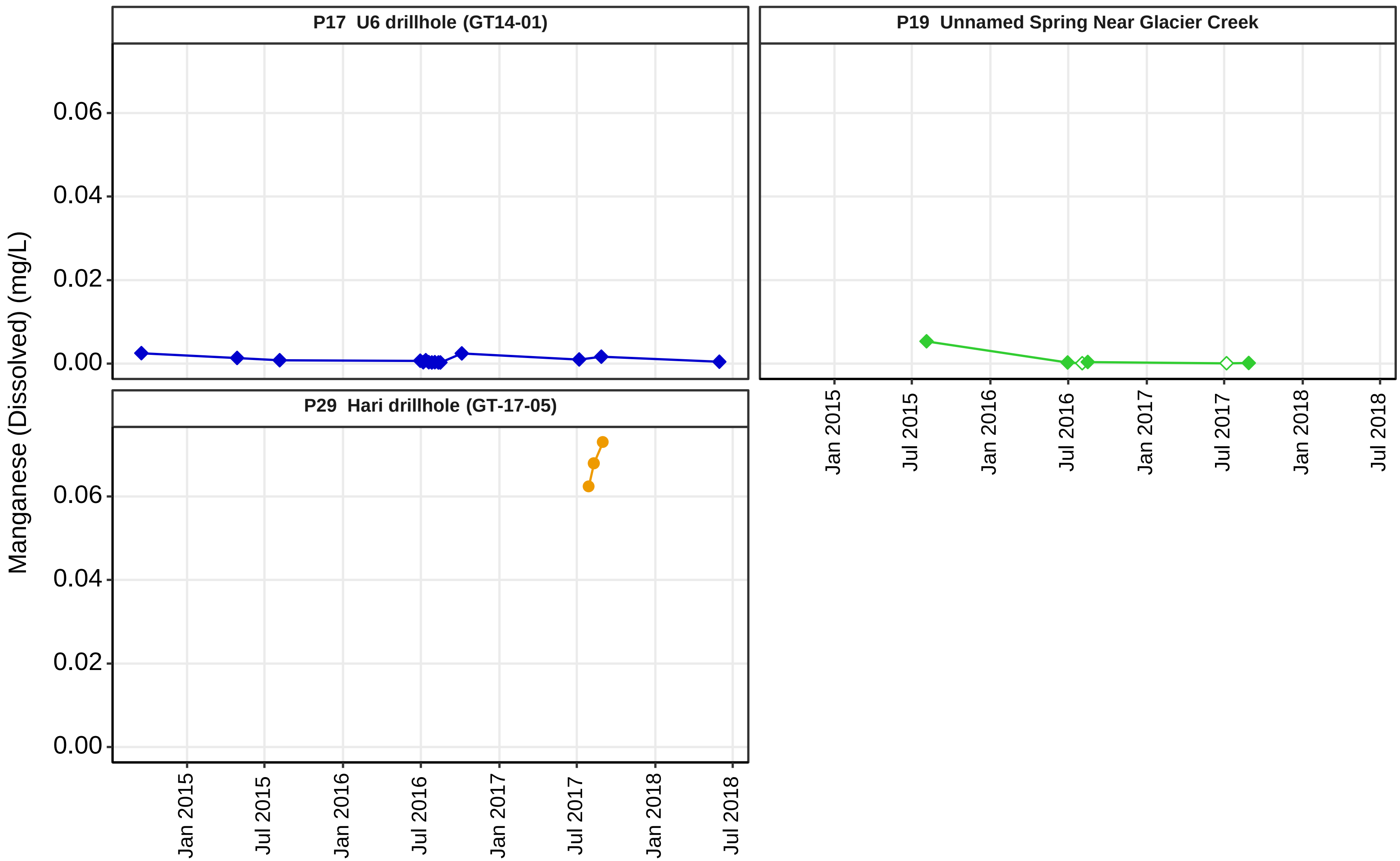
Figure 3-36. Time Series Plots: Magnesium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

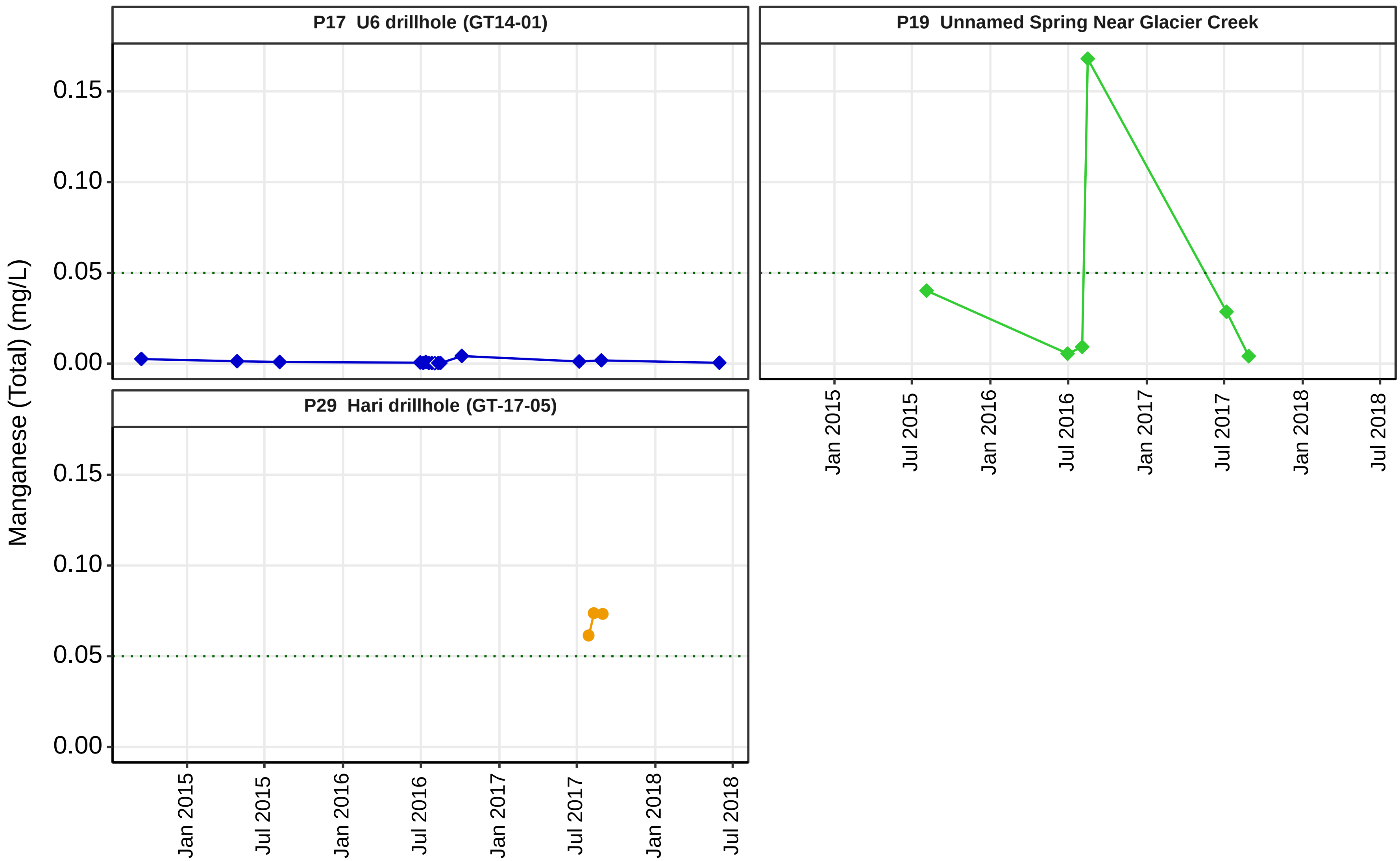
Figure 3-37. Time Series Plots: Magnesium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

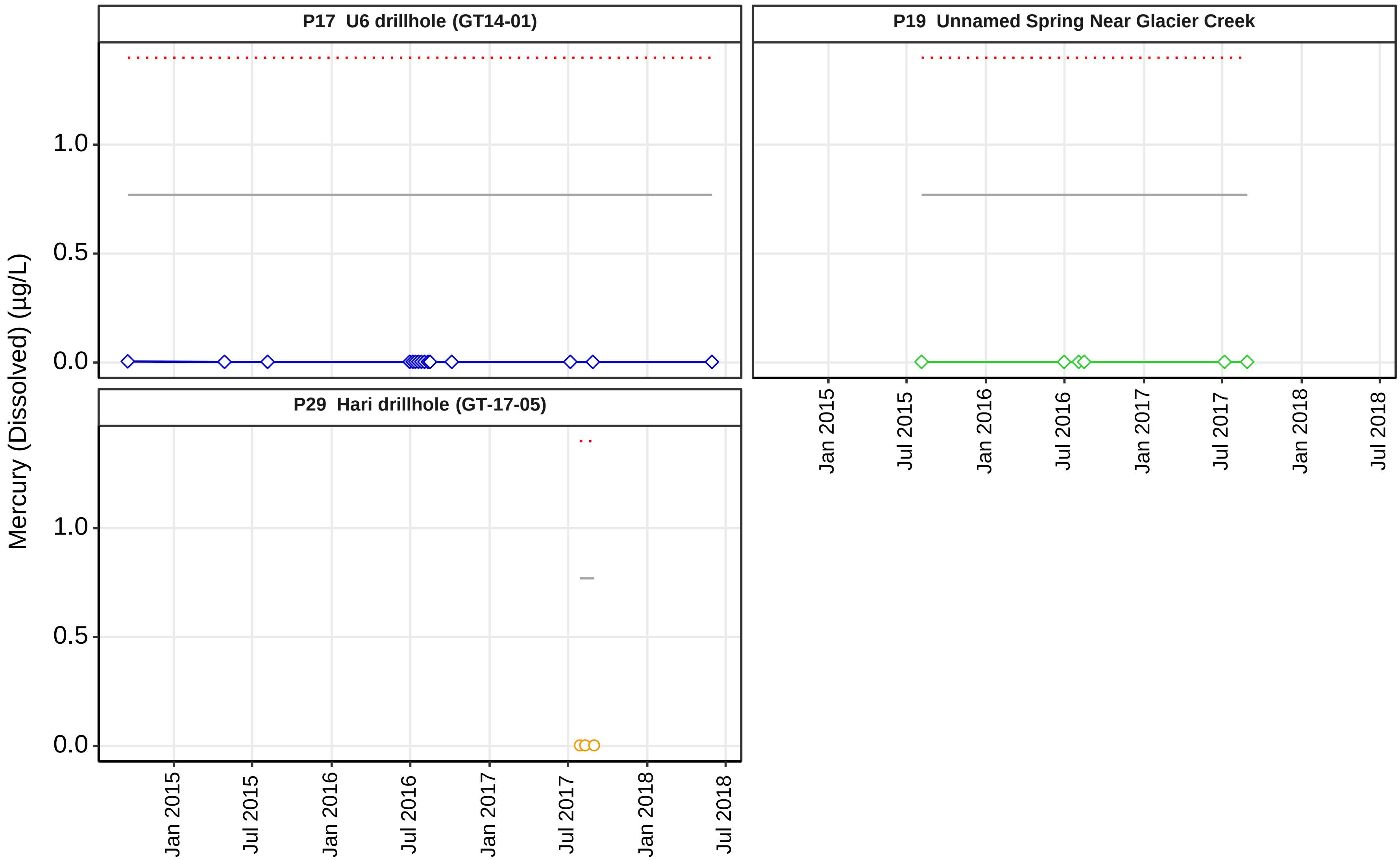
Figure 3-38. Time Series Plots: Manganese (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

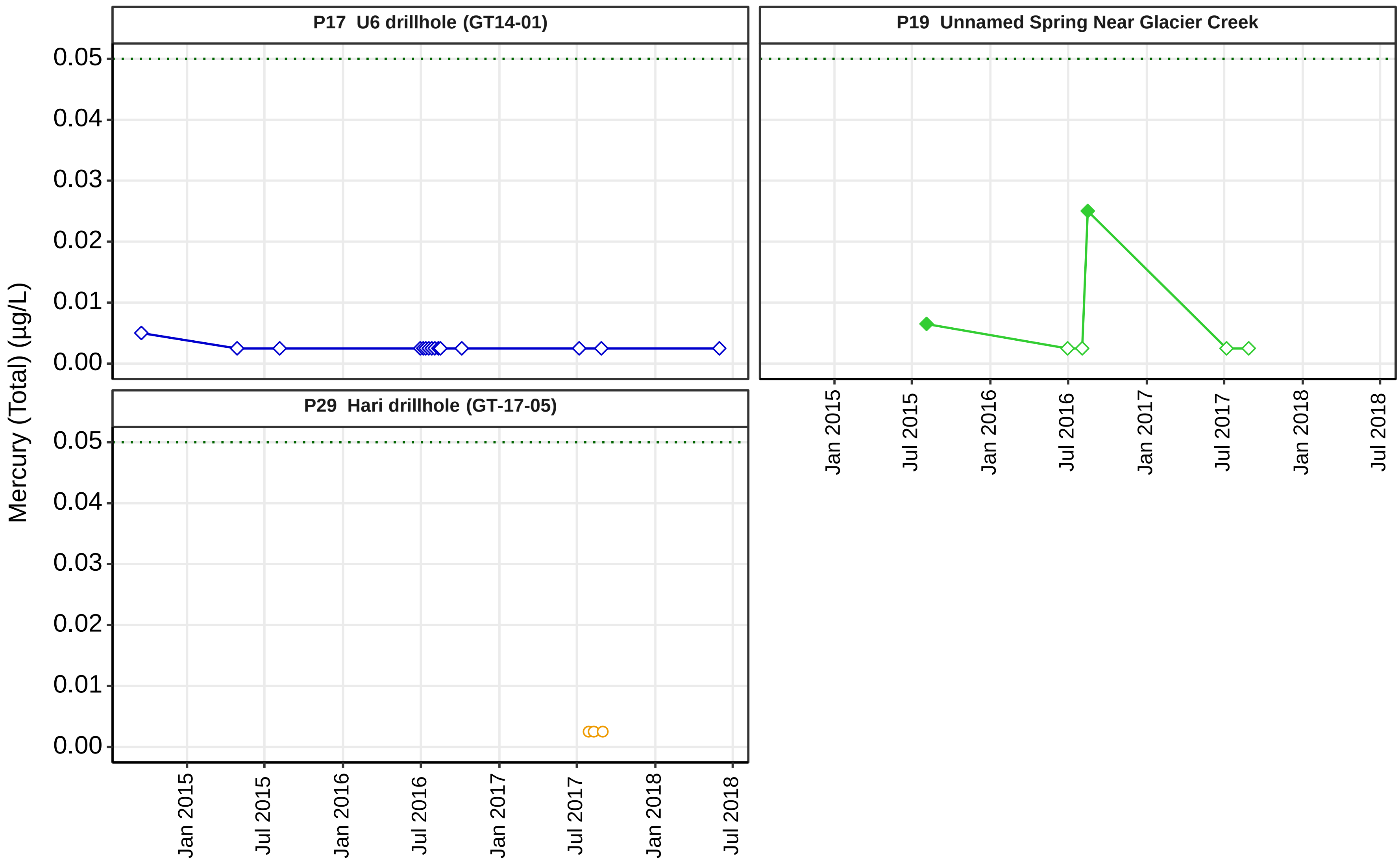
Figure 3-39. Time Series Plots: Manganese (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

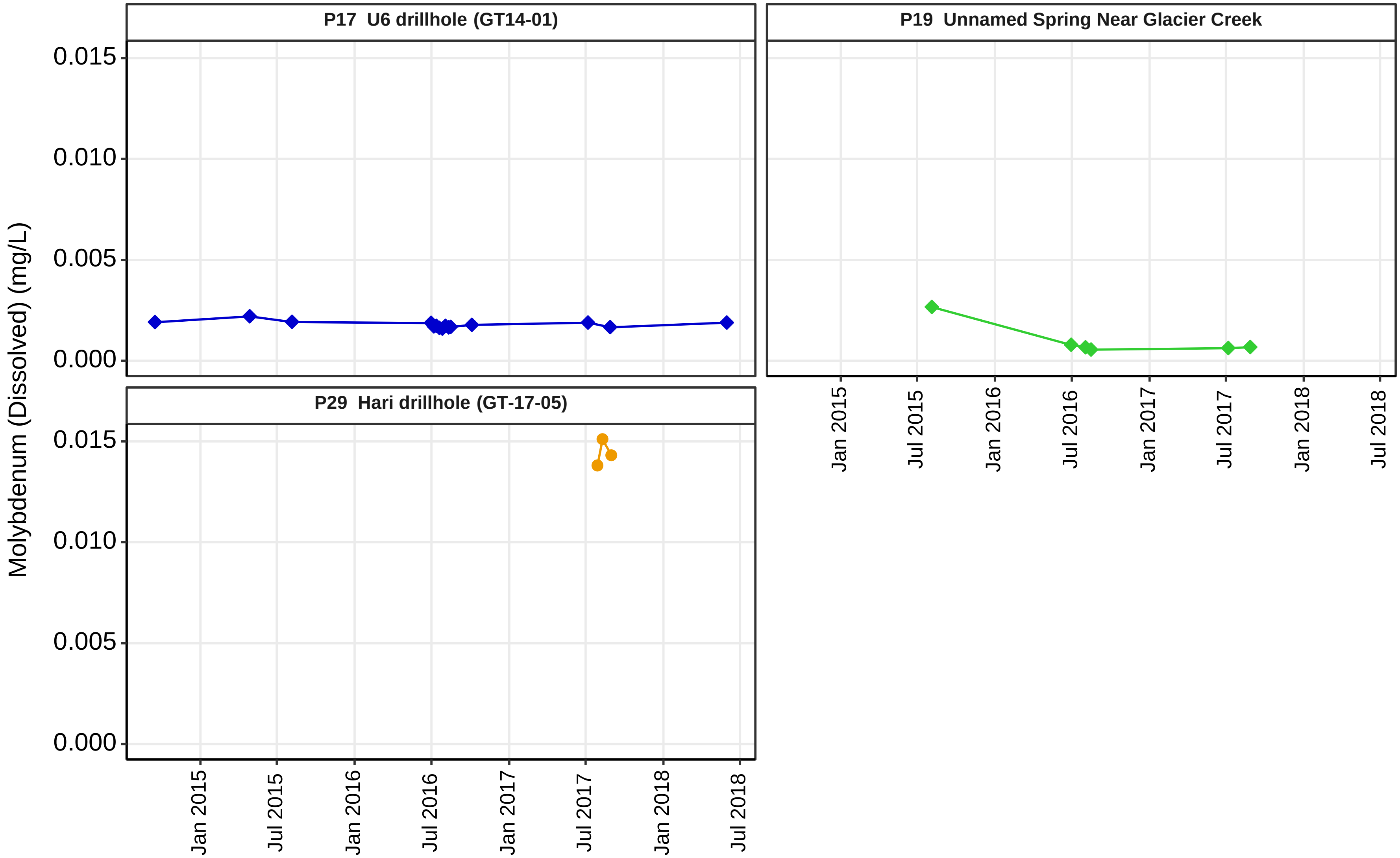
Figure 3-40. Time Series Plots: Mercury (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

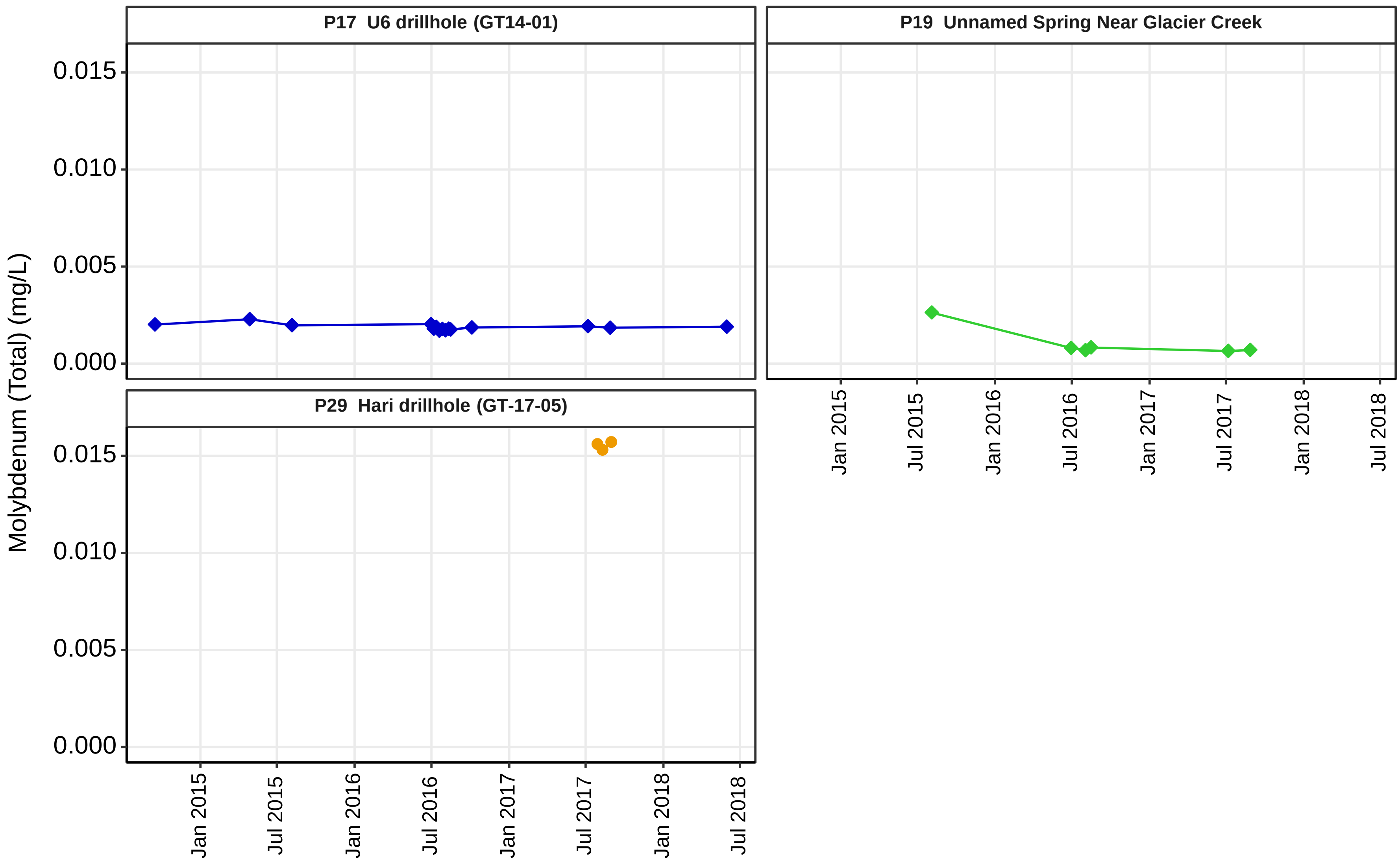
Figure 3-41. Time Series Plots: Mercury (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

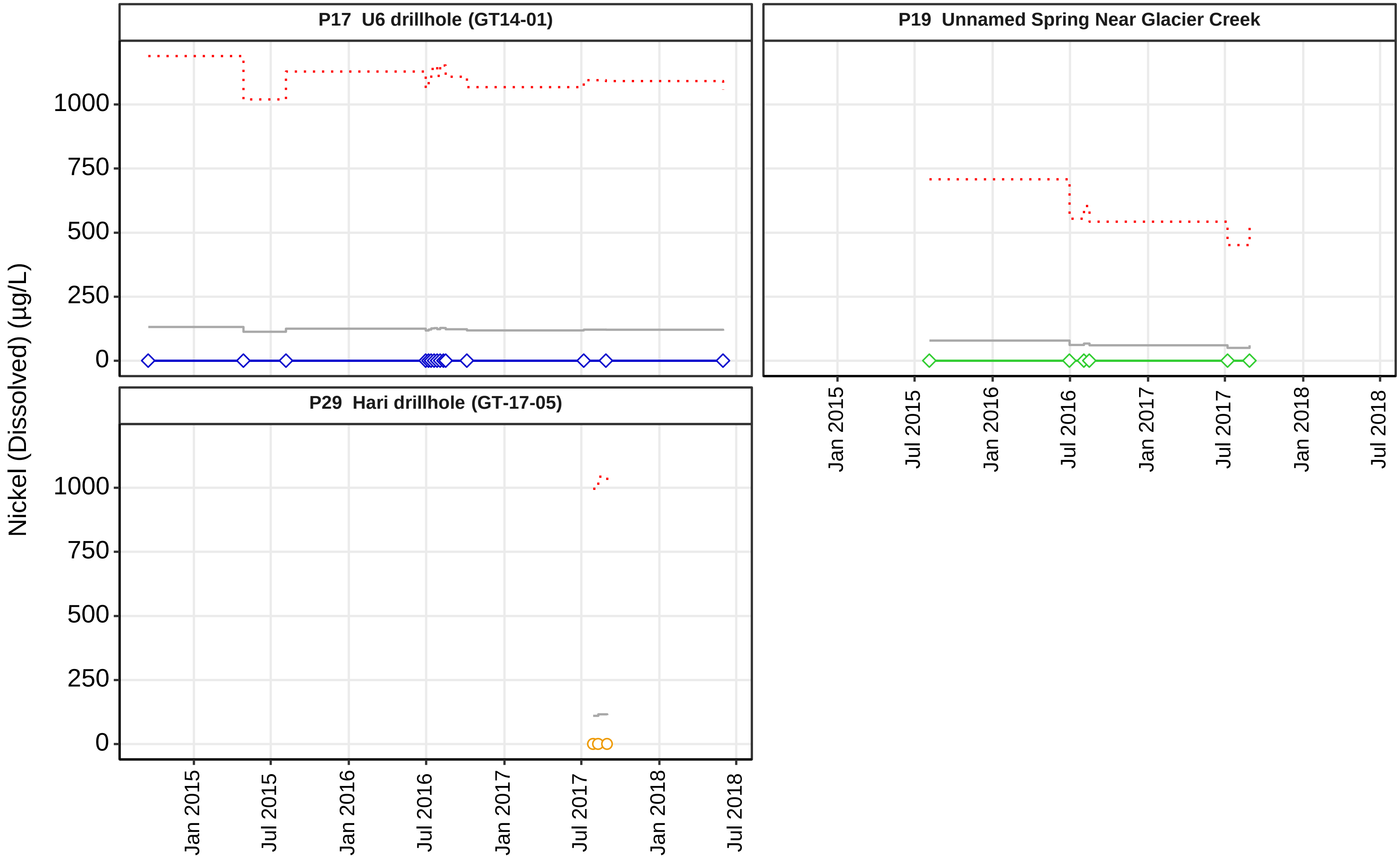
Figure 3-42. Time Series Plots: Molybdenum (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

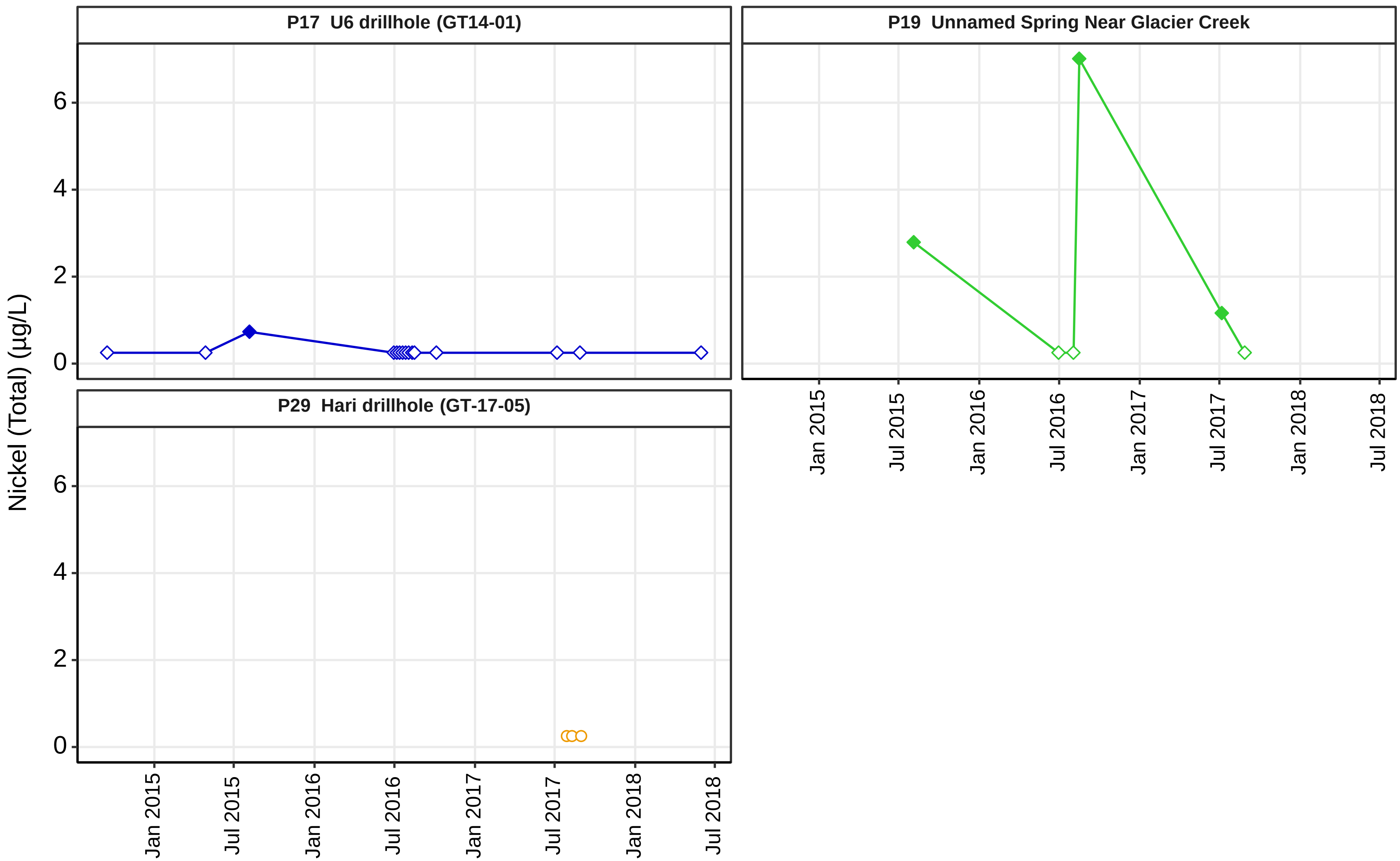
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-43. Time Series Plots: Molybdenum (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



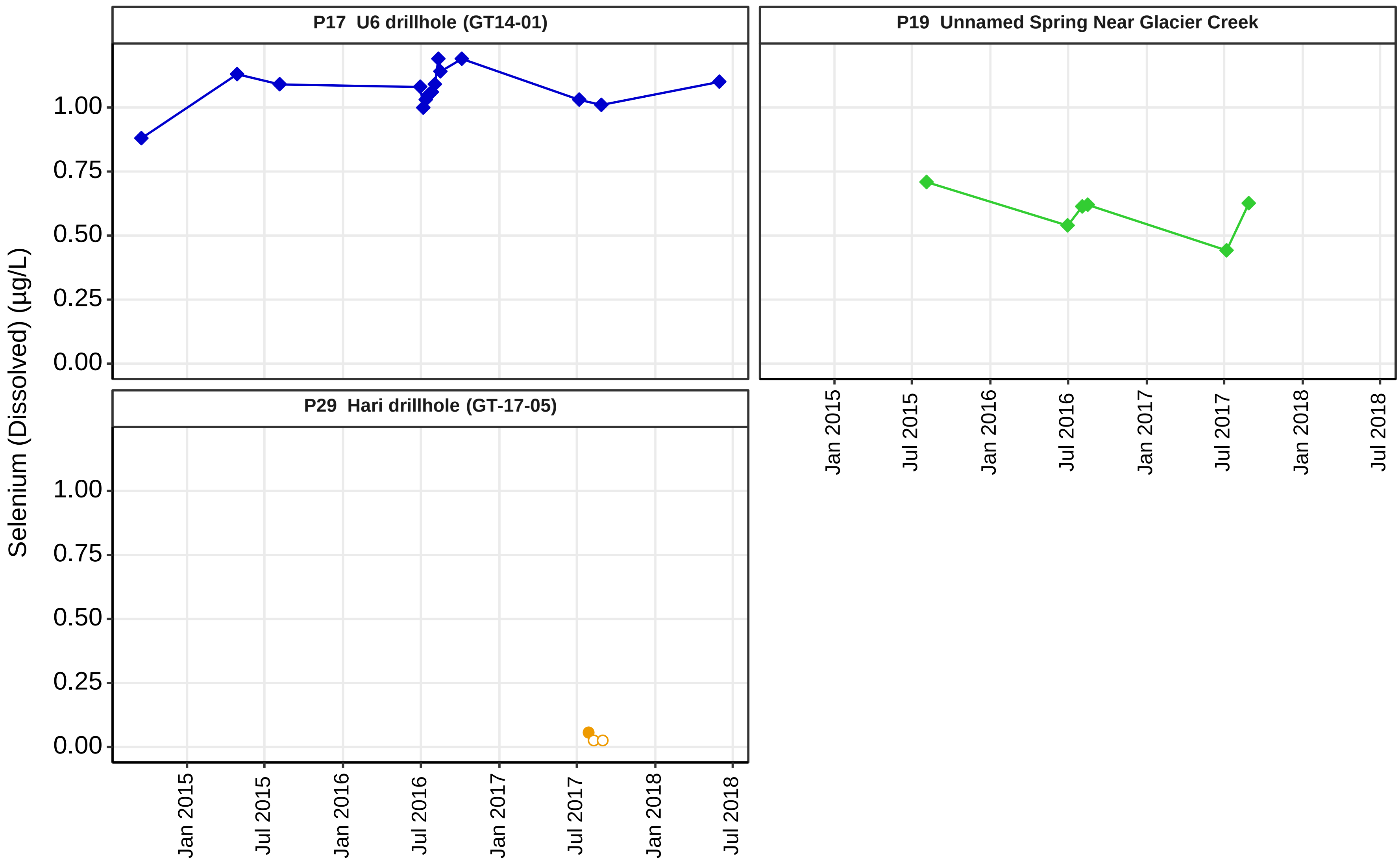
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-44. Time Series Plots: Nickel (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

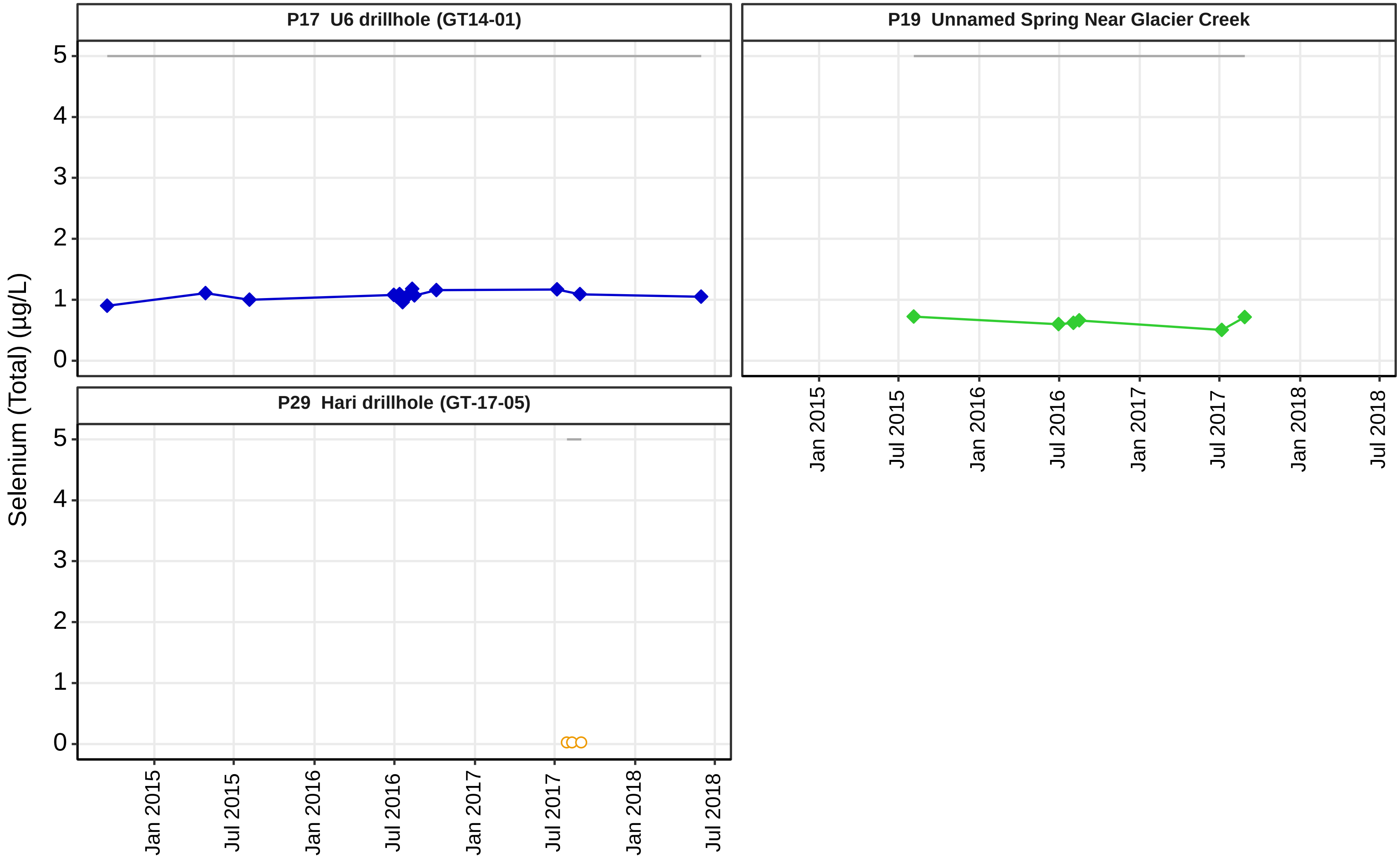
Figure 3-45. Time Series Plots: Nickel (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

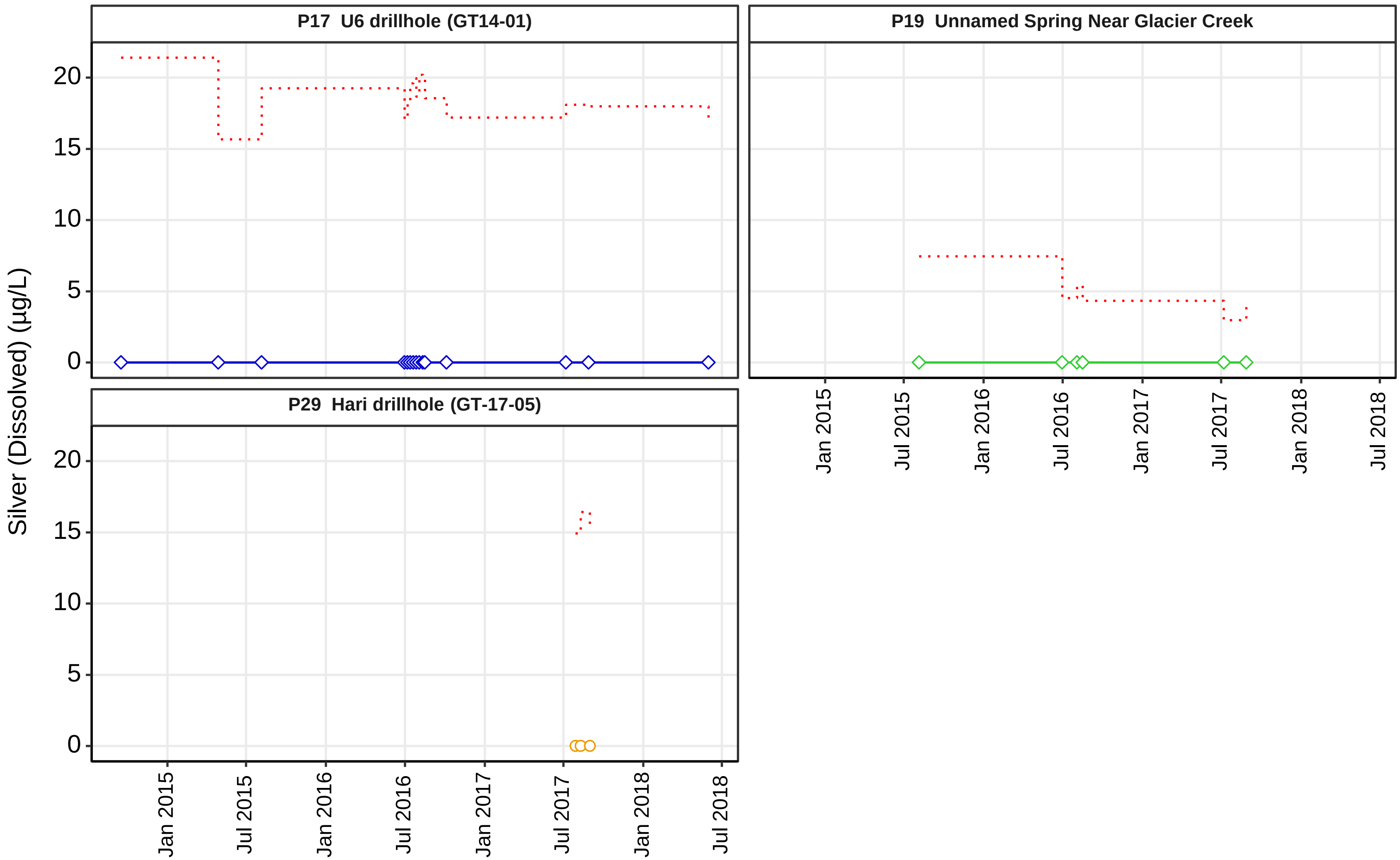
Figure 3-46. Time Series Plots: Selenium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

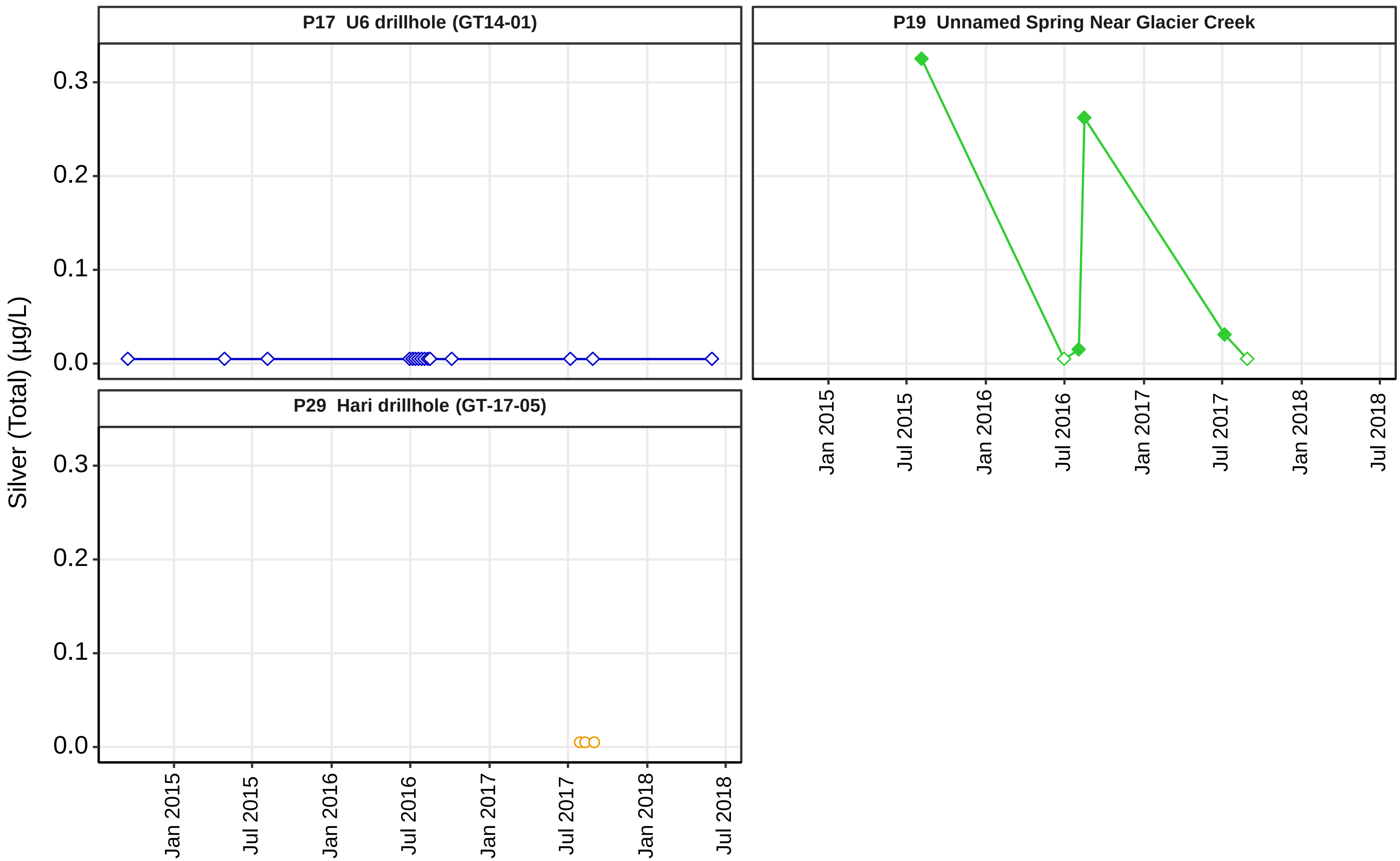
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-47. Time Series Plots: Selenium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

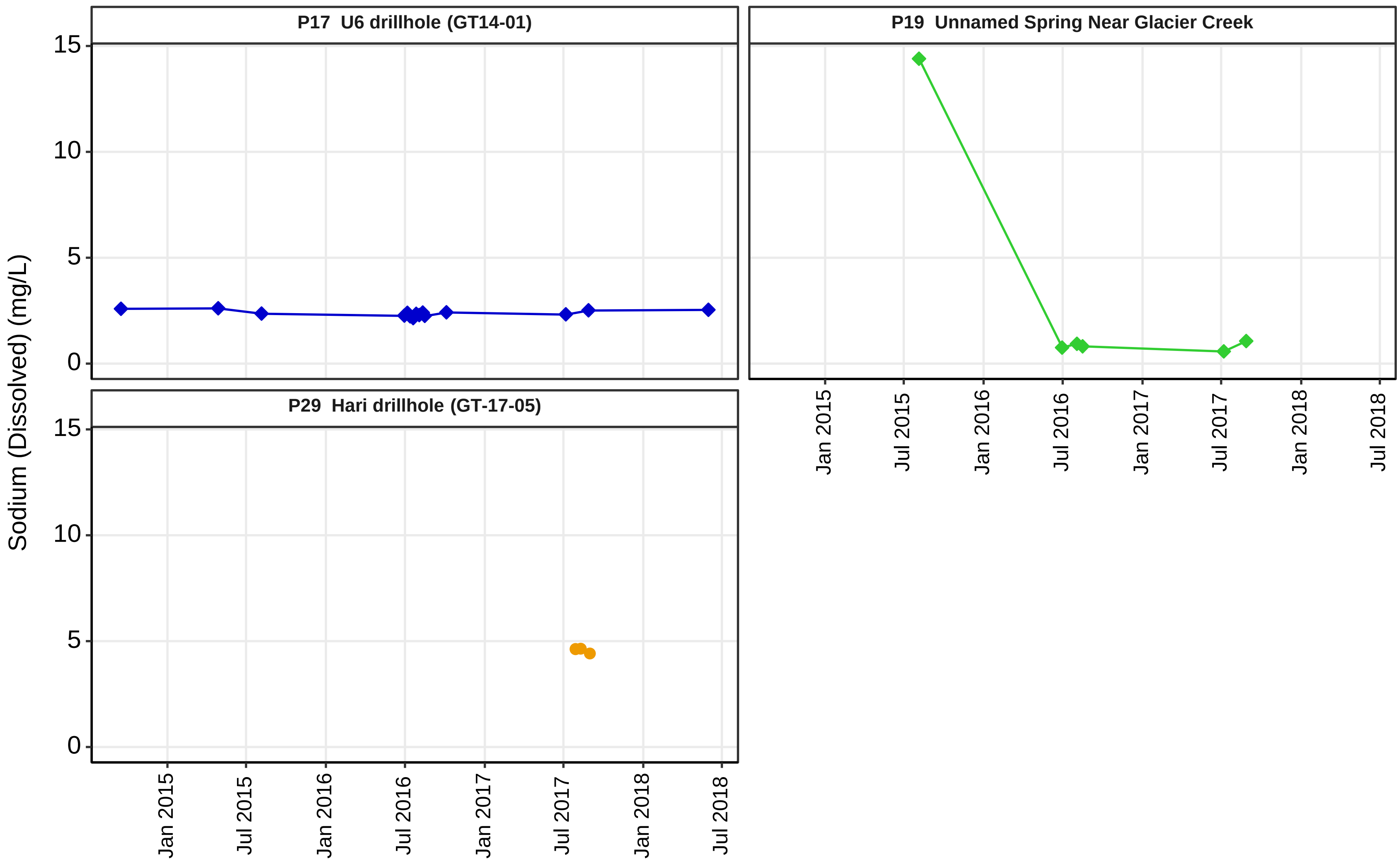
Figure 3-48. Time Series Plots: Silver (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

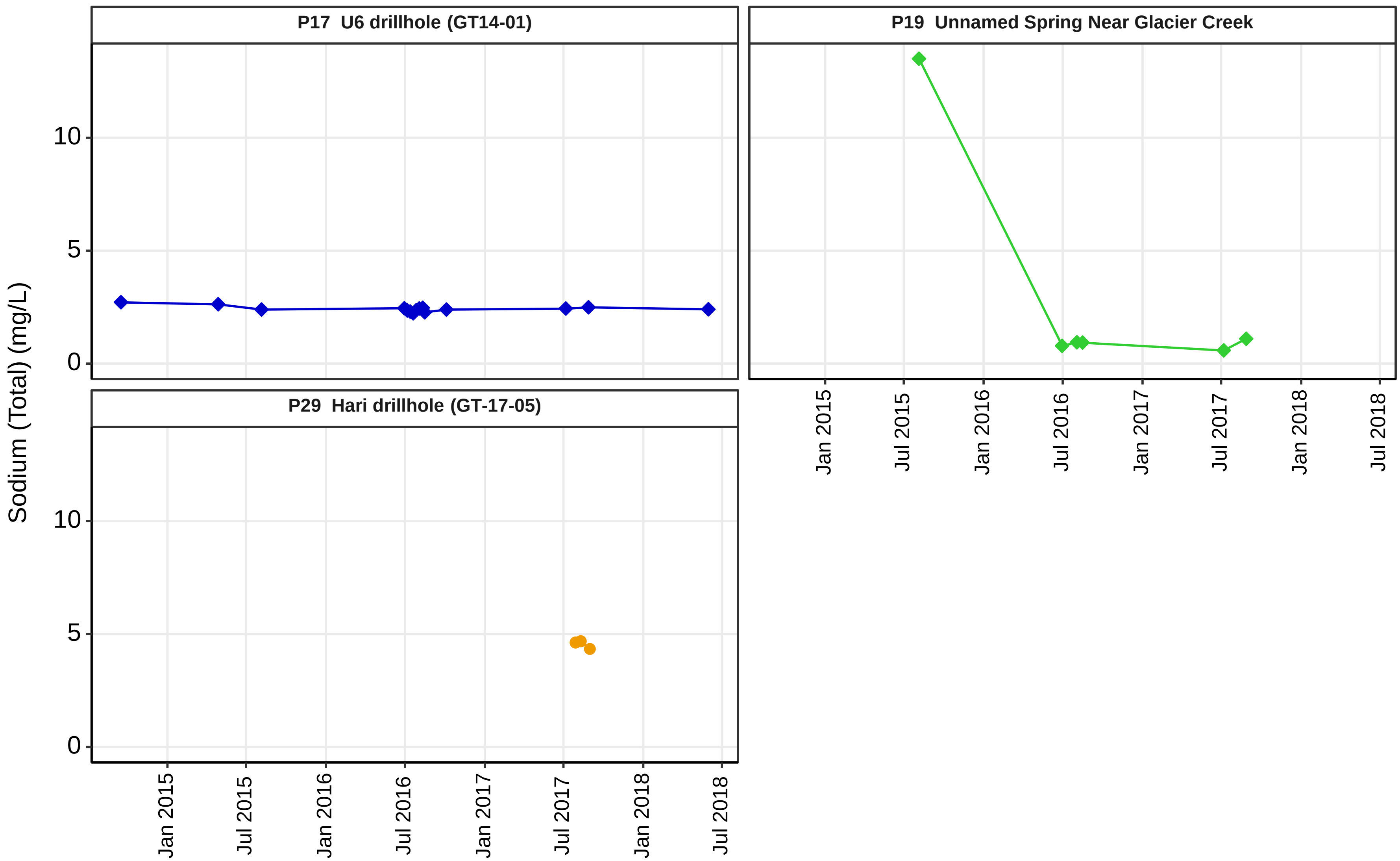
Figure 3-49. Time Series Plots: Silver (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

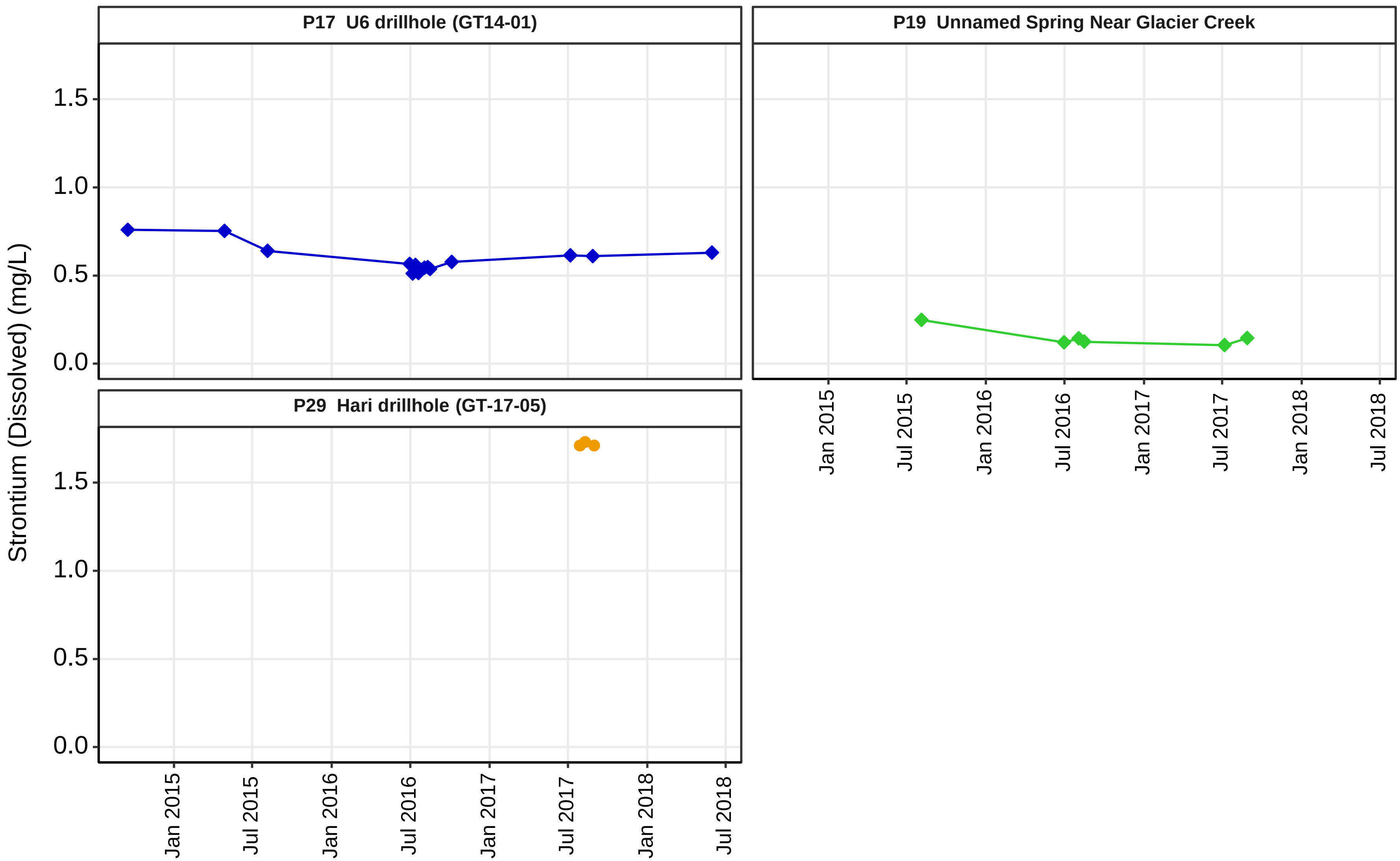
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-50. Time Series Plots: Sodium (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-51. Time Series Plots: Sodium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-52. Time Series Plots: Strontium (Dissolved) Groundwater Stations
Palmer Project
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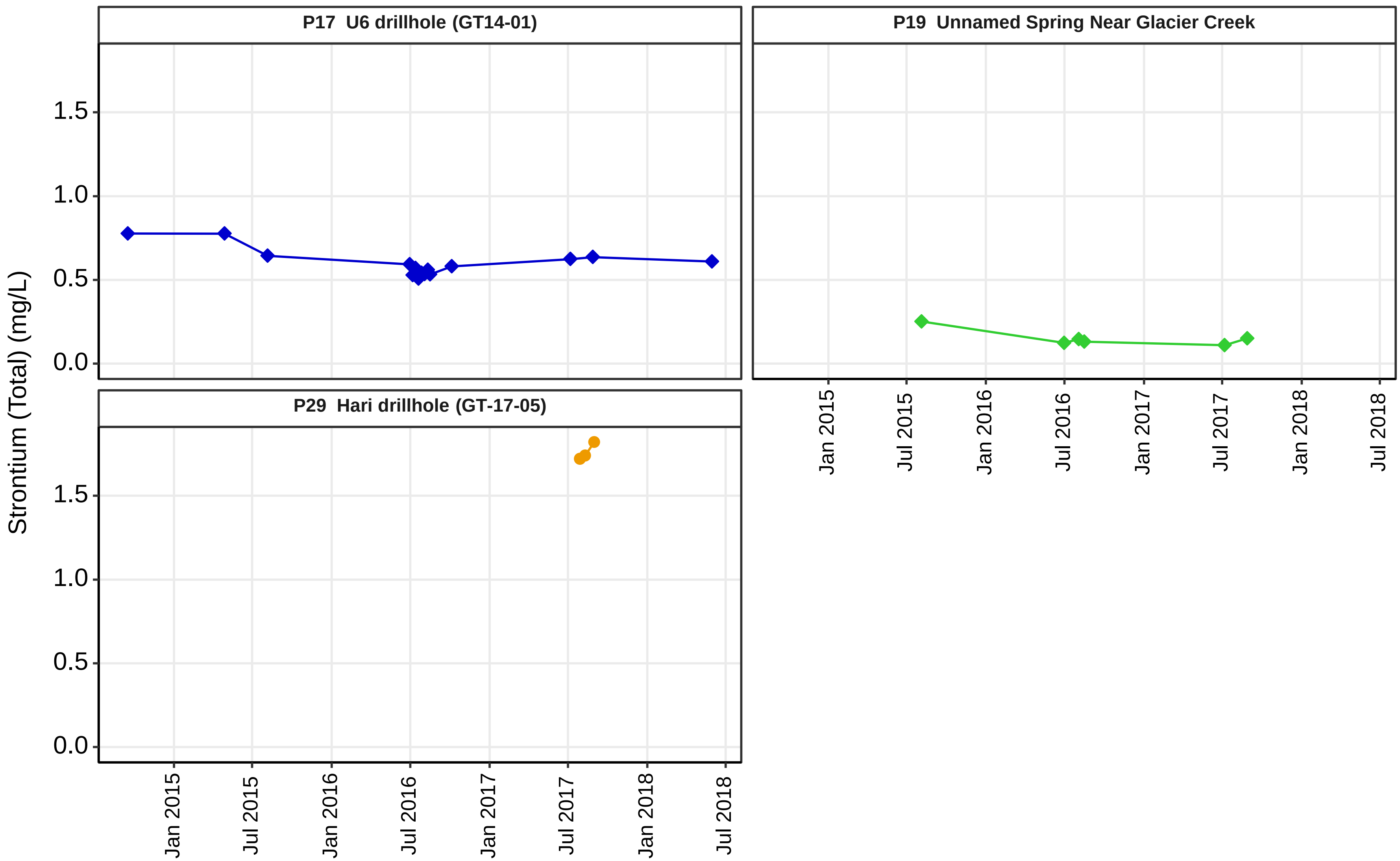
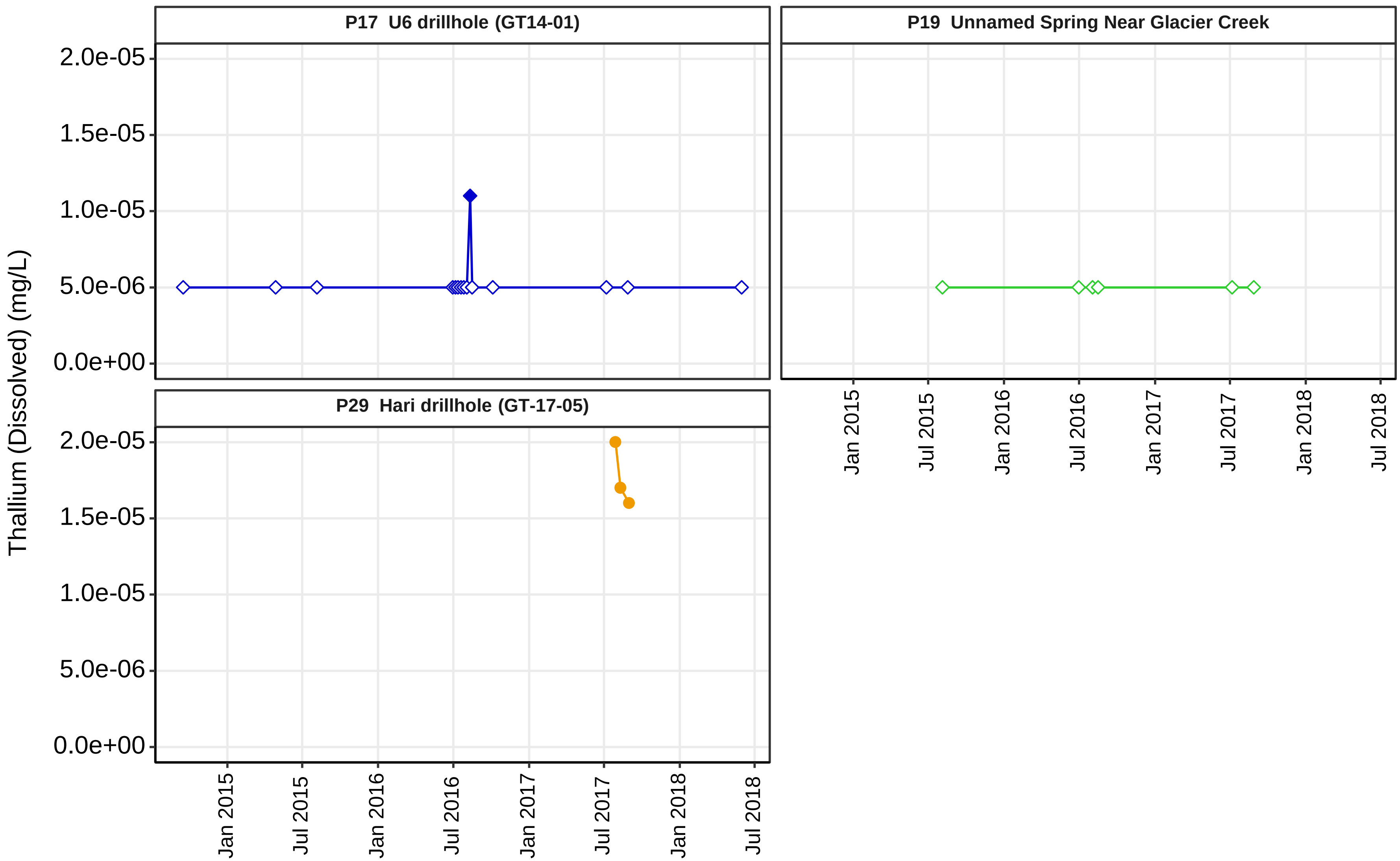


integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-53. Time Series Plots: Strontium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-54. Time Series Plots: Thallium (Dissolved) Groundwater Stations
Palmer Project
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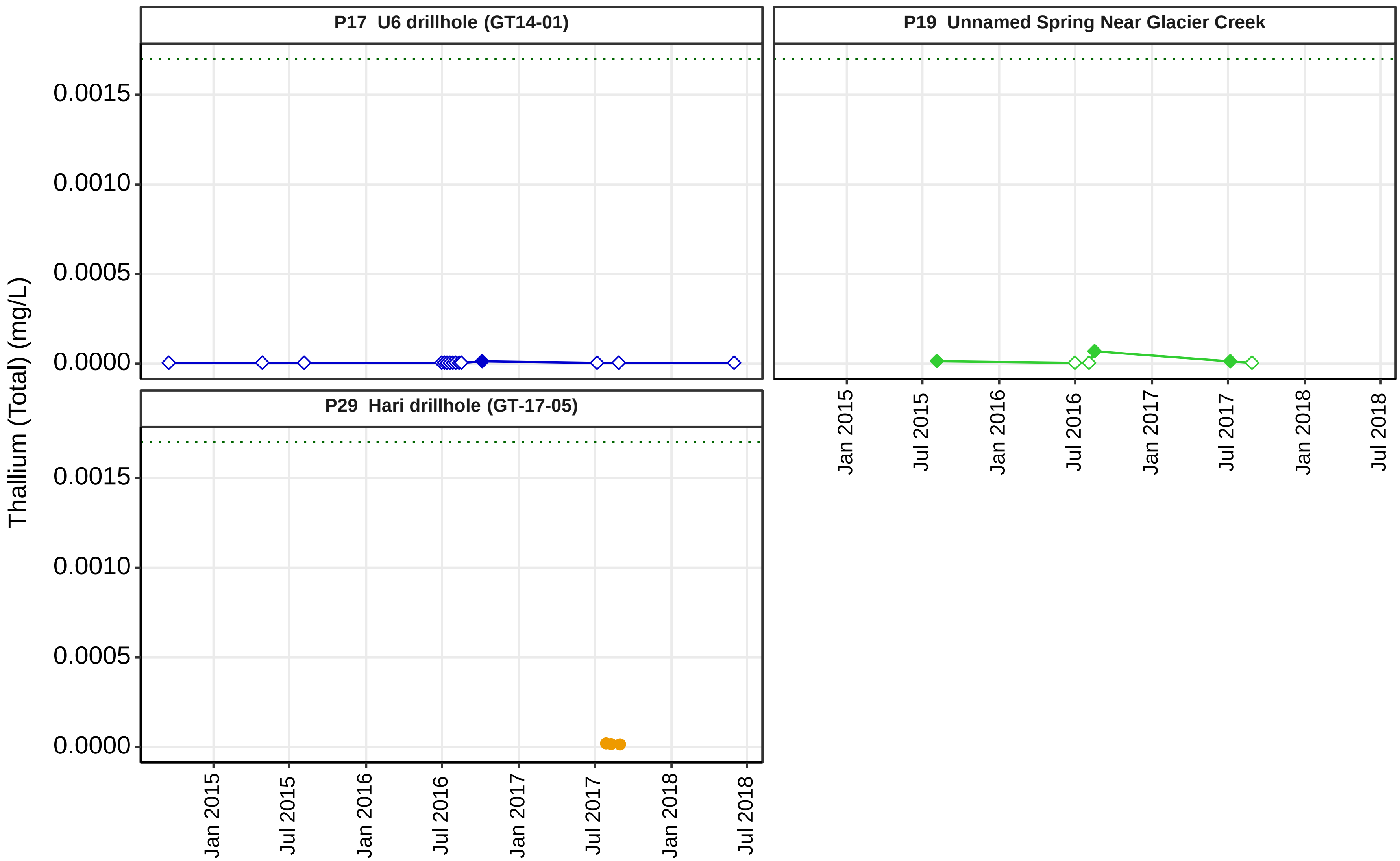

integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-55. Time Series Plots: Thallium (Total) Groundwater Stations
Palmer Project
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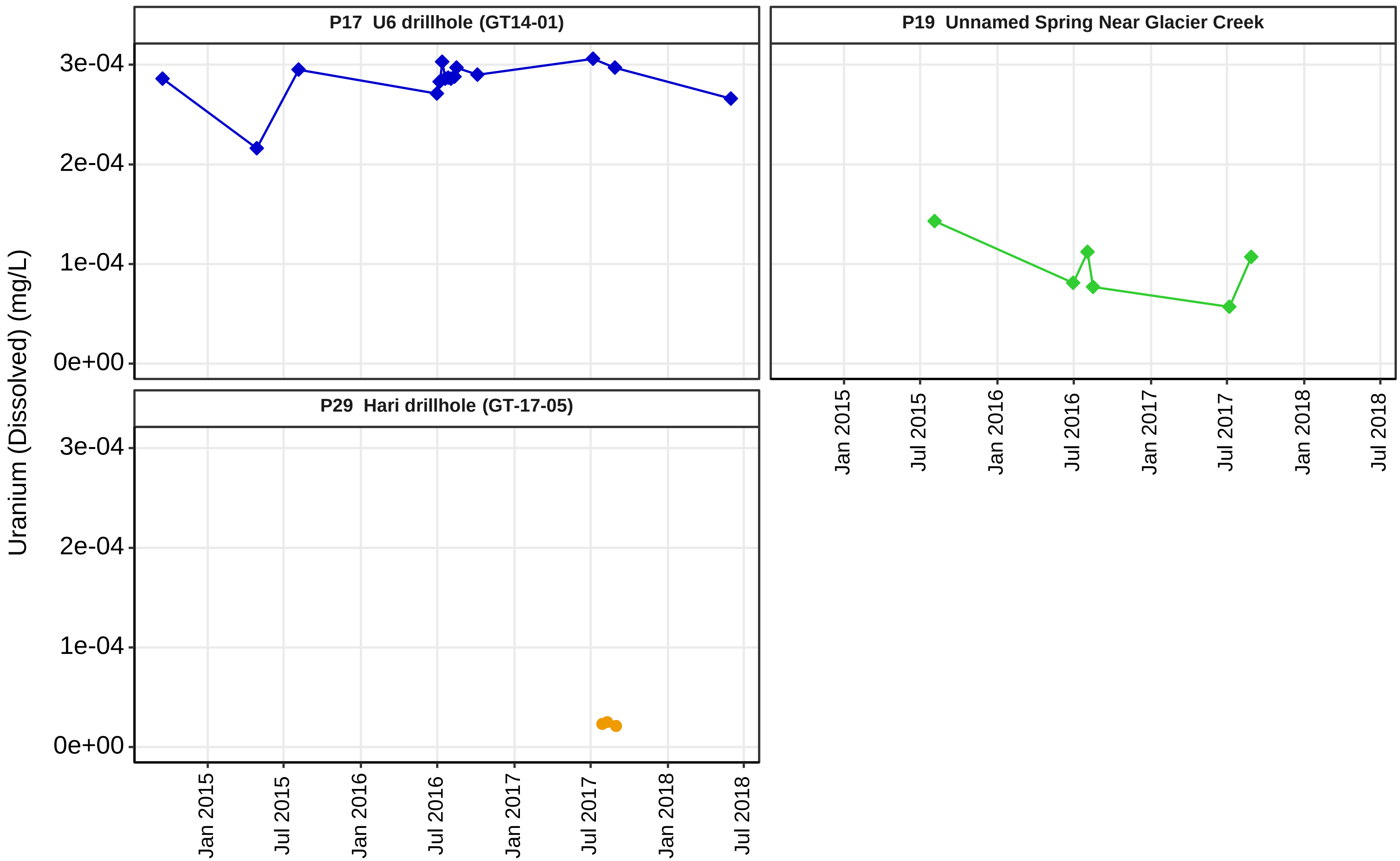

integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-56. Time Series Plots: Uranium (Dissolved) Groundwater Stations
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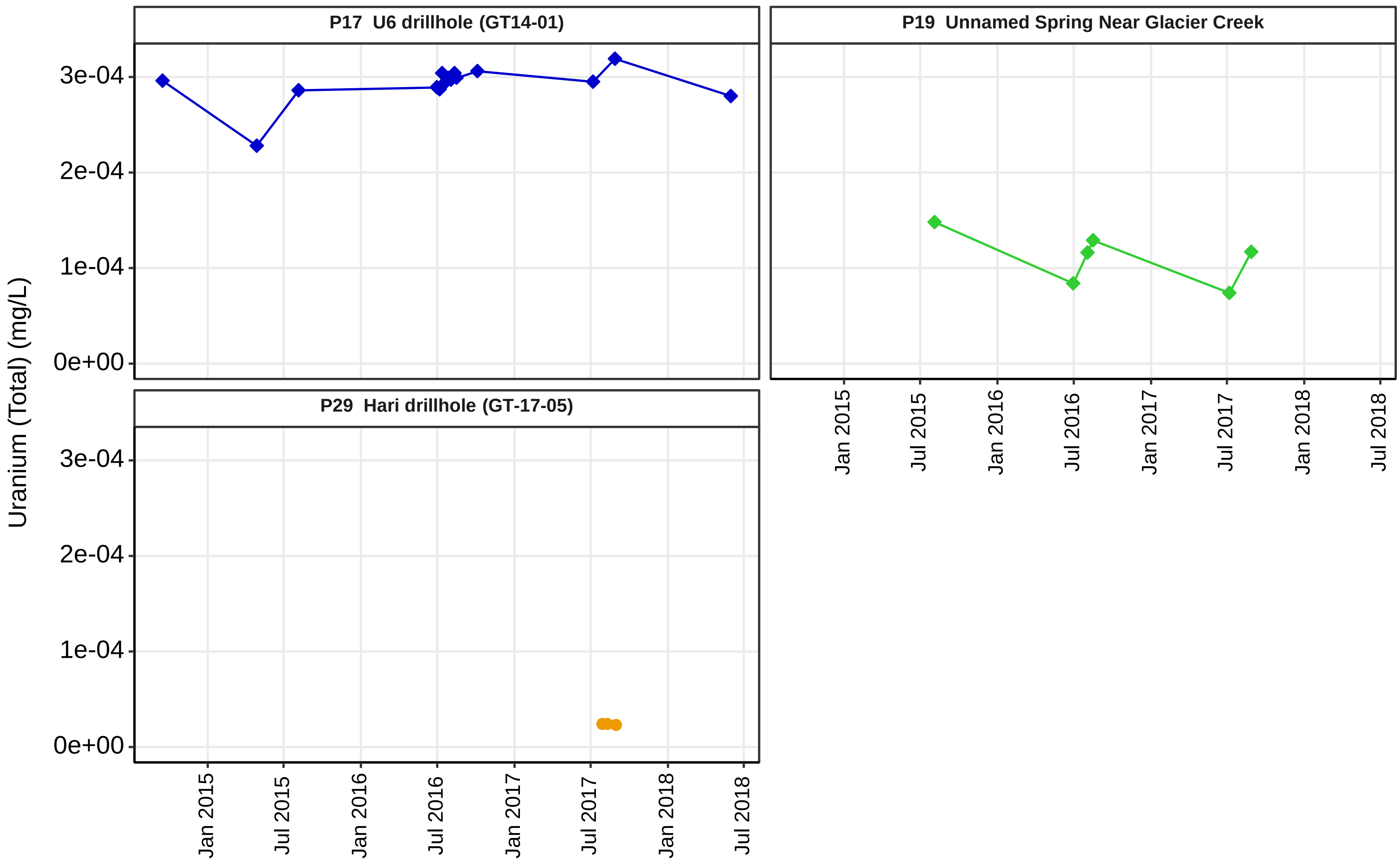

integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-57. Time Series Plots: Uranium (Total) Groundwater Stations
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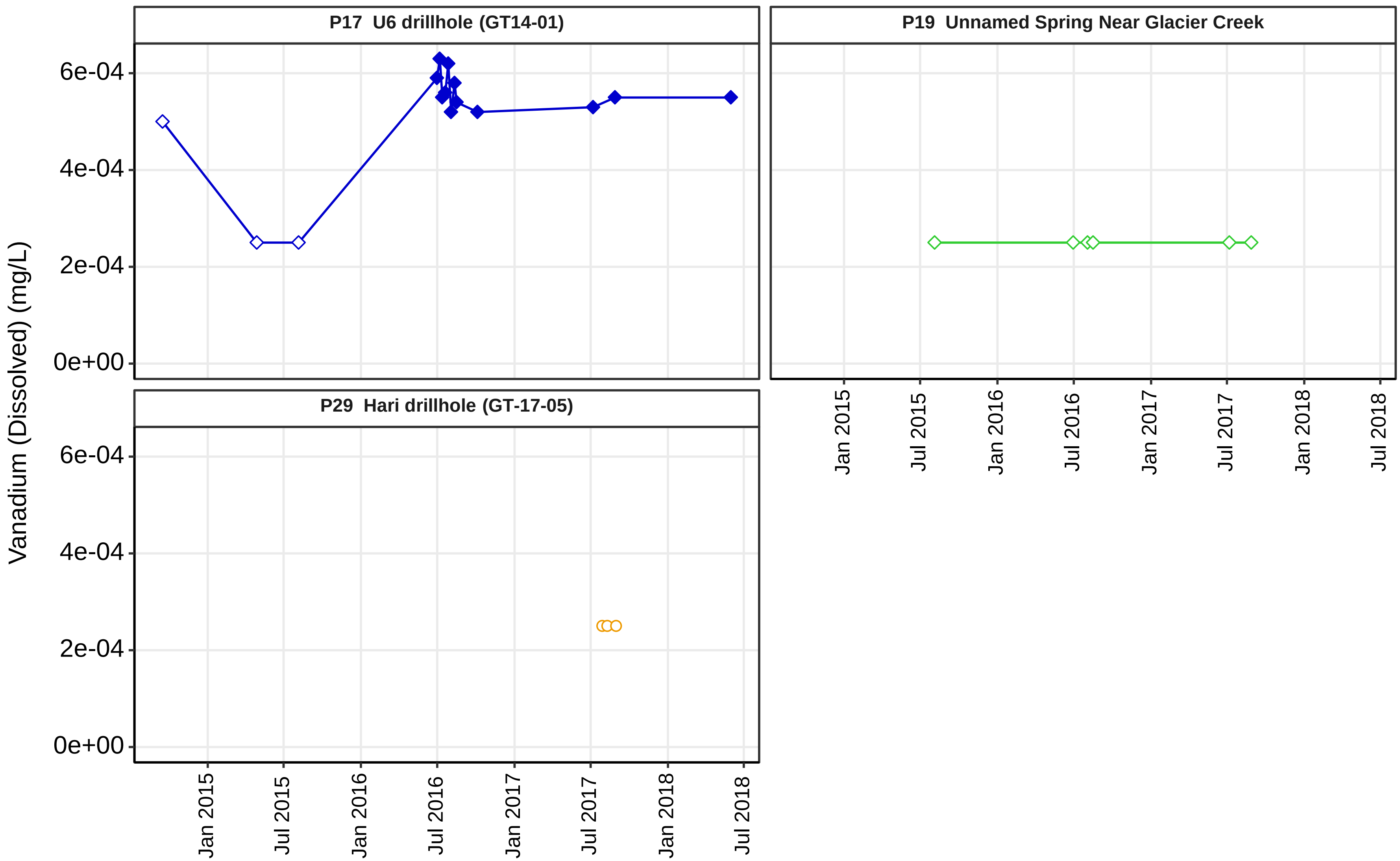

integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-58. Time Series Plots: Vanadium (Dissolved) Groundwater Stations
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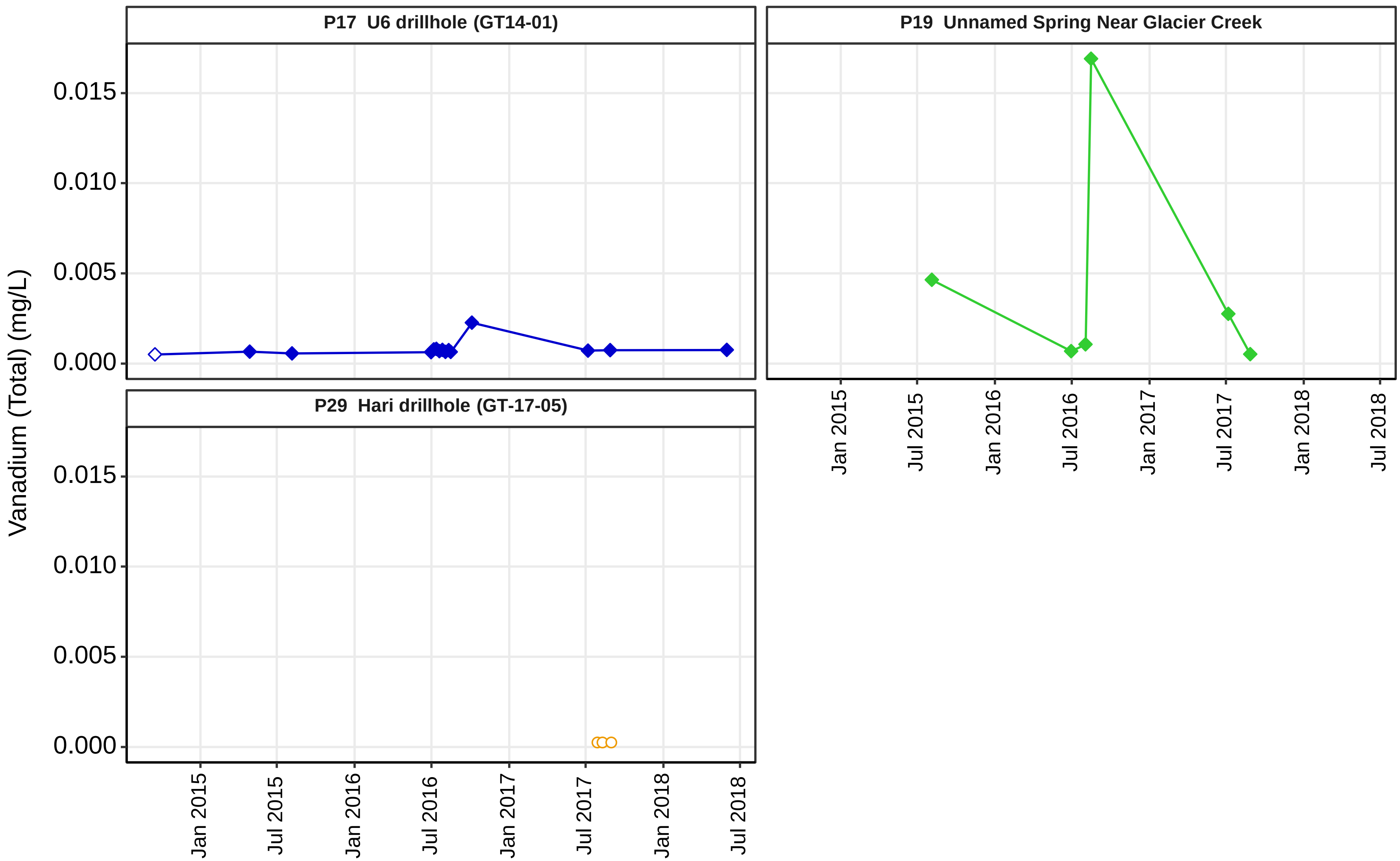
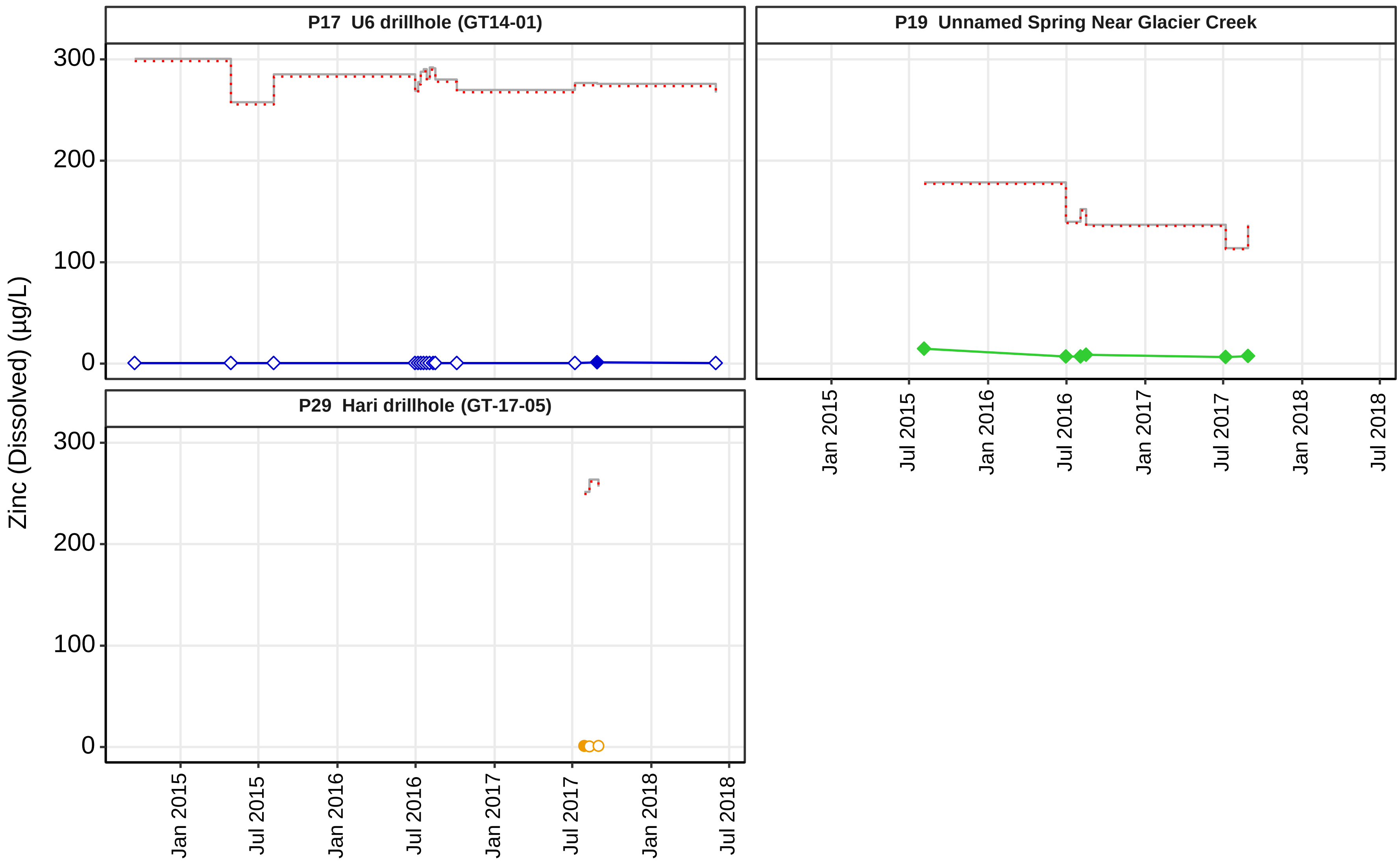


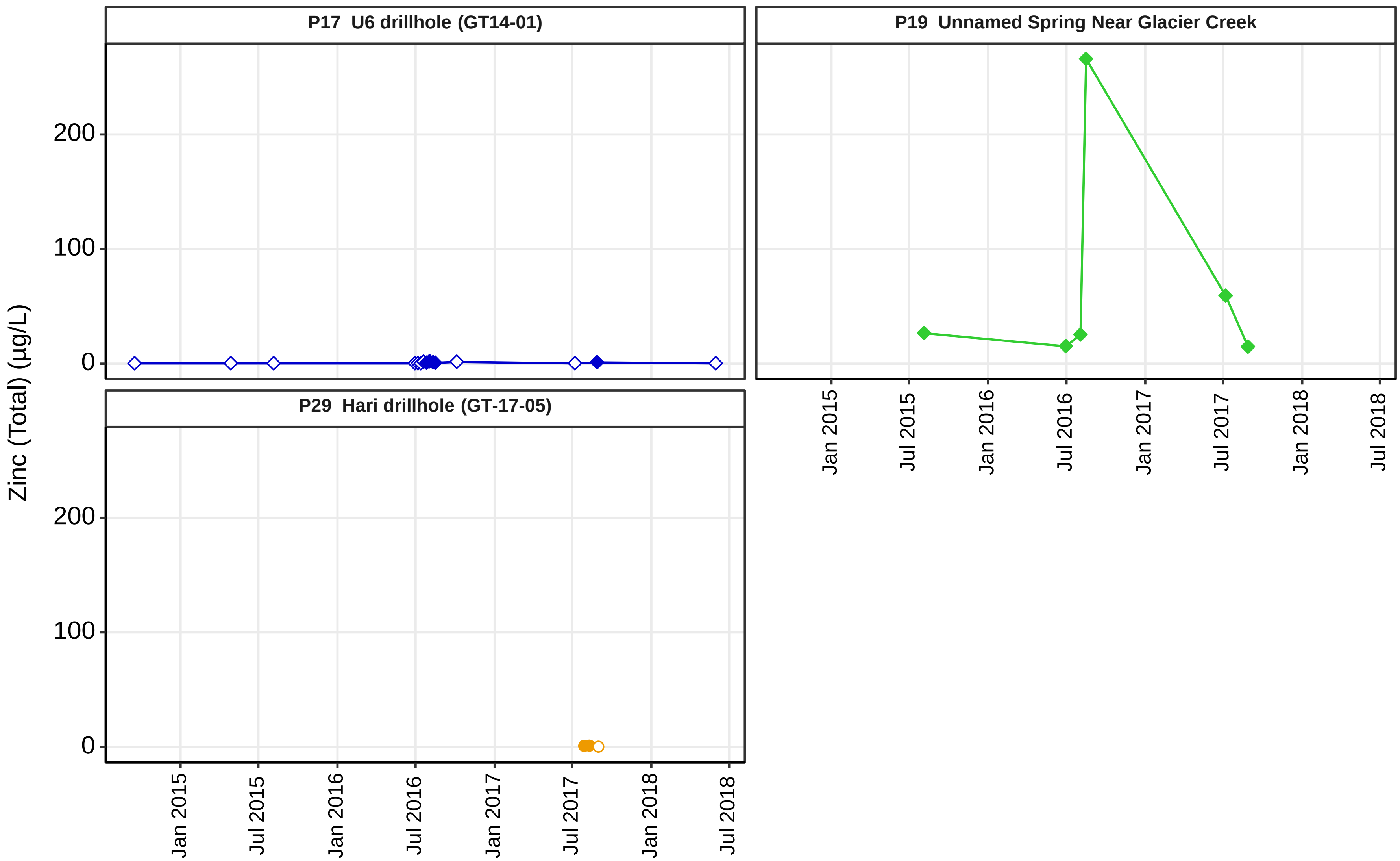
Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-59. Time Series Plots: Vanadium (Total) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-60. Time Series Plots: Zinc (Dissolved) Groundwater Stations
Palmer Project
Baseline Groundwater Quality Memorandum



integral consulting inc.

Notes:
Non-detect values shown at half detection limit as hollow symbols. If shown: red, grey, and green lines indicate acute quatic life, chronic aquatic life and human health (water + organism comsultion) screening levels, respectively.

Figure 3-61. Time Series Plots: Zinc (Total) Groundwater Stations
Palmer Project
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TABLES

Table 1-1. Groundwater Baseline Monitoring Locations and Location Selection Rationale

Sample ID	Location Description	Station Coordinates (NAD83, UTM08 Alaska)		Altitude (feet AMSL)	Dip Angle (degrees)	Hole Length (feet)	Station Rationale[a]	Description of Human Influence Near/Upstream of Station[a]
P17	U6 Drillhole (GT14-01	421856 E	6584588 N	2,600	-5	990	Characterizes groundwater from the South Wall. Station is a gently inclined geotechnical borehole located in the general area of potential future underground development.	This borehole was drilled as part of the exploratory drilling program; human activity following drilling has been minimal.
P29	Hari Drillhole (GT17-05)	421160 E	6583884 N	2,946	-15.47	960	Characterizes groundwater from the Jasper Mountain. Station is an inclined geotechnical borehole located in the general area of potential future underground development.	This borehole was drilled as part of the exploratory drilling program; human activity following drilling has been minimal.
P19	Unnamed Spring near Glacier Creek	422089 E	6584235 N	1,714	n/a	n/a	Artesian expression that flows into Glacier Creek upstream of the Oxide Creek inflow	This station is located near exploratory drill holes.

Notes:

n/a = not applicable

AMSL = above mean sea level

[a] Station rationale and description of human influence determined based on visual observations, evaluation of maps/images, and site knowledge from Constantine staff.

Table 1-2. Baseline Water Sampling Measurement Quality Objectives

Group	Analyte	Sample Preparation Method	Analytical Method [a]	Units	MDL	PQL	Alaska Water Quality Standards [b]: Aquatic Life (Fresh Water) Acute	Aquatic Life (Fresh Water) Chronic	Human Health Water + Aquatic Organisms	Drinking Water MCL	Resolution	Precision (RPD)	Accuracy (% rec)
Field Parameters [c]	Dissolved oxygen	NA	SM 4500-O G	mg/L	NA	1.0E-02	4 – 17	4 – 17	--	--	0.01 mg/L	--	0 to 20 mg/L, ±0.2 mg/L or ±2% of reading, whichever is greater; 20 to 50 mg/L, ±6% of the reading.
	pH	NA	SM 4500-H B	pH units	NA	1.0E-02	6.5 – 8.5 [d]	6.5 – 8.5 [d]	--	6.5 – 8.5 [e]	0.01 pH units	--	±0.2 pH units
	Temperature	NA	SM 2550B	° C	NA	1.0E-01	13 – 20 [f]	13 – 20 [f]	--	--	0.1°C	--	±0.15 °C
	Turbidity [u]	NA	EPA 180.1	NTU	NA	1.0E-01	NC [g]	NC [g]	--	NC [g]	0.01 NTU (0.00-10.99 NTU), 0.1 NTU (11.00-109.9 NTU), and 1 NTU (110-4000 NTU)	--	±2% (0-100 NTU), ±3% (above 100 NTU)
	Conductivity	NA	SM 2510	mS/cm	NA	0.001-0.1	--	--	--	--	0.001 mS/cm to 0.1 mS/cm (range dependent)	--	±0.5% of reading or 0.001 mS/cm, whichever is greater (4-m cable) ±1% of reading or 0.001 mS/cm, whichever is greater (20-m cable)
Conventional Analyses	Hardness as $CaCO_3$	SM 2340B, 20th ed.	SM 2340B, 20th ed.	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	80–120 %
	Total dissolved solids	SM 1030E, 20th ed.	SM 1030E, 20th ed.	mg/L	1.0E+01	1.0E+01	1,000	1,000	--	500 [e]	--	20	85–115 %
	Acidity	SM 2310B, 20th ed.	SM 2310B, 20th ed.	mg/L	1.0E+00	1.0E+00	--	--	--	--	--	20	85–115%
	Turbidity [u]	NA	APHA 2130	NTU	NA	1.0E-01	--	--	--	--	--	15	85–115%
	WAD cyanide	SM 4500-CN, 20th ed.	SM 4500-CN, 20th ed.	mg/L	5.0E-03	5.0E-03	0.022	0.0052	0.7	0.2 [u]	--	20	80-120
	Settleable solids	SM 2540F, 20th ed.	SM 2540F, 20th ed.	mL/L	1.0E-01	1.0E+00	NC	NC	--	--	--	--	--
	Total suspended solids	SM 2540D, 20th ed.	SM 2540D, 20th ed.	mg/L	3.0E+00	3.0E+00	--	--	--	--	--	20	85–115 %
Cations/Anions	Alkalinity as $CaCO_3$	SM 2320, 20th ed.	SM 2320, 20th ed.	mg/L	1.0E+00	2.0E+00	--	20 [h]	--	--	--	20	85–115 %
	Ammonia as N	Waston et al. [i]	Waston et al. [i]	mg/L	5.0E-03	5.0E-03	PD [j]	PD [k]	--	--	--	20	85–115 %
	Bromide	EPA 300.1	EPA 300.1	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	85–115%
	Chloride	EPA 300.1	EPA 300.1	mg/L	5.0E-01	5.0E-01	860 [l]	230 [l]	--	250 [e]	--	20	90–110 %
	Fluoride	EPA 300.1	EPA 300.1	mg/L	2.0E-02	2.0E-02	--	--	--	4.0	--	20	90–110%
	Nitrate + Nitrite (complex)as N	EPA 352.3	EPA 352.3	mg/L	5.0E-02	5.0E-02	--	--	--	10	--	20	90–110 %
	Sulfate	EPA 300.1	EPA 300.1	mg/L	3.0E-01	3.0E-01	--	--	--	250 [e]	--	20	90–110 %
Metals	Aluminum	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	3.0E-03	3.0E-03	0.75 [m]	0.087 [m, n]	--	0.05 - 0.2 [e]	--	20	80–120 %
	Antimony	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	--	--	0.014	0.006	--	20	80–120 %
	Arsenic	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	0.34 [o]	0.15 [o]	--	0.01	--	20	80–120 %
	Barium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-05	5.0E-05	--	--	--	2	--	20	80–120 %
	Beryllium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	2.0E-05	2.0E-05	--	--	--	0.004	--	20	80–120 %
	Bismuth	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-05	5.0E-05	--	--	--	--	--	20	80–120 %
	Boron	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-02	1.0E-02	--	--	--	--	--	20	80–120 %
	Cadmium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-06	5.0E-06	HD [o]	HD [o]	--	0.005	--	20	80–120 %
	Calcium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	80–120 %
	Chromium (total)	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	-- [p]	-- [p]	--	0.1 [m]	--	20	80–120 %
	Cobalt	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	--	--	--	--	--	20	80–120 %
	Copper	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-04	5.0E-04	HD [o]	HD [o]	1.3	1 [e]	--	20	80–120 %

Table 1-2. Baseline Water Sampling Measurement Quality Objectives

							Alaska Water Quality Standards [b]						
							Aquatic Life (Fresh Water)		Human Health	Drinking Water		Precision	Accuracy
Group	Analyte	Sample Preparation Method	Analytical Method [a]	Units	MDL	PQL	Acute	Chronic	Water + Aquatic Organisms	MCL	Resolution	(RPD)	(% rec)
	Iron	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-02	1.0E-02	--	1.0 [j]	--	0.3 [e]	--	20	80–120 %
	Lead	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-05	5.0E-05	HD [o]	HD [o]	--	--	--	20	80–120 %
	Lithium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-03	1.0E-03	--	--	--	--	--	20	80–120 %
	Magnesium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	80–120 %
	Manganese	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	--	--	--	0.05 [e]	--	20	80–120 %
	Mercury	EPA 1631E	EPA 1631E	mg/L	5.0E-06	1.0E-05	1.4E-03 [o]	7.7E-02 [o]	5.0E-05	2.0E-03	--	20	80–120 %
	Molybdenum	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-05	5.0E-05	--	--	--	--	--	20	80–120 %
	Nickel	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-04	5.0E-04	HD [o]	HD [o]	0.61	--	--	20	80–120 %
	Phosphorus	SM 4500-P, 20th ed.	SM 4500-P, 20th ed.	mg/L	2.0E-03	2.0E-03	--	--	--	--	--	20	80–120 %
	Potassium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-01	1.0E-01	--	--	--	--	--	20	80–120 %
Metals (continued)	Selenium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-05	5.0E-05	-- [q]	0.005 [m,q]	0.17	0.05	--	20	80–120 %
	Silicon	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	80–120 %
	Silver	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-05	1.0E-05	HD [o]	--	--	0.1 [e]	--	20	80–120 %
	Sodium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-02	5.0E-02	--	--	--	--	--	20	80–120 %
	Strontium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	2.0E-04	2.0E-04	--	--	--	--	--	20	80–120 %
	Thallium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-05	1.0E-05	--	--	1.70E-03	0.002	--	20	80–120 %
	Tin	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-04	1.0E-04	--	--	--	--	--	20	80–120 %
	Titanium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	3.0E-04	3.0E-04	--	--	--	--	--	20	80–120 %
	Uranium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	1.0E-05	1.0E-05	--	--	--	0.03	--	20	80–120 %
	Vanadium	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	5.0E-04	5.0E-04	--	--	--	--	--	20	80–120 %
	Zinc	EPA SW-846 3005A, Rev. 1	EPA SW-846 6010B, Rev. 2 EPA SW-846 6020A, Rev. 1	mg/L	0.0005 [t]	0.0005 [t]	HD [o]	HD [o]	9.1	5 [e]	--	20	80–120 %
	Gross alpha	EPA 900.0	EPA 900.0	picocuries/L	--	3.0E+00	--	--	--	15	--	2.13 [r]	70–130%
Radiochemistry	Radium-226	EPA 903.1	EPA 903.1	picocuries/L	--	1.0E+00	--	--	--	5 [s]	--	2.13 [r]	67–120%
	Radium-228	EPA 904.0	EPA 904.0	picocuries/L	--	1.0E+00	--	--	--	5 [s]	--	2.13 [r]	70–130%

Table 1-2. Baseline Water Sampling Measurement Quality Objectives

							Alaska Water Quality Standards [b]						
							Aquatic Life (Fresh Water)		Human Health	Drinking Water		Precision	Accuracy
Group	Analyte	Sample Preparation Method	Analytical Method [a]	Units	MDL	PQL	Acute	Chronic	Water + Aquatic Organisms	MCL	Resolution	(RPD)	(% rec)

Notes:

-- = criteria not available
ALS = ALS Laboratory Group
EPA = U.S. Environmental Protection Agency
HD = hardness-dependent criteria
MCL = maximum containment level
MDL = method detection limit
NA = not applicable
NC = natural conditions-based criteria
NTU = nephelometric turbidity units
PQL = practical quantitation limit
PD = pH-dependent criteria
RPD = relative percent difference

[a] Analytical methods for ALS Environmental are adapted from the referenced methods listed in this table.

[b] Water quality criteria source documents:

Alaska Department of Environmental Conservation. Water Quality Standards. 18 AAC 70. Amended April 8, 2012.

Alaska Department of Environmental Conservation. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. Draft. Amended December 12, 2008.

United States Environmental Protection Agency. National Primary Drinking Water Regulations. EPA 816-F-09-004. May 2009

[c] For field parameters, calibrated instruments that meet method requirements will be used.

[d] May not vary more than 0.5 pH units from natural conditions.

[e] Secondary MCL.

[f] The following maximum temperatures may not be exceeded, where applicable:

<15°C (migration routes and rearing areas)

<13°C (spawning and egg/fry incubation areas)

[g] For aquatic life, may not exceed 25 NTU above natural conditions. For drinking water, may not exceed 5 NTU above natural conditions (for natural turbidity < 50 NTU), or may not exceed 10% increase above natural conditions (for natural turbidity > 50 NTU).

[h] Minimum concentration as $CaCO_3$, except where natural alkalinity is lower

[i] Waston, R.J., C. Edward, V. Butler, L.A. Clementson, and K.M. Berry. 2005. Flow-injection Analysis with Fluorescence Detection for the Determination of Trace Levels of Ammonium in Seawater. *J. Environ. Monit* . 7:37-42.

[j] Acute (when fish are present) = $0.275/(1+10^{7.204-pH}) + 39.0/(1+10^{pH-7.204})$

Acute (when fish are not present) = $0.411/(1+10^{7.204-pH}) + 58.4/(1+10^{pH-7.204})$

[k] Chronic (when fish are present) = $(0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) \times MIN(2.85,1.45\times10^{0.028(25-Temperature)})$

Chronic (when fish are not present) = $(0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) \times (1.45 \times 10^{0.028-(25-MAX(Temperature,7))})$

[l] Applies to dissolved chloride when associated with sodium

[m] Total recoverable

[n] For pH > 7.0 and hardness > 50 mg/L $CaCO_3$, the chronic aluminum standard is equal to the acute aluminum standard (0.75 mg/L).

[o] Dissolved

[p] Criterion for dissolved Cr (VI) is 16 µg/L (acute) and 11 µg/L (chronic). Criterion for dissolved Cr (III) is hardness dependent.

[q] EPA needs to conduct additional work to complete its review of the mercury and selenium aquatic life criteria. The current criteria may change substantially in the future.

[r] Radiochemistry precision is not evaluated with an RPD calculation. A Duplicate Error Ratio is used to include sample specific total propagated uncertainty.

[s] The criterion of 5 pCi/L applies to the combined Radium-226 and Radium-228 value.

[t] Can only be achieved for low turbidity waters; other PQL is 3.0E-03 mg/L

[u] Field-measured turbidity will be used for comparison to screening levels. Turbidity analysis will also be conducted in the laboratory to support sample preparation and analytical method decisions.

Table 1-3. Palmer Groundwater Field Quality Control Sample Results, Station P19 Sampled on August 3, 2016

Parameter	Fraction	Units	Normal Sample		Field Replicate		Relative Percent Difference
Field Parameters							
Dissolved Oxygen	T	mg/L	--		--		nc
ORP	T	mV	--		--		nc
pH	T	SU	7.89		--		nc
Specific Conductivity	T	uS/cm	267		--		nc
Temperature	T	deg C	3.4		--		nc
Turbidity	T	NTU	0.88		0.94		-7%
Conventional Parameters							
Acidity as $CaCO_3$	T	mg/L	1	*UJ*	1	*UJ*	0%
Alkalinity as $CaCO_3$	T	mg/L	78	*J*	77	*J*	nc
Hardness as $CaCO_3$	T	mg/L	135		137		-1%
Settleable Solids, 1 hr	T	ml/L	--		--		nc
TDS	T	mg/L	173	*J*	167	*J*	nc
TSS	T	mg/L	3	*UJ*	4	*J*	nc
Anions and Nutrients							
Bromide	T	mg/L	0.05	*U*	0.05	*U*	nc
Chloride	T	mg/L	0.5	*U*	0.5	*U*	nc
Fluoride	T	mg/L	0.02	*U*	0.02	*U*	nc
Sulfate	T	mg/L	50.7		50.7		0%
Ammonia as N	T	mg/L	0.005	*UJ*	0.005	*UJ*	nc
Nitrate+Nitrite as N	T	mg/L	0.196	*J*	0.198	*J*	nc
Nitrate as N	T	mg/L	0.196	*J*	0.198	*J*	nc
Nitrite as N	T	mg/L	0.001	*R*	0.001	*R*	nc
Metals							
Aluminum	T	mg/L	0.187		0.0429	*U*	nc
Aluminum	D	mg/L	0.0021		0.0021		0%
Antimony	T	mg/L	0.00011		0.0001	*U*	nc
Antimony	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Arsenic	T	mg/L	0.0001	*U*	0.0001	*U*	nc
Arsenic	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Barium	T	mg/L	0.0678		0.0538		23%
Barium	D	mg/L	0.0511		0.0544		-6%
Beryllium	T	mg/L	0.00002	*U*	0.00002	*U*	nc
Beryllium	D	mg/L	0.00002	*U*	0.00002	*U*	nc
Bismuth	T	mg/L	0.00005	*U*	0.00005	*U*	nc
Bismuth	D	mg/L	0.00005	*U*	0.00005	*U*	nc
Boron	T	mg/L	0.01	*U*	0.01	*U*	nc
Boron	D	mg/L	0.01	*U*	0.01	*U*	nc
Cadmium	T	mg/L	0.000372		0.000159		80%
Cadmium	D	mg/L	0.000153		0.000151		1%
Calcium	T	mg/L	45.6		46.1		-1%
Calcium	D	mg/L	46		46.8		-2%
Chromium	T	mg/L	0.00087		0.00024		114%
Chromium	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Cobalt	T	mg/L	0.00027		0.0001	*U*	nc
Cobalt	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Copper	T	mg/L	0.00333		0.00075		126%
Copper	D	mg/L	0.0002	*U*	0.0002	*U*	nc
Iron	T	mg/L	0.391		0.086		128%
Iron	D	mg/L	0.01	*U*	0.01	*U*	nc
Lead	T	mg/L	0.0014		0.000353		119%
Lead	D	mg/L	0.00005	*U*	0.00005	*U*	nc
Lithium	T	mg/L	0.001	*U*	0.001	*U*	nc
Lithium	D	mg/L	0.001	*U*	0.001	*U*	nc
Magnesium	T	mg/L	5.04		4.94		2%

Table 1-3. Palmer Groundwater Field Quality Control Sample Results, Station P19 Sampled on August 3, 2016

Parameter	Fraction	Units	Normal Sample		Field Replicate		Relative Percent Difference
Magnesium	D	mg/L	4.89		4.99		-2%
Manganese	T	mg/L	0.00914		0.00231		119%
Manganese	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Mercury	T	mg/L	0.000005	*U*	0.000005	*U*	nc
Mercury	D	mg/L	0.000005	*U*	0.000005	*U*	nc
Molybdenum	T	mg/L	0.000694		0.000674		3%
Molybdenum	D	mg/L	0.000659		0.000665		-1%
Nickel	T	mg/L	0.0005	*U*	0.0005	*U*	nc
Nickel	D	mg/L	0.0005	*U*	0.0005	*U*	nc
Phosphorus	T	mg/L	0.002	*UJ*	0.002	*UJ*	0%
Phosphorus	D	mg/L	0.01	*UJ*	0.002	*UJ*	nc
Potassium	T	mg/L	1.44		1.38		4%
Potassium	D	mg/L	1.35		1.39		-3%
Selenium	T	mg/L	0.000621		0.000637		-3%
Selenium	D	mg/L	0.000613		0.000612		0%
Silicon	T	mg/L	1.62		1.41		14%
Silicon	D	mg/L	1.35		1.37		-1%
Silver	T	mg/L	0.000015		0.00001	*U*	nc
Silver	D	mg/L	0.00001	*U*	0.00001	*U*	nc
Sodium	T	mg/L	0.94		0.94		0%
Sodium	D	mg/L	0.933		0.958		-3%
Strontium	T	mg/L	0.146		0.145		1%
Strontium	D	mg/L	0.143		0.145		-1%
Thallium	T	mg/L	0.00001	*U*	0.00001	*U*	nc
Thallium	D	mg/L	0.00001	*U*	0.00001	*U*	nc
Tin	T	mg/L	0.0001	*U*	0.0001	*U*	nc
Tin	D	mg/L	0.0001	*U*	0.0001	*U*	nc
Titanium	T	mg/L	0.00715		0.0018		120%
Titanium	D	mg/L	0.0003	*U*	0.0003	*U*	nc
Uranium	T	mg/L	0.000116		0.000116		0%
Uranium	D	mg/L	0.000112		0.000114		-2%
Vanadium	T	mg/L	0.00106		0.0005	*U*	nc
Vanadium	D	mg/L	0.0005	*U*	0.0005	*U*	nc
Zinc	T	mg/L	0.0254		0.0106		82%
Zinc	D	mg/L	0.007		0.0074		-6%

Notes:

Relative Percent Difference (RPD) calculated by:

RPD = [X1 - X2] / [Xavg x 100]

where:

X1 = concentration of normal sample

X2 = concentration of field replicate

Xavg = average concentration [(X1 + X2)/2]

-- = data not available

D = dissolved

nc = RPD not calculated in cases where one or more concentrations were below reporting limits or not available (i.e., U or J qualified data not included in RPD calculation).

ORP = oxidation/reduction potential

T = total

TDS = total dissolved solids

TSS = total suspended solids

Data Qualifiers:

J = The analyte was

U = The analyte was not detected above the reported sample quantitation limit.

UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

R = Rejected

Table 3-1a. Palmer Groundwater Quality Sampling Results, 2008–2018, Field and Conventional Parameters

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Acidity as $CaCO_3$ N mg/L	ORP N mV	Settleable Solids, 1 hr N ml/L	Settleable Solids, 24 hr N ml/L	Temperature N deg C
Groundwater									
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	4.5 *U*	64.6	0	--	4.67
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	1 *U*	161.1	0	0	2.86
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	1 *UJ*	--	--	--	--
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	1 *UJ*	--	--	--	3.4
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	2.1 *U*	--	--	--	3.3
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	1 *UJ*	--	--	--	2.7
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	1 *UJ*	--	--	--	4.5
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	3.8 *U*	29	0	0	4.25
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	2.3 *U*	56.8	1	1	3.85
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	4 *U*	108	0	0	3.97
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	1.3 *U*	81	0	0	4.25
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	16.6	--	--	--	4.4
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	2.6 *UJ*	--	--	--	4.3
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	3.1 *U*	--	--	--	4.1
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	2.8 *UJ*	--	--	--	4.2
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	1.8 *UJ*	--	--	--	4.5
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	2.8 *UJ*	--	--	--	4.2
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	3.5 *U*	--	--	--	4.4
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	2.4 *UJ*	--	--	--	4.1
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	1 *UJ*	--	--	--	5.4
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	1 *UJ*	--	--	--	6.6
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	1.7 *UJ*	--	--	--	7
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	1 *UJ*	--	--	--	7
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	1 *UJ*	--	--	--	6.8
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	1 *UJ*	--	--	--	4.8

Table 3-1a. Palmer Groundwater Quality Sampling Results, 2008–2018, Field and Conventional Parameters

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Specific Conductivity N uS/cm	DO N mg/L	Turbidity N NTU	pH N SU	TDS N mg/L	Hardness as $CaCO_3$ N mg/L	TSS N mg/L
Groundwater											
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	238	14.39	55.7	7.78	368	163	54
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	256	13.81	0.97	8.12	144	122	3.6
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	--	--	0.94	--	167 *J*	137	4 *J*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	267	--	0.88	7.89	173 *J*	135	3 *UJ*
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	243	--	48.6 *J*	8.04	150	119	86
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	190.6	13.4	4.14	8.11	126 *J*	95.7	19.4 *J*
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	260.1	11.2	--	8.3	145 *J*	119	3 *UJ*
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	605	6.45	0.9	7.4	416	301	3 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	270	9.1	0.02	7.67	322	251	3 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	250	11.8	1.24	5.75	383	283	3.3 *U*
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	555	11.82	0.45	7.94	338	264	4.7
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	473	--	0.81 *J*	7.35	360	274	3 *U*
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	472	--	0.55 *J*	7.62	352 *J*	286	3 *U*
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	476	--	0.23	7.55	356	289	3 *U*
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	283	--	0.18	7.63	369 *J*	278	3 *UJ*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	542	--	0.11	7.67	358 *J*	291	3 *UJ*
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	547	--	0.21 *J*	7.91	382 *J*	290	5.7 *J*
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	535	--	0.16 *J*	7.81	358	277	3 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	531	--	5.5 *J*	7.73	378 *J*	265	3.8 *J*
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	565.6	7.64	--	7.81	356 *J*	273	3 *UJ*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	563.7	7.28	--	7.84	350 *J*	272	3 *UJ*
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	264.8	13.05	0.19 *J*	8.15	328 *J*	262	3 *UJ*
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	540.5	0.86	--	9.3	375 *J*	244	3 *UJ*
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	541	0.66	--	8.97	347 *J*	258	3 *UJ*
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	535.1	1.13	--	8.95	344 *J*	250	3 *UJ*

Notes:
-- = parameter not measured
DO = dissolved oxygen
FR = field replicate sample
N = natural sample
NTU = nephelometric turbidity unit
ORP = oxidation/reduction potential
TSS = total suspended solids
TDS = total dissolved solids

Data Qualifiers:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

Table 3-1b. Palmer Groundwater Quality Sampling Results, 2008–2018, Nutrient and Anions

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Cyanide	Alkalinity as $CaCO_3$	Bromide	Chloride	Fluoride	Sulfate	Ammonia as N	Nitrate+Nitrite as N	Nitrate as N	Nitrite as N
					D	N	N	N	N	N	N	N	N	N
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater														
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	--	106	0.05 *U*	0.92	0.02 *U*	90.9	0.193	0.31	--	--
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	--	83.2	0.05 *U*	0.5 *U*	0.02 *U*	37.9	0.005 *U*	0.265	0.265 *J*	--
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	--	77 *J*	0.05 *U*	0.5 *U*	0.02 *U*	50.7	0.005 *UJ*	0.198 *J*	0.198 *J*	--
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	--	78 *J*	0.05 *U*	0.5 *U*	0.02 *U*	50.7	0.005 *UJ*	0.196 *J*	0.196 *J*	--
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	--	74	0.05 *U*	0.5 *U*	0.02 *U*	42.4	0.005 *U*	0.128	0.128	0.001 *U*
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.005 *UJ*	74.3 *J*	0.05 *U*	0.5 *U*	0.02 *U*	27.4 *J*	0.005 *UJ*	0.232 *J*	0.232 *J*	0.001 *UJ*
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.005 *UJ*	85.7 *J*	0.05 *U*	0.5 *U*	0.02 *U*	46.1 *J*	0.005 *UJ*	0.153 *J*	0.153 *J*	--
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	--	119	0.05 *U*	0.5 *U*	0.042	182	0.005 *U*	0.0342	0.0342	0.001 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	--	117	0.05 *U*	0.5 *U*	0.044	150	0.005 *U*	0.0308	0.0308	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	--	115	0.05 *U*	0.5 *U*	0.039	172	0.005 *U*	0.1 *U*	--	--
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	--	113	0.05 *U*	0.5 *U*	0.036	150	0.005 *U*	0.0452	0.0452 *J*	--
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	--	121	0.05 *U*	0.5 *U*	0.04	157	0.005 *U*	0.0491	0.0491 *J*	--
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	--	120 *J*	0.05 *U*	0.5 *U*	0.041	156	0.005 *UJ*	0.0437	0.0437	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	--	117	0.05 *U*	0.5 *U*	0.036	159	0.0819	0.0438	0.0438	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	--	116 *J*	0.05 *U*	0.5 *U*	0.04	162	0.005 *UJ*	0.046 *J*	0.046 *J*	0.001 *UJ*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	--	115 *J*	0.05 *U*	0.5 *U*	0.038	160	0.005 *UJ*	0.0463 *J*	0.0463 *J*	--
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	--	119 *J*	0.05 *U*	0.5 *U*	0.038	162	0.005 *UJ*	0.0431 *J*	0.0431 *J*	0.001 *UJ*
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	--	115	0.05 *U*	0.5 *U*	0.037	162	0.005 *U*	0.0438	0.0438	0.001 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	--	109 *J*	0.05 *U*	0.5 *U*	0.041	164	0.005 *UJ*	0.0387 *J*	0.0387 *J*	--
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.005 *UJ*	114 *J*	0.05 *U*	0.5 *U*	0.037	166 *J*	0.005 *UJ*	0.0481 *J*	0.0481 *J*	0.001 *UJ*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.005 *UJ*	114 *J*	0.05 *U*	0.5 *U*	0.033	174 *J*	0.005 *UJ*	0.0461 *J*	0.0461 *J*	--
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.005 *UJ*	110 *J*	0.05 *U*	0.5 *U*	0.037	158 *J*	0.005 *UJ*	0.057 *J*	0.057 *J*	--
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.005 *UJ*	62 *J*	0.05 *U*	0.83	0.075	197 *J*	0.0328 *J*	0.0051 *UJ*	0.005 *UJ*	0.001 *UJ*
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.005 *UJ*	78 *J*	0.05 *U*	0.5	0.079	196 *J*	0.029 *J*	--	--	--
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.005 *UJ*	74.7 *J*	0.05 *U*	0.5 *U*	0.073	199 *J*	0.0306 *J*	0.0051 *UJ*	--	--

Notes:
-- = parameter not measured
FR = field replicate sample
N = natural sample

Data Qualifiers:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Aluminum T mg/L	Aluminum D mg/L	Antimony T mg/L	Antimony D mg/L	Arsenic T mg/L	Arsenic D mg/L	Barium T mg/L	Barium D mg/L	Beryllium T mg/L	Beryllium D mg/L	Bismuth T mg/L
Groundwater															
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	0.851	0.0123	0.0004	0.00043	0.0001	0.0001 *U*	0.257	0.19	0.00002 *U*	0.00002 *U*	0.00005 *U*
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.113	0.0025	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0756	0.067	0.00002 *U*	0.00002 *U*	0.00005 *U*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.0429 *U*	0.0021	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0538	0.0544	0.00002 *U*	0.00002 *U*	0.00005 *U*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.187	0.0021	0.00011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0678	0.0511	0.00002 *U*	0.00002 *U*	0.00005 *U*
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	3.8	0.0031	0.00047	0.0001 *U*	0.0015	0.0001 *U*	0.317	0.0556	0.000036	0.00002 *U*	0.000109
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.529	0.0024	0.00017	0.0001 *U*	0.0003	0.0001 *U*	0.175	0.0582	0.00002 *U*	0.00002 *U*	0.00005 *U*
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.087	0.0027	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0602	0.0521	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.0047	0.0029 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0164	0.0166	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0149	0.0153	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.0057	0.0011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0186	0.016	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.003 *U*	0.0011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0156	0.015	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.003 *U*	0.0014	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0154	0.0158	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.003	0.0013	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0153	0.0153	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0165	0.0165	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.003 *U*	0.0012	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0156	0.0157	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0149	0.0153	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0154	0.0152	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0149	0.015	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.0057	0.0011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0165	0.0163	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.003 *U*	0.001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0171	0.0154	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.003 *U*	0.0012	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0167	0.0165	0.00002 *U*	0.00002 *U*	0.00005 *U*
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.003 *U*	0.0012	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0156	0.0168	0.00002 *U*	0.00002 *U*	0.00005 *U*
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.0049	0.0031	0.00023	0.0002	0.0002	0.0002	0.0313	0.0324	0.00002 *U*	0.00002 *U*	0.00005 *U*
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.0039	0.0053	0.00013	0.00012	0.0002	0.0002	0.0312	0.0315	0.00002 *U*	0.00002 *U*	0.00005 *U*
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.005	0.0043	0.0001	0.0001 *U*	0.0002	0.0002	0.0298	0.031	0.00002 *U*	0.00002 *U*	0.00005 *U*

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Bismuth D mg/L	Boron T mg/L	Boron D mg/L	Cadmium T mg/L	Cadmium D mg/L	Calcium T mg/L	Calcium D mg/L	Chromium T mg/L	Chromium D mg/L	Cobalt T mg/L	Cobalt D mg/L	Copper T mg/L
Groundwater																
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.00075	0.000636	63.9	56.1	0.00553	0.0001 *U*	0.0011	0.0002	0.0054
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000162	0.00014	42	42.4	0.00051	0.0001 *U*	0.0002	0.0001 *U*	0.0017
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.00005 *U*	0.01 *U*	0.01 *U*	0.000159	0.000151	46.1	46.8	0.00024	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0008
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000372	0.000153	45.6	46	0.00087	0.0001 *U*	0.0003	0.0001 *U*	0.0033
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.00104	0.000203	41.4	40.3	0.0144	0.0001 *U*	0.0046	0.0001 *U*	0.0491
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000358	0.00014	36.7	33.3	0.00199	0.0001 *U*	0.0008	0.0001 *U*	0.0098
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000192	0.000159	41	39.5	0.00035	0.0001 *U*	0.0001	0.0001 *U*	0.0015
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.0005 *U*	0.013	0.01 *U*	0.00001 *U*	0.00001 *U*	98.7	99.8	0.00017	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	86.2	82.7	0.00019	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	92.3	95.2	0.00202	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	92.7	88.8	0.00013	0.0001 *U*	0.0001 *U*	0.0001	0.0005 *U*
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	93.5	93.3	0.00018	0.0001	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	95.8	97.2	0.00011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0006
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	98.9	98.6	0.00011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0006
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	94.4	94.6	0.00013	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.00005 *U*	0.016	0.01 *U*	0.000005 *U*	0.000005 *U*	98.2	99.1	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	92.8	98.9	0.00014 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	90.8	94	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	89.5	88.4	0.00018	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0021
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	96.3	91.2	0.00013	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	92.8	89.9	0.00013	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.00005 *U*	0.01 *U*	0.01 *U*	0.000005 *U*	0.000005 *U*	85.7	85.9	0.00011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.00005 *U*	0.027	0.026	0.000005 *U*	0.000005 *U*	77.9	77.6	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.00005 *U*	0.025	0.025	0.000005 *U*	0.000005 *U*	81.7	82.5	0.00012	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.00005 *U*	0.022	0.022	0.000005 *U*	0.000005 *U*	82.3	79.6	0.0001 *U*	0.00023	0.0001 *U*	0.0001 *U*	0.0005 *U*

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Copper D mg/L	Iron T mg/L	Iron D mg/L	Lead T mg/L	Lead D mg/L	Lithium T mg/L	Lithium D mg/L	Magnesium T mg/L	Magnesium D mg/L	Manganese T mg/L	Manganese D mg/L
Groundwater															
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	0.0018	2.18	0.182	0.000864	0.00028	0.0015	0.0012	7.07	5.6	0.0402	0.00531
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.0003	0.23	0.01 *U*	0.000777	0.00005 *U*	0.001 *U*	0.001 *U*	3.92	3.81	0.00549	0.00024
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.0002 *U*	0.086	0.01 *U*	0.000353	0.00005 *U*	0.001 *U*	0.001 *U*	4.94	4.99	0.00231	0.0001 *U*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.0002 *U*	0.391	0.01 *U*	0.0014	0.00005 *U*	0.001 *U*	0.001 *U*	5.04	4.89	0.00914	0.0001 *U*
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	0.0003	7.87	0.01 *U*	0.0236	0.00005 *U*	0.0017	0.001 *U*	7.65	4.48	0.168	0.00035
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.0002 *U*	1.22	0.01 *U*	0.00638	0.00005 *U*	0.001 *U*	0.001 *U*	3.62	3.07	0.0285	0.0001 *U*
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.0003	0.17	0.01 *U*	0.000565	0.00028	0.001 *U*	0.001 *U*	5.48	5.07	0.00403	0.00014
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.0003	0.13	0.127	0.00005 *U*	0.00005 *U*	0.0013	0.0012	12.5	12.5	0.0025	0.00247
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.0003 *U*	0.106	0.042	0.00005 *U*	0.00005 *U*	0.0013	0.0016	11.5	10.9	0.0013	0.00133
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.0003	0.035	0.027	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	11.1	11.1	0.00091	0.0008
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.0004	0.01 *U*	0.01 *U*	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	10.7	10.2	0.00051	0.00065
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.0004	0.024	0.012	0.00005 *U*	0.00005 *U*	0.0019	0.0012	10	9.98	0.00031	0.00033
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.0004	0.065	0.029	0.00005 *U*	0.00005 *U*	0.001	0.0011	10.5	10.5	0.00088	0.00078
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.0004	0.025	0.012	0.00005 *U*	0.00005 *U*	0.0014	0.0012	10.5	10.5	0.00033	0.00028
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.0004	0.014	0.011	0.00005 *U*	0.00005 *U*	0.0014	0.001	10.4	10.1	0.0003	0.00026
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.0003	0.013	0.013	0.00005 *U*	0.00005 *U*	0.0013	0.0013	10.4	10.5	0.00029 *U*	0.00029
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.0003	0.029	0.01 *U*	0.00005 *U*	0.00005 *U*	0.0013	0.0013	9.49	10.3	0.00033	0.00027
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.0003	0.012	0.01 *U*	0.00005 *U*	0.00005 *U*	0.0014	0.0012	10.2	10.3	0.00028	0.00025
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.0003	0.514	0.034	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	10.6	10.7	0.00417	0.00243
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.0003	0.04	0.01	0.00005 *U*	0.00005 *U*	0.001 *U*	0.0013	11	10.9	0.00118	0.00096
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.0003	0.072	0.025	0.00005 *U*	0.00005 *U*	0.0011	0.0011	11.5	11.5	0.00175	0.00165
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.0004	0.01 *U*	0.01 *U*	0.00005 *U*	0.00005 *U*	0.0015	0.0012	10.7	11.5	0.00044	0.00045
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.0002 *U*	0.166	0.15	0.00005 *U*	0.00005 *U*	0.0018	0.0017	12	12.2	0.0614	0.0624
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.0002 *U*	0.197	0.198	0.00005 *U*	0.00005 *U*	0.0015	0.0012	12.5	12.5	0.0737	0.0679
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.0002 *U*	0.175	0.177	0.00005 *U*	0.00005 *U*	0.0011	0.001 *U*	12.5	12.5	0.0733	0.073

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Mercury T mg/L	Mercury D mg/L	Molybdenum T mg/L	Molybdenum D mg/L	Nickel T mg/L	Nickel D mg/L	Phosphorus T mg/L	Phosphorus D mg/L	Potassium T mg/L	Potassium D mg/L
Groundwater														
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	6.5E-06	0.000005 *U*	0.00263	0.00266	0.0028	0.0005 *U*	0.078	0.0035 *J*	4.09	3.42
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.000005 *U*	0.000005 *U*	0.000807	0.000783	0.0005 *U*	0.0005 *U*	0.002 *U*	--	1.35	1.32
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.000005 *U*	0.000005 *U*	0.000674	0.000665	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	1.38	1.39
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.000694	0.000659	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.01 *UJ*	1.44	1.35
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	0.000025	0.000005 *U*	0.00083	0.000553	0.007	0.0005 *U*	0.0308	0.002 *U*	2.24	1.26
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.000005 *U*	0.000005 *U*	0.000654	0.000626	0.0012	0.0005 *U*	0.0099 *J*	0.002 *UJ*	1.34	1.13
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.000005 *U*	0.000005 *U*	0.000701	0.000674	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	1.28	1.23
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.00001 *U*	0.00001 *U*	0.00201	0.00191	0.0005 *U*	0.0005 *U*	0.002 *U*	0.002 *UJ*	3.79	3.81
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.000005 *U*	0.000005 *U*	0.00228	0.0022	0.0005 *U*	0.0005 *U*	0.002 *U*	0.002 *U*	3.7	3.48
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.000005 *U*	0.000005 *U*	0.00197	0.00192	0.0007	0.0005 *U*	0.02 *U*	--	3.74	3.69
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.000005 *U*	0.000005 *U*	0.00203	0.00187	0.0005 *U*	0.0005 *U*	0.002 *U*	--	3.84	3.64
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00179	0.0017	0.0005 *U*	0.0005 *U*	0.002 *U*	--	3.54	3.46
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00188	0.00172	0.0005 *U*	0.0005 *U*	0.01 *UJ*	0.002 *UJ*	3.68	3.64
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00169	0.00163	0.0005 *U*	0.0005 *U*	0.0027	0.01 *U*	3.55	3.49
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00178	0.00159	0.0005 *U*	0.0005 *U*	0.02 *UJ*	0.02 *UJ*	3.43	3.26
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00171	0.00172	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	3.53	3.56
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00179	0.00165	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.01 *UJ*	3.35	3.63
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00176	0.00168	0.0005 *U*	0.0005 *U*	0.01 *U*	0.002 *U*	3.42	3.44
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.000005 *U*	0.000005 *U*	0.00186	0.00178	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.01 *UJ*	3.74	3.8
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.000005 *U*	0.000005 *U*	0.00192	0.00189	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	3.68	3.46
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.000005 *U*	0.000005 *U*	0.00185	0.00166	0.0005 *U*	0.0005 *U*	0.004 *UJ*	0.002 *UJ*	3.74	3.81
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.000005 *U*	0.000005 *U*	0.0019	0.00189	0.0005 *U*	0.0005 *U*	0.002 *UJ*	--	3.81	4.07
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.000005 *U*	0.000005 *U*	0.0156	0.0138	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	3.23	3.26
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.000005 *U*	0.000005 *U*	0.0153	0.0151	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	3.41	3.31
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.000005 *U*	0.000005 *U*	0.0157	0.0143	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	3.2	3.32

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Selenium T mg/L	Selenium D mg/L	Silicon T mg/L	Silicon D mg/L	Silver T mg/L	Silver D mg/L	Sodium T mg/L	Sodium D mg/L	Strontium T mg/L	Strontium D mg/L	Thallium T mg/L
Groundwater															
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	0.000724	0.000709	3.21	1.86	0.000325	0.00001 *U*	13.5	14.4	0.252	0.248	0.000014
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.000598	0.000539	1.5	1.29	0.00001 *U*	0.00001 *U*	0.785	0.757	0.124	0.121	0.00001 *U*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.000637	0.000612	1.41	1.37	0.00001 *U*	0.00001 *U*	0.94	0.958	0.145	0.145	0.00001 *U*
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.000621	0.000613	1.62	1.35	0.000015	0.00001 *U*	0.94	0.933	0.146	0.143	0.00001 *U*
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	0.00066	0.00062	7.16	1.2	0.000262	0.00001 *U*	0.923	0.813	0.131	0.124	0.000069
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.000503	0.000442	2.03	1.19	0.000031	0.00001 *U*	0.579	0.569	0.11	0.105	0.000013
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.000717	0.000626	1.45	1.25	0.00001 *U*	0.00001 *U*	1.1	1.06	0.151	0.145	0.00001 *U*
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.0009	0.00088	3.41	3.42	0.00001 *U*	0.00001 *U*	2.71	2.59	0.777	0.759	0.00001 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.00111	0.00113	3.47	3.34	0.00001 *U*	0.00001 *U*	2.62	2.61	0.776	0.752	0.00001 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.001	0.00109	3.18	3.19	0.00001 *U*	0.00001 *U*	2.39	2.36	0.644	0.639	0.00001 *U*
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.00108	0.00108	3.37	3.22	0.00001 *U*	0.00001 *U*	2.45	2.26	0.593	0.565	0.00001 *U*
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.00105	0.000999	3.14	3.13	0.00001 *U*	0.00001 *U*	2.34	2.4	0.528	0.511	0.00001 *U*
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.00109	0.00103	3.24	3.28	0.00001 *U*	0.00001 *U*	2.3	2.23	0.57	0.559	0.00001 *U*
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.00096	0.00105	3.27	3.27	0.00001 *U*	0.00001 *U*	2.22	2.15	0.508	0.514	0.00001 *U*
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.00104	0.00106	3.11	3.1	0.00001 *U*	0.00001 *U*	2.36	2.35	0.542	0.532	0.00001 *U*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.00108	0.00109	3.21	3.27	0.00001 *U*	0.00001 *U*	2.43	2.29	0.535	0.544	0.00001 *U*
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.00118	0.00119	2.97	3.21	0.00001 *U*	0.00001 *U*	2.47	2.41	0.56	0.547	0.00001 *U*
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.00107	0.00114	3.14	3.24	0.00001 *U*	0.00001 *U*	2.27	2.25	0.533	0.537	0.00001 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.00116	0.00119	3.33	3.27	0.00001 *U*	0.00001 *U*	2.39	2.42	0.581	0.577	0.000013
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.00117	0.00103	3.28	3.4	0.00001 *U*	0.00001 *U*	2.43	2.32	0.624	0.614	0.00001 *U*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.00109	0.00101	3.35	3.17	0.00001 *U*	0.00001 *U*	2.49	2.51	0.636	0.61	0.00001 *U*
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.00105	0.0011	3.17	3.24	0.00001 *U*	0.00001 *U*	2.4	2.54	0.61	0.629	0.00001 *U*
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.00005 *U*	0.000056	5.27	5.13	0.00001 *U*	0.00001 *U*	4.62	4.62	1.72	1.71	0.00002
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.00005 *U*	0.00005 *U*	5.34	5.23	0.00001 *U*	0.00001 *U*	4.68	4.64	1.74	1.73	0.000016
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.00005 *U*	0.00005 *U*	5.16	5.15	0.00001 *U*	0.00001 *U*	4.34	4.41	1.82	1.71	0.000014

Table 3-1c. Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Thallium D mg/L	Tin T mg/L	Tin D mg/L	Titanium T mg/L	Titanium D mg/L	Uranium T mg/L	Uranium D mg/L	Vanadium T mg/L	Vanadium D mg/L	Zinc T mg/L	Zinc D mg/L
Groundwater															
P19	Unnamed Spring Near Glacier Creek	8/5/2015	August 2015	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0505	0.0003 *U*	0.000148	0.000143	0.00464	0.0005 *U*	0.0266	0.015
P19	Unnamed Spring Near Glacier Creek	6/30/2016	June 2016	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.00521	0.0003 *U*	0.000084	0.000081	0.00069	0.0005 *U*	0.0151	0.007
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	FR	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0018	0.0003 *U*	0.000116	0.000114	0.0005 *U*	0.0005 *U*	0.0106	0.007
P19	Unnamed Spring Near Glacier Creek	8/3/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.00715	0.0003 *U*	0.000116	0.000112	0.00106	0.0005 *U*	0.0254	0.007
P19	Unnamed Spring Near Glacier Creek	8/16/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.193	0.0003 *U*	0.000129	0.000077	0.0169	0.0005 *U*	0.266	0.009
P19	Unnamed Spring Near Glacier Creek	7/7/2017	July 2017	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0324	0.0003 *U*	0.000074	0.000057	0.00275	0.0005 *U*	0.0591	0.007
P19	Unnamed Spring Near Glacier Creek	8/28/2017	August 2017	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0039 *U*	0.0003 *U*	0.000117	0.000107	0.00052	0.0005 *U*	0.0148	0.007
P17	U6 Drillhole (GT14-01)	9/16/2014	September 2014	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.01 *U*	0.01 *U*	0.000296	0.000286	0.001 *U*	0.001 *U*	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	4/28/2015	April 2015	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000228	0.000216	0.00066	0.0005 *U*	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/6/2015	August 2015	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000286	0.000295	0.00056	0.0005 *U*	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	6/30/2016	June 2016	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000289	0.000271	0.00063	0.00059	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/7/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000287	0.000283	0.00078	0.00063	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/13/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000304	0.000303	0.00081	0.00055	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/20/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000294	0.000286	0.00068	0.00056	0.003 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/27/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000299	0.000287	0.00075	0.00062	0.0006	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/3/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000297	0.000286	0.00065	0.00052	0.002	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/11/2016	Borehole Sampling	N	0.000011	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000304	0.000288	0.00074	0.00058	0.0011	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/16/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000299	0.000297	0.00064	0.00054	0.0007	0.001 *U*
P17	U6 Drillhole (GT14-01)	10/5/2016	Borehole Sampling	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000306	0.00029	0.00227	0.00052	0.003 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	7/7/2017	July 2017	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000295	0.000306	0.00072	0.00053	0.0005 *U*	0.001 *U*
P17	U6 Drillhole (GT14-01)	8/28/2017	August 2017	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000319	0.000297	0.00074	0.00055	0.001	0.001
P17	U6 Drillhole (GT14-01)	5/31/2018	May 2018	N	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.00028	0.000266	0.00075	0.00055	0.0005 *U*	0.001 *U*
P29	Hari drillhole (GT17-05)	7/29/2017	July 2017	N	0.00002	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000024	0.000023	0.0005 *U*	0.0005 *U*	0.0009	0.001
P29	Hari drillhole (GT17-05)	8/10/2017	August 2017	N	0.000017	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000024	0.000025	0.0005 *U*	0.0005 *U*	0.0011	0.001 *U*
P29	Hari drillhole (GT17-05)	8/31/2017	August 2017	N	0.000016	0.0001 *U*	0.0001 *U*	0.0003 *U*	0.0003 *U*	0.000023	0.000021	0.0005 *U*	0.0005 *U*	0.0005 *U*	0.002 *U*

Notes:
FR = field replicate sample
N = natural sample

Data Qualifiers:
J = The analyte was positively identified; the
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

Table 3-2. Comparison of Background Groundwater Concentrations to Aquatic Life Screening Levels

			Water Measurements							Chronic Aquatic Life Standard Screen [a]				
Parameter	Basis	Units	Sample Count	Detect Count	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Minimum Detection Limit	Maximum Detection Limit	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Minimum Screening Level	Maximum Screening Level
P17 - U6 Drillhole (GT14-01)														
Aluminum	Total	mg/L	15	4	27%	0.003	0.0057	0.003	0.003	--	--	0%	0.087	0.75
Antimony	Total	µg/L	15	0	0%	--	--	0.1	0.1	--	--	0%	--	--
Arsenic	Dissolved	µg/L	15	--	0%	--	--	0.1	0.1	--	--	0%	0.15	0.15
Cadmium	Dissolved	µg/L	15	--	0%	--	--	0.005	0.01	--	--	0%	0.47	0.53
Chromium III	Dissolved	µg/L	15	1	7%	0.1	0.1	0.1	0.1	--	--	0%	157	183
Copper	Dissolved	µg/L	15	14	93%	0.3	0.39	0.26	0.26	--	--	0%	19.7	23.0
Iron	Total	µg/L	15	13	87%	12	514	10	10	--	--	0%	1,000	1,000
Lead	Dissolved	µg/L	15	--	0%	--	--	0.05	0.05	--	--	0%	6.7	8.2
Manganese	Total	µg/L	15	14	93%	0.28	4.17	0.1	0.1	--	--	0%	--	--
Mercury	Dissolved	µg/L	15	--	0%	--	--	0.005	0.005	--	--	0%	0.77	0.77
Nickel	Dissolved	µg/L	15	--	0%	--	--	0.5	0.5	--	--	0%	113	132
Selenium	Total	µg/L	15	14	93%	0.9	1.18	0.05	0.05	--	--	0%	5.0	5.0
Silver	Dissolved	µg/L	15	--	0%	--	--	0.01	0.01	--	--	0%	--	--
Thallium	Total	µg/L	15	1	7%	0.013	0.013	0.01	0.01	--	--	0%	--	--
Zinc	Dissolved	µg/L	15	1	7%	1.2	1.2	1	1	--	--	0%	258	301
P29 - Hari Drillhole (GT17-05)														
Aluminum	Total	mg/L	3	3	100%	3.9	5	0.003	0.003	--	--	0%	0.75	0.75
Antimony	Total	µg/L	3	3	100%	0.1	0.23	0.1	0.1	--	--	0%	--	--
Arsenic	Dissolved	µg/L	3	3	100%	0.19	0.22	0.1	0.1	--	--	0%	0.15	0.15
Cadmium	Dissolved	µg/L	3	--	0%	--	--	0.005	0.005	--	--	0%	0.46	0.47
Chromium III	Dissolved	µg/L	3	1	33%	0.23	0.23	0.1	0.1	--	--	0%	154	161
Copper	Dissolved	µg/L	3	--	0%	--	--	0.2	0.2	--	--	0%	19.2	20.1
Iron	Total	µg/L	3	3	100%	166	197	10	10	--	--	0%	1,000	1,000
Lead	Dissolved	µg/L	3	--	0%	--	--	0.05	0.05	--	--	0%	6.5	6.9
Manganese	Total	µg/L	3	3	100%	61.4	73.7	0.1	0.1	--	--	0%	--	--
Mercury	Dissolved	µg/L	3	--	0%	--	--	0.005	0.005	--	--	0%	0.77	0.77
Nickel	Dissolved	µg/L	3	--	0%	--	--	0.5	0.5	--	--	0%	111	116
Selenium	Total	µg/L	3	--	0%	--	--	0.05	0.05	--	--	0%	5.0	5.0
Silver	Dissolved	µg/L	3	--	0%	--	--	0.01	0.01	--	--	0%	--	--
Thallium	Total	µg/L	3	3	100%	0.014	0.02	0.01	0.01	--	--	0%	--	--
Zinc	Dissolved	µg/L	3	1	33%	1.0	1.0	1	1	--	--	0%	252	264

Table 3-2. Comparison of Background Grou

			Acute Aquatic Life Standard Screen [a]					Human Health Consumption (Water + Organisms) Screen [a]			
Parameter	Basis	Units	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Minimum Screening Level	Maximum Screening Level	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Screening Level
P17 - U6 Drillhole (GT14-01)											
Aluminum	Total	mg/L	--	--	0%	0.75	0.75	--	--	0%	--
Antimony	Total	µg/L	--	--	0%	--	--	--	--	0%	14
Arsenic	Dissolved	µg/L	--	--	0%	0.34	0.34	--	--	0%	--
Cadmium	Dissolved	µg/L	--	--	0%	4.92	5.9	--	--	0%	--
Chromium III	Dissolved	µg/L	--	--	0%	1,211	1,405	--	--	0%	--
Copper	Dissolved	µg/L	--	--	0%	32	38	--	--	0%	1,300
Iron	Total	µg/L	--	--	0%	--	--	--	--	0%	--
Lead	Dissolved	µg/L	--	--	0%	173	209	--	--	0%	--
Manganese	Total	µg/L	--	--	0%	--	--	--	--	0%	50
Mercury	Dissolved	µg/L	--	--	0%	1.4	1.4	--	--	0%	0.05
Nickel	Dissolved	µg/L	--	--	0%	1,020	1,189	--	--	0%	610
Selenium	Total	µg/L	--	--	0%	--	--	--	--	0%	170
Silver	Dissolved	µg/L	--	--	0%	15.7	21.4	--	--	0%	--
Thallium	Total	µg/L	--	--	0%	--	--	--	--	0%	1.7
Zinc	Dissolved	µg/L	--	--	0%	256	298	--	--	0%	9,100
P29 - Hari Drillhole (GT17-05)											
Aluminum	Total	mg/L	--	0	0%	0.75	0.75	--	--	0%	--
Antimony	Total	µg/L	--	--	0%	--	--	--	--	0%	14
Arsenic	Dissolved	µg/L	--	0	0%	0.34	0.34	--	--	0%	--
Cadmium	Dissolved	µg/L	--	0	0%	4.79	5.1	--	--	0%	--
Chromium III	Dissolved	µg/L	--	0	0%	1,183	1,238	--	--	0%	--
Copper	Dissolved	µg/L	--	0	0%	31.1	32.8	--	--	0%	1,300
Iron	Total	µg/L	--	--	--	--	--	--	--	0%	--
Lead	Dissolved	µg/L	--	0	0%	168	178	--	--	0%	--
Manganese	Total	µg/L	--	--	0%	--	--	Yes [b]	3	100%	50
Mercury	Dissolved	µg/L	--	0	0%	1.4	1.4	--	--	0%	0.05
Nickel	Dissolved	µg/L	--	0	0%	996	1,044	--	--	0%	610
Selenium	Total	µg/L	--	--	--	--	--	--	--	0%	170
Silver	Dissolved	µg/L	--	0	0%	15	16.4	--	--	0%	--
Thallium	Total	µg/L	--	--	0%	--	--	--	--	0%	1.7
Zinc	Dissolved	µg/L	--	0	0%	250	262	--	--	0%	9

Table 3-2. Comparison of Background Groundwater Concentrations to Aquatic Life Screening Levels

			Water Measurements							Chronic Aquatic Life Standard Screen [a]				
Parameter	Basis	Units	Sample Count	Detect Count	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Minimum Detection Limit	Maximum Detection Limit	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Minimum Screening Level	Maximum Screening Level
P19 - Unnamed Spring near Glacier Creek														
Aluminum	Total	mg/L	6	6	100%	0.087	3.8	0.003	0.003	Yes	2	33%	0.75	0.75
Antimony	Total	µg/L	6	4	67%	0.1	0.47	0.1	0.1	--	--	0%	--	--
Arsenic	Dissolved	µg/L	6	--	0%	--	--	0.1	0.1	--	--	0%	0.15	0.15
Cadmium	Dissolved	µg/L	6	6	100%	0.14	0.636	0.005	0.005	Yes	1	17%	0.24	0.35
Chromium III	Dissolved	µg/L	6	--	0%	--	--	0.1	0.1	--	--	0%	71	111
Copper	Dissolved	µg/L	6	4	67%	0.25	1.76	0.2	0.2	--	--	0%	8.6	13.6
Iron	Total	µg/L	6	6	100%	170	7870	10	10	Yes	3	50%	1,000	1,000
Lead	Dissolved	µg/L	6	2	33%	0.277	0.28	0.05	0.05	--	--	0%	2.4	4.3
Manganese	Total	µg/L	6	6	100%	4.03	168	0.1	0.1	--	--	0%	--	--
Mercury	Dissolved	µg/L	6	--	0%	--	--	0.005	0.005	--	--	0%	0.77	0.77
Nickel	Dissolved	µg/L	6	--	0%	--	--	0.5	0.5	--	--	0%	50	79
Selenium	Total	µg/L	6	6	100%	0.503	0.724	0.05	0.05	--	--	0%	5.0	5.0
Silver	Dissolved	µg/L	6	--	0%	--	--	0.01	0.01	--	--	0%	--	--
Thallium	Total	µg/L	6	3	50%	0.013	0.069	0.01	0.01	--	--	0%	--	--
Zinc	Dissolved	µg/L	6	6	100%	6.6	14.7	1	1	--	--	0%	114	179

Table 3-2. Comparison of Background Grou

			Acute Aquatic Life Standard Screen [a]					Human Health Consumption (Water + Organisms) Screen [a]			
Parameter	Basis	Units	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Minimum Screening Level	Maximum Screening Level	Exceedance Flag	Count of Exceedances	Exceedance Frequency	Screening Level
P19 - Unnamed Spring near Glacier Creek											
Aluminum	Total	mg/L	Yes	2	33%	0.75	0.75	--	--	0%	--
Antimony	Total	µg/L	--	--	0%	--	--	--	--	0%	14
Arsenic	Dissolved	µg/L	--	--	0%	0.34	0.34	--	--	0%	--
Cadmium	Dissolved	µg/L	--	--	0%	1.93	3.2	--	--	0%	--
Chromium III	Dissolved	µg/L	--	--	0%	550	850	--	--	0%	--
Copper	Dissolved	µg/L	--	--	0%	12.9	21.3	--	--	0%	1,300
Iron	Total	µg/L	--	--	0%	--	--	--	--	0%	--
Lead	Dissolved	µg/L	--	--	0%	62	109	--	--	0%	--
Manganese	Total	µg/L	--	--	0%	--	--	Yes [b]	1	17%	50
Mercury	Dissolved	µg/L	--	--	0%	1.4	1.4	--	--	0%	0.05
Nickel	Dissolved	µg/L	--	--	0%	451	708	--	--	0%	610
Selenium	Total	µg/L	--	--	0%	--	--	--	--	0%	170
Silver	Dissolved	µg/L	--	--	0%	3.0	7.5	--	--	0%	--
Thallium	Total	µg/L	--	--	0%	--	--	--	--	0%	1.7
Zinc	Dissolved	µg/L	--	--	0%	113	177	--	--	0%	9,100

Notes:

Table includes water samples collected from September 2008 through May 2018.
Table includes normal samples only (does not include field replicates).
Aluminum screening levels are determined as follows: where the pH is greater than or equal to 7.0 and the hardness is greater than or equal to 50 ppm as $CaCO_3$, the chronic aluminum standard will then be equal to the acute aluminum standard, 750
-- = indicates that screening value was not available or that a value was not calculated.
[a] Comparison of groundwater concentrations to water quality standards for surface water is for informational purposes only.
[b] As noted in ADEC 2008, the manganese criterion predates 1980 methodology and does not use the fish tissue bioconcentration factor approach.

ATTACHMENT A

ADDITIONAL SAMPLING DATA

Table Attachment A-1. Additional Groundwater Baseline Monitoring Locations and Location Selection Rationale

Sample ID	Location Description	Station Coordinates (NAD83, UTM08 Alaska)		Altitude (feet amsl)	Station Rationale	Description of Human Influence Near/Upstream of Station[a]
Glacier Creek Basin						
P24	Pocket Drillhole (CMR15-76)	421811 E	6584238 N	1,950	Measures groundwater from flat borehole located in the general location of a potential future exploration adit	This borehole was drilled as part of the exploratory drilling program; human activity following drilling has been minimal.

Notes:
amsl = above mean sea level

[a] Description of human influence determined based on visual observations, evaluation of maps/images, and site knowledge from Constantine staff.

Table A-2a. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Field and Conventional Parameters

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Acidity as $CaCO_3$ N mg/L		ORP N mV	Settleable Solids, 1 hr N ml/L	Settleable Solids, 24 hr N ml/L	Temperature N deg C
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	2.3	U	--	0	0	--
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	1.6	U	91	0	--	6.18
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	1.5	U	185.9	0	0	6.15
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	2.2	U	--	--	--	--
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	1	UJ	--	--	--	9
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	1	UJ	--	--	--	8.4
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	1	U	-138.9	--	--	6.65
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampling	N	5.6	U	--	--	--	4.5
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampling	N	1	UJ	--	--	--	4.3
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampling	N	1	U	--	--	--	4.5
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampling	N	1	UJ	--	--	--	4.3
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampling	N	1	UJ	--	--	--	4.3
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampling	N	1	UJ	--	--	--	4.4
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampling	N	1	U	--	--	--	4.6
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampling	N	1	UJ	--	--	--	5.6
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	1	UJ	--	--	--	8.3
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	1	UJ	--	--	--	6.4

Table A-2a. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Field and

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Specific Conductivity N uS/cm	DO N mg/L	Turbidity N NTU	pH N SU	TDS N mg/L	Hardness as $CaCO_3$ N mg/L	TSS N mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	--	--	--	--	189	139	3 *U*
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	190	14.1	0.9	7.1	179	141	3 *U*
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	270	12.75	0.77	7.65	181	145	3 *U*
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	206	--	0.34 *J*	7.95 *J*	144	83.8	3 *U*
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	310.2	7.03	0	7.77	199 *J*	145	3 *UJ*
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	284	6.77	--	7.82	159 *J*	130	4 *J*
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	1079	0.87	13.2	9.15	648	39	16.2
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampling	N	1006	--	2.72 *J*	8.67	705	51.5	3 *U*
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampling	N	953	--	1.01 *J*	8.96	702 *J*	52	3 *U*
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampling	N	953	--	0.96	8.9	718	53.9	3 *U*
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampling	N	997	--	1.01	8.97	727 *J*	54.6	3.3 *J*
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampling	N	1119	--	0.47	9.12	702 *J*	54.6	3 *UJ*
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampling	N	1191	--	0.4 *J*	9.26	694 *J*	54.2	3 *UJ*
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampling	N	1117	--	0.36 *J*	9.07	690	55.2	3 *U*
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampling	N	1132	--	0.34 *J*	9.04	697 *J*	53.5	3 *UJ*
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	1102	0.51	--	9.21	726 *J*	35.8	3 *UJ*
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	1080	1.3	--	9.27	654 *J*	31.4	3 *UJ*

Notes:
-- = parameter not measured
DO = dissolved oxygen
N = natural sample
NTU = nephelometric turbidity unit
ORP = oxidation/reduction potential
TSS = total suspended solids

Data Qualifiers:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

Table A-2b. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Nutrient and Anions

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Cyanide D mg/L	Alkalinity as $CaCO_3$ N mg/L	Bromide N mg/L	Chloride N mg/L	Fluoride N mg/L	Sulfate N mg/L	Ammonia as N N mg/L	Nitrate+Nitrite as N N mg/L	Nitrate as N N mg/L	Nitrite as N N mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	--	112	0.05 *U*	4.85	0.029	28.8	0.005 *U*	0.013	0.013	0.001 *U*
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	--	116	0.05 *U*	4.67	0.026	28.3	0.005 *U*	0.1 *U*	--	--
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	--	109	0.05 *U*	4.42	0.027	29.5	0.005 *U*	0.0192	0.0192 *J*	--
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	--	80	0.05 *U*	6.08	0.022	20.1	0.005 *U*	0.0232	0.0232 *J*	--
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.005 *UJ*	111 *J*	0.05 *U*	4.63	0.025	35.7 *J*	0.005 *UJ*	0.0259 *J*	0.0259 *J*	0.001 *UJ*
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.005 *UJ*	118 *J*	0.05 *U*	4.66	0.024	28.8 *J*	0.005 *UJ*	0.0326 *J*	0.0326 *J*	--
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	--	259	0.25 *U*	2.5 *U*	2.62	269	0.0849	0.025 *U*	--	--
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampling	N	--	277	0.25 *U*	1 *U*	3.89	300	0.0832	0.01 *U*	--	--
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampling	N	--	273 *J*	0.25 *U*	1 *U*	3.2	294	0.0732 *J*	0.01 *U*	0.01 *U*	0.002 *U*
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampling	N	--	250	0.25 *U*	1 *U*	3.24	291	0.005 *U*	0.01 *U*	0.01 *U*	0.002 *U*
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampling	N	--	264 *J*	0.25 *U*	1 *U*	3.11	281	0.0832 *J*	0.01 *UJ*	0.01 *UJ*	0.002 *UJ*
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampling	N	--	267 *J*	0.25 *U*	1 *U*	3.27	293	0.0798 *J*	0.01 *UJ*	--	--
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampling	N	--	271 *J*	0.25 *U*	2.5 *U*	3.22	305	0.0814 *J*	0.025 *UJ*	0.025 *UJ*	0.005 *UJ*
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampling	N	--	266	0.25 *U*	0.88	3.54	288	0.0868	0.0051 *U*	0.005 *U*	0.001 *U*
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampling	N	--	268 *J*	0.25 *U*	2.5 *U*	3.31	283	0.0934 *UJ*	0.025 *UJ*	--	--
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.005 *UJ*	301 *J*	0.25 *U*	2.5 *U*	3.51	273 *J*	0.0914 *J*	0.025 *UJ*	0.025 *UJ*	0.005 *UJ*
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.005 *UJ*	286 *J*	0.25 *U*	2.5 *U*	3.27	246 *J*	0.0944 *J*	0.025 *UJ*	--	--

Notes:
-- = parameter not measured
N = natural sample
NTU = nephelometric turbidity unit

Data Qualifiers:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Aluminum T mg/L	Aluminum D mg/L	Antimony T mg/L	Antimony D mg/L	Arsenic T mg/L	Arsenic D mg/L	Barium T mg/L	Barium D mg/L	Beryllium T mg/L	Beryllium D mg/L	Bismuth T mg/L	Bismuth D mg/L	Boron T mg/L	Boron D mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	0.0064	0.0055 *U*	0.00029	0.00026	0.00075	0.00076	0.00618	0.00614	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0005 *U*	0.201	0.184
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	0.0041	0.0036	0.00034	0.00033	0.00092	0.00091	0.00684	0.00671	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.205	0.191
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	0.0058	0.0046	0.00031	0.00033	0.00111	0.00107	0.00619	0.00629	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.219	0.203
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	0.0246	0.0267	0.00023	0.00017	0.00096	0.0006	0.0051	0.00417	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.156	0.128
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.0045	0.0038	0.00032	0.0003	0.00115	0.00106	0.00702	0.00649	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.236	0.223
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.004	0.0041	0.00028	0.00029	0.0011	0.00108	0.00638	0.00651	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.204	0.192
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	0.615	0.0361	0.00011	0.00241	0.00019	0.00011	0.03	0.03	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.381	0.353
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampli	N	0.0452	0.0068	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0352	0.0336	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.377	0.367
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampli	N	0.028	0.0082	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0356	0.0334	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.328	0.371
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampli	N	0.0376	0.0063	0.00012	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0344	0.0341	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.401	0.37
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampli	N	0.0261	0.0079	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0332	0.0326	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.392	0.387
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampli	N	0.0164 *U*	0.0062	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0309	0.0317	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.377	0.396
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampli	N	0.013	0.0059	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0302	0.0309	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.379	0.358
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampli	N	0.0118	0.0058	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0313	0.031	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.386	0.382
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampli	N	0.017	0.0067	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0292	0.0289	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.389	0.37
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.0571	0.0053	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0246	0.0254	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.406	0.402
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.0102	0.0053	0.0001 *U*	0.0001 *U*	0.00011	0.0001 *U*	0.0234	0.0229	0.00002 *U*	0.00002 *U*	0.00005 *U*	0.00005 *U*	0.357	0.387

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Cadmium T mg/L	Cadmium D mg/L	Calcium T mg/L	Calcium D mg/L	Chromium T mg/L	Chromium D mg/L	Cobalt T mg/L	Cobalt D mg/L	Copper T mg/L	Copper D mg/L	Iron T mg/L	Iron D mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	0.000202	0.000203	52.1	51.2	0.0001	0.0001 *U*	0.0002	0.0002	0.0095	0.009	0.01 *U*	0.01 *U*
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	0.000173	0.000166	52.6	51.9	0.0001 *U*	0.0001 *U*	0.0002	0.0003	0.0095	0.0089	0.01 *U*	0.01 *U*
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	0.00012	0.000121	54.2	53.6	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0002	0.0082	0.0074	0.01 *U*	0.01 *U*
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	0.00011	0.000158	37.3	30.5	0.00014	0.00014	0.0001	0.0002	0.0319	0.0285	0.018	0.019
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.000129	0.000119	55.7	53.5	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0075	0.0068	0.01 *U*	0.01 *U*
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.000122	0.000128	48.6	47.6	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0084	0.0086	0.01 *U*	0.01 *U*
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	0.000005 *U*	0.000005 *U*	6.05	5.83	0.00181	0.0001 *U*	0.0004	0.0001 *U*	0.0005 *U*	0.0002 *U*	1.02	0.06
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	7.34	7.37	0.00017	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.359	0.052
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	7.31	7.43	0.00013	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.551	0.051
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	8.03	7.69	0.00011	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.116	0.044
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampli	N	0.000005 *U*	0.0000113	7.76	7.54	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.075	0.043
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	7.7	7.81	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.072	0.04
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	7.78	7.75	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.058	0.039
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	7.57	7.84	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.054	0.036
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampli	N	0.000005 *U*	0.000005 *U*	8.35	8.09	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.049	0.03
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.000005 *U*	0.000005 *U*	5.65	5.55	0.00034	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.106	0.036
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.000005 *U*	0.000005 *U*	5.22	5.18	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*	0.0002 *U*	0.031	0.025

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Lead T mg/L	Lead D mg/L	Lithium T mg/L	Lithium D mg/L	Magnesium T mg/L	Magnesium D mg/L	Manganese T mg/L	Manganese D mg/L	Mercury T mg/L	Mercury D mg/L	Molybdenum T mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	0.00005 *U*	0.00005 *U*	0.0005 *U*	0.0006	2.81	2.73	0.00005 *U*	0.00005 *U*	0.00001 *U*	0.00001 *U*	0.00492
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	2.74	2.67	0.0001 *U*	0.0002	0.000005 *U*	0.000005 *U*	0.00537
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	2.73	2.66	0.0003	0.00047	0.000005 *U*	0.000005 *U*	0.00584
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	2.2	1.86	0.00047	0.00014	7.2E-06	0.0000105	0.00409
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	2.9	2.82	0.00015	0.0001 *U*	0.000005 *U*	0.000005 *U*	0.00628
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.00005 *U*	0.00005 *U*	0.001 *U*	0.001 *U*	2.79	2.77	0.00011	0.0001 *U*	0.000005 *U*	0.000005 *U*	0.00475
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	0.00005 *U*	0.00005 *U*	0.0058	0.005	6.42	5.93	0.0149	0.00407	0.000005 *U*	0.000005 *U*	0.000384
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.0054	0.0049	8.06	8.04	0.0155	0.00585	0.000005 *U*	0.000005 *U*	0.000366
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.0055	0.0047	8.22	8.11	0.0185	0.00564	0.000005 *U*	0.000005 *U*	0.000554
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Samplii	N	0.000179	0.00005 *U*	0.0051	0.0049	8.89	8.42	0.00754	0.00555	0.000005 *U*	0.000005 *U*	0.000334
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.005	0.0054	8.88	8.69	0.00628	0.00571	0.000005 *U*	0.000005 *U*	0.000315
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.005	0.0053	8.36	8.54	0.00625	0.00568	0.000005 *U*	0.000005 *U*	0.000308
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.0051	0.005	8.55	8.45	0.00619	0.0057	0.000005 *U*	0.000005 *U*	0.000327
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.0048	0.0048	8.47	8.65	0.006	0.00558	0.000005 *U*	0.000005 *U*	0.000294
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Samplii	N	0.00005 *U*	0.00005 *U*	0.0048	0.0047	8.14	8.08	0.00513	0.00494	0.000005 *U*	0.000005 *U*	0.00033
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.00005 *U*	0.00005 *U*	0.0043	0.0044	5.36	5.34	0.00401	0.00304	0.000005 *U*	0.000005 *U*	0.000576
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.00005 *U*	0.00005 *U*	0.0044	0.0046	4.69	4.49	0.00291	0.00276	0.000005 *U*	0.000005 *U*	0.000398

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Molybdenum D mg/L	Nickel T mg/L	Nickel D mg/L	Phosphorus T mg/L	Phosphorus D mg/L	Potassium T mg/L	Potassium D mg/L	Selenium T mg/L	Selenium D mg/L	Silicon T mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	0.00465	0.0005 *U*	0.0005 *U*	0.002 *U*	0.002 *U*	0.33	0.32	0.00041	0.00043	4.01
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	0.00512	0.0005 *U*	0.0005 *U*	0.002 *U*	--	0.25	0.23	0.000391	0.000395	4.03
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	0.00564	0.0005 *U*	0.0005 *U*	0.002 *U*	--	0.26	0.24	0.000365	0.000356	4.31
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	0.00283	0.0005 *U*	0.0005 *U*	0.003	0.004	0.39	0.4	0.000416	0.000488	3.92
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.00593	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	0.26	0.25	0.000449	0.000422	4.21
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.00462	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	0.31	0.27	0.00058	0.000526	4.1
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	0.00035	0.0008	0.0005 *U*	0.008	0.0042 *J*	2.41	2.42	0.00005 *U*	0.000052	5.18
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampli	N	0.000298	0.0005 *U*	0.0005 *U*	0.01 *U*	0.0057 *J*	2.46	2.44	0.00005 *U*	0.00005 *U*	3.68
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampli	N	0.000287	0.0005 *U*	0.0005 *U*	0.0048 *J*	0.002 *UJ*	2.66	2.43	0.00005 *U*	0.000069	3.47
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampli	N	0.00028	0.0005 *U*	0.0005 *U*	0.02 *U*	0.002 *U*	2.57	2.41	0.00005 *U*	0.000116	4.37
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampli	N	0.000265	0.0005 *U*	0.0005 *U*	0.0041 *J*	0.002 *UJ*	2.47	2.46	0.00005 *U*	0.00005 *U*	4.26
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampli	N	0.000295	0.0005 *U*	0.0005 *U*	0.002 *UJ*	0.002 *UJ*	2.41	2.42	0.00005 *U*	0.00005 *U*	4.13
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampli	N	0.000271	0.0005 *U*	0.0005 *U*	0.0032 *J*	0.002 *UJ*	2.64	2.54	0.00005 *U*	0.000157	4.15
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampli	N	0.000268	0.0005 *U*	0.0005 *U*	0.002 *U*	0.0021	2.42	2.44	0.00005 *U*	0.00005 *U*	4.13
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampli	N	0.000306	0.0005 *U*	0.0005 *U*	0.0021 *J*	0.011 *J*	2.46	2.48	0.00005 *U*	0.00005 *U*	4.42
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.000266	0.0005 *U*	0.0005 *U*	0.01 *UJ*	0.0042 *J*	2.13	2.19	0.00005 *U*	0.000125	4.37
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.000355	0.0005 *U*	0.0005 *U*	0.0036 *J*	0.0036 *J*	2.17	2.14	0.00005 *U*	0.00005 *U*	4.23

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Silicon D mg/L	Silver T mg/L	Silver D mg/L	Sodium T mg/L	Sodium D mg/L	Strontium T mg/L	Strontium D mg/L	Thallium T mg/L	Thallium D mg/L	Tin T mg/L	Tin D mg/L	Titanium T mg/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	3.9	0.00001 *U*	0.00001 *U*	4.08	4.04	0.0711	0.0685	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.01 *U*
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	3.92	0.00001 *U*	0.00001 *U*	4.23	4.14	0.0707	0.0686	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	4.23	0.00001 *U*	0.00001 *U*	4.63	4.14	0.0761	0.073	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	3.6	0.00001 *U*	0.00001 *U*	3.8	3.51	0.0549	0.041	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.00043
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	4.4	0.00001 *U*	0.00001 *U*	4.23	3.95	0.0834	0.081	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	4.14	0.00001 *U*	0.00001 *U*	4.3	4.08	0.0766	0.0731	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	4.4	0.00001 *U*	0.00001 *U*	237	226	1.12	1.08	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.00797
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Sampli	N	4.03	0.00001 *U*	0.00001 *U*	240	238	1.51	1.48	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.00051
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Sampli	N	4.13	0.00001 *U*	0.00001 *U*	210	219	1.51	1.46	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Sampli	N	4.16	0.000014	0.00001 *U*	240	214	1.56	1.46	0.000013	0.00001	0.0001 *U*	0.0001 *U*	0.00052
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Sampli	N	4.14	0.00001 *U*	0.00001 *U*	243	241	1.61	1.56	0.00001 *U*	0.000011	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Sampli	N	4.13	0.00001 *U*	0.00001 *U*	230	236	1.55	1.63	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Sampli	N	4.1	0.00001 *U*	0.00001 *U*	232	237	1.64	1.59	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Sampli	N	4.19	0.00001 *U*	0.00001 *U*	229	227	1.58	1.6	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Sampli	N	4.33	0.00001 *U*	0.00001 *U*	235	232	1.44	1.39	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	4.14	0.00001 *U*	0.00001 *U*	227	228	1.04	1.02	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0005 *U*
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	3.88	0.00001 *U*	0.00001 *U*	227	222	0.929	0.875	0.00001 *U*	0.00001 *U*	0.0001 *U*	0.0001 *U*	0.0003 *U*

Table A-2c. Additional Samples: Palmer Groundwater Quality Sampling Results, 2008–2018, Metals

Station ID	Station Description	Sample Date	Sample Event	Sample Type	Titanium D mg/L	Uranium T mg/L	Uranium D mg/L	Vanadium T mg/L	Vanadium D mg/L	Zinc T mg/L	Zinc D mg/L	Gross Alpha N Bq/L	Gross Beta N Bq/L	Radium-226 N Bq/L
P18	Mud Bay Spring in Haines	9/18/2014	September 2014	N	0.01 *U*	0.000015	0.000015	0.001 *U*	0.001 *U*	0.0358	0.035	--	--	--
P18	Mud Bay Spring in Haines	8/6/2015	August 2015	N	0.0003 *U*	0.000021	0.000021	0.0005 *U*	0.0005 *U*	0.0295	0.03	--	--	--
P18	Mud Bay Spring in Haines	7/1/2016	June 2016	N	0.0003 *U*	0.000018	0.000016	0.0005 *U*	0.0005 *U*	0.0212	0.021	--	--	--
P18	Mud Bay Spring in Haines	2/13/2017	February 2017	N	0.00036	0.00001 *U*	0.00001 *U*	0.0005 *U*	0.0005 *U*	0.0238	0.034	--	--	--
P18	Mud Bay Spring in Haines	7/8/2017	July 2017	N	0.0003 *U*	0.000016	0.00002	0.0005 *U*	0.0005 *U*	0.018	0.019	--	--	--
P18	Mud Bay Spring in Haines	8/31/2017	August 2017	N	0.0003 *U*	0.000016	0.000015	0.0005 *U*	0.0005 *U*	0.0183	0.019	--	--	--
P24	Pocket drillhole (CMR15-76)	6/29/2016	June 2016	N	0.00041	0.000017	0.000011	0.00364	0.0005 *U*	0.003 *U*	0.001	--	--	--
P24	Pocket drillhole (CMR15-76)	7/7/2016	Borehole Samplii	N	0.0003 *U*	0.00001	0.000012	0.0005 *U*	0.0005 *U*	0.003 *U*	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	7/13/2016	Borehole Samplii	N	0.0003 *U*	0.00001 *U*	0.000011	0.0005 *U*	0.0005 *U*	0.0009	0.003	--	--	--
P24	Pocket drillhole (CMR15-76)	7/20/2016	Borehole Samplii	N	0.0003 *U*	0.000014	0.000012	0.0005 *U*	0.0005 *U*	0.0005 *U*	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	7/27/2016	Borehole Samplii	N	0.0003 *U*	0.000012	0.000014	0.0005 *U*	0.0005 *U*	0.0006	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	8/3/2016	Borehole Samplii	N	0.0003 *U*	0.000013	0.000012	0.0005 *U*	0.0005 *U*	0.0016	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	8/11/2016	Borehole Samplii	N	0.0003 *U*	0.000013	0.000012	0.0005 *U*	0.0005 *U*	0.0011	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	8/16/2016	Borehole Samplii	N	0.0003 *U*	0.000011	0.000011	0.0005 *U*	0.0005 *U*	0.0009	0.001	--	--	--
P24	Pocket drillhole (CMR15-76)	10/5/2016	Borehole Samplii	N	0.0003 *U*	0.000013	0.000012	0.0005 *U*	0.0005 *U*	0.0005	0.001 *U*	--	--	--
P24	Pocket drillhole (CMR15-76)	7/29/2017	July 2017	N	0.0003 *U*	0.000016	0.000013	0.0005 *U*	0.0005 *U*	0.0005 *U*	0.001	--	--	--
P24	Pocket drillhole (CMR15-76)	8/28/2017	August 2017	N	0.0003 *U*	0.000016	0.000015	0.0005 *U*	0.0005 *U*	0.0006	0.001 *U*	--	--	--

Notes:
-- = parameter not measured
N = natural sample

Data Qualifiers:
J = The analyte was positively identified; the
U = The analyte was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit is approximate.

ATTACHMENT B

PHOTOS OF GROUNDWATER SAMPLING LOCATIONS

Photo Set B1.
Palmer Project
Station P19—Unnamed Spring near Glacier Creek

Photo Set B2.
Palmer Project
Station P17—Drillhole GT14-01

Photo Set B3.
Palmer Project
Station P29—Geotechnical Drillhole GT17-05