QUALITY ASSURANCE PROJECT PLAN
LUMMI NATION AMBIENT GROUNDWATER QUALITY AND QUANTITY MONITORING PROJECT

Version 1.2

Water Resources Division
Natural Resources Department
Lummi Indian Business Council

Prepared for EPA Region 10

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Lummi Nation Ambient Groundwater Quality and Quantity Monitoring Project Quality Assurance Project Plan Approval (A1):

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REVISION RECORD

Approval	Date	Responsible Person	Description of Change	Location of Change
1	October 2018	Kara Kuhlman	Initial Approval and Release of Version 1.0	N/A
1.1	December 2019	Kara Kuhlman	Staffing updates (new staff)	Distribution List, Section 1.2
			Remove completed studies	Section 1.1
			Update parameters measured at sites (add water level to GW145)	Section 3.1, Table 6.1, 6.2, Figure 3.1
			Reporting frequency increased from annual to every two years	Sections 3.1, 5.2, 11.2
			Replace sign-out board with informing supervisor	Section 7.3
			Update equipment used	Table 7.1, Sections 8.2, 9
			Clarify parameters duplicated	Section 8.1.3
1.2	July 2021	Kara Kuhlman	Change EPA Tribal Coordinator to Michael Ortiz	Signature page, Distribution list
			Remove ZAPS Technologies LiquID Station Continuous Water Quality Monitoring Study. The study has been completed.	Section 1.1
			Correct frequency of Water Quality Assessment Report from annual to every two years	Section 4.0
			Clarify flushing of wells prior to sampling	Section 7.4, 13.1
			Update references	Section 13.2
			Update STORET with WQX	Sections 3.1, 5.2, 10.0

SIGNATURE PAGE

Document: Lummi Nation Ambient Groundwater Quality and Quantity Monitoring Project

Version 1.2

The following technical staff have read this manual. A copy of this page will be distributed to the employee training record file.

Signature	**Date**
Name (printed)	**Title**

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1. DOCUMENT AND PROJECT ORGANIZATION

1.1 Document Organization

This document is organized following Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA 2001, reissued 2006a) with the companion document Guidance for Quality Assurance Project Plans (EPA 2002). Where a letter and number follow a section title (*e.g.,* Distribution List [A3]), they indicate the corresponding section in the EPA Requirements for Quality Assurance Project Plans.

This Quality Assurance Project Plan (QAPP) Version 1.2 for the Lummi Nation Ambient Groundwater Quality Monitoring Project supersedes the Lummi Nation Water Quality Monitoring Program QAPP Version 4.0 (the 2010 QAPP; LWRD 2010).

The 2010 QAPP (LWRD 2010) has been reviewed, revised, and reorganized into a new framework. Whereas the 2010 QAPP included quality procedures for all Lummi Nation Water Quality Monitoring Program (WQM Program) projects (*e.g.,* surface and ground water) and equipment under one QAPP, the new framework includes a Quality Management Plan (QMP) as the umbrella document outlining the overall quality system for the WQM Program and several QAPPs for each individual project. The individual projects include the following:

- Ambient Surface Water Quality Monitoring Project
- Ambient Groundwater Quality and Quantity Monitoring Project (this document)
- Continuous Water Temperature Monitoring Project
- First Flush Monitoring Project
- Department of Health Support (National Shellfish Sanitation Program) Project
- Nutrient, Metal, and Hydrocarbon Monitoring Project
- Continuous Water Level Monitoring Project
- Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project

In addition, Standard Operating Procedures (SOPs) have been developed for each instrument used or parameter measured.

1.2 Project Organization (A4)

The Lummi Nation Ambient Groundwater Quality and Quantity Monitoring Project (Ground Water Project) is administered and implemented through the Lummi Water Resources Division (LWRD), a division within the Lummi Natural Resources Department (LNR), contained under the Lummi Indian Business Council (LIBC). An organizational chart of the individuals participating in the Ground Water Project and laboratories providing analytical services is provided in the QMP. A complete and detailed discussion of the structure of the WQM Program, including organization charts identifying the components of all WQM Program projects and individuals participating in the WQM Program are provided in the QMP (LWRD 2021c).

The Water Resources Specialist II is the primary staff person responsible for Ground Water Project coordination, including maintaining the official, approved QAPP. The Water Resources Specialist II, Water Resources Technician II, and Natural Resources Technician II are responsible for implementing the Ground Water Project. The Water Resources Specialist II supervises the Water Resources Technician II and the Natural Resources Technician II and provides approval and oversight to the Ground Water Project, including coordination with the independent contracted laboratory. The Water Resources Manager evaluates compliance with project goals and makes recommendations to the LNR Director and Deputy Director, who make decisions based upon data collected as part of this project. The Database Manager created and maintains the Water Database and is the primary staff member responsible for database development, training, and documentation.

1.3 Special Training Requirements and Certification (A8)

Details on the roles, contact information, position requirements, and qualifications held by the individuals responsible for managing and implementing the Ground Water Project are listed in detail in the QMP. The QMP also includes details on the required and recommended training and certification for all staff involved in the project. Supervisors and the Water Resources Manager are responsible for ensuring staff are qualified and trained.

2. PROBLEM DEFINITION AND BACKGROUND (A5)

2.1 Project Summary

The Lummi Nation Ground Water Project has been ongoing since 1993, and is focused on monitoring groundwater quality and aquifer level on the Lummi Indian Reservation (Reservation). The Ground Water Project provides water quality data at 14 groundwater sites and aquifer level data at 19 groundwater sites on the Reservation to determine groundwater quality, risk of groundwater mining and saltwater intrusion, and seasonal aquifer level changes. The Ground Water Project is one of the LWRD's ongoing core monitoring projects that is complemented by other, shorter-term or more intensive monitoring projects. Summaries of other WQM Program projects are provided in the QMP.

A total of 20 groundwater wells are sampled five times per year (April, June, August, October, and December).[1] Chloride and water quality parameters (temperature, salinity, specific conductivity, and pH) are measured at 14 groundwater sites. Water level is measured at 18 groundwater sites. The data collected as part of this project are used to identify trends (annual and multi-year), establish baseline conditions, evaluate risk of groundwater mining and saltwater intrusion, and generally monitor aquifer level.

2.2 Water Quality

As summarized in the QMP, there are numerous threats to Lummi Nation Waters.[2] The QMP provides a detailed description of Lummi Nation Waters and the geographical location of the Reservation. Groundwater resources on the Reservation are vulnerable to groundwater mining and salt water intrusion because the Reservation is located in a coastal area with most of the existing water-supply wells within a half-mile of marine waters (LWRD 1997). The majority of residential development has occurred along the marine shoreline placing the most vulnerable portion of aquifers at risk through direct pumping of groundwater near marine shorelines. Currently, groundwater supplies over 95% of the potable water used on the Reservation.

Two apparently separate potable groundwater systems occur on the Reservation. One system is located in the northern upland area and appears to flow onto the Reservation from the north and drains to the west, south, and east. The second potable groundwater system is located in the southern upland area of the Reservation (Lummi Peninsula) and is completely contained within the Reservation boundaries (LWRD 1997). The floodplain of the Lummi and Nooksack

[1] The only exception to this sampling schedule is Mackenzie 4, which is sampled four times per year in March, June, September, and December. Mackenzie 4 is sampled less frequently due to accessibility and the remoteness of the site. Due to the proximity of the wells, Mackenzie 4 is sampled during quarterly site visits to Mackenzie 3, as described in the Continuous Aquifer Level Monitoring Project QAPP.

[2] Pursuant to 17.09.010 of the Lummi Code of Laws, Lummi Nation Water includes all fresh and marine waters that originate or flow in, into, or through the Reservation, or that are stored on the Reservation, whether found on the surface of the earth or underground, and all Lummi Nation tribal reserved water rights.

rivers, which contains a surface aquifer that is saline (Cline 1974), separates the two potable groundwater systems. A third potable water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive. Additional details on groundwater resources and water quality are provided in the QMP.

2.3 Project Context

The Ground Water Project is implemented by the LWRD, which has the overall goal of protecting treaty rights to water of sufficient quantity and quality to (a) support the purposes of the Reservation as a permanent economically viable homeland for the Lummi People, and (b) to support a sustainable harvestable surplus of salmon and shellfish sufficient to maintain a moderate living standard.

The Ground Water Project is the primary groundwater component of the WQM Program. The goals of the WQM Program are threefold:

1. To establish the baseline conditions of surface and ground waters on and flowing onto the Reservation;
2. To use this information to evaluate regulatory compliance of waters flowing onto the Reservation; and
3. To support the development and implementation of a water quality regulatory program (*e.g.,* Lummi Code of Laws Title 17, Water Quality Standards) on the Reservation.

The WQM Program is an important element of the Comprehensive Water Resources Management Program (CWRMP). Related WQM Program groundwater monitoring projects include the Continuous Aquifer Level Monitoring Project (LWRD 2019d) and the Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project (Settlement Compliance Project) (LWRD 2019e). Additional details on project context and related projects are provided in the QMP. Applicable criteria and action limits are also provided in the QMP.

2.4 Project Justification

An ample supply of good quality groundwater is needed to serve the purposes of the Reservation as a permanent and economically viable homeland for the Lummi People. Regular measurement of water quality parameters is required to accurately evaluate ambient conditions of groundwater on and flowing onto the Reservation and to determine risk of groundwater mining and salt water intrusion, and water availability in Reservation groundwater. Because sites are visited five times annually on a random schedule, the ambient conditions of the groundwater on the Reservation can be assessed during both the wet and dry seasons. Sites are sampled “randomly” in that the tides, season, and weather are not used to bias sampling efforts. Sampling is focused on providing sufficient resolution to observe seasonal changes; groundwater sampling commences at the end of the rainy season (April) and proceeds

through the dry season (June and August) to the beginning of the next rainy season (October and December).

The data collected as part of this project are used to identify trends (annual and multi-year), establish baseline conditions, evaluate risk of groundwater mining and saltwater intrusion, and generally monitor aquifer level. Sample runs have been established to monitor water quality and aquifer level conditions in the two potable groundwater systems on the Reservation. Details on the justification of the experimental design for this project are provided in Section 6.1.

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3. PROJECT DESCRIPTION (A6)

The Lummi Nation Ground Water Project has been ongoing since 1993. The overall objective of the Ground Water Project is to achieve the overall LWRD mission and the WQM Program goals (Section 2.3). Specifically, the Ground Water Project objectives are to:

1. Provide high quality data sufficient to establish baseline conditions of groundwater on the Reservation;
2. Protect groundwater supplies from groundwater mining and saltwater intrusion; and
3. Support the development of a water quality regulatory program (*e.g.,* Lummi Code of Laws Title 17, Water Quality Standards) on the Reservation.

3.1 Project Description

The Ground Water Project is focused on monitoring the quality and quantity of groundwater on the Reservation. Twenty sampling sites have been selected to characterize the two major potable aquifer systems on the Reservation. Figure 3.1 provides a map of the sample site locations.

Static water level is measured at 19 groundwater sites.[3] Groundwater quality is measured at 14 groundwater sites; at these sites, temperature, specific conductivity, pH, and salinity are measured using a multi-parameter water quality sonde. At groundwater quality sites chloride concentration is measured either using a chloride sensor or a lab sample is collected for analysis at the independent contracted laboratory, Edge Analytical, Incorporated (Edge). At tribal supply wells maintained and operated by the Lummi Water District, pump rate is also recorded.

Groundwater sites are sampled five times per year beginning at the end of the wet season; sites are sampled in April, June, August, October, and December.[4]

As the potability of the groundwater resources on the Reservation is of utmost concern, regular sampling of chlorides, pumping rates, and water levels can provide indications of potential saltwater intrusion and groundwater mining. Based on these data, measures can be implemented (*e.g.,* reduce duration or rate of pumping) to reduce risk of saltwater intrusion or diminished well water levels.

Summary statistics are calculated for each parameter, as needed, and chloride results are compared to chloride trigger values developed for each individual well. A summary of water quality data for the two-year reporting period, comparison to the chloride trigger values, and

[3] Static water level is not measured at the Finkbonner (GW109) well due to inaccessibility. All other groundwater sites are monitored for static water level.

[4] The only exception to this sampling schedule is Mackenzie 4, which is sampled four times per year in March, June, September, and December. Mackenzie 4 is sampled less frequently due to accessibility and the remoteness of the site. Due to the proximity of the wells, Mackenzie 4 is sampled during quarterly site visits to Mackenzie 3, as described in the Continuous Aquifer Level Monitoring Project QAPP.

comparison with results from the period of record is included in the Water Quality Assessment Report provided to the EPA every-other year to fulfill Clean Water Act Section 106 grant funding requirements by March 31 of the year following the two-year reporting period (EPA 2006b). Groundwater quality data collection funded by the EPA is transmitted to EPA via the Water Quality Exchange (WQX) framework annually by March 31 after the year of record.

Field visits and sample collection occurs April-December of each year. Data analysis and report preparation is conducted every-other year in January-March of the year following data collection for the two-year reporting period. The transfer to EPA via WQX is scheduled for transmission to EPA annually by March 31 of the year following data collection. It is anticipated that all sites will be sampled as scheduled (five times per year for most sites; four times per year for Mackenzie 4). Equipment failure, staffing limitations, and budget restrains may restrict planned site visit frequency depending on the year.

Quality Assurance/Quality Control (QA/QC) procedures include duplicate field measurements as well as equipment calibration, accuracy checks, and maintenance as specified in the equipment SOPs. Detailed QA/QC procedures are provided in Section 8 of this QAPP.

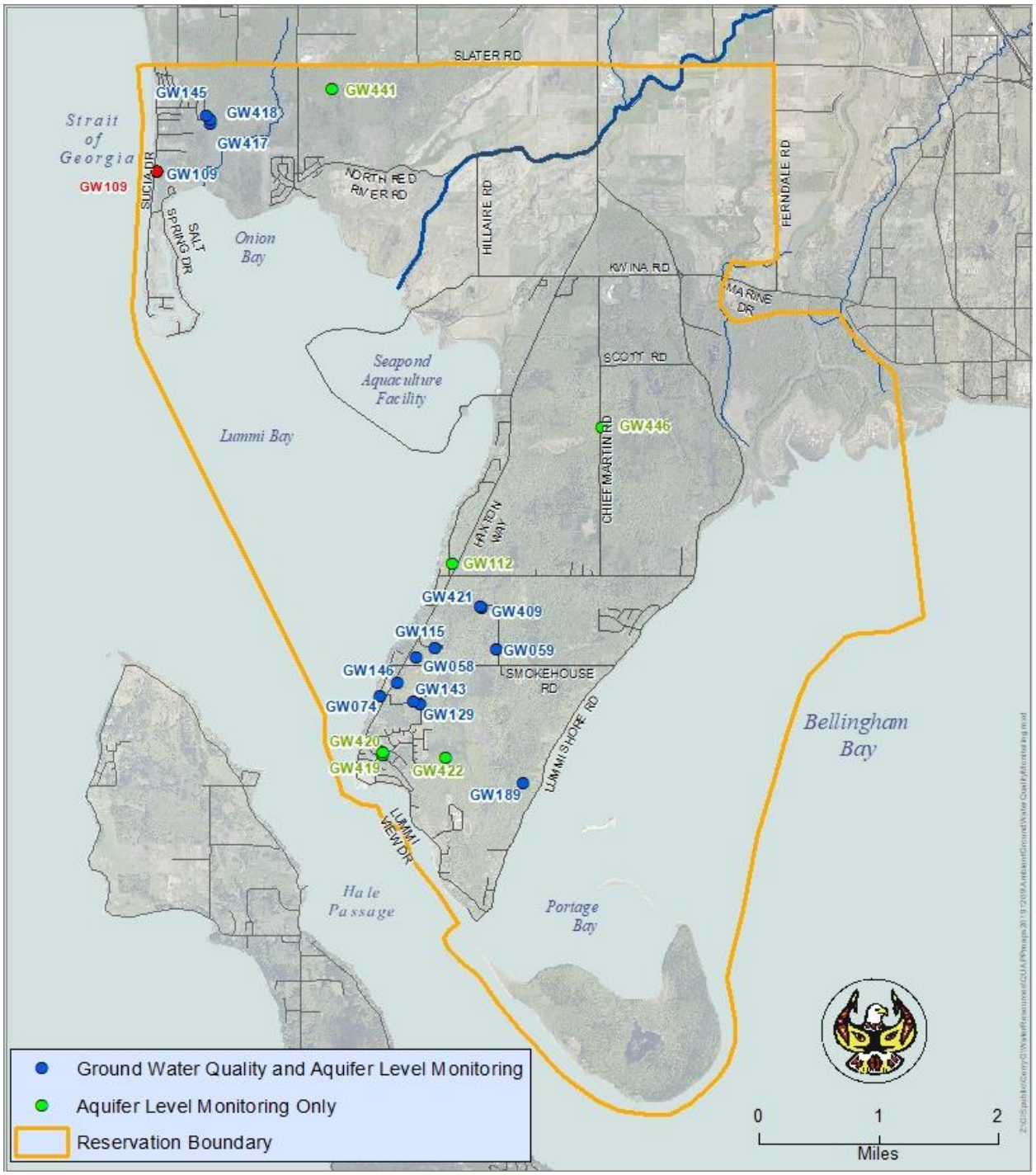

Figure 3.1 Groundwater Quality Monitoring Sample Site Locations

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4. QUALITY OBJECTIVES AND CRITERIA (A7)

The overall performance standard for the Ground Water Project is the collection of high-quality data sufficient to meet project goals. Data must be of sufficient quality (*i.e.,* known precision, accuracy, bias, traceability, completeness, and representativeness) to support scientifically valid, legally defensible decisions. Project quality control activities are designed to indicate data quality in the field and prompt corrective actions at that time, if necessary. In addition, quality control activities provide the necessary information to assess and quantify data quality and comparability for data analysis.

The Ground Water Project is ongoing and is not designed to prove or disprove a specific hypothesis. The data are used to assist in identifying and addressing actual and potential impairments of water quality and for evaluation of water quality and quantity trends. Quality control activities are in place to ensure the reliability and usefulness of the water quality and aquifer level data for evaluation of trends, impairment, and risk of saltwater intrusion and groundwater mining.

Summary statistics for parameters are calculated, as needed, and used for comparison with previous results from the period of record and to established chloride trigger levels for each well. See QMP for calculation of summary statistics, including field variability and quality control parameters. These summary data are presented in the Water Quality Assessment Report submitted to the EPA.

4.1 Measurement Performance/Acceptance Criteria

Quality assurance/quality control (QA/QC) procedures include: equipment calibration, accuracy checks, and maintenance activities as required by the equipment SOPs; appropriate laboratory sample collection techniques and chain of custody procedures as required by the Chloride Sample Collection SOP; and field duplicates (Section 8).

Acceptance criteria and detection limits vary depending on the parameter measured. Refer to equipment SOPs for details. Project action limits include chloride measurements that exceed trigger levels and measurements that are unusual or unexpected for the site. Additional details on project action limits are included in the QMP.

4.2 Precision

The precision of the parameters measured is specified by the manufacturer (see instrument SOPs) or laboratory (QMP Appendix C).

At least 10% of water quality measurements are duplicated in the field during each sample run, except for samples collected for analysis at a laboratory. Static water level measurements are not duplicated. Field duplicates provide information on both the precision of the instrument used to measure the parameter and the natural field variability of the parameter. However, duplicate measurements are not routinely used to calculate the precision of the instrument;

they are primarily used as an indicator of field variability. Because groundwater quality is generally stable, large differences in duplicate measurements may indicate instrument malfunction.

If quantification of precision of an instrument is required, standard error can be calculated from repeated accuracy checks with a known standard. However, quantification of precision in addition to manufacturer-stated resolution is not routinely conducted.

4.3 Accuracy and Bias

The accuracy of the parameters measured is specified by the manufacturer (see instrument SOPs) or laboratory (see Chloride Sample Collection SOP). Parameters measured using a water quality monitoring sonde (*i.e.,* the YSI ProPlus or YSI 556) are calibrated and verified against National Institute of Standards and Technology-traceable standards. If the instrument cannot be calibrated or the accuracy check is not within acceptance criteria, corrective actions are taken to determine and correct the problem (see instrument SOPs for details).

4.4 Representativeness

Representativeness of water quality measurements and laboratory samples are ensured through collection of groundwater samples from water taps located as close to the wellhead as possible. The samples are collected prior to drinking water treatment (if applicable) and after the source has been sufficiently flushed. Water quality data are only collected at wells that are in use (*i.e.,* the water has not been sitting in the well casing for an extended period of time). The measurement of well water level three times over a several minute period provides information about the representativeness of that water level measurement along with data about water use.

4.5 Comparability

Data quality can be assessed and quantified for all data collected over the period of record. Although different brands of water quality meters or model types have been used over time, methods for collecting water quality data have not changed significantly since 1993. Equipment changes are documented in field log books, field datasheets, and the Water Database. Units of measurement have remained consistent throughout the period of record. The measures of accuracy, precision, and traceability have not changed and provide for the ability to assess these quality objectives for data collected over the entire period of record.

Information regarding data quality allows for comparison of data collected at different times over the period of record within the Ground Water Project and with other WQM Program projects (*e.g.,* Continuous Aquifer Level Monitoring Project and Settlement Compliance Project), as well as comparison with non-WQM Program sources of data, assuming quality control information is available for non-WQM Program data.

4.6 Completeness

The goal of the Ground Water Project is for the majority of sample sites to be visited at least five times per year. One site (Mackenzie 4) is only visited four times per year due to accessibility. Sample site visits are equally distributed throughout the year (every other month beginning in April), but do not have to occur on specific days.

Data are considered complete when all efforts have been taken to collect the data. It is anticipated that all samples will be collected as outlined in this QAPP. Equipment failure, staffing limitations, budget reductions, or changing department priorities may result in temporary reduction of sample collection depending on the year. If 80% or fewer of the planned samples are collected in a calendar year, the experimental design of this project will be re-evaluated.

Data gaps may affect future analysis of baseline conditions and comparison to the period of record, but do not immediately compromise the integrity of the monitoring project because monitoring is not attempting to answer a specific hypothesis. Data gaps are addressed on a case-by-case basis. Missing data may be due to staff turnover, resource constraints, equipment failure, corrective actions, or logistical problems. Corrective actions are undertaken to remedy conditions that create missing data to prevent data gaps in the future (see instrument SOPs for details).

4.7 Range/Sensitivity

The sensitivity and range that can be measured depends on the equipment selected. See instrument SOPs for details. The goal of the Ground Water Project is to collect data with sufficient resolution (sensitivity) to establish baseline conditions and identify trends, evaluate risk of groundwater mining and saltwater intrusion, and support the development and implementation of a water quality regulatory program on the Reservation. Deficiencies in sensitivity are evaluated on a case-by-case basis and corrected for future monitoring.

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5. DOCUMENTS AND RECORDS (A9)

5.1 Quality Assurance Project Plan Distribution

The Water Resources Specialist II is responsible for ensuring that the people listed on the Distribution List for this QAPP have the most current version of the QAPP. Records are maintained by the Water Resources Specialist II documenting substantial and minor version changes, and the Water Resources Manager is responsible for the distribution of minor change letters and revised QAPPs. Details on documenting QAPP revisions, including version number conventions, are included in the QMP.

5.2 Data Report Package

Results of the Ground Water Project are included in the Water Quality Assessment Report, which summarizes the results of the WQM Program projects implemented by the LWRD. The reports include comparison to chloride trigger levels and time-series analysis of water quality data for the two-year reporting period as well as for the period of record. The report is provided to the EPA Project Officer every-other year by March 31 of the year after the two-year reporting period, following approval by the Water Resources Manager and the LNR Deputy Director.

The Ground Water Project data are transmitted to the EPA via WQX upon approval by the Water Resources Manager and the LNR Deputy Director. Data collected as part of the Ground Water Project are provided to the EPA Project Officer annually by March 31 of the subsequent calendar year.

5.3 Documentation and Storage

The QMP provides detailed requirements for project document storage, including field datasheets, lab results, and electronic data.

In summary, the Water Resources Specialist II is responsible for maintaining and storing all documents and records associated with the Ground Water Project. Quality control reports, field datasheets, and final lab results are stored in three-ring binders in the LWRD office. All paper records are scanned and saved on LIBC servers that are backed up nightly. All data are entered into the Water Database, which is saved on LIBC servers that are backed up nightly.

In this QAPP, reference to data or comments entered “into the Water Database” includes entry directly into the Water Database via the iPad or by recording onto hardcopy field datasheets that are later transcribed into the Water Database. Details are included in the QMP and specific instructions on data entry are provided in the Water Database User Guide (LWRD 2018). The QMP also details what information should be recorded in the Water Database and the conventions for making changes or correcting errors on hard copy field datasheets or electronically in the Water Database.

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6. EXPERIMENTAL DESIGN (B1)

The Ground Water Project is designed to achieve the following objectives:

1. Provide high quality data sufficient to establish baseline conditions of groundwater on the Reservation;
2. Protect groundwater supplies from saltwater intrusion and groundwater mining; and
3. To support the development of a water quality regulatory program (*e.g.,* Lummi Code of Laws Title 17, Water Quality Standards) on the Reservation.

The Ground Water Project is ongoing and not intended to prove or disprove a specific hypothesis.

6.1 Sample Runs and Structure

The Ground Water Project is comprised of two sample runs: Domestic Wells and Tribal Supply Wells.[5] All sample sites in the northern potable aquifer are sampled during the Domestic Wells Run, while sample sites in the southern potable aquifer are split between the two runs based on well type (domestic or tribal supply well). One well, Mackenzie 4, is sampled during quarterly site visits for Continuous Aquifer Level Monitoring Project wells due to the remoteness of this well.

Information from all site visits is used to establish baseline conditions and to evaluate risk of saltwater intrusion and groundwater mining. Sample runs are established to monitor water quality conditions in different geographical regions of the Reservation, and can serve to provide targeted information for each potable aquifer.

The primary sources of variability in aquifer level and water quality parameters are seasonal changes (*i.e.,* wet season and dry season) and pumping regimes (which are typically related to season). This temporal variability is addressed through regular, targeted sampling that commences at the end of the wet season (April) and proceeds through the dry season (June and August) to the beginning of the next wet season (October and December). Other than the targeted sampling in the experimental design to capture the wet and dry seasons, sites are sampled "randomly" in that the tides, season, and weather are not used to stratify sampling efforts.

Sample sites were selected to represent aquifer-wide conditions as practicable. The spatial representativeness for this project is limited by the lack of existing groundwater wells in some parts of the Reservation, particularly along the interior of the Lummi Peninsula and the eastern part of the northern upland.

[5] Note that the naming convention for the two Ground Water Project runs describes the majority of the wells sampled during that run. Tribal supply wells in the northern potable aquifer are sampled during the Domestic Wells Run.

6.2 Sample Sites

In order to characterize the two major potable aquifer systems on the Reservation, 21 groundwater quality sample sites (Figure 3.1) were selected. This includes 5 wells in the northern potable aquifer and 16 wells in the southern potable aquifer. Table 6.1 lists the project group, wells included, well number, aquifer, and well type.

Table 6.1 Groundwater Quality and Aquifer Level Monitoring Wells

Project Group	Wells	Well Number	Aquifer	Well Type
Groundwater Quality and Aquifer Level Monitoring	Balch	GW115	Southern	Tribal Supply
	Horizon	GW058		
	Kinley 1	GW059		
	Kinley 2	GW409		
	Kinley 3	GW421		
	Mackenzie 2	GW129		
	West Shore	GW146		
	Charles	GW074	Southern	Domestic
	Berg	GW143		
	Egawa	GW189		
	Northwest 1	GW417	Northern	Tribal Supply
	Northwest 2	GW418		
	Johnson	GW145		
Groundwater Quality Only	Finkbonner	GW109	Northern	Domestic
Aquifer Level Monitoring Only	Gooseberry Point 4	GW420	Southern	Tribal Supply (not in production)
	Gooseberry Point 5	GW419		
	Mackenzie 4	GW422		
	Howell	GW446		
	Jefferson	GW112	Southern	Domestic (not in use)
	Northwest 3	GW441	Northern	Tribal Supply (not in production)

Detailed maps, descriptions of sample locations, and driving directions to sample sites are provided to field personnel in the *Water Quality Monitoring Program Field Reference Manual* to ensure that sites are sampled in the proper location (LWRD 2019). Sample site access is usually not a problem. If sites are inaccessible, the sample site is skipped for that sample run, the

sample site is returned to at a later time, or the sample run is rescheduled. The QMP provides details on site inaccessibility. Off station sampling may occur if a different tap is used for collecting water quality samples. Details on documenting samples collected off station can be found in the QMP.

6.3 Water Quality Parameters

Table 6.2 lists the sample runs, sites included in each run, parameters measured, laboratory samples collected, and frequency of site assessment. An aliquot of water is collected after proper rinsing, and salinity, specific conductivity, water temperature, and pH are measured. Samples for laboratory analysis (chloride) are collected, labeled (site identifier, date, time, analysis, and collecting agency), and delivered to the laboratory using chain of custody procedures and the methods detailed in the Chloride Sample Collection SOP. Chloride can also be measuring with the YSI ProPlus if equipped with a chloride sensor. Chloride measurements by laboratory analysis or using the YSI ProPlus in the field are both included as options in this QAPP; however, note that only one method of measuring chloride will be used at any given time. Static water level is determined through the collection of three water level measurements within a three-minute period.

Table 6.2 Groundwater Quality Monitoring Sites, Parameters Measured, Laboratory Samples Collected, and Frequency of Sampling

Run Name	Site ID (GW)	Parameters Measured	Laboratory Samples Collected	Frequency
Domestic Well Run	417, 418, 145	Water temperature, salinity, specific conductivity, pH, chloride, pump rate, and static water level	Chloride	Five times per year (April, June, August, October, December)
	074, 109, 143, 189	Water temperature, salinity, specific conductivity, pH, chloride, and static water level	Chloride	
	112, 441, 446	Static water level	None	
Tribal Supply Well Run	058, 059, 115, 129, 146, 409, 421	Water temperature, salinity, specific conductivity, pH, chloride, pump rate, and static water level	Chloride	Five times per year (April, June, August, October, December)
	419, 420	Static water level	None	
Monitoring Well Run	422	Static water level	None	Four times per year (March, June, September, December)

Ten percent of sites sampled are treated as duplicates, with all water quality measurements, except laboratory sample collection, duplicated. Static water level measurements are not duplicated. Sites are randomly selected for duplication, or sites can be selected for duplicate analysis because water quality variability is suspected at a given site. Duplication provides information about the natural field variability concurrently with the inherent precision of the instrument or method used to measure the parameter. Duplicate measurements are recorded in the Water Database, and values are automatically averaged by the database for reporting the parameter results of a particular site on a given day. Groundwater quality is typically stable; if variability in duplicate measurements is detected, the cause of the variability may be instrument malfunction or operator error. If this is suspected, the problem is corrected, if possible. Measurements collected using a malfunctioning instrument or using improper technique are re-collected after the problem is remedied or data qualifiers are assigned in the Water Database (see QMP and Water Database User Guide for details on assigning data qualifiers).

Chloride and water level data are required in order to assess the risk of saltwater intrusion and groundwater mining. All data collection is critical in the sense that representative and complete data are required to meet the goals of the Ground Water Project. The parameters measured and analyzed provide substantial information about water quality and general environmental conditions. For example, water temperature, specific conductivity, salinity, and pH characterize basic water chemistry and site conditions, providing insight into the source of the groundwater, the suitability of the use of groundwater for potable uses, and both the variation and the potential causes of variation of these parameters.

The chloride concentration, pumping rate, and water levels of the water supply wells provide critical information about aquifer condition, pumping regimes, and the need for protective measures as these data indicate whether saltwater intrusion or groundwater mining are occurring or if the likelihood of these occurring have increased. For wells that are not used for water supply purposes (*i.e.,* inactive wells), water level provides information about aquifer conditions.

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7. SAMPLING METHODS (B2, B3, B4)

Sampling methods (B2), sample handling and custody (B3), and analytical methods (B4) for each parameter measured or sampled are described below. This section also describes sample handling and custody, safety during sampling, equipment required for sample runs, the water sampling sequence, and a summary of practices specific to each parameter measured. Details on parameter measurement and sample collection are included in the parameter and equipment SOPs.

7.1 Sampling Method Overview

At each sample site, static water level is measured. At sites to be sampled for water quality parameters, the well is flushed, and an aliquot of sample water is collected in a container rinsed with sample water. Water quality parameters (temperature, pH, salinity, specific conductivity) are measured using a multi-parameter water quality sonde. Chloride is either measured with the water quality sonde equipped with a chloride sensor or a sample is collected and delivered to the independent contracted laboratory, Edge, for chloride analysis. At supply wells, pump rate is also recorded. Data are recorded in the Water Database as described in the QMP and the Water Database User Guide.

7.2 Sample Handling and Custody (B3)

Details on sample handling and custody, including how samples are physically handled and transported to the laboratory, requirements for chain of custody procedures, and maximum holding times are provided in the Chloride Sample Collection SOP. Information on the system for identifying samples and sample tracking is included in the QMP.

7.3 Safety

All field work is conducted by teams of two or more. All procedures listed in the Lummi Water Resources Division Health and Safety Plan (LWRD 2015) are followed while conducting laboratory and field work outlined in this QAPP. Safety is not addressed in detail in this document; however no water quality measurement is worth risking injury or death. To ensure that hazards are identified and addressed, field personnel must maintain a general awareness of hazards and possess the ability to respond appropriately. Field personnel must be aware of the environment, use common sense and training, and not exceed their abilities or limits. Field personnel always carry a cell phone and car charger, and inform their supervisor of planned field work, including the time of departure, the time of the scheduled return, and the general location of field work.

7.4 Water Sampling Sequence

Upon arrival at a sample site, the following sequence is followed to measure static water level, collect groundwater quality samples for chloride analysis, and measure water quality parameters. Note that the same sequence is used for tribal supply wells and domestic wells, with the exception that pumps can be manually turned on and off for tribal supply wells but not for domestic wells. Additionally, tribal supply wells have drinking water treatments which must be turned off (or unplugged) prior to sample collection. Note that some groundwater sites are monitored only for aquifer level with no water quality samples are collected and some are monitored only for water quality with no aquifer level measurements collected.

1. Determine whether the well is actively pumping.
    - If no, turn pump off (for tribal supply wells) and collect static water level first.
    - If yes,
        - For tribal supply wells: collect water sample first, turn off pump, return later to collect static water level OR turn off pump, return later, collect static water level, then collect water sample.
        - For domestic wells: note in the Water Database that the well is actively pumping and that static water level could not be obtained. Time permitting, return to the site to attempt to measure static water level at a later time in the sample run.
2. Collect static water level with the well probe.
    - For tribal supply wells, turn pumps off and allow the aquifer level to stabilize before attempting to collect static water level. Aquifer level stabilization can take 30 minutes to an hour at some sites.
    - Details on collection of static water level and using the well probes are provided in the Well Water Level SOP.
3. Prepare for water sample collection.
    - For tribal supply wells, turn pumps back on, and record the pump rate once it has stabilized. Take note of units.
    - For tribal supply wells, unplug or turn off any chloride and fluoride treatments, especially if they are added to the supply water prior to sampling location.
    - Locate sampling location and attach hose, if possible. Collect sample from as close to the wellhead as possible.
    - Flush the system for 3 minutes or until the water temperature has stabilized as determined by touch, whichever requires more time. Flushing can be through the hose or by filling buckets. When time allows or if a well has not been in regular use, three well volumes are purged.[6]

[6] Purge volume calculated as follows: $V=0.041*d^2*h*3$ where, h=depth of water in feet (well depth-water level), d=diameter of the well in inches, and V=volume of water in gallons (EPA R4 2013). The time (in minutes) required

4. Collect aliquot of water for analysis of water quality parameters.
    - Collect water sample into plastic 1 L bottle
        - Rinse the bottle with sample water three times.
        - Fill the sample bottle by allowing the bottle to fill and overflow three times. Count number of seconds to fill the bottle and allow the bottle to overflow for twice again that amount of time.
5. Measure water quality parameters.
    - Rinse YSI ProPlus (or YSI 556) with distilled water.
    - Rinse YSI ProPlus (or YSI 556) with sample water.
    - Place YSI ProPlus (or YSI 556) in the sample water bottle.
    - Allow parameters to stabilize. Record pH, temperature, salinity, and specific conductivity.
    - Details on using the YSI ProPlus (or YSI 556) for measuring water quality parameters, including stabilization criteria, are provided in the instrument SOPs.
6. Collect chloride sample for analysis at the independent contracted laboratory.
    - Details, including bottle labeling and chain of custody procedures, are provided in Chloride Sample Collection SOP.
7. At 10% of sites, collect duplicate measurement of all parameters except chloride sample collection.
8. Clean up sample site.
    - At supply wells, return pumps and treatments back to the position they were in upon arrival (typically “Auto”).

7.5 Parameters Measured

Table 6.2 lists the parameters measured and the sampling frequency for every sample site. Table 7.1 summarizes the parameters measured, units, sampling equipment, measurement method, sample holding container, method of sample preservation, and the maximum holding time for each of the measured parameters. “General Observations” are not listed in Table 7.1 because they are not a specific method. General and noteworthy conditions are observed during the time period the sampler is at a sample site and recorded as comments in the Water Database (see Water Database User Guide for details on recording comments).

Cleaning of sample equipment follows manufacturer’s instructions and details listed in the equipment SOPs. Improper cleaning can cause damage to equipment. Clean chloride sample bottles are provided by the contracted laboratory and are not cleaned by LWRD staff.

to flush three casing volumes can be found by dividing the volume by the flow rate in gallons per minute.

Table 7.1 Lummi Nation Water Quality Sampling Methods

Parameter (units)	Measurement Equipment	Analytical Method	Sample Holding Container	Sample Preserv-ation[a]	Maximum Holding Time
Chloride (mg/L)	Laboratory using ion chromatography	EPA 300.0	250 mL plastic bottle with screw top	None	28 days
Chloride (mg/L)	YSI ProPlus	See YSI ProPlus SOP #002	1L plastic sample bottle	N/A	Immediately
PH (pH units)	YSI ProPlus or YSI 556	See YSI ProPlus SOP #002, YSI 556 SOP #001 SM 4500-H+ B-2000	1L plastic sample bottle	N/A	Immediately
Salinity (ppt)	YSI ProPlus or YSI 556	See YSI ProPlus SOP #002, YSI 556 SOP #001	1L plastic sample bottle	N/A	Immediately
Specific Conductivity (µS/cm)	YSI ProPlus or YSI 556	See YSI ProPlus SOP #002, YSI 556 SOP #001 SM 2510 B-1997	1L plastic sample bottle	N/A	Immediately
Water Temperature (°C)	YSI ProPlus or YSI 556	See YSI ProPlus SOP #002, YSI 556 SOP #001 SM 2550 B-2000	1L plastic sample bottle	N/A	Immediately
Well Water Level (feet)	Waterline Envirotech 500 ft well probe	Manufacturer's instructions See Well Water Level SOP #011	*In situ*	N/A	N/A

SM refers to Standard Methods (APHA various dates).

[a] Sample preservation methods listed are for the collection and delivery of samples to the laboratory by LWRD staff and do not include sample preservation methods performed at the independent contracted laboratory.

For all individual parameters listed below, see parameter or instrument SOPs for details regarding procedures, performance criteria, and corrective actions. The QMP provides details on method validation.

7.5.1 ***Static Water Level***

Static water level is measured at all groundwater sample sites using a Waterline Envirotech 500 ft well probe or Waterline Envirotech 300 ft Olympic well probe. Well water level is measured three times within three minutes to determine static water level, as described in the Well Water Level SOP.

7.5.2 ***Pump Rate***

At tribal supply wells, pump rate is recorded. The meter is either mounted on the water line or on the wall.

1. Use a flashlight to turn on the meter, if needed
    - Wall-mounted meters do not need to be turned on
2. Wait for the pump rate to stabilize
    - Note that water line-mounted meters will cycle between totalizer volume and pump rate
3. Record pump rate and units in Water Database

7.5.3 ***Water Quality***

Water quality is measured at all sites with active wells using a multi-parameter water quality sonde with sensors for water temperature, salinity, specific conductivity, and pH. The YSI ProPlus is the primary instrument used to measure groundwater quality parameters. The YSI 556 can be used as a back-up if the YSI ProPlus is unavailable or requires maintenance or repair. The YSI ProPlus can also be equipped with a chloride sensor (Section 7.5.4).

As described in the SOPs for the YSI ProPlus and YSI 556, the instrument must be calibrated and pass pre-run accuracy checks prior to use for field measurements. The SOPs for the instruments also detail use of the equipment to collect water quality measurements, stabilization criteria, corrective actions, and QA/QC procedures.

All parameter measurements are recorded in the Water Database.

7.5.4 ***Chloride***

Chloride is measured at all sites with active wells. Chloride can be measured by either (1) collecting a chloride sample for analysis at the independent contracted laboratory, Edge, or (2) field measurement using a chloride sensor on the YSI ProPlus.

A chloride sample is collected as outlined in the Chloride Sample Collection SOP. The bottle is labeled with the site identifier and other information as detailed in the SOP, and transported to

the independent contracted laboratory. Chain of custody forms are used to document sample information, analyses requested, and release of the samples to laboratory staff.

A chloride sensor can be attached to the YSI ProPlus to allow for measurement of chloride in a groundwater sample in the field (see Section 7.5.3 and the YSI ProPlus SOP for details).

Note that the measurement of chloride using the sensor is a nonstandard method, and that implications on data use are associated with the selection of this chloride measurement option. If data are to be used for regulatory actions, chloride measurement by laboratory analysis is required, as data generated by use of the chloride sensor are less precise and should be used as an estimate of chloride concentration. High chloride measurements obtained by the sensor are used as indicators of potential chloride contamination and trigger the collection of water samples for laboratory chloride analysis. In general, laboratory analysis of chloride is preferred over chloride measurement using the sensor. However, both options are provided within the Ground Water Project to allow for flexibility.

Laboratory analysis of chloride in water samples is required annually or three times annually, depending on the site, as part of the Settlement Compliance Project. Laboratory chloride sample collection as part of the Settlement Compliance Project and the Ground Water Project are combined (*i.e.,* when chloride sample collection is required as part of the Settlement Compliance Project during a given month, duplicate chloride samples are not collected as part of the Ground Water Project during that same month). All chloride results are analyzed as part of the Ground Water Project.

8. QUALITY CONTROL AND EQUIPMENT USE

Quality Assurance/Quality Control (QA/QC) activities (B5), equipment testing, inspections, maintenance (B6), and calibration (B7) are described below. Detailed information for each parameter and instrument is provided in the method and instrument SOPs. This section provides a summary of required activities for each parameter and instrument as well as general QA/QC procedures for the Ground Water Project.

Quality control activities are integral to equipment maintenance and provide information to the sampler and analyst about equipment condition and data reliability. The quality control activities can occur before, during, and after sample runs or regularly throughout the year. Equipment operation is assessed at startup and during operation as outlined in the equipment SOPs. Equipment problems or failure to meet QA/QC activity acceptance criteria initiates corrective actions. A summary of corrective actions are provided in Section 8.4 of this QAPP, with details provided in the individual equipment SOPs and the QMP. Determination and documentation of control action effectiveness is described in the QMP.

The goal of QA/QC activities for the Ground Water Project is to ensure that measurements have a known accuracy, precision, and traceability. QA/QC activities for the project are listed in this section and in the method and equipment SOPs. Calculation of statistics is detailed in the QMP and summarized in Section 10.2 of this QAPP.

8.1 Quality Control (B5)

Quality control procedures for the Ground Water Project include instrument calibration; pre-run, mid-run, post-run, and quarterly accuracy checks; appropriate sampling techniques; use of sample tracking forms; and field duplicates.

8.1.1 ***Water Quality***

The YSI ProPlus (or YSI 556) is calibrated according to the equipment SOP. The YSI ProPlus (or YSI 556) is accuracy checked according to the equipment SOP prior to the commencement of a sample run (pre-run), during the mid-way point of the sample run (mid-run), and at the end of the sample run (post-run). Detailed calibration and accuracy check requirements are listed in the instrument SOPs.

8.1.2 ***Chloride***

Details on the QA/QC procedures for chloride sample collection and analysis are provided in the Chloride Sample Collection SOP. A summary of these procedures are provided below for collection of a laboratory sample for chloride analysis. Section 8.1.1 provides as summary of QA/QC procedures for measuring chloride with the chloride sensor.

8.1.2.1 Aseptic Sampling Techniques

Field staff will ensure that all water samples are collected using aseptic techniques. This includes inspecting the laboratory-provided chloride sample bottles for contamination prior to use and proper handling of the sample bottle during chloride sample collection.

8.1.2.2 Sample Tracking

Every groundwater sample site has a unique numerical identifier. The site identifier is used to track water quality measurements and chloride samples collected at the site. Section 10.1 and the QMP provide details of sample tracking and data recording. Chain of custody forms are provided by the independent contracted laboratory and are used to handle and track samples from field collection to delivery to the laboratory. The number on the chain of custody form will follow the samples through analysis to final reporting.

8.1.2.3 Holding Times

Laboratory holding times are observed for all chloride samples collected (Table 7.1).

8.1.2.4 Laboratory QA/QC

The independent contracted laboratory is responsible for maintaining data quality for laboratory-analyzed results. Quality assurance samples may include blanks, matrix spikes, laboratory duplicates, and/or standards. Quality assurance practices will meet or exceed method and accreditation requirements as outlined in the laboratory QAPP or method SOP. A summary of laboratory QA/QC requirements are provided in the Quality Management Plan (QMP Appendix C).

8.1.3 Field Duplicates

Duplicate measurement of all field parameters except chloride sample collection for laboratory analysis and measurement of static water level (i.e., YSI measurements and pump rate, if measured) is conducted at 10% of sample sites. Sites are randomly selected for duplication, or sites can be selected for duplicate analysis because water quality variability is suspected at a given site. Duplication provides information about the natural field variability concurrently with the inherent precision of the instrument or method used to measure the parameter. Duplicate measurements are recorded in the Water Database, and values are automatically averaged by the database for reporting the parameter results of a particular site on a given day. Groundwater quality is typically stable; if variability in duplicate measurements is detected, the cause of the variability may be instrument malfunction or operator error. If this is suspected, the problem is corrected, if possible. Measurements collected using a malfunctioning instrument or using improper technique are re-collected after the problem is remedied or a data qualifier is assigned in the Water Database (see QMP and Water Database User Guide for details).

8.2 Equipment Maintenance (B6) and Calibration (B7)

Equipment maintenance and calibration activities are the responsibility of the Water Resources Specialist II, assisted by the Water Resources Technician II.

Information regarding calibration and maintenance of water sampling equipment is provided in the instrument SOPs and user manuals. The YSI ProPlus and YSI 556 and require periodic calibration. Details on actions to be taken when calibrations are unsuccessful are found in the method and equipment SOPs. The Waterline Envirotech 500 ft well probes require maintenance and cleaning by the manufacturer on an as needed basis. All equipment is inspected, including checking battery charge, prior to use in the field and repaired as necessary. Instruments and other field sampling equipment are kept clean and in working order.

An equipment module is included as part of the Water Database. The equipment module sends the Water Resources Specialist II and Water Resources Technician II email reminders of needed maintenance activities and deadlines according to manufacturer specifications. Details on the equipment module are provided in the QMP.

8.3 Acceptance Criteria and Control Limits

Acceptance criteria and control limits depend on the parameter measured and equipment used. Details on the standard procedures to follow when acceptance criteria are exceeded, calibrations are unsuccessful, or readings are otherwise suspect are found in the equipment and method SOPs. Details on determination and documentation of the effectiveness of control activities are included in the QMP.

8.4 Corrective Actions

The goals of corrective actions are to solve the problems at hand and to eliminate or reduce the occurrence of the problems. Problems with equipment detected during equipment use, calibration, or during QA/QC activities result in actions to correct the problem (see individual instrument and parameter SOPs). Corrective actions depend upon the parameter being measured. If the problem cannot be resolved on-site, the measurement is discontinued until the problem is identified, remedied, and reliable results are obtained. For most parameters, backup equipment are available for use while the deficiency with the standard equipment is being remedied. Problems with equipment and measurements, corrective actions, and outcomes are recorded in the Water Database.

Details on documenting problems, corrective actions, and outcomes, including assigning data qualifiers, in the Water Database are provided in the QMP and Water Database User Guide.

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9. SUPPLIES AND CONSUMABLES (B8)

The Water Resources Specialist II is responsible for ensuring that critical supplies and consumables are unexpired, ready for use, and that a minimum two-month supply is always available. Details on supply ordering, stocking levels, and management are provided in the QMP. Details on equipment and supply inspection are listed in the equipment SOPs.

Supplies and consumables used in the Ground Water Project include:

Data Recording:

- iPad
- Calibration and field datasheets in field clipboard
- Waterproof pen and/or pencil

General:

- Distilled water in marked squeeze bottles
- Bleach water in marked squeeze bottle
- Tool chest, including well keys, two adjustable wrenches, hammer, stopwatch, flashlight, 9 volt batteries

Water Quality Sampling Equipment:

- Yellow Springs Instruments (YSI) Professional Plus (YSI ProPlus) and associated reagents needed for calibration and accuracy checks as specified in the YSI ProPlus SOP. YSI ProPlus must meet all pre-run QA/QC requirements prior to use for collection of water quality parameters in the field.
    - The YSI 556 Multi Parameter System (YSI 556) can be used as a backup water quality sonde in the event that the YSI ProPlus is unavailable or inoperable. The YSI 556 must meet all pre-run QA/QC requirements prior to use for collection of water quality parameters in the field. See YSI 556 SOP for details on QA/QC requirements and associated reagents needed.
- Garden hose dedicated to groundwater sample collection
- 1L well sample bottle
- Waterline Envirotech 500 ft well probe
- 250 ml chloride sample bottles, provided by the independent contracted laboratory

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10. DATA MANAGEMENT (B10)

The Water Resources Specialist II is responsible for management of Ground Water Project data with support and supervision provided by the Water Resources Manager and the Database Manager.

A detailed description of the data management process, including record keeping and QA/QC procedures, is included in the QMP. Components of the Water Database, including data archiving and uploading, hardware and software configurations, and automated data validation and verification tools, are included in the QMP. A summary of the data management process is provided here.

All sampling and related water quality data are entered into the Water Database, either in real time using the iPad or through transcription of data from field datasheets and laboratory reports. Data entry is manually verified, and a QA/QC report is generated for each trip. All paper records (*e.g.,* field datasheets, final lab reports, chain of custody forms, and QA/QC reports) are stored by the Water Resources Specialist II in the LWRD office. All electronic records are saved in the Water Database and in a data archive folder on secure LIBC servers, which are backed up nightly. Data are verified and validated according to their quality as outlined in the QMP. Verified data are transmitted to the EPA via WQX upon approval by the Water Resources Manager and the LNR Deputy Director.

10.1 Sample Tracking and Data Recording

Details on data entry and use of the Water Database are provided in the QMP. A summary of sample tracking and data recording follows.

Every groundwater sample site has a unique numerical identifier. The site identifier is used to track water quality and well water level measurements and chloride samples collected at the site. Typically, water quality data and site observations for each site visit are entered directly into the Water Database in real time via an iPad. When field datasheets are used, the site identifier is recorded (a copy of the groundwater field datasheet is included in the QMP). The site identifier is also recorded on chloride sample bottles and chain of custody forms to track the results of laboratory analysis. Detailed procedures on labeling of chloride sample bottles, sample handling and transportation, and completion of chain of custody forms are provided in the Chloride Sample Collection SOP. The Chloride Sample Collection SOP also includes an example chain of custody form as an appendix.

All run details, QA/QC procedures completed (*i.e.,* instrument calibrations and accuracy checks), site visit observations, water quality parameter and well water level measurements, notes on measurements not taken and reasons why, issues, corrective actions, and outcomes are recorded either directly into the Water Database in real time using the iPad or are recorded on field datasheets. Notes and data from field datasheets are entered into the Water Database

within one week of trip date, if feasible, and data entry QA/QC is completed by the Water Resources Specialist II upon receipt of the final laboratory results for that trip.

10.2 Data Analysis

Calculation of precision (as available) and accuracy/bias, identification of outliers, and identification of data gaps provide the basis for quantifying data reliability for the Ground Water Project. Details on data validation and verification, database maintenance, calculation of statistics, and identification of outliers and missing data are provided in the QMP

Duplicate measurements are automatically averaged by the Water Database. Field variability can be calculated manually.

The Water Database includes an analysis module that allows for rapid and accurate filtering and querying of data for the period of record. The analysis module is in the process of being updated to automate analysis of various summary statistics. The Database Manager is responsible for changes to the Water Database with support from the Water Resources Specialist II and Water Resources Technician II. Additional data analysis details are supplied in the QMP.

10.3 Non-Direct Measurements (B9)

Non-direct measurements are not routinely used in the Ground Water Project. Details on documentation of non-direct measurement and external data, including data quality, are included in the QMP in the event that these data are acquired for use to supplement data collected as part of the Ground Water Project.

Laboratory samples collected for chloride analysis as part of the Ground Water Project are used for both this project and for the Settlement Compliance Project. Details are provided in the Settlement Compliance Project QAPP (LWRD 2019e).

10.4 Data Review and Usability (D1, D2, D3)

Data review, verification, and validation requirements (D1), verification and validation methods (D2), and reconciliation with user requirements (D3) are discussed in detail in the QMP.

11. OVERSIGHT AND REPORTING

11.1 Assessments and Response Actions (C1)

Section 1 of this QAPP and the QMP list the key personnel and their responsibilities. In summary, the person conducting the monitoring (primarily the Water Resources Specialist II and Water Resources Technician III) is responsible for performing all inspections, QA/QC activities, and data management. The Water Resources Specialist II is responsible for screening the data as necessary, with support from the Database Manager. The Database Manager is responsible for transmitting the data to EPA via WQX. The Water Resources Manager ensures that QA/QC objectives and reporting requirements are achieved.

Operator error and equipment problems detected during accuracy check and other QA/QC activities will initiate actions to correct the problem. Corrective actions and troubleshooting information are supplied in the equipment SOPs. Quality control activities also inform potential data correction factors that may be applied, as appropriate. Project action limits and assessments are described in the QMP.

11.2 Reports to Management (C2)

The Water Resources Specialist II is responsible for evaluating water quality, well water level, laboratory, and QA/QC data and reporting to the Water Resources Manager regularly and as needed if problems are detected. When problems are detected and not resolved through standard practices or are of a more complex nature than the staff conducting water quality sampling typically address, the Water Resources Specialist II, the Water Resources Technician II, and the Water Resources Manager will jointly develop an action plan to remedy the problem with clear roles, responsibilities, and timelines. The Water Resources Manager is immediately alerted if elevated levels of chloride are detected. Assessments are described in the QMP.

The Water Resources Specialist II prepares a Water Quality Assessment Report that summarizes the collected water quality and laboratory data for the two-year reporting period, compares the results with the data for the period of record and chloride trigger levels, and documents risk of saltwater intrusion and groundwater mining. These reports are reviewed and approved by the Water Resources Manager and the LNR Deputy Director, and approved reports are transmitted to the EPA every-other year by March 31st of the year following the two-year reporting period. The Water Resources Manager submits bi-annual (twice per year) progress reports to the EPA Project Officer that describe project status, problems, remedies, and schedules.

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12. ACRONYMS AND ABBREVIATIONS

CWRMP	Comprehensive Water Resources Management Program
EPA	Environmental Protection Agency
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department
LWRD	Lummi Water Resources Division
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
QA/QC	Quality Assurance/Quality Control
SM	Standard Method
SOP	Standard Operating Procedure
WQM	Lummi Nation Water Quality Monitoring [Program]
WQX	Water Quality Exchange
YSI 556	Yellow Springs Instruments 556 Multi Parameter System
YSI ProPlus	Yellow Springs Instruments Professional Plus

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