

Standard Operating Procedure #011



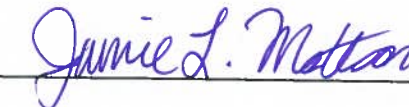

Well Water Level

Version 1.1
December 2019

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Prepared for:
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This project has been funded wholly or in part by the United States Environmental Protection Agency under Assistance Agreement BG-00J89601-1 to the Lummi Nation. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use

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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	Added staff	Distribution
			Update equipment	Section 2, Table 2.1, Figures 2.1, 2.2

SIGNATURE PAGE

Document: Well Water Level SOP #011

Version 1.1

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

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1. INTRODUCTION

This document, the Standard Operating Procedures (SOP) for well water level, should be used any time well water level is measured at a groundwater site. This document describes the standard operating procedures and best practices for measuring well water level, including measurement technique, equipment needed, and quality assurance/quality control (QA/QC) procedures. This document is to be used in conjunction with the relevant project Quality Assurance Project Plan (QAPP).

1.1 Method Summary

Well water level is measured at all accessible groundwater sites using a Waterline Envirotech 500-ft electric tape (with engineering scale) and probe directly in the well. The probe is lowered into the well and the tape is measured when the meter indicates contact with water. Static water level is determined by measuring well water level three times within a three-minute period. Quality assurance and quality control procedures include bi-annual (every two years) maintenance of the electric tape.

1.2 Health and Safety Warnings

No water quality measurement is worth risking injury or death. Field personnel must be aware of the environment, use common sense and training, and not exceed their abilities or limits. Field work is never conducted alone. All Lummi Natural Resources (LNR) Water Resources Division (LWRD) Health and Safety Plan (LWRD 2015) requirements and guidelines are followed at all times while conducting fieldwork.

2. INSTRUMENT SPECIFICATIONS

Well water level is measured using a Waterline Envirotech 500-ft electric tape (with engineering scale) and probe directly in the well. The instrument is fitted with a custom thin probe to allow passage within small-diameter access tubes. The electric tape is marked in feet, and tenths and hundredths of a foot. Water level is measured in feet and inches from the well measuring point.

The range, accuracy, and readability of the water level meter used for well water level measurement are listed in Table 2.1. The LWRD maintains two Waterline Envirotech 500-ft electric tape (with engineering scale) well probes. See Error! Reference source not found. for image of the well probes used and maintained by LWRD.

Table 2.1 Range, Accuracy, and Readability of Well Probes for Well Water Level Measurement

Equipment	Range	Accuracy	Readability
Waterline Envirotech Electric 500-ft Well Probe	0 to 500 ft	± 0.01 ft	0.01 ft



Figure 2.1 Waterline Envirotech Electric 500-ft Well Probe

3. WELL WATER LEVEL MEASUREMENT

Well water level is measured *in situ* at domestic and tribal supply well groundwater sites.

3.1 Well Housing

The wellhead may be located outside in an open area, inside a well house, be housed with a protective metal cover, or have a well cap. Some wells have a removable portion at the top of the well cap, while others require removal of the entire well cap to access the well. Tools may be needed to remove the bolts and nuts from well caps to access the well. Rusty bolts and nuts should be removed and replaced with new stainless steel hardware.

Most wells on the Reservation have an access tube through which well water level can be measured. If an access tube is not present, a marking on the well casing indicates the measuring point for collection of well water level.

3.2 Site Conditions

Using the decision tree below and professional judgment, determine the best course of action for preparing the site for measurement of well water level.

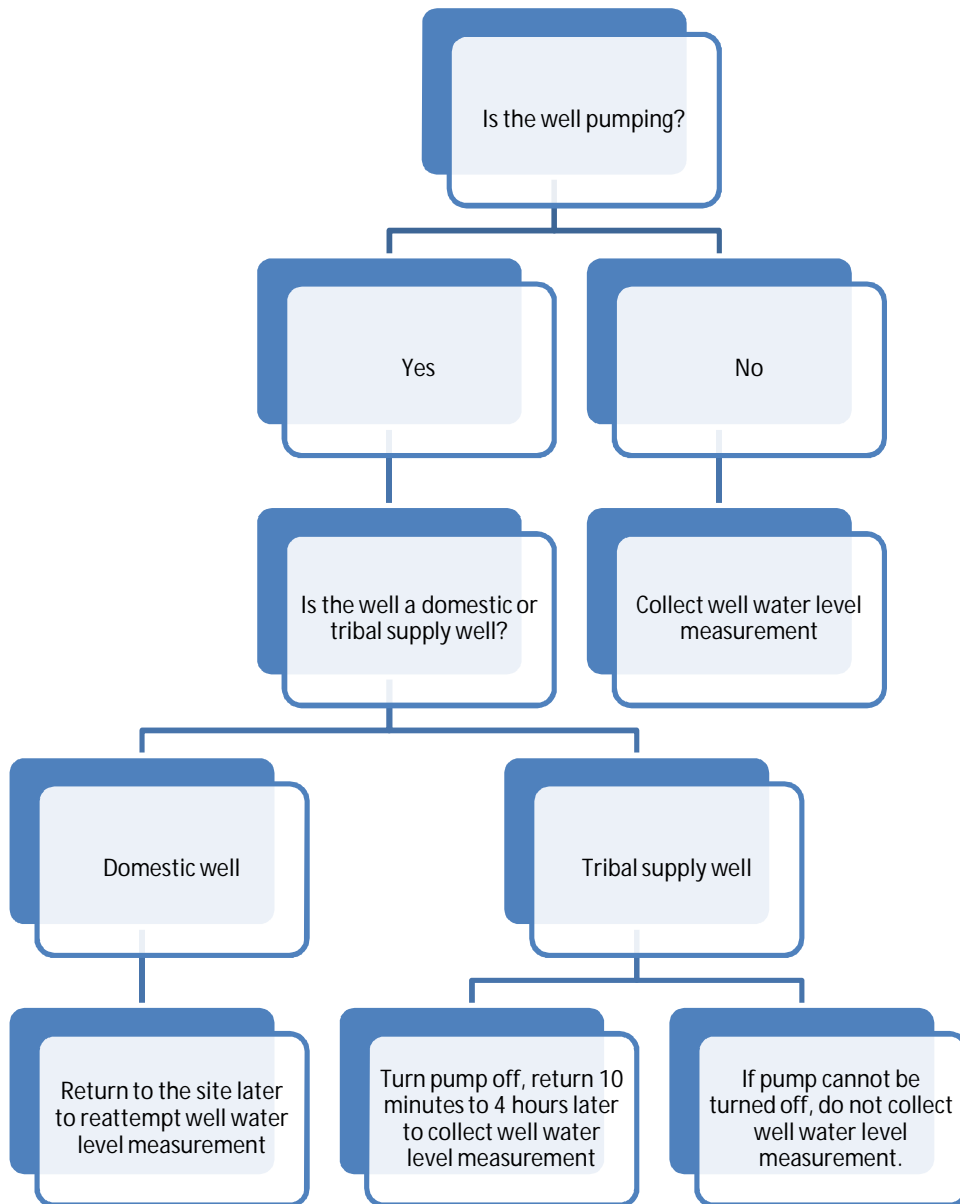


Figure 3.1 Decision Tree for Collection of Well Water Level Measurement

3.2.1 Domestic Wells

Pumps for domestic wells (wells used to supply private domestic water to homes) cannot be turned off by field staff. If the pump is on during a site visit, do not measure the water level. Either visit the site at a later time during the sample run to measure water level or note in Water Database or on field datasheet that water level could not be measured due to active pumping.

3.2.2 Tribal Supply Wells

Pumps for tribal supply wells can be turned off with the permission of the Lummi Tribal Sewer and Water District. Before turning the pump off, note the position of the switches. After 10 min to 4 hrs have elapsed, measure water level. Time that pump is off depends on the rebound rate of the well and the Lummi Tribal Sewer and Water District's needs. After water level measurement, return all switches and associated devices to prior position.

If the tribal supply well pump is on and cannot be turned off, do not measure the water level. Either visit the site at a later time during the sample run to measure water level or note in Water Database or field datasheet that water level could not be measured due to active pumping.

3.3 Equipment

Equipment needed for measurement of well water level include:

- Waterline Envirotech Electric 500-ft tape
- Waterline Envirotech Electric 300-ft Olympic Well Probe and tape measure (as backup)
- Flathead screwdriver
- Two crescent wrenches
- Fresh replacement 9 volt battery for probe
- Extra bolts and nuts (sizes encountered on wellheads in the field)
- Bottle with dilute bleach solution (bottle filled 5-10% with bleach and diluted with tap water)
- Mild detergent (*e.g.*, Alconox)
- Distilled or deionized water
- Lint-free towels

3.4 Measuring Well Water Level

Measure and record water level as described below.

1. Examine previous water level measurements in Water Database for that well to determine approximate water level.
2. Turn the sensitivity of the meter to mid-high range. Ensure that the buzzer works, and set the indicator to buzz.
3. If access tube is present, use it for water level measurement.
 - If access tube is present and not used, document in Water Database or on field datasheet.
4. Lower probe into the access tube or well in the immediate vicinity of the measuring point, playing out line and paying attention to the speed and weight of the line and the amount of line in the well as it drops. If the line becomes light in weight relative to how

much line is in the well, hangs up in the well, or too much line has been used (amount exceeds expected well depth) gently pull the line back up (keeping tape/cable off of the ground) until probe and line clear the location where the tape/cable had hung up. Feel for obstructions and work past them when re-lowering the probe. If a particular depth(s) is the site of chronic hang-ups, note in Water Database and well inventory. Consider installing access tube for chronic problems. If probe becomes stuck or water cannot be located in the well, view Section 4 for corrective actions.

5. When water level is detected, raise and lower the probe several times about one foot above and one foot below water level to confirm detected water level is representative.
6. The measuring point is marked at the top of the well casing or is the marked (or higher) side of the access tube. Hold electric tape at the measuring point when the water level is indicated (or note the measurement). The back-up cable probe can be pinched to mark the measuring point. Very slightly raise and lower probe to ensure location of electric tape is accurate. Then raise probe several inches and return to the previously measured level.
 - If location of electric tape is accurate, record water level and time of measurement
 - If location of electric tape is not accurate, repeat process starting with Step 5 above
7. Collect measurement and record in the Water Database with time measurement taken.
 - For electric tape, read water level directly from tape and record level in feet to nearest hundredth of a foot.
 - For back-up cable probe, hold cable at the measuring point and use tape measure to measure distance between where cable pinched and nearest mark (marks are 5 ft apart). Redo measurement (start with Step 4) if cable moves relative to fingers at pinched point when using tape measure. Record water level as feet and inches to nearest 1/8 inch. Record time of measurement as time the cable was pinched or marked.

3.4.1 Static Water Level

Most projects call for measurement of static well water level, which requires three measurements of well water level within a 3-minute period. See project QAPP for measurements required.

Perform a total of three water level measurements following the instructions in Section 3.4 above. Begin timing when first measurement is collected; the second measurement is taken 1 minute after the first measurement and the third measurement is taken 2 minutes after the second measurement. To be considered "static" water level, the three measurements must be within 0.02 ft of each other.

Perform four water level measurements if second and third measurements are not within 0.02 ft of initial water level measurement. Repeat if necessary to obtain three measurements that are within 0.02 ft of one another within a 3-minute period.

3.4.2 Measuring During Active Pumping

If necessary, well water level measurements can be taken during active pumping if they can be performed safely. Note in the Water Database that pumps are active and that well water level measured does not represent static water level. Note purpose of well water level measurement during active pumping (*e.g.*, determining well drawdown rate). Record pump rate simultaneously with well water level measurements.

If water level is falling or rising rapidly, forego step 5 in Section 3.4 and measure and record water level after fine adjustment.

3.4.3 Total Well Depth

In general, the well probe is not used to measure total well depth as this information is available on the well log of a given well. Total well depth should never be measured using the well probe in wells that are actively pumping. If, during troubleshooting (Section 4), well depth is measured for a well, take extreme care not to let the sensor become hung up or stuck in the well. If well depth is measured, the well probe and tape/cable needs to be thoroughly cleaned with mild detergent (*e.g.*, Alconox), fully rinsed, rinsed with distilled or deionized water, and dried with lint-free towels. Well depth is never measured in multiple wells without washing of the probe and tape/cable between wells to avoid contamination.

4. TROUBLESHOOTING

For all troubleshooting activities, document observations, corrective actions, and outcomes in Water Database or field datasheet, as specified in the relevant project QAPP and the Water Database User Manual (LWRD 2018)

If equipment malfunction is suspected, discontinue measurement of well water level. Note problems in Water Database. Upon return to the laboratory, repair, replace, or service the well probe as soon as possible. A back-up well probe is maintained to ensure that a functioning instrument is available for measurement of well water level in the event that one probe is damaged or malfunctions.

If water cannot be found in the well at expected location, determine if operator error or equipment problem (*e.g.*, cable hung up). If troubleshooting and corrections determine the equipment is faulty, have it serviced or replaced as soon as possible.

4.1 Operator Error

If operator error is suspected, attempt the following actions:

- Check that the buzzer is turned on and sensitivity is in mid-high range
- Ensure battery has charge
- Check well depth on the well log, if available, and previous well water level measurements in Water Database

4.2 Equipment Error

If cable is hung up, pull the probe up several feet and feel for obstructions and work past them when re-lowering the probe. Allowing the probe to pull itself down swiftly via the weight of the line can assist the probe in passing an obstruction. If a particular depth is the site of chronic hang-ups, note in Water Database and well inventory. Consider installing access tube for chronic problems.

If cable is stuck, attempt the following actions:

- Gently tug on the probe several times.
- Do not pull hard, as this can damage the electric tape or stretch the cord, which can create errors in subsequent water level measurements.
- Lower a bit more tape or cable down the well and then raise the probe again. It may be possible to “feel” how hard the probe is stuck. Take great care not to make the probe more stuck.
- If the probe is freed and anything more than gentle tugging was used to accomplish the removal, the probe tape or cord needs to be evaluated for damage or stretch and, if necessary, correction factors developed. Return probe to manufacturer for inspection and damage or stretch evaluation.

- If the probe cannot be freed and the well site can be secured, leave the probe in the well overnight to try again the following day. If the site cannot be secured or two days of effort have not freed the probe, cut the tape or cable, leaving about ten feet of extra tape or cable and tie off the tape/cable in the well so that it does not fall down the well. If the tape/cable is cut, return instrument to manufacturer for repair.

4.3 Dry Well

If confident that neither equipment nor operator are at fault, slowly and carefully lower probe farther into well to locate water. Check often that probe is not hung up. Amount of tape/cable out should not exceed well depth.

5. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

If there is potential that the electric tape is bent or the cable is stretched, the instrument must be returned to the manufacturer for re-straightening for electric probes and determination of correction factors for the coaxial cable probe.

The electric tape probes are serviced every two years, or as needed, by the manufacturer (Waterline Envirotech). The manufacturer evaluates the accuracy and function of the tape, and repairs any nicks or bends in the tape. The back-up coaxial probe is serviced by the manufacturer whenever the cable could potentially or has actually been stretched. Only the manufacturer can evaluate and quantify the accuracy of the marked cord for the coaxial probe; correction factors may be required for use of the coaxial probe if stretching has occurred.

6. ACRONYMS AND ABBREVIATIONS

LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources
LWRD	Lummi Water Resources Division
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure

7. REFERENCES

- Lummi Water Resources Division (LWRD). 2015. Health and Safety Plan. Prepared for the Lummi Indian Business Council. April.
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