1.0 Purpose and Scope

This document describes the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) procedure for measurement and collection of water quality parameters. The objectives of this procedure are to describe the processes needed to attain Quality Assurance (QA) type measurements and general field measurements (non-QA). During some operations, water quality measurements such as pH, temperature, and conductance are used as indicators of changing conditions only and are not used as data. This procedure will describe guidelines for obtaining both types of measurements. This SP is used in support of activities described in several WIPP Test Plans (TPs). Both SNL and contractor personnel will use this SP.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the Sandia National Laboratories (SNL) WIPP Online Documents web site.

2.0 Implementation Actions

Several different models and brands of water quality measurement instruments will be used for water quality measurement activities in support of the field studies. This document is not meant to substitute for the manufacturer instruction manuals for these instruments. The user is responsible for reading and understanding the appropriate manuals. Guidelines for implementing and documenting QA procedures are presented in this document, and follow the general guidelines given in Nuclear Waste Management Procedure (NP) 12-1 “Control of Measuring and Test Equipment.”

2.1 Safety and Training

The activities described in this SP shall conform to SNL Environmental Health and Safety Programs (ES&H). Activities described in this SP that are performed within the WIPP facility are subject to ES&H requirements governed by the WIPP Industrial Safety Program and the WIPP Industrial Hygiene Program.

As defined in the SNL ES&H manual, personnel will not be exposed to hazardous voltages. The voltage levels expected in the performance of this procedure will be 24 VDC or less.
Disposal of pH, conductivity, dissolved oxygen (DO) and oxidizing reduction potential (ORP) buffers used during the performance of this procedure will adhere to SNL/Carlsbad lab practices.

2.2 Responsibility

The Principal Investigator (PI), or designee, whose activities warrant the use of this procedure, is responsible for implementing the requirements of this procedure. Typical designees (but not limited to these) are the Field Testing Lead (FTL), the Well Testing Lead (WTL), the Person-in-Charge (PIC) of the activity, or the job task leader.

The PI or designee is responsible for performing the measurements following the requirements of this procedure, documenting those measurements, and assuring that the latest revision of this document is followed.

2.3 Water Quality Measurement Instrument Selection

The PI or designee will ensure that the water quality measurement instruments are of the proper type, design, range, accuracy, and tolerance to accomplish their required function. This information will be recorded in the applicable scientific notebook.

2.4 Identification

The water quality measurement instruments are identified by manufacturer, model number, and serial number, if applicable. When not supplied with a serial number, the instruments will each be assigned a permanent number that will be recorded in the scientific notebook or supplement, if that instrument is used.

2.5 Instrument Preparation

Prior to use of any instrument, inspect the instrument for damage, wear, or contamination. If the instrument is damaged or in disrepair, notify the PI or designee and implement corrective actions following their direction. If cleaning of the instrument or sensor electrodes is required, follow the manufacturer’s recommendations before use.

2.6 Measurements Using In-line/Flow-through Systems

**Note:** These In-line systems are comprised of fixed plumbing and multiple sensors that are continually immersed and supplied with a flow of water from the well or source undergoing testing. These systems may be installed in a well testing trailer or may be used in a stand-alone configuration.

2.6.1 GLI Water Quality Instruments Manifold (Specific Conductance and pH)

**2.6.1.1** If recording QA-data, verify the calibration of the system components.

- **2.6.1.1.1** Ensure that the GLI Specific Conductance (SC) and pH probe/analyzer sets have been calibrated (refer to [SP 12-15](#)).

- **2.6.1.1.2** Confirm that the data acquisition system (DAS) is within its current certification interval.

**Note:** Manual readings may be obtained from the analyzer displays (pH and SC only), or from the DAS (Hydrology Monitoring System Overview screen).
2.6.1.2 Perform an operational check of the SC and pH sensors by verifying that they are outputting values to the DAS that are within normal bounds:
   SC: 0 – 200 mS/cm
   pH: 4 – 12 pH

2.6.1.3 Setup the DAS to record data on the interval requested by the PI or designee, and note this information in the project’s scientific notebook. The interval is normally setup with the group of other test parameters being monitored by the DAS.

2.6.1.4 Start recording baseline (pre-test) data, which may include stability checks using calibration standards.

2.6.1.5 After the PI, or designee has obtained enough baseline data, start circulating water from the test source through the water quality manifold. Typically, a portion of the water being pumped from a well will be routed to the manifold, to permit measurement of the WQ parameters. Ensure that the starting time of the sampling/pumping event is recorded in the project’s scientific notebook.

Note: Some Pumping Tests may run continuously for up to 30 days. Purging and Sampling of Low-Flow wells may require repeating several pumping cycles, resulting in longer durations.

2.6.1.6 When the pumping test or sampling event is complete, discontinue recording of data and ensure that the ending time of the sampling/pumping event is recorded in the project’s scientific notebook.

2.6.1.7 Record the make, model, serial number, and calibration due date (if applicable) of the instruments used to obtain these measurements in the project’s scientific notebook.

2.6.1.8 After the equipment is returned from the field and as soon as practical, perform an As-found calibration check (refer to SP 12-15) that correlates to the range of values measured during the preceding testing activity.

2.7 Measurements Using Hand-held/Portable Instruments

Note: These instruments may be used to obtain bench-top measurements of representative samples that are manually collected during a well pumping test or from a source undergoing testing. Other applications may require direct placement in a fluid discharge stream, or in a well, or in a storage vessel or pond. Some instruments can measure only a single parameter, while multi-sensor probes may be configured to measure several parameters. The In-line system sensors are also capable of being reconfigured for use in sample-based measurement systems.

2.7.1 Combined Water Quality Instruments Configuration
   (YSI Model 30M or equivalent for Specific Conductance and Temperature)
   (YSI Model 60 or equivalent for pH and Temperature)
   (GLI Specific Conductance and pH probe/analyzer sets)
   (Ertco-Eutechnics Model 4400 Digital Thermometer or equivalent—if Certified Temperatures are required)

2.7.1.1 If recording QA-data, verify the calibration of the system components.
   2.7.1.1.1 Ensure that the Specific Conductance (SC) and pH sensors have been calibrated (refer to SP 12-15) – these are typically calibrated at-time-of-use instruments.
   2.7.1.1.2 If applicable, verify that the temperature probe and readout are within their current certification interval.
2.7.1.2 Check and replace batteries as required (refer to Operator’s Manuals):
   2.7.1.2.1 If the YSI Conductance or pH meter displays “LO BAT”.
   2.7.1.2.2 If the Ertco display includes a flashing battery symbol.

2.7.1.3 Perform an operational check of the Conductivity, pH, and Temperature sensors by verifying that they are outputting values that are within normal bounds:
   
   Specific Conductance: 0 – 200,000 µS (or 200 mS)
   pH: 4 – 12 pH
   Temperature: 0 - 50°C

2.7.1.3.1 Incorrect unit settings or measurement modes may be changed by accessing the device’s settings (refer to Operations Manuals or Instructions as needed).

2.7.1.3.2 If using the YSI Conductance meter, the °C symbol (small numbers) must be flashing and either µS or mS must follow the large numbers. If necessary use the Mode button to change to this setting.

2.7.1.3.3 To toggle the Ertco’s display between °F and °C, press and hold the lower half of the rocker switch for approximately 4 seconds.

2.7.1.4 If not specified in the test plan or the project’s scientific notebook, confer with the PI, or designee for direction on required devices/measurements and frequency of data collection, and note this information in the project’s scientific notebook.

2.7.1.5 Obtain a representative sample from the plumbing system being used for well pumping/purging test or from the source undergoing testing. Typically, the sample will be collected from the sampling port on the water quality manifold, or from the flowline discharge hose.
   2.7.1.5.1 Select a clear, stable, open-topped sampling container of sufficient size to allow emplacement of the instrument:
      - A 150-mL beaker is adequate for the YSI Conductance, and Ertco measurement probes.
      - The YSI pH meter will require a 6-inch high (minimum) container, to permit immersion of both the pH and temperature sensors. The 100-mL graduated cylinder provided by YSI may be used, or an equivalent container.
      - A 200-mL wide-mouth container is adequate for GLI pH and SC sensors.
      - If a specific gravity measurement using a hydrometer is also required, a 500-mL ungraduated cylinder may be used for all the measurements (see last section).
   2.7.1.5.2 Open the sampling line and allow it to run for several seconds (depending on flow-rate) to purge it of air, and to provide a fresh batch of fluid.
   2.7.1.5.3 To ensure that the sampling container does not contain residue from previous sample, rinse the container with the fluid to be sampled.
   2.7.1.5.4 Ensure that the starting time of the sample collection is recorded in the project’s scientific notebook.
   2.7.1.5.5 Dispense sufficient fluid into the container to ensure immersion of all sensors in the sample.

2.7.1.6 Measure the required water quality parameters.
   2.7.1.6.1 Measurements should be taken as soon as possible (ideally within several minutes of grabbing the sample). Some samples may require settling time for sediment to precipitate or for the fluid to finish off-gassing.
2.7.1.6.2 Emplace the instrument electrodes in the sample container and move the measurement probes around in the sample to make sure that the sample remains homogenous.

2.7.1.6.3 Do not permit the instrument probes to rest against the side or bottom of the sample container, and ensure that any air bubbles are dislodged from the probe openings.

2.7.1.6.4 Wait for the readings to stabilize prior to recording values.

2.7.1.6.5 Record the selected WQ parameters in the project’s scientific notebook.

2.7.1.6.6 Record the make, model, serial number, and calibration due date (if applicable) of the instruments used to obtain these measurements in the project’s scientific notebook.

2.7.1.7 If additional measurements are required, prepare the instruments for their next set of measurements.

2.7.1.7.1 Allowing the pH and Conductance probes to “soak” in the previously obtained sample is preferred, as this will stabilize the sensors near their measurement points (will decrease dwell time for subsequent readings).

2.7.1.7.2 After obtaining the next sample, remove the probes from their conditioning sample, and either:
   a) Rinse with fluid being sampled before emplacement (preferred), or
   b) Rinse with deionized water and dry the probe assembly before emplacement.

2.7.1.7.3 Repeat the measurement steps outlined in the previous sequence.

2.7.1.7.4 If the instruments are being used on a daily basis and if practical, optional single-point calibration checks (refer to SP 12-15) may be performed before initiating the day’s measurements. Record any calibration check information in the project’s scientific notebook or scientific notebook supplement.

2.7.1.7.5 If the calibration check reveals that the instrument(s) requires an adjustment and recalibration (refer to SP 12-15), a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in the instrument’s performance as described in SP 12-15.

**Note:** Some Pumping Tests may run continuously for up to 30 days. Purging and Sampling of Low-Flow wells may require repeating several pumping cycles, resulting in longer durations.

2.7.1.8 When the pumping test or sampling event is complete, discontinue recording of data and ensure that the ending time of the sampling/pumping event is recorded in the project’s scientific notebook.

2.7.1.9 After the equipment is returned from the field and as soon as practical, perform an As-found calibration check (refer to SP 12-15) that correlates to the range of values measured during the preceding testing activity.

2.7.2 Multiparameter Water Quality Instruments

*YSI Pro Plus Multiparameter Sonde for pH, Specific Conductance, Temperature, DO and ORP.*

*EXO 1 Multiparameter Sonde for Depth-Level, pH, Specific Conductance, Temperature, DO and ORP.*

*(Ertco-Eutechnics Model 4400 Digital Thermometer or equivalent—if Certified Temperatures are required)*
2.7.2.1 If recording QA-data, verify the calibration of the necessary system components (all sensors may not be required).

2.7.2.1.1 If required, ensure that the Specific Conductance (SC) pH, Oxidizing Reduction Potential (ORP) and Dissolved Oxygen (DO) sensors have been calibrated (refer to SP 12-38) – these are typically calibrated at-time-of-use instruments.

2.7.2.1.2 The multi-parameter instruments are equipped with uncertified (non-QA) thermometers to monitor fluid temperature. Use a certified thermometer, if QA-type measurements are required.

2.7.2.1.3 The YSI Pro Plus is recommended for grab-sampling, where a single sample is measured and the readings recorded in a scientific notebook. The EXO 1 Sonde is recommended for continuous monitoring in-situ or where a flow cell is utilized to record continuous water quality parameter measurements over a period of time. Refer to the instruments owner’s manual for detailed instructions on using the flow cells.

2.7.2.2 Check and replace batteries as required (refer to Operator’s Manuals):

2.7.2.2.1 If the YSI Pro Plus Sonde or EXO1 Sonde Battery power icon displays less than 2 bars.

2.7.2.3 YSI Pro Plus Operation (Refer to Owner’s Manual for more Detailed Setup and Operation)

2.7.2.3.1 Communication with the instrument probes is performed through a menu-based interface. Press the “hot keys” to access the System, Sensors, Calibration, and File menus (from left to right at the top of the keypad). To navigate through the menus, use the up and down arrow keys to highlight a desired menu option with a highlight bar, and press the Enter key to activate the selection. Use the left arrow keys to go back one screen. Press the Esc key to return to the run screen or to exit an alpha/numeric entry screen. The Pro Plus will automatically power on to Run screen.

2.7.2.4 Setting the Date and Time

2.7.2.4.1 Press the System key.

2.7.2.4.2 Highlight Date/Time and press Enter.

2.7.2.4.3 Highlight Date Format and press Enter. Highlight the correct format and press Enter.

2.7.2.4.4 Highlight Date and press Enter. Use the keypad to enter the correct date, then highlight Enter on the display keypad, and press Enter.

2.7.2.4.5 Highlight Time and press Enter. Use the keypad to enter the correct time, then highlight Enter on the display keypad, and press Enter.

2.7.2.4.6 Press Esc to return to the Run screen.

2.7.2.5 Setting up Sensors & Reporting Units

Notes:

1. A Sensor must be enabled in the Sensor menu before it can operate.
2. Once a sensor is enabled, the desired units for that sensor must be selected in the Display menu to determine what will be displayed.
3. A sensor must be installed in port 1, before port 2 will operate correctly.
4. However, if a pH/ORP combo sensor is installed into port 1 or port 2, measurement of ORP is not available.
5. Install the Dissolved Oxygen sensor in the port labeled DO.
6. Install the Conductivity/Temperature sensor in the port labeled CT following the instructions included with the sensor.

2.7.2.5.1 Press the Sensor key.
2.7.2.5.2 Highlight Setup and press Enter. Highlight the parameter of interest and press enter. Highlight Enabled and press enter to ensure a checkmark in the box. When enabling the ISE1 and ISE2 ports, you must select the correct sensor after enabling the port.
2.7.2.5.3 When Dissolved Oxygen is enabled, a submenu allows the user to select the sensor type (Polarographic or Galvanic) and membrane type being used. Highlight Sensor Type or Membrane and press Enter to modify these settings.
2.7.2.5.4 Press the left arrow key to return to the previous screen or press Esc to return to the Run screen.

**Note:** After changes to the Sensor menu have been completed, determine which units will be reported (i.e. %, mg/L, °C, °F, etc.).

2.7.2.5.5 Select the Sensor hot key on the keypad, highlight Display, and press Enter.
2.7.2.5.6 Highlight the parameter you want to access and press Enter.
2.7.2.5.7 A submenu will open allowing selection of the reporting units. Some parameters can be reported in multiple units. For example, DO can be reported in DO%, DO mg/L, and DO ppm. If necessary, consult with the PI or designee to ensure the desired parameter units are selected. Other parameters, for example temperature, can only be reported in one unit. Make selections from the submenu, and then press the left arrow key to return to the Display menu or press Esc to return to the Run screen.

2.7.2.6 If not specified in the test plan or the project’s scientific notebook, confer with the PI, or designee for direction on required devices/measurements and frequency of data collection, and note this information in the project’s scientific notebook.

2.7.2.7 Obtain a representative sample from the plumbing system being used for well pumping/purging test, from the source undergoing testing, or in the case of passive sampling, from the bailer or Snap Sampler (refer to SP 12-36). For pumping/purging tests the sample will typically be collected from the sampling port on the water quality manifold.
2.7.2.7.1 The Pro Plus comes equipped with a screw on sample jar which allows for the emplacement of the instrument in the sample.
2.7.2.7.2 Open the sampling line and allow it to run for several seconds (depending on flow-rate) to purge it of air, and to provide a fresh batch of water. When taking the sample from a bailer or using a Snap Sampler, transfer the sample to the sample jar when the water sample arrives at the surface.
2.7.2.7.3 To ensure that the sampling container does not contain residue from previous sample, rinse the container with the fluid to be sampled.
2.7.2.7.4 Ensure that the starting time of the sample collection is recorded in the project’s scientific notebook.
2.7.2.7.5 Dispense sufficient fluid into the container to ensure immersion of all sensors in the sample. The water level should at least come up to the temperature sensor at the top of the conductance probe (small hole at the top of the sensor).
2.7.2.8 Measure the required water quality parameters.

2.7.2.8.1 Measurements shall be taken as soon as possible (ideally within several minutes of grabbing the sample).

2.7.2.8.2 Emplace the instrument electrodes in the sample container and move the measurement probes around in the sample to make sure that the sample remains homogenous.

2.7.2.8.3 Do not permit the instrument probes to rest against the side or bottom of the sample container, and ensure that any air bubbles are dislodged from the probe openings.

2.7.2.8.4 Wait for the readings to stabilize prior to recording.

2.7.2.8.5 Record the selected WQ parameters in the project’s scientific notebook.

2.7.2.8.6 Record the make, model, serial number, and calibration due date (if applicable) of the instrument in the project’s scientific notebook.

2.7.2.9 If additional measurements are required, prepare the instrument for the next set of measurements.

2.7.2.9.1 Allowing the pH and Conductance probes to “soak” in the previously obtained sample is preferred, as this will stabilize the sensors near their measurement points (will decrease dwell time for subsequent readings).

2.7.2.9.2 After obtaining the next sample, remove the probes from their conditioning sample, and either:
   a) Rinse with fluid being sampled before emplacement (preferred), or
   b) Rinse with deionized water and dry the probe assembly before emplacement.

2.7.2.9.3 Repeat the measurement steps outlined in the previous sequence.

2.7.2.9.4 If the instrument is being used on a daily basis and if practical, repeat single-point calibration checks (refer to SP 12-38) before initiating the day’s measurements. Record any calibration check information in the project’s scientific notebook or scientific notebook supplement.

2.7.2.9.5 If the calibration check reveals that the instrument(s) requires an adjustment and recalibration (refer to SP 12-38), a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in the instrument’s performance as described in SP 12-38.

Note: Some Pumping Tests may run continuously for up to 30 days. Purging and Sampling of Low-Flow wells may require repeating several pumping cycles, resulting in longer durations.

2.7.2.10 When the pumping test or sampling event is complete, discontinue recording of data and ensure that the ending time of the sampling/pumping event is recorded in the project’s scientific notebook.

2.7.2.11 After the equipment is returned from the field and as soon as practical, perform an As-found calibration check (refer to SP 12-38) that correlates to the range of values measured during the preceding testing activity.

2.7.2.12 YSI EXO1 Water Quality Instrument Operation (Refer to Owner’s Manual for more Detailed Setup and Operation)

2.7.2.12.1 EXO sensors have identical connectors and identify themselves via onboard firmware; therefore, users can install any probe into any universal sonde port. Individual ports are physically identified by an engraved number on the sonde bulkhead. Users should clean, lubricate, and dry the sonde and sensors prior to installation or service.
2.7.2.12.2 Insert the sensor into the port by properly aligning the connectors’ pins and sleeves (male and female contacts); then press them firmly.

2.7.2.12.3 The sensors are fastened to the bulkhead using the locking nut. A probe tool is used to tighten and loosen the locking nut for installing and uninstalling sensors and port plugs.

2.7.2.12.4 The EXO 1 Sonde is activated (awakened) using a magnet tool that the user passes over the identified magnetic activation area on the sonde’s bulkhead. Simply hold the magnet within (1) cm of the symbol, until the LEDs activate.

2.7.2.13 Connecting Sonde to Computer via USB Connection

2.7.2.13.1 The USB signal output adapter (SOA) allows users to connect an EXO sonde over a standard USB connection.

2.7.2.13.2 Prior to use, users must install KOR software and its drivers on the associated PC. The USB-SOA will not work without the drivers that accompany KOR.

2.7.2.13.3 Remove the protective cap from the USB end of the SOA, and ensure that the connector is clean and dry. Insert the small end of the USB cable into the SOA connector and the large end (standard side) into one of the PC’s USB ports.

2.7.2.13.4 Attaching the adapter to the PC causes a new device to be recognized. Windows automatically installs the drivers and creates a new port. Each new adapter that is attached creates a new port.

2.7.2.14 EXO 1 Sonde KOR Software and Sensor Deployment

Note: The Deploy menu is used mainly to configure an EXO sonde to collect unattended data and to manage deployment templates. Two or three submenu options are available from here including, “Read Current Settings,” “Open a Template,” and if connected sonde is logging, a “Stop Deployment button.”

2.7.2.14.1 Selecting the “Read Current Setting” button will pull up menu that scans the attached device and summarizes its current configuration, including battery life, sample count and when the next sample will be taken. The user can view the configuration, edit the configuration, or apply a saved template. Note: If the sonde clock and the computer clock differ, or if time zones differ, then KOR notifies the user. These prompts are informational only and can be disabled as noted on the screen.

2.7.2.14.2 Click the Deploy button to start logging water quality parameters. Several options are available to the user for setting the time at which logging begins:

a) Start Logging Now: For example, a first sample logs at 11:32:31, and with a 15-minute logging interval the next sample will log at 11:47:31.

b) Start Logging at Next Even Interval: For example, a first sample logs at 00:00:00, and with a 15-minute logging interval the next sample will log at 00:15:00, then 00:30:00, 00:45:00, etc. This set-up is typical. Logged data will be uniform.

c) Set a Custom Start Time: Choose the start date and time, which can vary from minutes to days in the future, then click Apply button to prepare the sonde for deployment. Setting a start time in the past causes the sonde to start logging immediately.

2.7.2.14.3 To stop a deployment when the EXO device is actively logging, click the Stop Deployment button. After stopping a deployment, the button disappears and the icon in the upper right changes state to indicate the sonde is not actively logging data.
Note: The EXO 1 Sonde and associated software has many more features for sampling and logging. Refer to the EXO 1 Sonde Owner’s Manual for more detailed instructions.

2.7.2.15 Using EXO 1 Sonde for Grab-Sampling

2.7.2.16 Obtain a representative sample from the plumbing system being used for well pumping/purging test, from the source undergoing testing, or in the case of passive sampling, from the bailer or Snap Sampler (refer to SP-12-36). For pumping/purging tests the sample will typically be collected from the sampling port on the water quality manifold.

2.7.2.16.1 The EXO 1 comes equipped with a screw on sample jar which allows for the emplacement of the instrument in the sample.

2.7.2.16.2 Refer to sections 2.7.2.7.2 through 2.7.2.11 for remaining steps.

2.7.3 Specific Gravity/Temperature Measurements (Hydrometers)

2.7.3.1 If recording QA-data, verify the certification of the hydrometer and thermometer.

2.7.3.2 Perform an operational check of the instruments.

Note: Hydrometers are sealed units that rely on the principles of the displacement of mass to provide specific gravity data and therefore do not require recalibration.

2.7.3.2.1 Inspect the hydrometer for damage (fractures in the glass, etc.) and remove any instruments from service that are broken or damaged.

2.7.3.2.2 The Ertco thermometer’s unit settings may be changed from °F to °C by pressing and holding the lower half of the rocker switch for approximately 4 seconds (refer to Operations Manual as needed).

2.7.3.2.3 Verify that the Ertco thermometer is outputting values that are within normal bounds (0 - 50° C)

2.7.3.3 If not specified in the test plan or the project’s scientific notebook, confer with the PI, or designee for direction on required devices/measurements, frequency of data collection, whether temperature corrected specific gravity readings are required, and note any new information in the project’s scientific notebook.

2.7.3.4 Obtain a representative sample from the plumbing system being used for well pumping/purging test or from the source undergoing testing. Typically, the sample will be collected from the sampling port on the water quality manifold.

2.7.3.4.1 Select a clear, stable, open-topped sampling container of sufficient size that will allow the hydrometer to float completely free, while not touching the bottom of the container. A 500-mL ungraduated cylinder (glass is preferred) is an adequate container.

2.7.3.4.2 Open the sampling line and allow it to run for several seconds (depending on flow-rate) to purge it of air, and to provide a fresh batch of fluid.

2.7.3.4.3 To ensure that the sampling container does not contain residue from previous sample, rinse the container with the fluid to be sampled.

2.7.3.4.4 Ensure that the starting time of the sample collection is recorded in the project’s scientific notebook.

2.7.3.4.5 Dispense sufficient fluid into the container to ensure full displacement of the hydrometer within the sample.
2.7.3.5 Measure the specific gravity and temperature of the fluid.

**Note:** Specific gravity readings are influenced by temperature. Try to minimize the effect of extreme field conditions (direct sunlight, wind, hot or cold ambient temperatures, etc) by selecting a sheltered area for the measurement station, and expedite completion of the measurements.

2.7.3.5.1 Measurements shall be taken as soon as possible (ideally within several minutes of grabbing the sample). However, samples containing suspended solids or entrained air/gas may require additional settling time.

2.7.3.5.2 Since hydrometers come in a variety of ranges, if the range of the fluid to be tested is unknown, use a broad range hydrometer to narrow the range.

2.7.3.5.3 Place the hydrometer in the fluid, stir the sample and ensure that any air bubbles are dislodged from hydrometer.

2.7.3.5.4 Allow the hydrometer to float freely and to come to rest.

2.7.3.5.5 Sight through the clear cylinder and read the hydrometer following the method outlined in 27 CFR, Chapter 1, Section 30.23:

“In reading the hydrometer, a sighting should be made slightly below the plane of the surface of the liquid and the line of sight should then be raised slowly, being kept perpendicular to the hydrometer stem, until the appearance of the surface changes from an ellipse to a straight line. The point where this line intersects the hydrometer scale is the correct reading of the hydrometer.”

2.7.3.5.6 Remove the hydrometer and emplace the thermometer in the sample container. Move the measurement probe around in the sample to make sure that the sample remains homogenous.

2.7.3.5.7 Do not permit the instrument probe to rest against the side or bottom of the sample container.

2.7.3.5.8 Wait for the readings to stabilize prior to recording.

2.7.3.5.9 Record the selected WQ parameters in the project’s scientific notebook.

2.7.3.5.10 Record the make, model, serial number, and calibration due date (if applicable) of the instruments used to obtain these measurements in the project’s scientific notebook.

2.7.3.5.11 Rinse the hydrometer and thermometer with deionized water, dry, and return them to their storage cases.

2.7.3.5.12 If required, use the following spreadsheet or equivalent method to calculate the corrected specific gravity based on the temperature of the sample and the raw specific gravity value.

<table>
<thead>
<tr>
<th>Specific Gravity Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter Temperature (C2)</td>
</tr>
<tr>
<td>Enter Hydrometer SG Reading (C4)</td>
</tr>
<tr>
<td>Corrected Specific Gravity= =(((0.22624*C2)-3.81115)<em>C4)+((-0.01728</em>C2)+0.33731)*0.001)+C4</td>
</tr>
</tbody>
</table>

**Note:**
Correction for Specific Gravity based on regression of correction table provided by Pfeiffer Glass, Manufacturer for Fisher Scientific Hydrometers. Correction is for Hydrometers calibrated at 60 degrees F.
Note: Some Pumping Tests may run continuously for up to 30 days. Purging and Sampling of Low-Flow wells may require repeating several pumping cycles, resulting in longer durations.

2.7.3.6 When the pumping test or sampling event is complete discontinue recording of data and ensure that the ending time of the sampling/pumping event is recorded in the project’s scientific notebook.

2.8 References

- Users Manual, Professional Plus Multi-Parameter Instrument, YSI Incorporated, Rev D.
- Users Manual, EXO 1 Multi-Parameter Instrument, YSI Incorporated, Rev D.
- 27 CFR Chapter 1, Section 30.23, Use of precision hydrometers and thermometers, 4-1-05 Edition.

3.0 Records

The following records generated through implementation of this procedure shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1 "Records".

QA Record

- Scientific Notebook(s)

4.0 Appendices

Not Applicable
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