Groundwater-Level Data Processing, Review, and Validation

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REVISION HISTORY

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SOP-5230,R0	3/4/2009	New	New procedure, supersedes RRES-WQH-QP-062.1 T/E
ER-SOP-20231,R0	4/16/15	New	Updated procedure to new template and given new document number to reflect organizational changes. Major Revision to improve clarity and accuracy. T/E Supersedes SOP-5230.

CONTENTS

1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) describes the process for the review and validation of groundwater-level data obtained from pressure transducers at the Los Alamos National Laboratory (LANL) for the Environmental Remediation Program (ER)This procedure applies to all ADEP personnel, students, and contract personnel who work with groundwater-level data obtained from pressure transducers.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

To address the requirements of the New Mexico Environment Department (NMED) Compliance Order on Consent, groundwater levels in most monitoring wells are monitored using automated pressure transducers. To ensure the accuracy and competency of the data, groundwater-level data obtained from pressure transducers must be reviewed and validated before loading data into the Environmental Information Management (EIM) Database. This SOP addresses the review and validation of groundwater level data from the transducers.

2.2 Precautions

None.

3.0 EQUIPMENT AND TOOLS

No equipment or tools are needed.

4.0 REFERENCES

- SOP-5223, Manual Groundwater Level Measurements
- EP-DIV-SOP-10010, Pressure Transducer Installation, Removal, and Maintenance
- SOP-5225, Groundwater Sampling Using Westbay System
- SOP-5226, Westbay Pressure Transducer Installation, Removal, and Maintenance, Transducer Data Retrieval
- EP-DIR-AP-10003, Records Transmittal and Retrieval Process

5.0 DEFINITIONS AND ACRONYMS

5.1 Definitions

Absolute pressure – The total or absolute pressure measured by a sensor without correction for atmospheric pressure. A pressure measurement that includes atmospheric pressure is an absolute pressure. Units are expressed in psia (pounds per square inch absolute).

Calculated data files – Groundwater-level data files that result from calculation of the raw data files into groundwater elevation data using the proprietary software provided by the transducer manufacturer.

Calculated data files can be comma separated value (csv) text files (or similarly separated values, such as tab or space separated), spreadsheet files, database files, etc.

Gage pressure – The pressure measured relative to atmospheric pressure. Measurements exclude atmospheric pressure and are said to be compensated or gaged for atmospheric pressure. A vented or gage pressure transducer sensor uses a vent tube in the cable that exposes one side of the pressure sensor to atmospheric pressure, measuring pressure of the water column only. Units are expressed in psig (pounds per square inch gage).

Ground elevation – The elevation of the ground surface of the well expressed in feet above mean sea level. If the well has a concrete surface pad, ground elevation is usually the elevation of the top of the concrete pad. If a brass cap is present to identify a well, ground elevation is usually the elevation of the brass cap in the concrete pad.

Pressure head – The height in feet of a column of water measured by a transducer at a point in a well.

Pressure transducer (transducer) – A device that measures pressure. The two types of pressure transducers are those that measure absolute pressure and those that measure gage pressure.

Piezometric elevation – The elevation to which water rises in a well in a confined aquifer.

Water-table elevation – The groundwater-level elevation (pressure head) in unconfined portions of an aquifer. The top of the aquifer is defined by a water-table surface.

P_i – Pressure measured inside the Westbay casing usually at a specific measurement port. P_i measured above the deionized water column in the Westbay casing is equal to atmospheric pressure at a given port elevation; calculated pressure head will approximate the elevation of the port. P_i measured below the deionized water level inside the Westbay casing will be the pressure head of the deionized water column; calculated pressure head will be the height of the deionized water (DI) water column above the port.

P_o – Pressure measured of the formation outside the Westbay casing at a specific monitoring port. P_o of "dry" monitoring ports will approximate P_i at that port if the port is above the DI column. P_o of "wet" monitoring ports should not normally equal the P_i of the port. Calculated pressure head represents the groundwater level at this location of the monitoring port.

Pounds per square inch (psi) – Unit of pressure measurement.

Pounds per square inch absolute (psia) – Unit of pressure measurement, see absolute pressure.

Pounds per square inch gage (psig) – Unit of pressure measurement, see gage pressure.

Raw data files – Electronic pressure transducer data files that are obtained from pressure transducers or data loggers at a well site. Raw data files are often binary computer files that can be opened, read, and interpreted only by software developed by the manufacturer of the transducer. The raw data files must be stored and archived appropriately in order to secure the original data from the pressure transducer. Raw data files contain the raw pressure measurements and date/time stamp from the transducer and may

also contain information entered into the transducer software program at the time of installation, such as well name, date/time, measurement interval, reference water elevation at the time of installation, etc.

Reference level – The elevation of the surface of the water in a well at the time of installation of the transducer; determined by manual measurement of the groundwater elevation according to SOP-5223, *Manual Groundwater Level Measurements*.

Water elevation – The elevation of the level of the groundwater in a well, expressed in feet above mean sea level.

Water level – (1) Depth to water (DTW) in a well below ground elevation expressed in feet, or (2) the water elevation expressed in feet above mean sea level. Refer to SOP-5223, *Manual Groundwater Level Measurements* for information about measuring groundwater level in a well.

5.2 Acronyms

DI	deionized water
EIM	Environmental Information Management
ft	feet
ft amsl	feet above mean sea level
LANL	Los Alamos National Laboratory
psi	pounds per square inch
SOP	standard operating procedure

6.0 STEP-BY-STEP PROCESS DESCRIPTION

6.1 Temperature-Corrected Water-Density Values

Field Team Member

1. *NOTE: Some transducer manufacturer software programs, such as recent versions of the Win-Situ and Data Manager programs by In-Situ, Inc., allow user input of water density values. Water density is dependent on the quantity of dissolved minerals or contaminants and temperature (In-Situ, Inc, 2000). The density of water containing relatively few dissolved minerals or contaminants, such as most groundwater at Los Alamos, is primarily dependent on temperature.*

   USE the correct density value of water during processing of the raw transducer data to reduce the amount of error introduced by the calculation process.

Field Team Member, cont.

2. **USE** the following table to select the appropriate water density values based on the average temperature of the water derived from the transducer measurements. Temperature of the water is typically measured by transducer equipment and is usually available during processing of the raw data files.

Density Values of Pure Water as Function of Temperature

Temp (C)	Density (g/cc)		Temp (C)	Density (g/cc)		Temp (C)	Density (g/cc)
1	0.9999		11	0.9996		21	0.9980
2	0.9999		12	0.9995		22	0.9978
3	1.0000		13	0.9994		23	0.9975
4	1.0000		14	0.9992		24	0.9973
5	1.0000		15	0.9991		25	0.9970
6	0.9999		16	0.9989		26	0.9968
7	0.9999		17	0.9988		27	0.9965
8	0.9998		18	0.9986		28	0.9962
9	0.9998		19	0.9984		29	0.9959
10	0.9997		20	0.9982		30	0.9956

C = Celsius
g/cc = grams/cubic centimeter

Source: In-Situ, Inc. 2000

6.2 Latitude and Elevation Correction Parameters for Water Density

Field Team Member

[1] Using the following parameters as a guide, **INPUT** latitude and elevation values to correct for acceleration in the water-level calculation.

A. The elevation of the groundwater is obtained from manual measurement (see SOP-5223, *Manual Groundwater Level Measurements*). Input the groundwater elevation to the nearest 10 feet as appropriate.

B. Approximate latitude of the Los Alamos area is 36 degrees north.

C. Document parameters used to calculate water-level data in the calculated data file.

6.3 Calculating Water Levels in Westbay Wells

Field Team Member

[1] **SELECT** the fixed value option for atmospheric pressure in the WinGT software to adjust the absolute pressure measurements as a general guideline for calculating water levels in Westbay wells that use absolute pressure measurement transducers.

[2]

CAUTION:

Be certain that the port for the P_i measurement nearest the surface of the saturated zone is above the deionized water inside the Westbay casing. The top of the deionized water column inside the Westbay casing is typically located between the monitoring zone at the top of the regional aquifer and the next lower monitoring zone. Check the Westbay completion report and pressure-head calculations of the deionized water level obtained from the Pi measurements from monitoring zones below the top of the regional aquifer.

USE a fixed atmospheric pressure that is computed at the approximate elevation of the surface of the saturated zone for which the water level calculation is being prepared. The P_i value of monitoring ports located near the top of an intermediate zone or at the top of the regional aquifer will typically measure the atmospheric pressure at the elevation nearest the top of the saturated zones. Use the average Pi value of a port if multiple measurements are available.

Field Team Member, cont.

[3] *NOTE: If P_i values are not available for the surface of the saturated zone, it is possible to calculate atmospheric pressure at a specific elevation: For the standard atmosphere, variation of pressure with elevation is approximately linear in the elevation range 8,202–4,921 feet (ft), which corresponds to 10.83 pounds per square inch (psi) and 12.26 psi, respectively, for a slope of 4.36×10^{-4} psi/ft. The correction for increased pressure is P_{atm} at saturated surface (psi) = P_{atm} at ground surface + [4.36×10^{-4} psi/ft × depth to water (ft)]. Use TA-54 weather station to obtain the atmospheric pressure records (http://environweb.lanl.gov/weathermachine/).*

USE a fixed (rather than fluctuating) atmospheric pressure to prevent introduction of potential error in the resulting water-level data, because atmospheric pressure fluctuates daily and seasonally because of temperature changes in the atmosphere and passing weather fronts.

[4] Depending on the hydrogeologic properties of each zone in the well, the type of atmospheric pressure needed to adjust absolute formation pressure data may be different for different wells and for different zones within a well. To determine how best to adjust for atmospheric pressure, it may be necessary to **CONSTRUCT** overlapping time-series plots of monitoring port pressure data and atmospheric pressure data measured at the well to determine, for example, if an immediate response to atmospheric pressure occurs at each monitoring port. In a shallow well with an unconfined aquifer, it may be appropriate to use the well's own atmospheric pressure measured at ground surface for the adjustment.

[5] The resulting calculated water-level characteristics of each zone will depend on which atmospheric pressure corrections are used. Deeper zones of saturation, such as those in the Los Alamos area, typically do not exhibit immediate responses to atmospheric pressure changes, and therefore it is not appropriate to use the well's own atmospheric pressure to adjust the measured pressure.

[6] If in doubt, **USE** the fixed average atmospheric pressure (P_i) measured at, or calculated for, the surface of each zone of saturation.

6.4 Raw Data File Handling

Field Team Member

[1] **RETRIEVE** raw data files from transducer equipment in accordance with sections in EP-DIV-SOP-10010, *Pressure Transducer Installation, Removal, and Maintenance,* and SOP-5226, *Westbay Pressure Transducer Installation, Removal, and Maintenance, Transducer Data Retrieval*.

Data Validator

[2] ***NOTE**: Data files should not be deleted from the transducer until they are safely stored on the server. The name of raw data files should include port name and the beginning and end dates.*

ENSURE that the raw data files are transferred to the common (shared) ER server for permanent storage and archival.

Data Validator, cont.

[3] **ARCHIVE** processed data files on the ER server.

6.5 Processing Transducer Data

The raw electronic transducer data files are processed to obtain meaningful groundwater-level data. The raw binary pressure data files are converted into useable data format using transducer manufacturer proprietary software. In-Situ, Inc., transducers and data loggers typically create a raw data file with a "wsl" extension. Westbay data loggers create either "WD2" or "WDF" raw data files.

6.6 Processing Data from In-Situ, Inc., Data Files

Data Validator

Compare information in the data file with information recorded during installation or removal of the transducer by field personnel by performing the following steps.

[1] **OPEN** the data file using WinSitu. The data file will have a .WSL filename extension.

[2] **VERIFY** that the data file name represents data for the correct well. If necessary, change the data file name to reflect the well name. Verification of location can be done by checking serial numbers, field records, dates, and elevation of groundwater.

[3] **CHECK** that beginning and ending dates and times are in Mountain Standard Time (MST) without daylight saving correction and that the transducer serial number and other information in the data file header correspond with field records.

[4] **VERIFY** the water density used during set up from the table in Section 6.1.2, Temperature Corrected Water Density Values.

[5] **VERIFY** transducer was set to record in either surface elevation mode, using a reference level in feet of elevation above sea level, or depth mode, using a depth-to-water measurement in feet. Inappropriate selections of mode and reference level can create an inverse data curve.

[6] ***NOTE**: If a manual water level was not obtained at the beginning of a data file, use the most recent water elevation calculated from an immediately preceding transducer dataset. This method can be used if the elapsed time between the end of the previous dataset and the beginning of the next transducer dataset is less than 2 hours and the water level change is less than 0.1 foot. Ideally a corresponding manual water measurement should be collected for each data set.*

DETERMINE that the reference water elevation in the data file corresponds with the manual water elevation obtained when the transducer was installed.

Data Validator, cont.

[7] **VERIFY** that the beginning pressure head recorded by the transducer corresponds with the pressure head recorded when the transducer was installed. Make corrections to initial reference settings as appropriate to create a valid dataset.

[8] If the transducer was set to record in a method other than groundwater elevation, **CALCULATE** groundwater elevation using the appropriate parameters. Compensation for atmospheric pressure is not necessary for the gage transducers used at LANL. Compensation for atmospheric pressure may be necessary for the absolute transducers used at LANL.

[9] **TRANSFER** transducer water-level data to text file or spreadsheet format for further data review and validation.

6.7 Processing and Validating Data from Westbay Transducers

Field Team Member

Compare information in the data file with information recorded during installation of the transducer on the MOSDAX Probe String Installation/Retrieval Field Form (EP-DIV-SOP-10010, Attachment 3) by performing the following steps.

[1] **OPEN** the data file using WinGT or MLOG (Convert Utility) software programs. Data file will have a .WD2 or .WDF file name extension.

[2] **VERIFY** that the time zone value is set to –7.00 hours with respect to Coordinated Universal Time when prompted by the software.

[3] **VERIFY** that beginning and ending dates and times, transducer serial numbers, and other information in the data file header correspond with field data recorded on the Probe String Installation/Retrieval Field Record (EP-DIV-SOP-10010, Attachment 3) or the field data recorded on the Westbay Groundwater Sampling Field Data Sheet (SOP-5225, *Groundwater Sampling using Westbay® System*, Attachment 4).

[4] **VERIFY** that correct well zone information, port name, port depth, and probe numbers coincide with those for the appropriate well, as published in the well completion report.

[5] **VERIFY** that the correct ground elevation of the well (brass cap elevation) has been entered into the data file header.

[6] **REVIEW** the P_i and P_o pressure data from the Westbay Probe String Installation Data Form (EP-DIV-SOP-10010, Attachment 3) or the Westbay Groundwater Sampling Field Data Sheet (SOP-5225, Attachment 4) for each port, and **CHECK** that measured pressure data are consistent with previous measurements.

[7] **DETERMINE** that each probe was properly attached to the appropriate port by checking that P_o values are similar to previous Po values for each port.

Field Team Member, cont.

[8] If P_o values are not similar to previous measurements, **DETERMINE** if measured P_o values are consistent with the following:

A. previous P_i values (if the probe did not properly connect to the monitoring port), or

B. atmospheric pressures at the elevation of the port (for monitoring ports above the level of the deionized water in the Westbay casing), or

C. equivalent to surface atmospheric pressure (response for probes not installed in the well).

[9] Review time series of the pressure data to check for possible sensor drift with time or cyclical, spiking, or fading response that may indicate transducer or transducer power supply failure.

[10 *NOTE: Use this option only if assured that a WDF or WD2 data file is appropriate for a given well, which will save time in entering correct well information, port depths, zone intervals, etc., and allows the transducer data to be merged with pre-existing data for a specific well.*

IMPORT data file to WinGT data file (.WGT extension file) by either:

Importing the data file into an existing WinGT data file (.WGT extension file) that has previously been created for that well.

OR

Manually enter or import Po and Pi data from groundwater sampling events (WDF or WD2 data file) into a WinGT data file (.WGT extension file) that has been created for that well.

[11] ***NOTE****: As a general guideline for calculating water levels in Westbay wells that use absolute pressure measurement transducers, select the fixed value option for atmospheric pressure in the WinGT software to adjust the absolute pressure measurements. Refer to Attachment 2, Westbay Well Screen Atmospheric Pressure Chart.*

SELECT the atmospheric pressure source to use to adjust the absolute formation pressure data. The WinGT software provides three choices for selecting atmospheric pressure data:

A. the well's own atmospheric pressure measurements obtained concomitantly with the monitoring port pressure data,
B. atmospheric pressure data from another nearby well, and
C. a fixed value for atmospheric pressure.

Field Team Member, cont.

[12] ***NOTE**: If the header file contains 0.00 for the elevation of the well, the software will calculate depth to the pressure head of the water based on the depth of each monitoring port. If the header file contains the appropriate ground elevation of the well in feet above mean sea level (ft amsl), the software will calculate groundwater elevation in ft amsl for each monitoring port.*

CALCULATE the water elevation for each monitoring port using the WinGT software.

[13] **TRANSFER** groundwater elevation data to spreadsheet file format for further review and validation.

6.8 Transducer Data Review and Validation

Data Reviewer/ Validator

[1] Groundwater-level data shall be reviewed for completeness and appropriateness and validated on a routine basis as the data are collected for each well. A determination as to the acceptance or rejection of the data shall be provided by the designated data reviewer.

[2] **ASSIGN** data quality codes and data quality descriptions from the following table to identify valid and invalid data.

Data Quality Code	Data Quality Description	Comment
I	Invalid data	
IQ	Invalid data with some validity question	
V	Valid data	Null entry implies valid data
VQ	Data are considered valid with some validity question	
VR	Data are considered valid but with reduced measurement accuracy	Accuracy of measurement is less than optimal
VRVQ	Reduced measurement accuracy with validity question	Combination of VR and VQ

Data Reviewer/ Validator, cont.

[3] **ASSIGN** data validation reason codes and reason descriptions from the following table to explain why the data have been determined to be VQ, VR, I, or IQ.

Reason Code	**Reason Code Description**	**Comment**
BT	Water level is below transducer, data are not valid	
C	Composite water level	Composite water level measured in multiple screen well
D	Port/zone is dry, pressure data not valid	
DI	Data values interpolated using manual measurement values	Transducer drift prompted interpolation of data
DN	Port/zone is nearly dry (e.g., with 0.5 ft of port)	Transducer data may be unreliable
E	Equipment malfunction	
KP	Transducer data calculated from known point location of transducer	
M	Motor arm/shoe report inconsistent	Westbay transducers
MA	Measurement tool or method. Accuracy not optimal	Accuracy of the measurement not as good as possible.
MMNA	Manual measurement not available	
NC	Nonconforming water-level data for zone	
P_i	Pressure data is P_i, not P_o	Westbay transducers
RL	Manual measurement for reference level not documented or in question	Manual measurement not well documented
RW	Transducer removed from well, pressure data are not valid	Pressure data are atmospheric
WC	Well construction makes pressure data questionable	Well construction may not provide reliable pressure data
WS	Water level measures in sump	Water in sump not indicative of formation water level

Data Reviewer/ Validator, cont.

[4] **ASSIGN** water-level type codes from the table below to describe the type of water level data that are available for data review and validation, and for population in the Water Level Database.

Water Level Type Code	Water Level Type Code Description	Comments
DR	Water level derived from raw pressure data	
DI	Interpolated water level data	Data recovered from drifting transducer
DV	Single daily water level value	Daily value selected from multiple measurements
MD	Mean daily water level	Calculated mean daily value from multiple measurements

[5] Suggested steps for performing data review and validation of transducer groundwater-level data are provided in the following steps; however, data review and validation personnel must **REVIEW** and **EVALUATE** the data for each well on an individual basis because not all potential problems with data can be addressed in a procedure.

[6] **OPEN** the QA spreadsheet for the well to be reviewed.

[7] **PLOT** the time series of the groundwater elevation (hydrograph) and, if available, the time series of the atmospheric pressure data.

[8] **REVIEW** and **ASSESS** trends observed in water-level data on daily, seasonal, and yearly scales using the following guidance. Focus on unusual spikes or cyclical trends that may indicate equipment problems.

A. Rising water levels may cause over-pressurization of the transducer; look for reduced sensitivity or flat data responses.
B. Falling or highly fluctuating water levels may drop below the level of the transducer or below the well screen or port; look for uncharacteristic water-level responses, and check if the response is possibly the result of a groundwater sampling event, nearby well pumping, etc.

Malfunctioning transducers may record normal-looking data that have no relation to the water level. **REVIEW** water-level data for changes in character over time.

Data Reviewer/ Validator, cont. [9] **DOCUMENT** the following information on the Transducer Data Review and Validation Form (Attachment 1)

1. Well name
2. Reviewer name
3. Date of data review
4. Transducer manufacturer, serial number, and transducer pressure rating
5. File name of the raw data file and the calculated data file
6. Start and end time of the transducer data
7. Data collection rate in minutes
8. Data review comments
9. Stat if data are valid or invalid
10. Reason for invalidating data (data quality code and validation reason code)

6.9 Reviewing the Hydrograph for Single Completion Wells

Data Reviewer/ Validator [1] **DETERMINE** if beginning and ending water levels correspond with manually measured water levels obtained before the transducer was installed and at the time of transducer data retrieval.

When considering what is an acceptable difference, guidance should be the uncertainty of the measurement system. Measurement uncertainty has been determined to be +/- 0.05 for a 15 psi transducer, +/- 0.09 for a 30 psi transducer, and +/- 0.268 for a 100 psi transducer. These uncertainties include imported uncertainties from manual measurements used for reference levels. Best professional judgment must be used to determine the validity of the data. Some wells have rapidly changing water levels, the time difference between the measurement and the recorded transducer data points must be considered when determining accuracy.

- If beginning transducer water level is different from the manual water level obtained at the time of transducer installation, determine the source of the difference. Some normal water level change could have occurred between the time of the manual measurement and the beginning of transducer measurements, especially if transducer measurements began over several hours after the manual measurement.
- Check that the correct reference elevation was used during transducer installation and for water-level calculations, revise and recalculate the groundwater-level data, if necessary.

Data Reviewer/ Validator [2] **CHECK** the beginning of transducer water-level data for signs of cable stretch or slippage. Identify suspect data.

A. If ending transducer water level does not coincide with the manual water level obtained at the end of the data series, check calculations to determine the source of the error.

B. If beginning transducer water level coincides with the manual water level obtained at the time of installation, but the ending transducer water level does not coincide with the manual water level obtained at the end of the data series, transducer sensor drift may have occurred, the cable may have slipped, transducer battery voltage may have declined causing erroneous measurements, or the manual measurement may contain an error. If deadlines for data submittal allow, consider collecting another manual measurement or waiting for the subsequent download to compare hydrographs. Consider correcting transducer data to align with manual measurements.

C. If transducer water-level measurements do not coincide with the manual measurements, and data cannot be corrected, invalidate the transducer data, and have the transducer checked and calibrated according to EP-DIV-SOP-10010 or replaced.

6.10 Reviewing the Hydrograph for Multiple Completion Wells

Data Reviewer/ Validator [1] **COMPARE** the hydrograph screen as described in section 6.9.

[2] ***NOTE****: Watch for anomalies in multiple completion wells that may indicate loss of packer pressure. If any type of packer failure is suspected, immediately inform the groundwater program task leader.*

PLOT data for all screens on a hydrograph, and review the data for inconsistencies or irregularities. Many multi-completion wells will exhibit the same fluctuations based on nearby pumping or weather events.

[3] ***Note:*** *Especially perched zones or watertable zones that may be reported dry during sampling events. Continuous absolute pressure data from these zones may erroneously indicate a water level fluctuating in response to atmospheric pressure.*

If calculated water elevation is within 0.5 ft of the elevation of the monitoring port or the bottom of the screen, **CHECK** if sample events have reported the zone dry; **REJECT** erroneous data, and **REPORT** the zone dry if appropriate.

[4] For Westbay completion wells, **CHECK** zones where P_i is similar to P_o.

[5] **ENSURE** that the transducer was properly attached to the port and was recording appropriate data.

[6] **EVALUATE** P_i data of zones below the deionized water level in the Westbay casing by calculating the water level and plotting the hydrograph of the P_i water level. Note and document any significant water-level changes, and investigate unusual circumstances.

If water level changes occur, **CHECK** field notes of transducer installation and retrieval and groundwater sampling events to determine the source of the water-level change.

[7] **REVIEW** and **ASSESS** trends observed in water-level data on daily, seasonal, and yearly scales using the following guidance. Focus on unusual spikes or cyclical trends that may indicate equipment problems.

A. Rising water levels may cause over-pressurization of the transducer; look for reduced sensitivity or flat data responses.
B. Falling or highly fluctuating water levels may drop below the level of the transducer or below the well screen or port; look for uncharacteristic water-level responses, and check if the response is possibly the result of a groundwater sampling event, nearby well pumping, etc.
C. Malfunctioning transducers may record normal-looking data that have no relation to the water level. Review water-level data for changes in character over time
D. Malfunctioning in packers separating the screen of multiple completion wells may cause the pressure heads in the screens to be similar. Check the pressure records for the packers. Review water-level data for changes in character over time.

[8] **REJECT** water-level data determined to be erroneous, atypical, or non-conformable. Several years of data may need to be collected before a dataset can be properly evaluated using these parameters.

[9] **DOCUMENT** all primary and subsequent reviews of data on the Transducer Data Review and Validation Form (Attachment 1).

[10] **VALIDATE** groundwater-level data that meet the criteria of the review process.

[11] **DOCUMENT** the data review and validation process on the Groundwater-Level Data Review and Validation Worksheet (Attachment 1).

6.11 Records Management

All

[1] **MAINTAIN** and **SUBMIT** the following records and/or documents generated to the Records Processing Facility according to EP-DIR-AP-10003, *Records Management Procedure for ADEP Employees.*

A. Transducer Data Review and Validation Form (Attachment 1),
B. raw data files, and
C. calculated data files.

7.0 ATTACHMENTS

Attachment 1 Groundwater-Level Data Review and Validation Form
Attachment 2 Westbay Well Screen Atmospheric Pressure Chart

Attachment 1 Groundwater-Level Data Review and Validation Form

Los Alamos National Laboratory
ADEP/LWSP
Transducer Data Review and Validation Form

Well Name: Data Reviewer:

	Transducer				Data Review						Data Validation	
Date of Review	Manu-facturer	Serial No.	Port	Sensor Range (psi)	Raw Data File Name	Calculated Data File Name	Date/Time Data Start	Date/Time Data End	Data Collection Rate (min)	Groundwater Level Data Review Comments	Data Valid? Y/N	Comment / Reason for Invalidation of Data

Example

SOP-5230-1

Attachment 2 – Westbay Well Screen Atmospheric Pressure Chart

Well	Screen	Average Surface Atmos (psia)	Surface Elevation (ft)	Approx. Water Elevation (ft)	Approx. Water Level Depth (ft)	Calculated Atmos P at Saturation (psia)	Comment
CDV-R-15-3	4, 5	11.34	7258.9	6020	1238.9	11.34	Top of regional aquifer, perched zones dry
CDV-R-37-2	2, 3, 4	11.32	7330.6	6140	1190.6	11.32	Regional Zone
R-5	2	11.63	6472.6	6130	342.6	11.63	Intermediate Zone WL Elevation
R-5	3, 4	11.63	6472.6		695.1	11.63	Regional Aquifer Zone, Port MP3A has gone dry, sampling from MP3B
R-7	1, 2	11.51	6779.2	6405	374.2	11.51	Intermediate Zone WL Elevation. Zones 1 and 2 are dry
R-7	3	11.51	6779.2	5880	899.2	11.51	Top of Regional Aquifer
R-8	1, 2	11.62	6544.7	5850	694.7	11.62	Top of Regional Aquifer
R-9i	1	11.68	6383.2	6240	143.2	11.68	Intermediate Zone
R-9i	2	11.68	6383.2	6130	253.2	11.68	Intermediate Zone
R-12	1, 2	11.64	6499.6	6075	424.6	11.64	Intermediate Zones 1 and 2 have similar piezometric water levels
R-12	3	11.64	6499.6	5700	799.6	11.64	Regional Aquifer Zone
R-14	1, 2	0.00	7062.1	5880	1182.08	0.00	Lack of Sfc Atmos data, use empirical
R-16	1, 2, 3, 4	11.76	6256.9	5640	656.87	12.00	Zone 1 at top or regional aquifer blocked, calculate from formula
R-19	1	11.39	7066.3	6222.1	844.2	11.39	Intermediate Zone, Dry
R-19	2	11.39	7066.3	6170	896.3	11.39	Intermediate Zone WL Elevation
R-19	3	11.39	7066.3	5890	1176.3	11.39	Top of Regional Aquifer, inadequate data, use function
R-20	1, 2, 3	11.57	6694.4	5865	829.4	11.57	All zones in regional aquifer
R-22	1, 2, 3, 4, 5	11.59	6650.5	5760	890.5	11.59	All zones in regional aquifer
R-25	1, 2	11.20	7516.1	6790	726.1	11.20	Intermediate Zones 1 and 2 have similar piezometric water levels
R-25	3	11.20	7516.1	6453	1063.1	11.20	Zone 3, port MP3A is dry, MP3B has water
R-25	4	11.20	7516.1	6350	1166.1	11.20	Intermediate zone
R-25	5, 6, 7, 8, 9	11.20	7516.1	6230	1286.1	11.20	Top of regional aquifer
R-26	1		7641.7	7030	611.69	0.00	Intermediate Zone
R-26	2		7641.7	6550	1091.69	0.00	Top of regional aquifer
R-31	2	11.72	6362.5	5830	532.5	11.72	Top of regional aquifer
R-32	1, 2, 3	11.59	6637.6	5860	777.6	11.59	Top of regional aquifer
R-33	1, 2	11.49	6850.0	5860	990.0	11.49	Top of regional aquifer