STANDARD OPERATING PROCEDURES

MANUAL WATER LEVEL MEASUREMENTS

CONTENTS

* These sections affected by Revision 1.1

SUPERCEDES: SOP #2043; Revision 1.0, 02/11/00; U.S. EPA Contract 68-C99-223

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for determining the depth to water in a well using an electronic water level indicator. In this SOP, wells are defined as monitoring wells, piezometers, temporary well points, and potable wells. Permanent wells should be surveyed such that wells can be located and water elevations can be determined. At sites where there are multiple wells, a complete round of water level measurements should be collected site-wide prior to commencement of activities that will affect groundwater levels.

Groundwater level measurements are used to:

- Construct water table/potentiometric surface maps,
- Identify the groundwater drawdown and recovery during an aquifer test,
- Document variations in water level,
- Provide a baseline measurement to convert the height of the water column above an installed transducer to water level elevations, and
- Determine groundwater volume in wells prior to purging.

2.0 METHOD SUMMARY

A permanent survey mark should be placed on the top of the riser pipe or casing as a reference point for groundwater level measurements. If the lip of the riser pipe is not flat, a notch can be made on the polyvinyl chloride (PVC) riser and used as the reference point. Alternatively, the reference point may be located on the top of the outer protective casing (if present). If using a measurement reference point, it must be documented in a site-specific logbook or on a field data sheet (Figure 1, Appendix A). All field personnel must be informed of the measurement reference point used to ensure the collection of consistent data.

NOTE: If data are recorded in the sampler's personal logbook only, the pages must be photocopied and retained in the project files.

Before measurements are made, water levels in piezometers and monitor wells should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low yield situations, recovery of water levels to static equilibrium may take longer. All measurements should be recorded to one hundredth (0.01) of a foot. Water level measuring equipment must be decontaminated prior to and after use at each measuring location. When possible, measurements should be taken from the least to the most contaminated borehole, well, or piezometer.

Open the well and monitor the head space with an appropriate air monitoring instrument to determine the presence of volatile organic compounds (VOCs). For electrical sounders, ground the measuring equipment, and then lower the water level probe into the well until the water surface is reached, as indicated by a tone or meter deflection. Record the distance from the water surface to the reference point. (Measurement with a chalked tape will necessitate lowering the tape below the water level and holding a convenient foot marker at the reference point. Record the water level as indicated on the chalked tape section and the depth mark held at the reference point. The depth to water is the difference between these two readings.) Remove the water level probe, replace the riser pipe cap, and decontaminate the equipment as necessary.

NOTE: If a separate phase product is present, a product/water interface probe is required for the measurement of product thickness and water level.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- Cascading water, particularly in open-hole or rock wells and especially during aquifer pumping tests, may interfere with the water level measurement.
- Some older types of meters are only marked at 5-foot intervals. A surveyor's tape is necessary for accurate measurements.
- Oil or other product on or in the water column can insulate the contacts of the probe of a meter and give false readings. For accurate water level measurements in wells, containing separate phase product, a special product/water level indicator is required.
- Tapes (electrical or surveyor) may have damaged or missing sections, or may be spliced inaccurately. Always examine the tape for continuity and completeness.
- When using a chalked steel tape, it is necessary to lower the tape below the water level in order to take a measurement. This method is more successful when the operator has knowledge of the approximate groundwater level.

5.0 EQUIPMENT/APPARATUS

- Electric water level indicator, marked in increments of 0.01-foot
- Steel tape, chalked, marked in in increments of 0.01-foot.
- Spare batteries
- Appropriate air monitoring equipment [photoionization detector (PID) and/or flame ionization detector (FID)]
- Product/water interface probe
- Chalk
- Ruler/Measuring tape
- Site logbook and field data sheets
- Decontamination supplies
- Paper towels and trash bags

6.0 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solutions may be necessary. If decontamination of equipment is required, refer to SERAS SOP #2006, *Sampling Equipment Decontamination* and the approved site-specific Quality Assurance Project Plan (QAPP).

7.0 PROCEDURES

7.1 Preparation

If historical records are available, they should be reviewed to determine which wells are likely to be contaminated. Historical records may also indicate the presence of VOCs in the headspace, light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL). Water levels across a site should be measured from the least contaminated to the most contaminated wells to prevent cross-contamination.

All equipment should be inspected to ensure that they are in working order and clean. Both the speaker and indicator light on an electronic water level indicator should activate when the probe enters water. If the contaminant of concern includes the possibility of an LNAPL, an interface probe that indicates the top of the LNAPL and the interface with the groundwater should be checked also at this time.

All wells should be surveyed by a licensed surveyor; however, a relative survey can be used in most applications of water levels. The surveyor shall mark the top of casing (TOC) at the point that it was surveyed. Information on the well, including survey data, total depth and screened interval, should be available and brought to the site. When water level measurements are made in support of groundwater sampling, the log sheet included in SERAS SOP #2007, *Groundwater Well Sampling* should be used for documentation. For other uses, document measurements on an appropriate log sheet or logbook.

7.2 Liquid Level Determination

1. Open the well by removing the well cover and well cap and record the well identification (ID) number in the site log book.

2. The headspace of the well should be monitored with a photo-ionization detector (PID) and/or flame-ionization detector (FID), as indicated in the Health and Safety Plan (HASP).

3. Identify the TOC as marked by the surveyor. If the well has not been surveyed, establish a reference point on the casing using a permanent mark or notch, and document its location in the site log book (ASTM 2001). Measure the height of the mark relative to the well pad and record.

4. Turn on the water level indicator and set the sensitivity to middle of the range (5 or 6) (Durham Geo Slope Indicator).

5. Lower the probe of the electronic water level indicator into the well until an audible tone and a light indicates contact had been made with the water.

6. Raise and lower the probe until the interface is identified by the tone terminating when the probe is raised slightly.

7. Determine the distance from the water surface to the TOC by holding the graduated tape against the reference mark and read the distance to the nearest 0.01 of a foot. Repeat until a consistent and repeatable measurement is made. If water is suspected to be clinging to the probe, a gentle shake will remove the water.

8. If LNAPL presence is suspected, use an interface probe in a similar fashion as described above, noting the difference in tones for the top of the LNAPL and interface with the water.

9. Measure the depth to LNAPL in the same manner as with the water level indicator noting the steady tone and light indicating that the probe is in a non-conducting liquid. Water is indicated by an intermittent tone and light.

10. To determine the LNAPL–water interface, repeat the process except raising the probe from the water layer up into the LNAPL. Raising the probe prevents LNAPL from coating the probe obscuring the interface (Solinst, 1998). DNAPL occurs below the water level, and the interface is detected when the intermittent tone and light becomes a steady tone and light.

11. Document the depths of all interfaces detected in the site logbook.

12. Remove the probe from the well. Replace the well cap and secure the wellhead cover in place.

13. Decontaminate the equipment by washing thoroughly with a non-abrasive mild detergent with warm (not hot) water and a soft cloth (Solinst, 1998).

14. Store the water level indicator and interface probe for transport in their padded cases and move to the next well.

In the site-specific logbook and on a field data sheet (Appendix A, Figure 1) record the well ID, latitude/longitude, date and time of day, participating field personnel, all measurements, any PID or FID results, and any physical changes at the well (e.g. erosion or cracks in the protective concrete pad).

8.0 CALCULATIONS

Groundwater elevations can be determined for surveyed wells using the equation:

$$E_w = E - D \qquad \text{(Equation 1)}$$

Where:

E_W = Elevation of the groundwater relative to the survey datum
E = Elevation of the TOC as marked by the surveyor
D = Depth to water

To calculate the volume of the well, first the height of the water column must be determined. The height of the water column may be available from site records or can be determined by sounding the well, which is a measure of the total depth of the well from the TOC. Subtracting the depth to the water from the total depth provides the height of the water column in the well. Well volume in gallons is then determined by:

$$\text{Well Volume (gallons)} = \pi r^2 hk \qquad \text{(Equation 2)}$$

Where:

π	=	3.14
r	=	inside radius of monitoring well (feet)
h	=	height of the water column (feet)
k	=	conversion factor, 7.48 gallons per cubic foot (gal/ft^3)

In cases where LNAPL is present, the weight of the LNAPL on the water column effects the water elevation. The corrected water elevation is calculated by:

(LNAPL thickness)(LNAPL density) + water elevation = corrected water elevation

For purposes of approximation, specific gravity of LNAPL of 0.8 can be used when the density is not known.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

1. All data must be documented in site logbooks and/or field data sheets. If data are only recorded in a personal logbook, copies of data must be forwarded to the Task Leader.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP.

3. Each well must be tested a minimum of three times to compare results. Results should agree within 0.02 of a foot. Consistent failure of consecutive readings to agree suggests that levels are changing because of tidal influences or the well is hydraulically connected to a near-by pumping well.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potential hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) and corporate health and safety procedures.

If the FID/PID results obtained while monitoring the head space and breathing zones indicate that VOCs are present, the personal protection level may need to be upgraded as denoted in the HASP.

12.0 REFERENCES

American Society for Testing and Materials (ASTM) International. 1987 (Reapproved 2001). *Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)*. Designation: D 4750-87 (Reapproved 2001).

Durham Geo Slope Indicator *Water Level Indicator Instructions*.

Solinst 1998. *Interface Meter Operation Instructions*.

APPENDIX A
Example Field Data Sheet
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May 2013

FIGURE 1. EXAMPLE FIELD DATA SHEET

PAGE __ OF_

SITE NAME: _____ LOGGER NAME: _____

SITE LOCATION: _____ ERT WAM: _____

LOG DATE: _____ WA# _____

Time	Well I.D.	Latitude	Longitude	Elevation of well (TOC)	Depth to bottom of well (feet)	Depth to water (feet)	Depth to product (feet), if any	Product type/ Product thickness	COMMENTS (pH, temperature, specific conductance, weather conditions)

TOC = Top of casing

NOTES:

MEASUREMENT REFERENCE POINT FROM_____GROUND SURFACE OR_____TOP OF CASING

Weather Conditions: Temperature (^{o}F/^{o}C):_____

Rain: Heavy: ____Medium:____ Light:____

Barometric Pressure: ____

Other significant observations: