

15.0 Well Gauging Purging and Sampling

15.1 Introduction

Obtaining consistent and accurate well gauging data is a critical part of each project. The well gauging data collected at each site provide a long-term record of:

- the seasonal groundwater fluctuations at a site;
- the presence, location, and thickness of measurable amounts of separate-phase hydrocarbons; and
- the effectiveness of recovery well operations.

Water quality samples are collected from wells to establish the chemical quality of groundwater at each sampling point and to obtain bacteriological information as part of a bioremediation program. Special care must be taken to ensure that the sample taken from a well is representative of the water at that location and that the sample is not altered or contaminated by the sampling and handling procedure. The equipment and procedures used in sampling a monitoring well depend on many factors. These include, but are not limited to:

- the design and construction of the well;
- the rate of groundwater flow; and
- the chemical species of interest.

Standard water quality analyses for volatile organic compounds (VOCs) are:
EPA Analytical Method 601/8010,
EPA Analytical Method 602/8020, and
EPA Analytical Method 624/8240.

The standard analysis for semi-volatile organics is EPA Analytical Method 625/8270.

Bacteriological analyses for a bioremediation program can be obtained by:
standard plating,
membrane plating, and
fermentation inoculum.

15.2 Purpose

The purpose of this document is to present standard procedures relating to the following:
the gauging of monitoring wells to determine an accurate depth to water and depth to separate phase floating product (if product exists) relative to surveyed elevations;
the purging of stored water from each well prior to sampling in order to obtain a representative groundwater sample; and
the most common types of water sampling methods employed by FDGTI for samples being collected for laboratory analysis.

This SOP will discuss various sampling methods, QA/QC sampling protocol, proper packaging and preservation procedure, considerations regarding the transport of samples, necessary documentation procedure and standard decontamination procedure. Not all water sampling methods are discussed in this document. Other sampling methods are presented in ASTM Standards and related documents presented in the references, below.

This SOP is based on USEPA guidelines and ASTM Standards, and is intended to be general. State or local regulations may take precedence over this procedure and should be documented accordingly. Refer to the specific sampling plan developed for each individual site for specific instruction.

15.3 References

The following ASTM Standards were consulted in the preparation of this SOP:

- D 596-91 Practice for Reporting Results of Analysis of Water
- D 3325-90** Practice for Preservation of Waterborne Oil Samples
- D 3370-82** Practices for Sampling Water
- D 3694-93** Practices for Preparation of Sample Containers and for Preservation of Organic Constituents
- D 3856-88 Guide for Good Laboratory Practices in Laboratories Engaged in Sampling and Analysis of Water
- D 3864-79(90) Guide for Continual On-Line Monitoring Systems for Water Analysis
- D 4448-85a(92)** Guide for Sampling Groundwater Monitoring Wells
- D 4489-85(90) Practice for Sampling of Waterborne Oils
- D 4515-85(90) Practice for Estimation of Holding Time for Water Samples Containing Organic Constituents
- D 4687-87** Guide for General Planning of Waste Sampling
- D 4750-87(93)** Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)
- D 4840-88(93)** Practice for Sampling Chain of Custody Procedures
- D 4841-88(93) Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents
- D 4979-89 Test Method for Physical Description Screening Analysis in Waste
- D 5088-90** Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites
- D 5410-93 Guide for Set of Data Elements to Describe a Ground-Water Site; Part Three - Usage Descriptors
- D 5495-94 Practice for Sampling with a Composite Liquid Waste Sampler (COLIWASA)
- D 5521-94 Guide for the Development of Ground-Water Monitoring Wells in Granular Aquifers

Note: an ASTM serial designation in bold type denotes a major reference used in the preparation of this SOP. Non-bold serial designations denote references useful in obtaining additional information pertinent to the subject matter.

The following additional references were also used in the preparation of this document:

- Driscoll, Fletcher G., Ph.D., 1986, *Groundwater and Wells*, Second Edition, Johnson Division, St. Paul, Minnesota.
- Scalf, Marion R., McNabb, James F., Dunlap, William J., Cosby, Roger L., Fryberger, John, 1981, *Manual of Ground-Water Sampling Procedures*, Robert S. Kerr Environmental Research Laboratory, U.S. Environmental Protection Agency,
- U.S. EPA, 1977, *Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities*, SW-611, U.S. EPA, Cincinnati, Ohio.

Wright State University, 1985, *Ground Water Practice I, A workbook in Applied Hydrogeology*, IRIS Program, Center for Ground Water Management.

15.4 Equipment

The following equipment should be taken to the site by the field scientist or technician for well gauging:

- an electronic water level measurement device,
- appropriate keys or special tools for accessing secured wells or well protectors,
- a bailer for extracting groundwater from the borehole or well,
- a dedicated product bailer for removing separate phase product from the well, if applicable,
- bailer string,
- an hydrometer,
- a clean knife,
- clean rags or paper towels,
- non-phosphate detergent,
- a 10% nitric or hydrochloric acid wash, if appropriate,
- methanol, if appropriate,
- deionized water,
- 3 to 4 wash buckets,
- a trash bag to collect debris,
- splash protection (disposable gloves and other personal protection equipment as necessary),
- traffic safety equipment (traffic cones, barriers, etc.),
- blank well monitoring forms,
- blank monitoring/sampling record forms,
- the project field log book,
- a site plan showing well locations,
- a clipboard,
- waterproof ink pens,
- a waterproof ink marking pen; and
- copies of previous well gauging and analytical data, if available.

When purging and sampling of wells is to be performed, the above equipment should be taken to the site with the additional following equipment:

- a field instrument for screening volatile organic vapors,
- a device for purging water from wells (bailer can be used),
- any accessories for purging device (e.g., tubing and power source if pump is used),
- drums for storing purged water, if necessary,
- a dedicated sampling bailer,
- a polyethylene squirt bottle of dilute hydrochloric (HCL) acid,
- a polyethylene squire bottle of dilute nitric acid, if appropriate,
- narrow range pH paper (1.0 - 2.5 pH range),
- field meter(s) which read temperature, pH, electrical conductivity,
- a dissolved oxygen meter, if appropriate,
- plastic bags,
- sample labels,
- a cooler with ice or frozen cold packs,
- chain of custody records, and
- the site sampling plan.

15.5 Well Gauging

Well gauging is performed separately or in conjunction with purging and sampling of the well. In either case, use the procedure presented below.

- 15.5.1 Assure that the electronic gauging instrument (such as an ORS Interface Probe® (IP)) that will be used to gauge the wells is functioning properly before going to the field. When at the site, check instrument operation before beginning to gauge by inserting the probe into a container of water and noting that the presence of water is signaled.
- 15.5.2 Familiarize yourself with the way the gauging instrument works (some instruments can read depth to water *and* depth to product while others only read depth to water). Each brand of instrument has unique operating properties. For example, an ORS IP gives off a beeping tone to indicate water and a solid tone to indicate a fluid other than water. Read the instrument's operating manual or consult the person in charge of instrument care for instructions before using an instrument you are unfamiliar with.
- 15.5.3 Inform appropriate parties (such as the station manager) of your scheduled arrival at the site and the purpose of your visit several days prior to the visit.
- 15.5.4 At sites with light non-aqueous phase liquid (LNAPL, i.e., floating separate-phase product), arrange to bail the product from the wells 24 to 48 hours prior to gauging all of the wells. Be consistent and establish a routine. Bailing accumulated product from the wells is done in an effort to obtain an accurate measurement of the amount of product in the formation surrounding the well. Dispose of the bailed product following the procedure in SOP No. 16.
- 15.5.5 Prior to gauging the first well, decontaminate the instrument probe and that portion of the tape that is likely to contact the water in the well. Follow the procedure for decontamination presented in Section 15-16, below. After gauging each well, decontaminate the instrument again before gauging the next well.
- 15.5.6 Consult prior gauging and analytical data for the wells if it is available before gauging. Always attempt to gauge wells in the order of cleanest to dirtiest if possible in order to avoid cross contamination.
- 15.5.7 If the instrument has a grounding wire, attach it to the metal well protector or to a metal rod driven into the ground prior to gauging.
- 15.5.8 The gauging measurement should be taken to the surveyed mark on the rim of the well riser or the rim of the well protector (traffic box or standpipe). If you do not know where that point is, ask the project manager. Generally, the survey point will be a filed or chiseled notch marked with paint or permanent ink. If you cannot determine where the mark is, take measurements from the highest point on the well casing, the lip of the well protector and the top of the well protector. If the riser is flat and even take the measurement from the north side of the riser. Make a notation as to which gaugings were taken from which reference points. (For example: "DTW 10.00 ft. from N side of top of PVC riser; DTW 10.32 ft. from top of road box lip.") It is extremely important to measure to the same point

each time a well is gauged. If you find a survey mark that is not clearly visible, take the time to mark it with permanent ink or paint. If the well head appears to have been damaged or altered in such a way that the top of the well casing or well protector elevation might have changed, note this, as any previous top of casing (TOC) survey elevation may now be invalid. Take a photograph of the well head, if necessary, to document any alteration. When gauging from a survey mark, gauge the rim of the riser adjacent to the notch, **not** the bottom of the notch.

- 15.5.9 Clean and dry the probe then slowly lower it into the well until it registers the presence of water (or product). Record the depth to water (and to product if the instrument detects it) to the nearest 0.01 ft. on a well data monitoring form. Figure 15-1, attached, shows a standard well data monitoring form, and Figure 15-2 is an example of a completed well data monitoring form. It is not necessary to complete all calculations to determine the ground water elevation while on site. Corrected depth to water cannot be calculated in wells containing product unless a known (or assumed) product specific gravity is used. Specific gravity of a product sample can be determined in the field using an hydrometer.
- 15.5.10 If a gauging instrument is missing any footage from the tape, make a notation on the gauging form. (For example: write "subtract 1 ft. from all gaugings" in the comments section of the form.) **Read the measurements directly from the tape**; don't try to make the adjustment in your head as it could lead to errors. The data will be corrected when final calculations are made. If you reduce the data on the field form while at the site, correct the depth measurements by placing a single line through the reading so that it can still be read, then write the correct depth above it in the same box (you will have to write small). Another method is to copy the data with the corrected depths onto a second form. Keep **both** forms as part of your record.
- 15.5.11 Depth to the bottom of the well should be verified periodically, say, once a year, to determine if the well is silting in. The depth to the bottom of the well must be known if the well is to be purged and sampled in order to calculate the volume of purge water. When gauging depth to the bottom of a well, be aware of the documented depth to the bottom and lower the probe slowly to avoid damaging it when it contacts bottom. After gauging to the bottom of the well, the entire length of tape that was submerged must be decontaminated.
- 15.5.12 Check gauging depth several times before recording it. Compare current gaugings to previous gaugings. Regauge any wells showing large, unexplainable discrepancies.
- 15.5.13 Note any unusual occurrences such as bacterial buildup on equipment. At
- 15.5.14 It is important to keep field instruments clean and free of dirt. Always clean and dry the instrument tape **before** reeling it back into the housing. Use a clean rag or paper towel.
- 15.5.15 When LNAPL is detected in a well, confirm the reading with a bailer that is dedicated to product bailing (**do not** use a bailer that will be used to sample wells!) Note the color and clarity of the product in the field log, and whether it smells like gasoline, diesel, or has some other type of odor.

15.5.16 If gauging for the presence of a dense non-aqueous phase liquid (DNAPL) in a well such as a chlorinated solvent, the device must be capable of detecting separate phase hydrocarbons. The probe must be carefully lowered to the bottom of the well because a DNAPL will collect at the bottom of the aquifer.

15.5.17 If product is detected in a well where product has not been detected before or has not been detected in several gaugings, verify the reading with a bailer, then communicate this finding to the project manager when you call the office.

15.5.18 **Write down everything you see or do while on site.** Refer to Section 10.7 of SOP No. 10 for proper data recording procedures. **Record all field data while in the field, do not wait until you get to the office.** No matter how hard you try, you cannot remember everything you did at a site when you are back at the office.

15.5.19 Complete all paper work (well data monitoring forms, monitoring/sampling record form, long-hand field notes) with notes as to any events that occurred while you were at the site. Figure 15-3, attached, is a standard monitoring/sampling record form, and Figure 15-4 is an example of a completed monitoring/sampling record form. Do not forget to note the weather, temperature, operation of equipment, the number of the instrument used, whether water samples were obtained and from where, etc. If you are visited by the client or by agency representatives while on site, note the name and the affiliation of the person, the questions asked, and the answers given.

15.5.20 Call the project manager prior to leaving the site. Under no circumstances

should y

15.5.21 When you return to the office, submit all paper work to the project manager.

15.5.22 The actual length of the tape of a measuring device should be checked periodically against a new steel tape, as electronic tapes will tend to stretch with age. If the tape has stretched to a point where the taping error is unacceptable, it must be replaced.

15.6 Reduction of Well Gauging Data

Well gauging data is reduced in order to convert the water level in each well to an elevation that is relative to a common datum (either assumed or actual). This makes it possible to prepare a map of groundwater gradient across the site. A second function of well gauging data reduction is to remove the effect of floating separate-phase product (LNAPL) on the depth to water in a well (separate-phase product will depress the water table beneath it).

Refer to the completed well data monitoring form in Figure 15-2, attached, and to the corrected water table schematic in Figure 15-5.

15.6.1 The following information is required in order to reduce the gauging data collected in the field:

- TOC elevation - note the survey point from which the gauging is measured,
- depth to water (DTW),

- depth to product (DTP), if product was detected, and
- specific gravity (G) of the product (either determined in the field or by laboratory; if not, use an accepted average for the type of product encountered),

15.6.2 To determine the product thickness (PT), subtract DTP from DTW.

For example (see MW-4, Fig. 15-2):

$$\text{DTW} = 2.63 \text{ ft.}$$

$$\text{DTP} = 2.44 \text{ ft.}$$

$$\text{PT} = \text{DTW} - \text{DTP} = 2.63 - 2.44 = 0.19 \text{ ft.}$$

15.6.3 To determine the hydraulic equivalent (HE) of the product, multiply the product thickness by the product's specific gravity (G).

For example (see MW-4, Fig. 15-2):

$$\text{PT} = 0.19 \text{ ft.}$$

$$G = 0.75$$

$$\text{HE} = \text{PT} \times G = 0.19 \times 0.75 = 0.14 \text{ ft.}$$

15.6.4 To determine the correct depth to water (CDTW), subtract the hydraulic equivalent from the measured depth to water.

For example (see MW-4, Fig. 15-2):

$$\text{DTW} = 2.63 \text{ ft.}$$

$$\text{HE} = 0.14 \text{ ft.}$$

$$\text{CDTW} = \text{DTW} - \text{HE} = 2.63 - 0.14 = 2.49 \text{ ft.}$$

15.6.5 To determine the correct water elevation (CWE), subtract the corrected depth to water from the top of casing (TOC) elevation (TOC was determined by survey).

For example (see MW-4, Fig. 15-2):

$$\text{TOC} = 174.89 \text{ ft.}$$

$$\text{CDTW} = 2.49 \text{ ft.}$$

$$\text{CWE} = \text{TOC} - \text{CDTW} = 174.89 - 2.49 = 172.40 \text{ ft.}$$

Note: in wells that do not contain product, there is no corrected depth to water. Therefore, the measured depth to water is subtracted from the top of casing elevation to determine the corrected water elevation.

15.6.6 Table 1 summarizes the calculations used to reduce gauging data.

Table 1 Calculations Used to Reduce Groundwater Gauging Data

For wells with measured product:

Symbol	Term
DTP	DTW = Depth to Water = Depth to Product =
TOC	= Top of Casing Elevation = (surveyed) G = Product Specific
PT	= Product Thickness =
HE	= Hydraulic Equivalent of Product = PT x G
CDTW	= Corrected Depth to Water = DTW - HE
CWE	= Corrected Water Elevation = TOC - CDTW
CWE	= Corrected Water Elevation = TOC - DTP

For wells containing no product:

15.7 Construction of a Groundwater Gradient Map

Groundwater movement and hydraulic gradient can be determined from water table or piezometric maps. Gauging data from a minimum of three wells a sufficient distance apart and in a roughly evenly spaced triangular arrangement are needed to determine groundwater gradient, though more wells are used if they exist. The relative locations of the wells on the ground (to scale) and the water table (or piezometric) elevation in each well must be known.

For example, the following procedure is used to construct a gradient map using data from three wells:

1. Using a scaled site plan on which the well locations have been plotted, pick two of the wells. Calculate the gradient (I) between the two wells by dividing the change in water elevation (h) by the distance between the two wells (L):

$$I = h/L.$$

2. Draw a line between the two chosen wells and mark off intervals of equal length that correspond to the gradient along the line between the wells (i.e., for a 0.02 ft/ft gradient, mark off intervals of, say, every ten feet; therefore, a change in elevation of 0.2 ft. for every 10-ft. increment will occur along the line). Mark the water elevation at each increment along the line.
3. Repeat steps 1 and 2 for the other two well pairs in the triangle.
4. Draw dashed contour lines across the plan that join points having the same elevation. Choose contour line increments (e.g., every 0.05 ft. or every 0.1 ft. of elevation, as appropriate) that will allow the drawing of contour lines that are neither too closely spaced nor too far apart.
5. Draw flow lines perpendicular to the contour lines. Direction of flow, represented by arrowheads drawn on the flow lines, is from highest to lowest contour elevation.

Appendix A, attached, which is taken from the Wright State University publication entitled *Groundwater Practice I, A Workbook in Applied Hydrogeology*, presents several graphical examples of groundwater contour construction for multiple well configurations, including the contouring of draw-down around pumping wells.

15.8 Well Purging

Water that stands within a monitoring well for a long period of time may become unrepresentative of formation water because chemical or biochemical change may cause water quality alterations and even if it is unchanged from the time it entered the well, the stored water may not be representative of formation water at the time of sampling, or both. Well purging is performed prior to collection of groundwater samples from wells in order to remove all stored water from the casing prior to sampling. The following procedure should be used to properly purge stored water from a well before sampling it.

- 15.8.1 There are varying opinions as to the amount of water that must be removed from a well before sampling, the method for calculating well volumes, etc. among professionals associated with environmental sampling. The protocol presented here is based on the ASTM D4448-85a procedure. This protocol may be superseded by requirements of state or local regulatory authorities, as such agencies often have adopted their own purging methodologies, or by conducting tests that prove that samples collected after purging less water than recommended (or no water at all) will yield representative aquifer samples. Before purging and sampling wells at a site, check pertinent agency regulations governing these practices and follow the specific protocol of the governing agency. If no such protocol exists, follow the procedure given here. Tests conducted for the purpose of minimizing purging must be completed under the direction of an Fluor Daniel GTI senior technical advisor.
- 15.8.2 All purging equipment should be cleaned before use at the site and between each well purging and at the end of each sampling round. Follow the standard procedure for equipment decontamination presented in Section 15.17, below. Also, check with the laboratory to find out if special cleaning methods are required when sampling for non-typical chemical analyses.

- 15.8.3 Calculate the volume of the well to include the well screen **and** the gravel pack of the well.

For example, if

borehole diameter, $BD = 8$ in. (0.67 ft.),
well diameter, $WD = 4$ in. (0.33 ft.),
porosity of gravel pack, $n = 0.25$ (assumed),
depth to water, $DTW = 16$ ft., and
depth to well bottom, $DTB = 28$ ft.,

then the water column in the well, $h = DTB - DTW = 12$ ft.,

the volume of water within the well casing, V_1 is

$$V_1 = (WD/2)^2 h = \pi \times 0.027 \times 12 = 1.03 \text{ ft}^3,$$

the volume of water within the gravel pack, V_2 is

$$\begin{aligned} V_2 &= ((\text{borehole area}) - (\text{casing area})) \times n \times h \\ &= ((BD/2)^2 - (WD/2)^2) \times n \times h \\ &= (0.35 - 0.09) \times 0.25 \times 12 = 0.78 \text{ ft}^3, \end{aligned}$$

and the total volume of water in the well, V_T is

$$V_T = V_1 + V_2 = 1.03 + 0.78 = 1.81 \text{ ft}^3.$$

To convert to gallons, multiply the number of cubic feet by 7.48:

$$V_T = 1.03 \text{ ft}^3 \times 7.48 \text{ gal/ft}^3 = 7.70 \text{ gallons in one well volume.}$$

- 15.8.4 Remove 5 to 10 times the volume of water in the well (per ASTM D4448-85a) by pumping from near the free water surface in the well (i.e., between 38.5 and 77 gallons from the well in the example above). If removal of this volume of water is not feasible due to budgetary or other constraints, a minimum of 3 to 5 well volumes must be removed prior to sampling.
- 15.8.5 As an alternative approach to removing 5 to 10 (or 3 to 5) well volumes, monitor the water quality parameters pH, temperature and electrical conductivity (using a water quality field meter) as follows:
1. Remove one well volume of water from the well from any location within the casing/screen. The water may be removed by bailing, submersible pumping, or via a purge system.
 2. Take a water sample from the well and analyze it for pH, temperature and electrical conductivity (record all readings).
 3. Remove an additional half a well volume of water from the well.

4. Take a second water sample from the well and analyze it for pH, temperature and electrical conductivity (record all readings).
5. If two out of three of the water quality parameters agree to within 10%, purging can stop. If not, continue to purge, sample and analyze the three parameters in half-volume increments until:
 - a) two out of three of the parameters do not vary more than 10% from the prior readings, or
 - b) five well volumes of water have been removed from the well.

A disadvantage of this approach is that there is no assurance in all situations that the stabilized parameters represent formation water. If significant drawdown has occurred, water from some distance away may be pulled into the screen causing a steady parameter reading but not a representative reading.

- 15.8.6 In deep or large diameter wells having a volume of water so large as to make removal of all the water impractical, it is acceptable practice to lower a pump or pump inlet to some point well below the water surface, purge only the volume below that point, then withdraw the sample from a deeper level. Sealing the casing above the purge point with a packer may make this approach even more dependable, but the packer must be above the top of the screened zone or stagnant water may flow into the purged zone through the well's filter pack.
- 15.8.7 In low yielding wells, remove all standing water by emptying the entire casing/screen. If possible, let the well recover at least once and empty it a second time before sampling.
- 15.8.8 Whichever purging technique is used, use a withdrawal rate that minimizes drawdown while satisfying the time constraints of the project. Excessive drawdown distorts the natural flow patterns around the well and can cause contaminants that were not present originally to be drawn into the well.
- 15.8.9 Record all water quality readings taken, all purge volumes and duration from beginning to end of each well purging.

15.9 General Sampling Procedures and Cautions

- 15.9.1 The types of species (chemical or biological) that are to be monitored as well as the concentration levels are prime factors for selecting sampling devices. The sampling device and all materials and devices the water contacts must be constructed of materials that will not introduce contaminants or alter the analyte chemically in any way.
- 15.9.2 As the concentration level of the chemical species of analytical interest decreases, the work and precautions necessary for sampling are increased. Therefore the sampling objective must be clearly defined ahead of time (SOP No. 5 discusses the protocol for planning a subsurface environmental assessment).

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- 15.9.4 Chemical changes can take place if the sample is aerated during sampling. It is critical to avoid aeration of samples when sampling for volatiles. This can be avoided by using bottom emptying bailers or by pouring very slowly.
- 15.9.5 All samples must be **properly** and **promptly** preserved (see Section 15.15, below).
- 15.9.6 All samples must be analyzed within the appropriate holding times or results will not be considered valid. Notify the laboratory in advance of sampling to insure proper delivery and turnaround.
- 15.9.7 Bailer string that has contacted water or contaminants must be replaced between each well to avoid contamination from a bailer string that has absorbed contamination. Replace the string of both the evacuation and sampling bailers at the start of each sampling round, and between wells.
- Caution:** some bailer string is treated with a fungicide which may be detected in priority pollutant analysis. Therefore, string manufacturers should be questioned about such treatment or chemicals, if used.
- 15.9.8 On the chain of custody record, note what type of preservation chemicals were used (see Section 15.16, below).

15.9.9 Care must be taken not to cross contaminate samples or monitoring wells with gauging, purging or sampling devices or materials. All samples, sampling devices and containers must be protected from the environment when not in use.

15.9.10 Gauging data must be obtained before wells are purged.

15.9.11 Field water quality measurements must be done prior to any significant atmospheric exposure.

15.9.12 Sampling procedures for a particular project must be planned in advance and sample containers should be prepared and labeled prior to going to the field.

15.9.13 The following down-hole sample collection devices are available for collecting water samples from a well:
bailers,
pneumatic samplers,
suction lift pumps,
electrical submersible pumps,
gas lift pumps,
gas displacement pumps,
bladder pumps,
gas driven piston pumps, and
packer pump arrangements.

The pros and cons regarding the use of each of the above types of sampling devices are discussed in ASTM D4448, and will not be discussed here. The single check valve bailer is the most common water sampling device used by Fluor Daniel GTI personnel.

15.9.14 Wear splash protection to avoid having contaminated groundwater come in contact with your body. At a minimum, eye protection and disposable gloves must be worn at all times during gauging, purging and sampling.

15.10 Preparation for sampling

Prior to commencement of water sampling, the following preparations must be completed:

Pre-determine the sampling strategy, including which wells to be sampled for which analytes, and a QA/QC sampling plan. This should be contained in a written work plan that has been approved by the customer..

Prepare a site plan showing monitoring well locations.

Notify the laboratory to schedule analyses and order glassware, blanks, etc. from them (see Section 15.15.1, below).

Notify appropriate site personnel (e.g., station manager) several days prior to visiting the site.

prepare equipment to take to the site (see Section 15.4, above), and coordinate rental equipment and items that will be supplied by others (i.e., the lab).

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Set up field notes in advance, including the well data monitoring form(s) and a scheme for logging other essential field data (such as water quality parameters)

in an orderly fashion. Pre-determine a sample labeling system, particularly for QA/QC samples.

Prepare sample containers (including preservatives and field blanks as necessary) and labels in advance, if possible.

Assure that all items that will be used for sampling such as sampling devices and sample containers are sterilized or have been decontaminated prior to collecting the first sample.

Assure that selected sampling equipment is chemically compatible with the expected contaminants and contaminant analyses (i.e., don't plastic sample bottles for collecting samples for analysis of petroleum hydrocarbons).

15.11 Sampling for Organic Compounds

15.11.1 Gauge all of the wells to be sampled **before** sampling (see Section 15.5, above regarding well gauging procedure). Gauge both depth to water and depth to bottom in order to calculate water volume. (A depth to bottom measurement is not necessary if a recent measurement is available).

15.11.2 If possible, sample the wells starting with the cleanest well and ending with the most contaminated well.

15.11.3 Wells containing floating separate-phase product (LNAPL) are generally not sampled. However, the sampling plan should specify details of sampling protocol if sampling is required. Wells containing heavier than water product (DNAPL) may also be sampled. A sample of the product itself may also need to be collected.

15.11.4 Purge each well before sampling it following the procedure described in Section 15.5, above. If a local or state agency has a required protocol for well purging, follow that protocol. If water quality parameters are checked during purging, record all readings.

15.11.5 Use only Teflon, stainless steel or disposable/dedicated plastic bailers to obtain the sample. (Other sampling devices available for collecting groundwater samples are detailed in ASTM D 4448, but are not discussed here). Use Teflon for sampling water containing chlorinated compounds and also for bacteriological samples. Disposable bailers can be used for one-time sampling for other than EPA 624/8240 analysis. Using a disposable bailer for a one-time sampling reduces the possibility of cross-contamination, but increases waste. Therefore discretion should be used in selecting the appropriate bailer.

15.11.6 Place new string on the sampling bailer prior to sampling each well.

15.11.7 Carefully remove five bailers full of water from the well using the sample bailer before retaining the sample from the fifth bailer; this thoroughly rinses the sample bailer with the water to be sampled helping to insure a representative sample and

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to reduce cross contamination. In the case where silt is prevalent, rinse the sample bailer once, then obtain the sample from the second bailer full of water.

- 15.11.8 When sampling, avoid stirring up any sediments in the well by obtaining the sample from the top of the water column.
- 15.11.9 Acidification is required for samples that will be analyzed by EPA Methods 601/8010, 602/8020, and 624/8240 to bring the pH of water just below a pH of 2. The procedure for acidification of samples is presented in Section 15.15.2, below. **Do not** acidify samples for EPA Method 625/8270 analysis.
- 15.11.11 **Do not** touch the rim of the sample container with your fingers or with the bailer. You should wear clean, disposable gloves during the sampling procedure.
- 15.11.12 **Do not** pour the sample from the sample bailer over the bailer cord; **do not** allow the cord to touch the sample container.
- 15.11.13 Avoid aeration of the sample during transfer of the water from the bailer to the sample container in order to reduce the possibility of oxidation of the sample. A bottom emptying device which allows the sample to be drained into sample containers through the bottom of the bailer is preferred. If no such device is available, gently and carefully pour the sample into each sample container in a steady stream from the top of the bailer. Sample containers should be held upright on a stand to avoid spills of preservative from the containers. An acrylic board serves well as a flat, cleanable surface.
- 15.11.14 Samples for EPA Methods 601/8010, 602/8020, and 624/8240 analyses are typically collected into 40-ml glass vials with Teflon septa in the vial caps. When capped, the sample vials must contain no air. To assure this, fill the sample vial to the top so that a meniscus is formed; wait a few seconds for any bubbles to rise to the surface; carefully and quickly slip the cap onto the vial and tighten securely.
- 15.11.15 Invert the full sample vial and tap it gently against the heel of your hand; look for any air bubbles. If the sample contains air bubbles, open the sample and add more water if the same sampling water is available, otherwise discard the sample and repeat the sampling process with new sampling containers.
- 15.11.16 Water samples for organic analysis are generally not filtered. However, water samples collected for analysis of polycyclic aromatic hydrocarbons (PAHs) are sometimes filtered if the sample water is turbid because suspended solids can contain PAH compounds whose presence can cause an error in the dissolved concentration analytical results. Field filtering consists of passing the water through a series of disposable paper filters contained in a special holder into the appropriate sample container using a disposable syringe to feed water through the filters. Each syringe is pre-sterilized and packaged and must be used to filter only one sample then discarded. Use new filters for each sample and replace filters if they clog while filtering a sample. Clean filter holders thoroughly before filtering each successive sample. PAHs samples are generally collected into 500 ml or 1L amber glass bottles. The field filtering of PAH samples must be noted in the field log.

- 15.11.17 When collecting separate phase product samples, package the product into 40-ml vials using the same collection technique as described in Sections 15.11.14 and 15.11.15, above. **Keep collected product samples away from water samples at all times.**
- 15.11.18 Samples for EPA Method 625/8270 are typically collected into 1-liter amber bottles. Attempt to fill each sample bottle completely then cap it tightly. **Do not** acidify these samples.
- 15.11.19 40-ml vial samples should be taken in triplicate (i.e., each sample should be split equally into three vials in case of breakage or the need to perform laboratory analyses more than once). 1-liter bottles should be taken in duplicate.
- 15.11.20 Pay special care to accurately label each sampling vial completely and correctly. Section 15.15.4, below, describes the proper sample labeling procedure.
- 15.11.21 Place 40-ml sample vials and 1-liter bottles into clean foam sponges in a cooler with ice in a standing position. If foam sponges are not available, place each set of three vials into a small plastic bag, close the bag, then wrap duct tape tightly around the packaged vials before placing them in the cooler. **Do not** place product samples in the same cooler as water samples. The 1-liter bottles can be wrapped in plastic bubble wrap to avoid breakage. Stand them up and pack them tightly to prevent their moving around in the cooler. Samples should be stored at 4 degrees centigrade. Make sure to drain all water from cooler before shipping samples.
- 15.11.22 Fill out the proper chain of custody documentation (see Section 15.16 for the COC documentation procedure).
- 15.11.23 Handling of decontaminated equipment:
- Always wear clean gloves (latex, solvex, etc.)
 - Place decontaminated bailers on a clean surface (a clean plastic surface or hung so it is not in contact with contaminants).
 - Do not wipe down bailer with paper towels or cloth. Follow

15.12 Sampling for Inorganic Analyses

Typical inorganic chemical analyses performed on groundwater samples include metals, total dissolved solids (TDS), cations/anions, electrical conductivity and pH. Specific sample containers are used to collect the sample depending on the intended analysis. In general, water for metals analysis is collected into 250 ml to 1-Liter plastic bottles while most other analyses require collection into 500 ml to 1-Liter amber glass bottles (consult the laboratory fir in doubt. Water for metals analysis must be preserved with several drops of nitric acid (HNO₃). Most other inorganic water samples require no preservation except cooling.

Water samples for metals analysis should ideally be field filtered during collection to remove sediment that can significantly affect analytical results. Samples may not need to be field filtered if holding time is very short before analysis is performed (check with the laboratory regarding the need to field filter samples). Field filtering consists of passing the water through a series of disposable paper filters contained in a special holder into the appropriate sample container using a disposable syringe to feed water through the filters. Each syringe is pre-sterilized and packaged and must be used to filter only one sample then discarded. Use new filters for each sample and replace filters if they clog while filtering a sample. Clean filter holders thoroughly before filtering each successive sample.

Except for the sample container types and preservatives (and possible filtering of water samples for metals analysis), follow the procedure in Section 15.11, above, for collection of water samples for inorganic analysis.

15.13 Bacteriological Sampling

15.13.1 Coordinate bacteriological sampling with the appropriate bio-laboratory. Discuss sample quantities, sample containers, preservation techniques, holding times, etc., with the laboratory prior to sampling, as these parameters will be different (and perhaps more critical) than for samples going for chemical analysis. Use only sterile sample containers provided by the laboratory.

15.13.2 The goal of sampling for an initial feasibility study should be assessing the total water ecology of the impact area. The following parameters should be determined:

- water temperature,
- dissolved oxygen,
- total dissolved solids (TDS),
- pH,
- electrical conductivity,
- inorganic chemistry,
- organic chemistry, and
- microbiology.

15.13.3 It is extremely important to limit the possibility of contamination of samples collected for microbiological analysis. Potential sources of contamination are:

- bacteria colonizing the well casing,
- sampling equipment and containers,
- air,
- rain,
- dust, and
- skin.

15.13.4 Regular and complete well development along with periodic treatment of the well with non-polluting chemical disinfectants such as hydrogen peroxide can significantly reduce contamination due to bacteria colonizing the well casing. Utilizing dedicated sampling equipment or disposable bailers is also an effective method of reducing the possibility of cross-contamination.

15.13.5 Purge the wells to be sampled following the standard purging protocol in Section 15.8, above, no more than 24 hours prior to sampling.

15.13.6 The following sample volumes are sufficient to carry out required bacteriological tests:

- 40 ml for standard plating,
- 100 ml for membrane plating (optional), and
- 1000 ml for fermentation inoculum (optional).

15.13.7 Follow the procedures outlined in Section 15.17, below to clean sampling equipment prior to sampling each well.

15.13.8 Avoid collecting sediment, whenever possible.

15.13.9 Keep the sample container closed until it is time for it to be filled. **Do not** add acid or any other preservative to sample containers. Protect the cap from contamination.

15.13.10 When filling sample containers, leave ample head space (approximately 3 cm) at the top of each container.

15.13.11 Immediately refrigerate the samples or place them on ice. Samples should be stored at 4 degrees centigrade.

15.13.12 Samples **must** be delivered to the testing laboratory **within 24 hours!** The type(s) of bacteria present are metabolically active and in order to get a good representation of the conditions at the time of sampling, rapid sample assay is essential.

15.13.13 After sampling, obtain dissolved oxygen readings from all wells sampled.

15.14 QA/QC Sampling

A project's QA/QC sampling protocol is pre-determined during work scope preparation, and will depend on a number of factors including project goals, level of detail, and cost constraints. The customer may already have a specific protocol for QA/QC sampling which may or may not include all of the samples recommended below. However, QA/QC sampling is essential to lending validity to the sampling program and analytical results. The QA/QC protocol presented here is taken from relevant ASTM standards and so is considered the industry standard protocol. State or local regulations may require a protocol that differs from the one presented here. If the customer's requested QA/QC sampling protocol varies significantly from either the state/local protocol or the one presented here (whichever is relevant to the project), the project manager should inform the customer of this discrepancy and advise him/her of the potential consequences.

Four types of quality control samples relate to the quality assurance of field sampling:

1. Field blanks,
2. Split samples,
3. Field rinsates, and
4. Field spikes.

The selection of the types of quality control samples to be used should be made prior to the sampling event and included in the site sampling plan.

15.14.1 Field Blanks

Field blanks are samples prepared in the laboratory using reagent water or other blank matrix and sent with the sampling team. These samples are exposed to the sampling environment and returned with the samples to the laboratory for analysis. The purpose of the field blank is to verify that none of the analytes of interest measured in the field samples resulted from contamination of the samples during sampling.

The sampling plan should normally include a minimum of **one field blank for each procedure for each sampling event**. These samples can be submitted blind to the laboratory to challenge their analytical system or can be shipped with the instruction to hold them unless there is a reason to suspect sample contamination. The submission of blind field blanks would normally be reserved for those situations where the competency of the analytical laboratory was unproven.

15.14.2 Split Samples

Split samples are used to challenge the analytical laboratory performance. Split samples are also used when two different parties are sampling the same site and verification of analyti

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A water sample that is to be split for non-volatile analysis should be placed in a large container and stirred or swirled to ensure thorough mixing of the medium prior to subsampling. For samples that will be analyzed for volatile constituents, discharge the water directly from the sampling bailer (or pump) directly into the two (or more) sets of sample containers by discharging a small portion to one container, then the next, then the next, and so on, until all containers are full.

Split samples are treated as separate study samples and are submitted to the analytical laboratory without distinguishing identification (i.e., label each sample so as not to indicate that it is a split). Split samples are an indication of the precision of the analytical procedures.

Where feasible, each sampling event should include a minimum of **one split sample for each type of media or location sampled**. Where the data are intended for demonstration of data quality to an outside agency, splits should be included at a greater frequency, **up to 10% of the total number of samples collected**.

15.14.3 Field Rinsates

Field rinsates are samples collected in the field by filling a sample collection vessel that has just been decontaminated (such as a sample bailer and bottom-discharge device) with reagent water or other blank matrix, and then transferring this water to the proper sample bottles. The purpose of a field rinsate is to ensure that sampling equipment cleaned in the field is not cross contaminating samples through improper cleaning techniques. These types of samples should be taken **at least once for each procedure for each sampling event when field**

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cleaning is performed. If only one such sample is taken it should be collected just prior to the last sample.

15.14.4 Field Spikes

Field spikes are samples collected in the field and spiked with compounds of interest or related compounds. These samples are used to check on the potential for loss of analyte on shipping and for recovery of analytes from a particular medium. The field spike is prepared by adding a known amount of the spiking material to a known amount of the matrix and mixing thoroughly prior to closing and sealing the sample container.

Field spikes are normally not required but may be desired where preservation techniques are in question and the integrity of analytes at the laboratory is not known, when there is a question concerning matrix effects, and when the results from the analytical laboratory for a particular analyte or class of analytes are in question.

Field spikes should be submitted blind to the laboratory in the same manner as outlined for the split samples. These samples should be carried through all stages of the sampling and sample handling process as the actual study samples to ensure that they truly indicate the integrity of the samples collected.

15.14.5 QA/QC Samples for Decontamination Procedure

It is important to document the effectiveness of the decontamination procedure (see Section 15.17, below). Therefore the project's QA/QC program should include provisions for the collection of samples to evaluate the completeness of the decontamination procedure. This could include:

Collection of rinse or wipe samples before the initial equipment decontamination prior to its use for sampling to establish a base line level of contaminants residing on or in the equipment;

Collection of final rinse or wipe samples after equipment decontamination following its use; and

The frequency of sampling to demonstrate the completeness of equipment decontamination is dependent upon objectives of the project as they relate to QA/QC. At a minimum it is recommended after every ten decontamination washings.

15.15 Preserving and Transporting Samples

Complete and unequivocal preservation of samples is practically impossible. At best, preservation techniques only retard the chemical and biological changes that inevitably continue after the sample is removed from the source. Therefore, insuring the timely analysis of a sample should be one of the foremost considerations in the sampling plan schedule.

ASTM Standards D 3694 and D 4448 contain detailed discussions and summary tables regarding sample preservation practices and holding times. The most common preservation practices used by Fluor Daniel GTI are detailed in Section 15.15.2, below.

15.15.1 Laboratory Notification

Prior to scheduled sample collection, the sample shipment and analysis requirements must be discussed with the laboratory. The exact requirements for the volumes of sample needed and the number and type of containers to use may vary from laboratory to laboratory. This will depend on the specific analyses to be performed, the concentration levels of interest, and the individual laboratory protocols. Turnaround time, holding time, report contents and pricing requirements must be discussed with the laboratory prior to sample shipment.

Notify the laboratory in advance of any laboratory blanks or sample containers that must be supplied by the laboratory. Confirm the minimum amount of sample required for specific analyses, types of containers, preservatives, etc. prior to sample collection.

15.15.2 Sample Preservation

Methods of preservation are intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce the volatility of constituents. Preservation methods are generally limited to pH control, chemical addition, refrigeration and freezing. For water samples, **immediate** refrigeration is often the best preservation technique available.

Some water samples require the addition of preservatives in the sample container (usually acid) while others do not. Sample containers must be tightly sealed to prevent the escape of vapors or introduction of vapors to the sample, and they should be subjected to minimal disturbance (i.e., agitation) after collection, particularly if the samples will be analyzed for volatile contaminants. Upon collection, the handling of each sample should be minimized. All collected samples should be immediately placed into a secure, light-proof storage container which is kept out of direct sun and away from any source of excessive heat or potential contaminated vapors (e.g. car exhaust). **Do not** place collected product samples into the same storage container as water samples.

All samples must be kept chilled to at least 4^o C (39^o F). To assure this, the samples, when being placed in the storage container (usually a cooler), should be packed in (i.e., surrounded by) ice or cold packs. Do not just place the samples on top of the ice as they may not stay cold enough. Also, assure that the sample integrity will not suffer from becoming wet from the ice or cold packs (i.e., labels or tape coming off). If necessary, place sample containers into individual sealable plastic bags as an extra protective measure.

Acidification of Organic Compounds:

At the start of each sampling round, the amount of acid required to

Prior to sample collection, put 2 to 10 drops of 15% to 25% dilute hydrochloric acid (HCL) into a 40-ml trial (practice) sampling vial (larger sampling containers will require more acid) and fill the vial with water from the well. Determine the pH of the water in the vial using pH paper. If the pH is higher than 2, repeat the procedure using more drops of acid in the vial. Repeat until the pH of the water in the sample vial is just less

than 2. Note the amount of acid required to lower the pH of the volume of water in the sampling vial. Discard the practice acidified sample in a disposal container.

Once the amount of acid required to reach a pH of 2 is known, the acid can be routinely added to each sample container directly. The water to be analyzed is added to vial or container containing the appropriate amount of acid. More frequent pH analysis may be required depending on chemical usage at a particular site or if significantly different hydrogeochemical environments exist at a site (e.g., a combination of limestone and sandstone deposits).

The volume of acid required depends on acid normality (concentration) and water pH. Therefore, note that the amount of acid required is site specific and should be noted in the field log.

The above procedure is valid for acidifying samples for EPA 601/8010, 602/8020, and 624/8240 analyses.

Do not acidify EPA 625/8270 samples. **Do not** acidify separate phase product samples.

Acidification of Metals:

Use dilute nitric acid (HNO_3) to preserve water samples for metals analysis. Using nitric acid instead of HCl, follow the procedure for acidification of organic compounds, above, to lower the pH of the sample to 2.

15.15.3 Sample Packaging

Water samples will be packaged into sample containers for shipment to the appropriate laboratory. The method of sample handling and containment is dependent on the method to be used in the laboratory for analysis of specified physical or chemical parameters. The following general rules apply to the preservation of the validity of a sample:
the sampling procedure should be completed in a minimum amount of time, with the least possible handling of the sample before it is sealed in a container;

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If possible, the sample should be physically inspected and its characteristics (color, sediment content, odor) documented; All packaged samples should be placed immediately into a secure, storage container that is out of direct sunlight, away from heat-generating sources and away from potential sources of cross-contamination such as car exhaust; all water samples must be immediately placed on ice or other cooling source that will sustain a temperature no greater than 4^o C (39^o F);

15.15.4 Sample Labeling

Identify each collected and packaged sample by attaching a water-proof tag or label to the container prior to sampling or immediately thereafter. Tags or labels must be completed using permanent, waterproof ink. They should be protected against detachment from the individual sample containers if they get wet. Each tag or label must include, at a minimum, the following information:
a sample number that uniquely identifies that sample (usually the borehole ID, for example "MW3");
company name (i.e., Fluor Daniel GTI);
the Fluor Daniel GTI project number;
the project name or site name;
the name, signature or initials of the person who collected the sample;
date and time of sample collection; and
preservative added.

If space exists on the tag or label, the requested analysis should also be recorded (this is important if the sample is collected into several different containers each having unique preservatives for specific laboratory analyses). Additional information that should be recorded at the time of sample labeling (either in the field notes or on the COC) includes:
place of sample collection;
observations and remarks pertinent to the sample collection; and
storage temperature if the sample is stored in a refrigerator.

15.15.5 Transporting Samples

When transporting samples from the site to either the office or the laboratory, they must be kept inside a secure storage container at all times the inside of which, if necessary, is kept chilled. The storage container should not be subjected to excessive heat or potential sources of contamination (e.g., car exhaust). **Do not store or transport samples in the trunk of a car.** Shipment and receipt of samples must be coordinated with the laboratory to minimize time in transit. Samples should ideally arrive at the laboratory within one day after they are shipped and be constantly maintained at about 4 degrees C during shipment.

If samples are relinquished by the sampler to another person for transport to the laboratory, proper chain of custody transfer documentation must be followed (see Section 15.16, below). **Custody of the samples should only be transferred to persons who are qualified to handle or transport them** (i.e., Fluor Daniel GTI technical personnel, certified couriers, or laboratory personnel).

Some samples (notably, product samples) are legally classified as hazardous substances because of the contaminants they contain, and as such they are under the control of federal regulations that govern the transport and handling of hazardous materials. It is the responsibility of Fluor Daniel GTI personnel to be aware of all regulations regarding the transport of samples containing specific contaminants and to conform to those regulations. If in doubt as to the legality of shipping a batch of samples, consult the Fluor Daniel GTI legal department **before arranging shipment.**

For information about legal requirements for packaging and shipping petroleum oils and other hazardous materials, refer to U.S. Postal Service Publication 52, "Acceptance of Hazardous, Restricted, or Perishable Matter," the Domestic Mail Manual, Part 124, "Nonmailable Matter - Articles and Substances; Special Mailing Rules," and the packaging requirements listed in the Domestic Mail Manual, part 121.

15.16 Chain of Custody Procedures

15.16.1 Importance

The purpose of chain of custody (COC) procedures is to permit traceability from the time samples are collected until all data has been generated. The procedures are intended to document sample possession from the time of collection and disposal. This practice provides documentation during each step, that is, during shipping, storage, and during the process of analysis. A COC is necessary if there is any possibility that analytical data or conclusions based upon analytical data will be used in litigation. This possibility is assumed to exist on **every** Fluor Daniel GTI project. Therefore sampling COC procedures **must** be followed during every sampling event, and the information contained on the COC must accurately represent the sample collection information and the associated analytical requests.

15.16.2 Field Custody Procedures

As few people as possible should handle samples.

The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred.

Labels or tags should be firmly attached to the sample containers and made of waterproof paper. Use waterproof ink to label the sample.

The field supervisor (i.e., the lead Fluor Daniel GTI person on site) determines whether custody procedures are being followed during the field work and decides if additional samples are required (the project manager must be notified immediately if the pre-planned sampling protocol is to be changed).

15.16.3 Chain of Custody Record

A blank copy of a typical COC record is included as Figure 15-6, attached. All laboratories and some customers furnish blank COC records, and they are all essentially the same as the one shown in Figure 15-6. All information listed

below that is required to be recorded must be recorded on the COC form. If a place does not exist on the form for the recording of any of the required information, then that information should be recorded in an existing "comments" or "remarks" section on the record or, at least, in the project field notes. A completed example of a completed COC for is presented as Figure 15-7 for reference.

As with all other field data, COC information should be recorded when the sampling is taking place. **Record all COC sampling data while on site.** Any errors on COC documents should be corrected by drawing a single line through the error. The error and the correction should be initialed and dated. If uncorrected errors are noted by the laboratory staff, the corrections must be made in writing by the project manager and submitted to the laboratory. These documents will also become part of the project file and must be dated and signed by the project manager.

The COC record accompanies the samples. When transferring possession of samples, the individuals relinquishing, the shipper, and the receiver of the samples are to sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in a laboratory. Document any opening or closing of sample storage containers (i.e., coolers) on the COC record.

15.16.4 Required Information

The following instructions describe the information required on the COC record. The numbers correspond to sections on the blank COC record shown in Figure 15-6, attached.

- (1) *Project Manager:* Print the name of the project manager or the name of the person who should receive the laboratory report.
Note: - the example COC does not have a space for recording the name of the company (i.e., Fluor Daniel GTI). Therefore, the company name should follow the project manager's name in this section.
- (2) *Address:* Enter the address of the project manager or the address of the person who should receive the report.
- (3) *Project #:* Enter the Fluor Daniel GTI project number.
- (4) *Phone #:* Enter the telephone number where the project manager or other contact person can be reached.
- (5) *Fax #:* Enter the facsimile telephone number where preliminary laboratory results should be sent.
- (6) *Site Location:* Enter the city and state where samples were collected.
- (7) *Project Name:* Enter the name of the project.
- (8) *Sampler Name:* Print sampler's name and the sampler should initial any existing statement regarding field sampling procedures.
- (9) *Field Sample ID:* Enter one sample ID per line per matrix. Print the ID which will identify the sample, it

should be identical to the sample ID on that sample's label. The ID must be limited to 8 characters.

(10) *Source of Sample*: This information is optional and is used to describe where the sample was taken from (e.g., "well" or "sump").

(11) *Lab #*: For Lab Use Only. Do not write in this space.

(12) *# Containers*: Enter the total number of containers, regardless of analysis or preservation type, for the sample ID listed on that line.

(13) *Matrix*: Put a check in the appropriate box to describe the sample matrix. If the matrix is "Other" specify what it is in the *Remarks* section.

(14) *Method Preserved*: Put the number of containers in the box which describes the type of preservation used. If ice is used, put a check in that box. Describe "Other" types of preservation in the *Remarks* section.

(15) *Sampling Date*: Enter the date (month, day, year) the sample was collected.

(16) *Sampling Time*: Enter the time (military) the sample was collected.

(17) *Analysis Request*: Choose a method by putting a check in the box(es) in the appropriate column(s). Most COCs list the most common methods requested plus have several blank columns where you can request analytical methods that are not already listed by writing the method(s) in the heading (note the three blank columns on the attached record). Contact the laboratory's customer service if you have any questions regarding the type of method to choose or to schedule special analysis requests.

(18) *Special Handling*: Request special handling of the analysis and report by putting a check in the appropriate box(es). If you have been given a quote number, it should be recorded in this section.

(19) *Special Detection Limits*: Specify special detection limits if they are required. For example, if your sample is from a municipal water supply you may need to specify drinking water detection limits.

(20) *Special Reporting Requirements*: Specify any special reporting requirements.

(21) *Remarks*: Any additional information regarding samples, analyses requested, or special considerations must be noted here. Samples which are known to be highly contaminated can be noted in this section. Enter the method of shipment, courier's name(s) and other pertinent shipping information in this section. Additional project identifiers should be specified in this section (site location, site number, code, etc.).

(22) *Lab Use Only/Storage Location/Lot #/Work Order #*: Do not write in this space.

(23) *Relinquished by Sampler*: To be signed by the sampler at the time the samples are relinquished by the

- sampler to the carrier for shipment, or to any other authorized person.
- (24) *Relinquished by/Received by Date*: The date is entered by the relinquisher at the time custody of the samples is relinquished to another person.
- (25) *Relinquished by/Received by Time*: The time is entered by the relinquisher when custody of the samples is relinquished to another person.
- (26) *Received by*: To be signed by each person who receives custody of the samples prior to the laboratory taking custody.
- (27) *Relinquished by*: The final acknowledgment of transferral is signed by the person who relinquishes custody of the samples to the laboratory.
- (28) *Relinquished by/Received by Date*: The final date is entered by the person who relinquishes custody of the samples to the laboratory.
- (29) *Relinquished by/Received by Time*: The final time is entered by the person who relinquishes custody of the samples to the laboratory.
- (30) *Received by Laboratory*: To be signed by laboratory log-in person at the time of sample receipt by the laboratory.
- (31) *Waybill #*: The shipping waybill number will be entered in this box at the time of receipt of the samples by the laboratory.

Reminders: To best achieve project objectives, all samples should be scheduled at least 48 hours prior to shipment. In order to insure that holding time are met, all samples should be shipped the day of collection. All changes on the chain of custody document must be initialed by the project manager or sampler.

A separate COC record must accompany each separate shipment of samples. The sample storage containers (i.e., coolers) should be padlocked or sealed with tape or other sealing material prior to shipment to the laboratory.

Alternative procedures can be used to establish a new COC form or document whenever a transfer of custody is made. In these cases, both the transferer and the transferee should keep a signed receipt of such a transfer. Note these procedures in the field log.

The original COC record must accompany each shipment to identify its contents. A copy of the COC record is retained by the Fluor Daniel GTI project manager. If sent by mail, register the package with return receipt requested. Freight bills, post office receipts, and bills of lading should be retained as part of the permanent documentation.

15.16.5 Sample Seals

Sample seals are sometimes used to detect unauthorized tampering of samples following collection up to the time of analysis. Use waterproof adhesive paper seals for this purpose. If a seal is used, add the date and the sealer to the COC record or on the seal itself. Each seal must be attached in such a way that it is necessary to break the seal to open the sample container. Seals must be affixed

to containers before the samples leave the custody of the sampling personnel.
Each split sample must have its own seal.

15.17 Decontamination of Sampling Equipment

An appropriately developed, executed and documented equipment decontamination procedure is an integral and essential part of environmental site investigations. The benefits of its use include:

minimizing the spread of contaminants within a study area and from site to site;
reducing the potential for worker exposure by means of contact with contaminated sampling equipment; and
improved data quality and reliability.

The following reagents will be used to decontaminate equipment in the field:

a non-phosphate detergent solution;
an inorganic desorbing agent consisting of a 10% nitric or hydrochloric acid solution made from reagent grade nitric or hydrochloric acid and deionized water (1% is applied to low-carbon steel equipment);
an organic desorbing agent consisting of a pesticide grade isopropanol, acetone, or methanol solvent rinse;
control rinse water, preferably from a water system of known chemical composition; and
organic-free, reagent grade deionized water.

Prior to initiating a field program that will involve equipment decontamination, a site specific decontamination protocol should be prepared. Information in the protocol should include:

site location and description;
statement of the sampling program objective and desired precision and accuracy;
summary of available information regarding hydrogeology and anticipated chemistry of the materials to be sampled;
listing of the equipment to be used for water sampling, and materials needed for decontamination;
detailed step-by-step procedure for equipment decontamination for each piece or type of equipment to be used and procedures for rinse fluids containment and disposal as appropriate;
summary of QA/QC procedures and QA/QC samples to be collected to document decontamination completeness including specific type of chemical analyses and their detection limit; and
outline of equipment decontamination verification report.

Equipment associated with water sampling can generally be defined as sample contacting equipment, i.e., equipment that can potentially come in direct contact with the water sample that will undergo chemical or biological analyses.

The general procedure for decontaminating water sampling equipment is as follows:

Wash with detergent solution, using a brush made of inert material to remove any particles or surface film.

For equipment that, because of internal mechanism or tubing cannot be adequately cleaned with a brush (e.g., sampling pumps, bailers), the decontamination solutions should be circulated through the equipment.

Rinse thoroughly with control water.

Rinse with an inorganic desorbing agent (i.e., acid rinse). This step may be deleted if the samples will not undergo inorganic chemical analysis.

Rinse with control water.

Rinse with an organic desorbing agent (i.e., solvent rinse). This step may be deleted if the samples will not undergo organic chemical analysis.

Rinse with deionized water.

Allow equipment to air dry prior to next use.

Wrap equipment for transport with inert material (aluminum foil or plastic wrap) to prevent direct contact with potentially contaminated material.

Sample containers such as jars and vials are generally assumed to be pre-sterilized by the manufacturer or supplier. This should be confirmed prior to their use. Any equipment whose cleanliness is not confirmed should be decontaminated using the above process prior to use.

Depending on site conditions, it may be appropriate to contain spent decontamination rinse fluids. If this is the case, the appropriate vessel for fluid containment (i.e., a drum approved by the Department of Transportation or similar container suitable for this purpose) should be used depending on the ultimate disposition of the material.

Depending on site conditions, it may be desirable to perform all equipment decontamination at a centralized location as opposed to the location where the equipment was used. If this is the case, care must be taken to transport the equipment to the decontamination area such that the spread of contamination is minimized.

□

Comments:

**FIGURE 15-3
MONITORING/SAMPLING RECORD**

Date: _____ Arrival Time: _____ Departure Time: _____
Project Name: _____

Operator: _____

Project Number: _____ Location: _____
Weather: _____ Call Project Mgr? Yes _____ No _____

PURPOSE OF SITE VISIT

Gauge

TOC
Survey
and
Map

Well D

Purge & Sample
Vapors

Monitor for

Drilling Supervision - borehole(s)/well(s)
Equipment Set-up:
Other:
Further description of activities on site:

EQUIPMENT USED

Gauging Device No.:

Surface Sampler

PID FID
Explosimeter

Other:

WATER SAMPLING

Samples taken? Yes _____ No _____ C-O-C record submitted? Yes _____ No _____

Sources of samples (list):

Method of water removal: _____ Volume removed:

Site blank taken? Yes _____ No _____ If Yes, name source:

Samples going to what lab?

NOTES

FIGURE 15-4
EXAMPLE OF A COMPLETED MONITORING/SAMPLING RECORD

Date: 12th May, 1996 Arrival Time: 10:20 Departure Time: 13:45
Project Name: ABC Company

Operator: J

Project Number: 01234-9999 Location: Centreville
Weather: Sunny, 85° Call Project Mgr? Yes No

PURPOSE OF SITE VISIT

	Gauge	TOC	
		Survey	
		and	
		Map	Well D
	Purge & Sample	Monitor for	
	Vapors		
Drilling Supervision - borehole(s)/well(s)			
Equipment Set-up:			
Other:			
Further description of activities on site:			

EQUIPMENT USED

	Gauging Device No.:	
		<u>139</u>
	Surface Sampler	PID FID Explosimete
Other:		

WATER SAMPLING

Samples taken? Yes No C-O-C record submitted? Yes No
Sources of samples (list): Influent and effluent of air stripper
Method of water removal: Grab Volume removed: 4 vials
Site blank taken? Yes No If Yes, name source:
Samples going to what lab? ACME Analytical

NOTES

Gauged all wells and recharge gallery. Took samples from influent and effluent of air stripper.
Well RW water pump tripped thermal circuit breaker. Monitored for vapors with PID at the side of the building.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ATTACH FIG. 15-5, CORRECTED WATER TABLE SCHEMATIC, HERE
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ATTACH FIG. 15-6, BLANK COC RECORD, HERE
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ATTACH FIG. 15-5, EXAMPLE OF COMPLETED COC, HERE
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ATTACH APPENDIX A, CONSTRUCTION OF WATER TABLE CONTOURS, HERE - NOTE
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IN HOUSE
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