

Appendix B. Delaware Solid Waste Authority Groundwater sample collection procedures

Groundwater Sample Collection Procedures

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Background: Implementation of Slow Purge Method

In October of 1991, the United States Environmental Protection Agency (USEPA) promulgated new regulations under RCRA called the "Solid Waste Disposal Facility Criteria - 40 CFR-258". These regulations present the minimum criteria that owners and operators of municipal solid waste landfill units must meet for protection of the surrounding environment. Some of the criteria covered in this document include:

1. Design
2. Operation
3. Closure
4. Post closure care
5. Monitoring
6. Record keeping
7. Financial Assurance

Although this document explains what criteria owners and operators have to meet to be in compliance with these regulations, the document does not present details concerning the selection and implementation of methodologies to meet compliance.

In 1992, a draft of the "Technical Manual for Solid Waste Disposal Facility Criteria - 40 CFR-258" was released to the State Governments for comment. This DRAFT technical manual discusses methods for selection of sites, materials, testing requirements, acceptance testing, sampling protocols, and monitoring requirements.

Review of this DRAFT technical manual, by the Delaware Department of Natural Resources and Environmental Control (DNREC) and the Delaware Solid Waste Authority

(DSWA), raised questions concerning the benefits of implementing certain sampling protocols put forth within the document. Both Agencies felt that upgrading the current groundwater monitoring systems with dedicated equipment necessary to comply with these protocols would:

1. Add excessive and unnecessary costs to the current Environmental Monitoring Program.
2. Increase the time necessary for sample collection.
3. Not yield fully representative samples.

Due to the presence of fine sands, silts, and clays in the aquifers being monitored at all Delaware Solid Waste Authority solid waste management centers, DSWA has implemented a "Common Sense" approach for the collection and preparation of groundwater samples for analysis. Using guidance provided by DNREC, in 1993, DSWA began using slow-purge or micro-purge techniques to collect groundwater samples. These techniques or sampling protocols were implemented to accomplish the following:

1. Reduce the heavy pieces of field equipment, purge pumps, steam cleaners, and generators needed to purge wells and decontaminate equipment;
2. Reduce the number of wells being sampled;
3. Eliminate hand bailing;
4. Significantly reduce time spent purging wells;
5. Reduce or eliminate field filtering as required by 40 CFR-258;

Both the DNREC and the DSWA understand that these methods may vary significantly from many of the currently accepted methods. However, the hydrogeologic conditions that exist on the Delmarva Peninsula (and many other locations where the primary aquifers were formed by weathering and tidal deposition) make certain requirements of 40 CFR-258 difficult to meet without modification.

i. Monitoring

Groundwater samples shall be analyzed in accordance with the schedules set forth in DSWA's Monitoring Plans. Sample collection, preservation, Chain-of-Custody, labeling, shipment, and equipment decontamination, shall follow the same procedures as outlined in this Plan.

ii. Analytical Methodology

All samples shall be collected and analyzed using the methods provided in the following publications:

1. SW-846 (Most Recent Edition) to be used first;
2. 40 CFR-136 (Most Recent Edition) to be used only if methods are not available in A above;
3. Standard Methods (Most Recent Edition) to be used only if methods are not available in A or B above;
4. Other methods as jointly approved by DSWA and DNREC to be used only if methods are not available in A, B, or C above.

III. Well Head Protection/Security

Well heads at all DSWA facilities meet or exceed the standards set forth in DNREC's *Delaware Regulations Governing the Construction and Use of Wells*. All monitoring wells are constructed of PVC or stainless steel with protective outer steel casings and locking caps. Additionally, most DSWA wells have additional outer protective casings made of concrete or steel, or concrete pads enclosed by bollards as shown in Figure 2 on Page 12 of this Plan. All protective steel casings have been outfitted with a locking cap, are kept locked using tamper resistant, hardened steel or brass locks. All locks at the major landfill facilities are keyed alike.

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IV. Well Construction

All DSWA wells have been constructed and installed in a manner consistent with the existing specifications required by DNREC at the time of construction.

V. Well Locations

The inner well casings of all GMWs being monitored at DSWA facilities have been surveyed by a land surveyor licensed in the State of Delaware. All groundwater monitoring wells have been tied in to the National Geodetic Vertical Datum and Delaware State Coordinate plane using standard land surveying practices. At the time of this plan the coordinate systems being used are the 1927 Delaware State Plane coordinate system and 1929 National Geodetic Vertical Datum.

VI. Well Modifications for Current Sampling Protocols

- A. No modifications have been made to groundwater monitoring wells with average DTWs greater than 25 feet.
- B. All wells with an average DTW of 25 feet or less have been modified through the installation of a 3/16" Teflon™ tube extending the entire length of the casing and screen. The tube is plugged at the lower end to prevent uptake of solids during sampling, and is solid except for a liberally perforated 2-3 foot section located at mid screen of the well casing. The tube is secured to the outer steel casing by way of nylon cord and straps as shown in Figure 3 on Page 13 of this Plan.

VII. Sample Collection Procedures

The following presents the methods by which DSWA collects or has its Environmental Monitoring Contractors collect groundwater samples from DSWA solid waste management centers. It is believed that these methods allow for uniform sampling of the aquifers without drawing in fine sediments from the surrounding aquifer, or disturbing sediments present in the well casings.

A. Field Preparation: Mobilization/Demobilization

The following outlines those procedures DSWA requires of its environmental monitoring contractors for preparation for the sampling of groundwater at the DSWA facilities:

- 1. Standard QA/QC required by the monitoring contractor include:

- a. External audits through certification programs;
 - b. External audits through acceptance of blind samples and round robin testing;
 - c. Internal audits through splitting samples and shipping samples to other local and regional laboratories;
 - d. Performance audits of all laboratory personnel and stations.
2. Many times, the bottles used by a contractor for sample collection, shipment, and storage are purchased pre-cleaned and (some with preservatives added) by an independent company. However, all sampling and field equipment is usually cleaned and maintained by the contractor. Therefore, as a part of standard quality checks, all bottle shipments should be tested by the contracted monitoring company on a routine basis for contamination. If the monitoring company elects to clean their own bottles, quality checks should be standard protocol, and should be run on every lot washed. As a minimum, the following should be done prior to any bottles going into the field:
- a. Fresh disposable Nitrile gloves should be worn whenever handling the glassware (prior to and after cleaning);
 - b. All labels should be affixed to the bottles prior to issuance to field crews;
 - c. All sample preservatives that can be placed in bottles prior to sample collection should be done so before the bottles are issued to the field crews. The type and amount of preservative should be placed on the label immediately prior to or after addition to the bottle;
 - d. Specific analytes and sample locations should be placed on the labels in indelible ink prior to the bottles leaving the laboratory. Note that all caps for volatile organic samples should be screwed down tightly prior to labeling to eliminate any airborne volatile contaminants from the label glues or ink from indelible markers, pens, or type.
3. Preparation of field equipment should include the following:
- a. Cleaning of all manual sampling equipment should include the following procedures:
 1. A general rinse with water to remove debris and solids.
 2. An Alconox Wash.
 3. Sterile rinses with deionized/distilled water.
 4. Acid Wash.
 5. Sterile rinses with Deionized/distilled water.
 6. Hexane Wash.
 7. 3 sterile rinses with deionized/distilled water.All acids and chemical rinses used should be GCMS grade or better. The field sampling crew is required to carry the necessary chemicals and deionized/distilled water into the field in order to clean any materials that may become contaminated during sampling.
 - b. All pumps and field meters should be cleaned and calibrated prior to each monitoring event using chemicals and standard procedures recommended by the manufacturer. The equipment should undergo the same protocols when it is returned to the lab.
 - c. Maintenance and parts replacement should be performed as required by the manufacturers suggested schedule.
 - d. The monitoring company is required to retain records of maintenance and calibration certification. These records are periodically checked by the DSWA.

- e. All field equipment should be inspected and tested for proper operation prior to being sent into the field.
- f. The sampling crew is required to carry duplicates of all major pieces of sampling equipment.

VIII. Groundwater Sample Collection

A. General

During all phases of groundwater monitoring at DSWA facilities, field sampling crews are required to:

1. Sign the Visitor's Log and enter their time of arrival at the Administration Building or Weigh Station. If needed, request an escort to the location where the samples are to be collected.
2. The Contractor shall be responsible for the health of its employees. The Contractor shall designate an individual in their organization as the "Safety Coordinator" for the site.
The Safety Coordinator shall evaluate the sites to determine what safety equipment is required, and shall what measures of procedures should be followed by the field crew. The Safety Coordinator shall develop a Health and Safety Plan (HASP) delineating these. The Contractor shall be responsible for ensuring compliance with the HASP. The Contractor shall submit the HASP to DSWA within two (2) weeks prior to commencement of monitoring activities.
3. A minimum of one pair of Nitrile gloves (two are recommended) are to be used while handling equipment and all phases of the collection, preparation, and shipment of samples. Gloves are changed between monitoring locations. (e.g. gloves are changed prior to sample collections and after equipment decontamination.) This insures minimal opportunity for contamination through handling of samples and equipment by operators.
4. At least one member of the sampling crew collecting samples at DSWA facilities shall carry the following valid certifications:
 - a. 40 hour OSHA Emergency Response Program
 - b. First Aid and CPR.
5. All monitoring events must be overseen by an individual with a minimum of three years field experience in the collection, preparation, and shipping of groundwater samples.
6. The monitoring company shall conduct annual audits of the procedures and equipment being used by their field crews.
7. DSWA shall conduct random inspections of the field crews sampling protocols during each monitoring event.

B. Gauging

Prior to the collection of any groundwater samples from a DSWA facility, the field sampling crew is required to measure the static groundwater levels to 1/100 of a foot in all groundwater monitoring wells on site. The contractor is required to use an electronic water level indicator dedicated specifically for this purpose. The inner well

casings of all groundwater monitoring wells being monitored at DSWA facilities have been surveyed by a land surveyor licensed in the State of Delaware. Each is marked with a reference point that is tied into the National Geodetic Vertical Datum (NGVD). All depth to water readings are to be measured from these reference points.

The following procedures are used by environmental monitoring contractor's field sampling crews for gauging the groundwater monitoring wells prior to collection of samples from DSWA facilities:

1. The following protocols are to be used by the field sampling crew whenever groundwater elevations are taken:

- a. All measurements at a DSWA site are to be taken on the same day.
- b. All GMWs are to be inspected externally and internally for damage, and notations of physical well inspection entered in the field log prior to and after opening the well casing.
- c. Well casings are to be re-locked after measurements have been completed on the well.
- d. Measurements are to be taken from a reference point marked on the inner casing.
- e. A minimum of three measurements are to be taken from each well. The location of the well and the three measurements are to be recorded in a field log along with the time and date. These readings are to be averaged. The average of these measurements will be used for:

1. Mapping the potentiometric head elevations of each aquifer.
2. Tracking groundwater elevation fluctuations in the aquifers.
3. Calculating the flow directions and hydraulic gradients of the aquifers.
4. Entry into a data base for engineering applications as well as possible fate-transport modeling.

2. Between each well being sampled, the field sampling crew is required to rinse the electronic water level indicator thoroughly with deionized-distilled water. If any procedural or well contamination is suspected, the field sampling crew is required to use the following protocols to decontaminate the water level indicator:

- a. A general rinse with water to remove debris and solids.
- b. An Alconox Wash.
- c. Sterile rinses with deionized/distilled water.
- d. Acid Wash.
- e. Sterile rinses with deionized/distilled water.
- f. Hexane Wash.
- g. 3 sterile rinses with deionized/distilled water.

C. Purging

After all wells have been gauged, the field sampling crew is to use the following procedures to collect the groundwater samples:

1. For wells with depth to water measurements (DTWs) equal to or less than 25 feet:

The field sampling crew attaches a sterile piece of silicone tubing to the Teflon™ tube installed in the well. The sample crew attaches a fresh piece of dedicated Teflon™ tubing between the outflow of the peristaltic pump and a decontaminated flow-through sample chamber. The sample chamber contains the following probes and meters:

- a. pH
- b. Dissolved Oxygen
- c. Temperature
- d. Specific Conductance
- e. Oxidation/Reduction Potential
- f. Turbidity (measured initially at the outflow from the sample cell.)

2. For wells with DTWs greater than 25 feet:

The field sampling crew lowers the pump head of an adjustable speed low flow pump down to the middle of the GMW screen and ties off, clips off, or sets the brake on the hose spool to maintain the preferred depth. The sample crew affixes a piece of Teflon™ tubing between the outlet of the pump and a decontaminated flow-through sample chamber. The sample chamber contains the following probes and meters:

- a. pH
- b. Dissolved Oxygen
- c. Temperature
- d. Specific Conductance
- e. Oxidation/Reduction Potential
- f. Turbidity is also measured initially at the outflow from the sample cell.

3. The field sampling crew begins the purge by recording the following:

- a. Date
- b. Start Time
- c. Location
- d. Location Description:
 1. Well Diameter
 2. Casing Type
 3. Top of Casing
 4. Depth of Well

5. Depth to Water
 6. Standing Water in Casing
 7. Land Surface Elevation (if necessary)
 8. Sample Methods (Grab, Bailer, Pump, etc...)
4. The field sampling crew starts the purge at a flow rate of 1L/Min or less, and records the following in the field log:
- a. The flow rate setting of the peristaltic pump.
 - b. Initial pH
 - c. Initial Dissolved Oxygen
 - d. Initial Temperature
 - e. Initial Specific Conductance
 - f. Initial Oxidation/Reduction Potential
 - g. Initial Turbidity
- Stabilization of these indicator analytes (except Turbidity) is indicative of uniform water being drawn in from the aquifer. Therefore, the well is considered purged after stabilization has occurred. The field sampling crew is required to purge at least 5 minutes, and no longer than 10 minutes at each sampling point.
5. After purging is complete, the field sampling crew records the following in the field log.
- a. Final pH
 - b. Final Dissolved Oxygen
 - c. Final Temperature
 - d. Final Specific Conductance
 - e. Final Oxidation/Reduction Potential
 - f. Final Turbidity
 - g. Stop time of purge
 - h. Total amount of water purged (Gallons), and the number of well volumes removed
 - i. Any problems encountered during purging including:
 1. Mechanical problems/calibration problems.
 2. Any strange color, clarity, or odor problems with the samples.
 3. Any notes on problems with the wells such as the presence of roots, or gravel pack in the wells, or damage to the well and casing.

D. Well Closeout

1. Upon completion of sampling, the field crew is to rinse off the well plug or expansion cap prior to replacement in the inner casing, replace or close the

- outer protective well lid, and re-lock the well.
2. The field crew shall use decontamination procedures recommended by the equipment manufacturer.
 3. Readings from all equipment are verified 3X before final acceptance. If readings cannot be verified, re-calibration is required. If re-calibration does not result in verification, the monitoring company is required to switch to the back-up meter. Although they are generally done more frequently, calibration checks are required every three samples for most field meters.

Note: If the monitoring event only requires field analytes, instruments, sample cells, and sample tubes may be decontaminated between GMWs by flushing thoroughly with deionized- distilled water. All pump heads, and hosing of the variable speed pump must be thoroughly rinsed with deionized-distilled water between monitoring points.

IX. Groundwater Monitoring Well Sampling

If the monitoring event requires indicators or indicators/DNREC Supplemental Analysis for Groundwater Samples to be collected, the sample crew is required to use fresh or decontaminated/dedicated sample tubing in the peristaltic pump. Low flow variable speed pumps must undergo decontamination procedures recommended by the manufacturer. All sample cells are to be decontaminated using the procedures described in VII.A.3.a. above.

The following procedures are to be used by the field sampling crew to collect samples from DSWA GMW wells during a monitoring event that requires indicators or indicator/DNREC Supplemental Analysis for Groundwater Samples analysis to be run on GMW samples:

- A. After purging is completed, the field sampling crew shall collect Volatile and Semi-Volatile Organic samples using the peristaltic pump or variable speed pump at a flow rate of 100 mL/Min or less. This is done to insure that Volatile Organic Compounds (VOCs) are not stripped from the samples.
- B. Samples can be collected directly into the bottles, however no contact is allowed between sample bottle or tubing from the pump. VOC vials are to be checked for air entrainment. If air entrainment occurs, the sample shall be retaken. After the VOC and Semi-Volatile Organic samples have been collected, the field crew can increase the flow rate of the pump to expedite the sampling of the remaining sample types which could include:
 1. Heavy Metals and Indicator Metals
 2. Cyanide
 3. Sulfate and Chloride

4. Nitrate and Ammonia
5. Radionuclides
6. All other analytes of interest

The Metals fraction of the samples is to be collected after the Volatile and Semi volatile samples have been collected. Metals samples are the only type of sample that will be considered for filtration. Filtration of Metal samples is to be used as a last resort, and will only be allowed under the following conditions:

1. The turbidity of the sample is >10 NTU's.
2. Reduction in flow rates fail to decrease the Turbidity below 10 NTU's.

If filtration is necessary, the field crew are required to filter the samples through a 0.45 micron mesh cellulose or glass fiber filter.

- C. After the sample is collected, the field crew is to record the flow rate of the peristaltic pump in the field logs.
- D. After collection of each type of sample is completed, the field crew is required to add any preservatives not added during the bottle prep.
- E. Labels affixed to any extra bottles that were not prepared in the laboratory, shall be filled out in indelible ink. Each label is to include the following information:
 1. Customer Name or Identification
 2. Facility Location
 3. Sample Collection Location
 4. Time
 5. Date
 6. Analysis Required
 7. Preservatives Used
 8. Flow rates used for sample collection.
 9. Name of Person that collected the sample.
 10. Analytes being analyzed for.
- F. After the labels are completed, all samples are to be wrapped in bubble wrap, and placed in shipping boxes containing ice, dry ice, or freezer packs, and preserved at 4° C for shipment.
- G. Chain of Custody forms (COC's) are to be filled out with the same information listed above. Each time the sample is transferred, the sample must have a signature of the individual who releases the sample, and one for the individual who receives the sample.
- H. The field sampling crew then packages the samples and hand delivers, or ships by overnight express to the contracted analytical laboratory for testing.
- I. As the samples arrive at the laboratory, they are to be logged into a laboratory information system where:
 1. They are given sample identification numbers (This number is to be noted on the

- COC).
2. Their pH and Specific conductance is measured and noted on the COC.
 3. They are stored or dispersed to the various laboratory stations for analysis.

J. After the samples are logged in, copies of all completed Field Data Sheets and Field logs are to be e-mailed to the DSWA via internet in upon completion of the monitoring event.

X. Quality Assurance/Quality Control

As a minimum, during each monitoring event, the following QA/QC samples are collected, or prepared and analyzed for the analytes required by State Permits/Regulatory Requirements and Federal Requirements under 40 CFR-258.

- Trip Blanks: One per sampling day per facility
- Field Blanks: One per sampling day per facility
- Laboratory Duplicates: One per 10 samples analyzed
- Surrogate Standards: One per sample set
- Surrogate Spike: One per 20 samples
- Lab Method Blanks: One per sample set This analysis is done to insure:
 1. Procedures or equipment being used in the sampling, preparation, and shipment train do not cause degradation of the samples.
 2. Procedures or equipment being used in the analysis train do not cause degradation of the samples.
 3. Samples are not contaminated through outside sources.
 4. Methods being used for analysis are conducive to the sample matrix.

XI. Supply Disposal

Non-hazardous expendable supplies and equipment used in the collection of samples can be disposed of at the small load collection station prior to the sampling team leaving the site. Unused or excess sample that has not contacted sample preservatives can be disposed of at the sample location. Disposal of hazardous expendable supplies such as excess preservatives are to be taken back to the laboratory by the sampling team for proper disposal.

XII. Prior to leaving the facility, the field sampling crew will sign out of the facility by entering their exit time in the "Visitor's Log" at the Administration Building or Weigh Station, after which they must leave the facility.

XIII. Reporting

Results of analysis and discussion of the groundwater monitoring activities shall be included and discussed in the first quarterly groundwater monitoring report generated following reception of the groundwater monitoring data. The CIL historical groundwater monitoring database will be transferred to the Solid and

Hazardous Waste Section of the Delaware Department of Natural Resources and Environmental Control by way of electronic media or direct file transfer on a quarterly basis.

As a final note, the environmental monitoring contractor and contracted laboratory providing analysis of samples is/are required to retain all field and laboratory records in hard copy format for a minimum of five years, with magnetic media storage for thirty years.