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WAS053

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Groundwater Monitoring Program for Permitted Solid Waste Disposal Areas

This Guidance Document is intended to assist permitted solid waste disposal areas in addressing the groundwater monitoring requirements of [Title 132 – Integrated Solid Waste Management Regulations](#), Chapter 7, Ground Water Monitoring and Remedial Action. These requirements apply to all solid waste disposal areas accepting municipal solid waste, industrial waste, delisted waste and fossil fuel combustion ash.

The purpose of this Guidance is to establish a groundwater sampling and analysis protocol that can be followed throughout the monitoring period of the site (operating, closure, and post-closure) required under the Title 132 regulations. The protocol is necessary so that acquired data can be compared over time and accurately represent groundwater quality. Sample collection, preservation, shipment, storage, and analyses, should always be done in a consistent manner, even if monitoring staff change during the monitoring period.

This guidance is not intended to address the design of groundwater monitoring systems required under Title 132 Chapter 7 [§002](#). Guidance for the design of groundwater monitoring systems is provided in “Hydrogeologic Characterizations for the Design of Groundwater Monitoring Systems and to Support Engineering Designs for Permitted Solid Waste Disposal Areas” and the “Municipal Solid Waste Disposal Area Permit Application Review Checklist”.

This material is intended for guidance purposes only. It will be implemented through the flexibility existing under Title 132 Chapter 7.

Sampling and Analysis Procedures

- **Sampling and Analysis Plan**

All facilities must submit a Sampling and Analysis Plan (SAP) for NDEE review and approval that addresses the requirements of Title 132, Chapter 7 [§003](#), [§004](#), and [§005](#). The SAP should also be prepared consistent with this guidance document. The SAP should include an example of the report format that will be used for submittal of the field data portion of the reporting requirements (see Reporting and Recordkeeping Requirements section of this guidance document). Documentation of the initial statistical method(s) to be used in evaluating groundwater monitoring data must be included in the SAP. The SAP may include procedures for changing the initial statistical method(s) over time as the nature and amount of available data changes. Selection of a specific method is described in the USEPA Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities – Unified Guidance

(USEPA, 2009) as well as ASTM D 6312-98 Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs. The statistical method must meet the requirements of Title 132 Chapter 7 §003.07 and §003.08.

- **General Considerations**

In each sampling event, the order of sampling each well should proceed from the upgradient monitoring well (s) to the downgradient monitoring wells, and within the latter group from the least to the most contaminated well, if this is known.

The SAP must indicate that all personnel that sample monitoring wells must be licensed as a Water Well Monitoring Technician (WWMT) or be under the supervision of a licensed Pump Installation Contractor, pursuant to Title 178, Chapter 10 - Regulations Governing Licensure of Water Well and Pump Installation Contractors and Certification of Water Well Drilling, Pump Installation, and Water Well Monitoring Supervisors. Licensure examinations are offered by the Nebraska Department of Health and Human Services (NDDHS) on a quarterly basis.

- **Well Inspection**

Prior to inspection, all in-situ field-monitoring equipment should be calibrated according to the manufacturers' specifications and the SAP by trained personnel. Calibrations should be documented in a field log book.

Well inspections should be performed during each sampling event. The conditions of the well and surrounding area should be observed and recorded in a field log book or well inspection form. Each well should be inspected for construction defects, damage, labeling, and security. Any appearance of tampering, damage, or lack of security should be documented in a field logbook. Attention should be paid to the condition of the well identification plate or sign and whether the well is locked and the key works. All wells should be properly identified. The physical surroundings of the well site should be noted, including the presence of high weeds, young saplings, standing water, conditions of the concrete pad and well guard-posts, cleanliness, evidence of vandalism and other conditions that can affect the integrity of well construction and quality of sampling results. In addition, abnormalities in the condition of dedicated pumps, protective casings, and well caps should be noted. Monitoring well maintenance procedures for the ongoing maintenance and repair of damaged wells should be included in the SAP. Weather conditions should be recorded during the well inspection process.

An Organic Vapor Analyzer (OVA) or other similar instrument should be used to measure volatile vapor releases when a well head is opened. Any measurements above background should be reported.

Volume of water in casing (unless low-flow sampling is being used, see below) and depth to static water level should be determined, recorded, and reported with known measurements for bottom of casing, borehole diameter, and casing diameter.

In wells screened in fine-grained material or with a history of high turbidity, the depth to bottom should be measured at least annually and compared against initial post-development depth to bottom readings in order to measure the amount by which fines have accumulated in the well. Wells with significant accumulation of fines should have the fines evacuated and be redeveloped. If redevelopment does not prevent the reoccurrence of fines accumulation, then the well should be considered a candidate for low-flow sampling, no-flow sampling, or replacement.

Groundwater elevation measurements should be taken and recorded to the nearest 0.01 foot from a defined point on the edge of the casing (surveyed top of casing). In accordance with Title 132, Chapter

7 §003.04, groundwater elevation measurements must be taken at all monitoring wells in a time frame that avoids changes that may occur as a result of barometric pressure changes, significant infiltration, or aquifer pumping.

The presence of an immiscible layer in the well should be checked while groundwater elevation measurements are being made. If present, the depth and thickness of any immiscible layer present in the well should be recorded.

- **Well Purging (Including low-flow purging techniques)**

To prevent false-positive monitoring results due to cross-contamination between monitoring wells and turbidity from the use of non-dedicated sampling equipment, it is strongly recommended that all monitoring wells be fitted with dedicated purging and sampling equipment. Use of dedicated equipment for long-term monitoring can also reduce overall sampling costs.

Prior to collection of groundwater samples from the monitoring well, the well should be purged until three casing volumes of stagnant water have been removed or until the following parameters have stabilized (stagnant water has been isolated due to setting of pump intake): pH, specific conductance, and temperature. Stabilization is considered to have occurred after less than 10% variance is observed in 3 consecutive measurements of the above parameters. In either case pH, specific conductance, and temperature, should be measured and recorded prior to purging, and at least after each casing volume. Parameter measurements during purging should be taken every three to five minutes. If a bailer is used to purge the well, at least 3 casing volumes should be evacuated to remove the stagnant water and great care should be taken to minimize disturbance to the well. Redevelopment of monitoring wells should be considered if a monitoring well has a history of parameters not stabilizing during purging. Casing volume is calculated using the equation for the volume of a cylinder,

$$V = \pi r^2 h$$

Where height (h) is the distance from the static water level to the bottom of the casing and radius (r) is one-half the inside casing diameter. At their option, facilities can monitor for redox potential (Eh), dissolved oxygen, and turbidity during purging to provide a better indication of stability.

For slowly recovering wells incapable of yielding three casing volumes of water during purging and not amenable to low-flow purging or no-purge/passive sampling methods (which should be attempted first), the well should be sampled as soon as a sufficient volume of groundwater has entered the well to enable the collection of the necessary groundwater samples. Wells meeting these criteria should have their water levels rechecked and should be sampled during the same site visit if water levels have sufficiently recharged. Waiting until the next day to sample should be done for only wells which take a full day to sufficiently recover. Waiting until the next day to sample wells which recover the day before will only lead to the wells stagnant again and requiring, which would require re-purging.

A well is considered “dry” for the sampling event if the monitoring well does not recharge sufficiently for obtaining a representative sample within a reasonable time period (i.e., 24 hours). Alternately, these types of wells should be considered for either low flow or passive/no-purge sampling (see below).

Wells should always be purged at low steady rates of withdrawal (i.e. approximately one (1) liter per minute) to reduce the possibility of stripping VOCs from the water, mobilizing solids that are immobile under natural flow conditions, and disturbing accumulated sediment in the well.

Sampling notes including time and date that sampling was completed should be included in field log book or sampling form.

Low-Flow Purging and Sampling:

As an alternative to traditional methods of purging described above, low-flow purging and sampling may be conducted. Low-flow purging and sampling usually requires dedicated sampling pumps in the wells in order to eliminate disturbance caused by insertion and removal of the pump. Acceptable low-flow sampling devices include pneumatic positive-displacement bladder-pumps or Grundfos-type electric submersible low-flow rate sampling pumps. Sometimes, reduced flow rates using variable-speed submersible pumps like the Grundfos may result in insufficient cooling of the motor and may elevate the water temperature and affect sample integrity. If elevated water temperature occurs during use of submersible pumps, other sampling alternatives should be considered (such as pneumatic bladder-pumps). High-flow turbine or submersible pumps, and gas-contact or suction lift pumps are not acceptable for low-flow sampling of monitoring wells.

Non-dedicated pumps are usually impractical for low-flow purging and sampling, but may be used, provided that after setting the pump within the well screen, wait until the disturbance effects (mixing, volatilization, and turbidity) caused by its lowering to this depth have sufficiently dissipated – this may take several hours to as much as a full day – before initiating purging.

Bailers should not be used for low-flow purging and sampling because due to disturbance effects within the standing water column of well, which would require the traditional removal of three casing volumes before sampling.

During low-flow purging, pumping rates should be low enough to achieve minimal drawdown of the water level to prevent mixing of water within the well. The pumping rate during low flow purging should not exceed 1.0 liter/minute. Although the pumping rate may be lowered during purging and sampling, it should never be increased. If increasing the pumping rate is unavoidable, then the purging process, including demonstration of field parameter stabilization must be done again before collecting samples. The intake of the sampling pump must be located within the well screen interval.

The sampling and analysis plan should describe whether traditional purging methods or low-flow purging and sampling methods are used for each monitoring well.

Water quality parameters should be measured and recorded in the same fashion as described in the traditional purge method above. Using an in-line flow cell for automated measurement of purge parameters is highly recommended.

No-Purge and Passive Sampling

A no-purge/passive sampling approach using water-filled passive diffusion bag (PDB) samplers is suitable for obtaining concentrations of volatile organic compounds (VOCs) in groundwater at monitoring wells. PDBs are not suitable for obtaining water samples for analyses of metals; consequently, they have limited utility for groundwater monitoring at landfills. However, other types of no-purge sampling devices, including the HydraSleeve® and the snap sampler, can be used for the full suite of parameters required at landfills.

Bailers

Bailers are generally not recommended for purging or sampling if other better methods will work, because bailers create disturbance effects (mixing, volatilization, and turbidity) while being lowered or raised within the water column. NDEE recommends that the use of bailers for purging or

sampling be restricted to only low-yielding wells that are not amenable to low-flow purging or no-purge/passive sampling methods and meet the following criteria:

1. During purging, the well either goes dry before three well volumes can be removed or after purging of three well volumes, there is insufficient well volume remaining for sample collection; and,
2. The well recharges sufficiently for obtaining a representative sample within a reasonable time period (i.e., 24 hours). As stated above, the well should have its water level rechecked and it should be sampled during the same site visit if it has sufficiently recharged.

Management of Purge Water:

Purge water should be managed in accordance with NDEE's guidance on "Investigation-Derived Waste (IDW) and Remediation Waste Considerations". According to this guidance purge water should be containerized when generated. If the water is a characteristic hazardous waste it may not be discharged to the ground or back to the well. If analysis of the water determines that it is not hazardous waste and it meets groundwater standards found in [Title 118 – Nebraska Groundwater Quality Standards and Use Classifications](#), Nebraska VCP Remediation Goals, or health based standards, then the water may be poured on the ground at or near the point of generation, but never back into the well.

Discharges to surface water or drainages should be avoided because of stringent aquatic life water quality standards.

Where there is prior approval by the affected Publicly Owned Treatment Works (POTW) (Municipal Wastewater Treatment Plant) Facility, discharges directly through an on-site sanitary sewer system to a POTW may be allowed. (Note: The water cannot be transported to a Nebraska POTW if it is a hazardous waste. Nor can listed or characteristic hazardous wastewater be transported to another site that has a sanitary sewer connection to a Nebraska POTW.)

• Sample Collections and Field Determinations

The following in-situ parameters should be determined in the field after purging is completed and prior to collection of the groundwater sample. These results should be reported with the analytical results: groundwater elevation, pH, specific conductance, temperature, color, and odor. At their option, facilities can also monitor for redox potential (Eh), dissolved oxygen, and turbidity. If an inline device is used to monitor the in-situ parameters, it should be disconnected or bypassed during sample collection.

Samples should be collected and containerized as soon as possible after purging in the order of the parameters' volatilization sensitivity: in-situ parameters, VOCs, extractable organics, pesticides/herbicides, dibenzofuran/dioxin, total metals, dissolved metals, TOC, TOX, phenols, cyanide, major cations and anions, sulfate and chloride, nitrate and ammonia, radionuclides, microbiological content. Filtering, where appropriate, should be done last and in-line filters should be used.

Pumping Rate During Sampling

Pumping rates during collection of groundwater samples should not exceed 100 mL/min so as to avoid aeration of groundwater samples. Sufficient time should be allowed to discharge water remaining in the pump discharge tubing from purging activities before the actual sample is taken because the rate of sample collection is much lower than the rate at which purging is conducted.

If the well becomes dry prior to completion of the sampling event, the sampling team should return to the well no more than 24 hours later and determine if sufficient volume is available for sampling by measuring the static water level and calculating volume of water in casing. If sufficient volume is present, the sampling team should complete sampling. If volume is not sufficient, the well is considered “dry” and sampling should not be completed for the well.

Sampling with Bailers

If bailers must be used to collect samples (see above) and should be lowered and raised within the water column as slowly as possible to minimize disturbance effects.

Sample Preservation and Handling

Specific preservation methods, proper containers, and holding times for each of the constituents to be analyzed for in the groundwater samples should be followed according to SW-846 “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, including all updates. Preservatives may be added to empty prepared containers in the laboratory prior to sampling, or they may be added to the sample in the field. It is generally better to have the bottles preserved in the laboratory prior to sampling to minimize handling in the field. Samples should not be brought to the laboratory for preservation.

Only laboratory approved containers should be used. All containers should be air tight, with Teflon septa for water samples for volatile analysis. Caps should be removed carefully so that the inside of the cap is not touched and the caps should never be put on the ground. Containers for volatile organic compound analyses should be topped off so that samples contain no headspace; the sample bottle should be turned upside down and tapped to check for any unwanted air bubbles. The bottle should be re-filled with a fresh sample and the procedure repeated if bubbles are present. Caution should be taken to avoid overfilling of sample bottles, which will cause the preservative to be diluted or lost. Appropriate gloves should be worn by the sampling team.

The groundwater samples should be cooled to a temperature of 4° C, placed in insulated containers and sealed as soon as possible after they are collected. These conditions should be maintained during storage and shipment of the groundwater samples and notated on the chain of custody.

All samples should be properly labeled with the following minimum information: sample number and location, facility name, type of analysis to be conducted, date and time of sampling, sampler’s signature, method of preservation (if any). The sampling team should record sampled designations on field chain-of-custody records and field information forms. Both forms should be placed in a plastic bag, sealed, and placed inside the container. To prevent holding times from being exceeded over a weekend, Friday shipment of samples to subcontract laboratories should be avoided. Sampling personnel should follow packaging and shipping instructions supplied by the testing laboratory in order prevent damage to samples during shipment as well as comply with packaging regulations.

Chain of Custody Control

To establish the documentation necessary to trace sample possession from time of field collection through completion of laboratory analysis, a chain-of-custody record should be filled out and accompany the samples. The record should contain the following information:

- sample identification number for each sample submitted,
- date and time of collection for each sample,

- media sampled (e.g. groundwater),
- sample type (grab),
- the corresponding analytical method or description of analytes for which testing is to be performed
- identification of sampling location/well,
- number of containers,
- parameters requested for analysis,
- signature of collector,
- signature of person involved in chain of possession and times, inclusive dates of possession with time in 24 hour notation,
- internal temperature of shipping container when samples were sealed into the container for shipping,
- internal temperature of shipping container when samples are removed at the laboratory,
- any remarks regarding potential hazards or to relay other information to the laboratory, and
- condition of samples (bubbles, cracks, leakage, unlabeled, frozen).

Field Information Forms

By documenting field tasks and data on field information forms, the sampling team provides quality control of field activities. Field notes for each monitoring well (See Table 1 below) should include:

- monitoring well number/identification,
- sample number with date and time of sampling,
- weather,
- sampler name(s),
- instrument calibrations,
- wellhead inspection,
- OVA readings,
- presence, elevation, and thickness of immiscible layer,
- depth to static water level,
- depth to bottom of casing, casing diameter, calculated casing volume,
- volume of water purged,
- water level measuring equipment used,
- purge equipment used, purge rate and elevation of pump intake (if pump used) (time to purge if bailer used),
- sampling equipment used, pump rate during sample collection (if pump used),
- purge parameters (volume purged, time, pH, temperature, specific conductivity, turbidity, redox potential, dissolved oxygen),
- well pumped to dryness,
- in-situ field parameters during sample collection (time, pH, temperature, specific conductivity, turbidity, redox potential, dissolved oxygen),
- method of sample preservation, and
- unusual occurrences

Forms should be signed by the appropriate individuals performing the field work. The forms should be included in the semi-annual monitoring reports.

Filtration

The following sampling parameters do not require field filtering: Semi Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs), Total Organic Halides (TOX), pH, Specific

Conductivity. All laboratory analyses for the metals should be for total concentrations on unfiltered samples.

At their option, facilities may also field filter groundwater samples, analyze them for dissolved metals, and submit the data to NDEE with the total metal results. A 10- micron filter should be used when collecting groundwater samples for dissolved metal analyses.

Filtration should be performed immediately after or during sample collection with inline filters and should be done in the field. Filtering equipment should be dedicated for groundwater only, and should be disposable. For example, surface water, private wells, and leachate samples are never filtered unless specifically required.

All samples requiring filtration should be filtered using an inline filtration system, if possible. Enough water should be allowed to pass through the filter to thoroughly wet it before obtaining a sample.

Filling Sample Bottles

Sample bottles should be filled directly from the sampling device with a minimal amount of air contact. Special care should be taken so that volatile organic analysis (VOA) and TOX bottles are completely filled and headspace-free; that is, no air bubbles present in the sample bottle. Special care should be taken to assure that the sample bottles for VOCs are completely filled, leaving no headspace at the top of the bottle. This is accomplished by inverting the full, capped bottle and tapping it to detect whether any air bubbles rise in the bottle. If bubbles are present, the bottle should be re-filled with a fresh sample, and the procedure should be repeated. All bottles or containers should be kept in a clean and locked storage area.

When filling the sample bottles, the following procedures should be followed:

Bottle caps should be removed carefully so that the inside of the cap is not touched. Caps should never put on the ground. Caps for VOA vials contain Teflon lined septum. The Teflon side of the septum should be facing the sample to prevent contamination of the sample through the septum. Sampling team members should wear appropriate gloves. The sample coolers should have ice packs in them before taking them into the field.

- **Analytical Procedures**

Title 132, Appendix I is a list of constituents for detection monitoring containing 47 volatile organics for which possible analytical procedures are provided in EPA Report SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods". This includes Method 8260; and 15 metals for which SW-846 provides either Method 6010 or a method from the 7000 series of methods. Procedures found in SW-846 are also applicable for analyzing Title 132, Appendix II constituents. SW-846 can be downloaded at: <https://www.epa.gov/hazardous-waste-test-methods-sw-846>.

Table 1 – Field Notes for Monitoring Well

FACILITY NAME:	SAMPLER NAME(S):
Monitoring Well Identification Number:	Date:

Groundwater Measurements and Purge data:

- | | |
|---|--|
| 1. Static Water Level ¹ (± 0.01 ft) _____ | 7. Water Level Measuring Equipment _____ |
| 2. Bottom of Casing ¹ (± 0.01 ft) _____ | 8. Purge Equipment Used _____ |
| 3. Casing Diameter _____ | 9. Dedicated? (Yes or No) _____ |
| 4. Casing Volume _____ | 10. Purge rate (if pump used) _____ |
| 5. 3 X Casing Volume _____ | 11. Time to purge well _____ |
| 6. Actual Volume of Water Purged _____ | 12. Immiscible layer observed (Yes or No) _____ |
| | 13. Thickness of immiscible layer (if present) _____ |

1-Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters

Time	Volume Purged	Temperature °C	pH	Conductivity

Well Evacuated to Dryness? (Yes or No) _____ Time to recharge? _____

Groundwater Sample Information:

	Time	Temperature °C	pH	Conductivity

1. Sampling Equipment used _____
2. Pump Rate _____

Other Information:
Decontamination Procedures

3. Sample Appearance:
Clear or Turbid? _____
Color _____

Instrument Calibrations:

4. Odor _____
5. Method of Sample Preservation _____

Unusual Occurrences

Quality Assurance Project Plans

The ultimate success of an environmental data collection effort depends on the quality of the data collected and used to make decisions. A Quality Assurance Project Plan (QAPP) should be prepared to document how environmental data collection operations are planned and implemented and how the results are assessed. The QAPP should also define the specific Quality Assurance (QA) and Quality Control (QC) activities that will be applied to ensure that the collected environmental data are of the type and quality needed for a specific decision or use. Field QC samples should be collected and analyzed to assess the quality of data generated from sampling activities. These samples may include trip blanks, field blanks, equipment rinse blanks, field duplicates, field split samples, matrix spike (MS) samples, matrix spike duplicate (MSD) samples, and matrix duplicate samples. Field QC measurements may also include field replicate measurements and checks of instrument responses against QC standards.

Trip blanks, field blanks, and equipment blanks should be free of contaminants. If contaminants are detected, the data from the environmental samples may be compromised.

- **Field Quality Control Procedures**

Trip Blanks

Trip blanks are a required part of the field sampling Quality Control (QC) program. Trip blanks are used to assess the potential for sample contamination during handling, shipment, and storage. Trip blanks will consist of VOA vials filled with ASTM Type II water at the laboratory. The trip blanks are sealed and transported to the field; kept with empty sample bottles and then with the investigative samples throughout the field effort; and returned to the laboratory for analysis with the investigative samples. Trip blanks are never opened in the field. One trip blank will be included within every shipping cooler of liquid samples to and from the field to be analyzed for VOCs to detect any cross-contamination during handling and transport. Trip blank results should be reported in the laboratory results as separate samples.

Field Blanks

Field blanks are a highly recommended part of the field sampling QC program. Field blanks are samples of the same or similar matrix as the actual investigative samples that are exposed to the sampling environment or equipment at the time of sampling. They are used to assess contamination resulting from ambient conditions; that is, any contamination which might be introduced into the groundwater samples through the air. For aqueous samples, field blanks consist of analyte-free water such as degasified organic-free water for VOC analysis, High Performance Liquid Chromatography (HPLC) water for SVOC analysis, and deionized or demineralized water for inorganic analyses. Typically, one field blank is collected for every 10 or fewer liquid investigative samples.

Field blanks should be prepared in the field (at the sampling site) using laboratory-supplied bottles and deionized or laboratory reagent-quality water. Each field blank is prepared by pouring the deionized water into the sample bottles at the location of one of the wells in the sampling program. The well at which the field blank is prepared should be identified on a field information form. Wind conditions or potential sources of airborne contamination should be noted on the Form to help explain anomalous results. Once a field blank is collected, it is handled and shipped in the same manner as the rest of the samples.

For dedicated or disposable equipment requiring no filtration, or inline filtration, the deionized or laboratory reagent-quality water is exposed to the air, transferred to the field blank bottles and the proper preservative added. For non-inline filtration, the water is exposed to the air, poured into pre-filtration bottles, filtered, placed in the field blank bottles, and the proper preservative added as required.

Field blank results should be reported in the laboratory results as separate samples, using the designations FB-(well #) as their sample point designation. The field QC data should be submitted with the groundwater monitoring results.

Equipment Blanks

Equipment rinsate blanks are collected when non-dedicated sampling equipment is used. One equipment rinsate blank should be collected to assess the cleanliness of sampling equipment and the effectiveness of equipment decontamination. This is accomplished by pouring analyte-free (deionized or laboratory reagent-quality) water over surfaces of cleaned sampling equipment that contact sample media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated but prior to being reused for sampling. Equipment should be rinsed once with the analyte-free water, brushing the equipment with laboratory quality soap, and triple rinsing the equipment with the analyte-free water. The analyte free water should be poured into the non-dedicated sampling device prior to sampling. Equipment rinsate blanks are typically collected for each type of decontaminated sampling equipment. This rinsate sampling analysis will be accomplished in a manner that will not interfere with the procedures and method requirements of the ongoing field-sampling program. The rinsate blank should be analyzed for the same required monitoring parameters as the well samples

If the analytes for the equipment blank would normally be filtered, this water should be placed into a pre-filtration bottle and subsequently filtered.

Equipment blank results should be reported in the laboratory results as separate samples, using the designation EB-(well#) as their sample point designation.

Field Duplicates

Field duplicate samples are independent samples collected as close as possible in space and time to the original well sample. Immediately following collection of the original sample, the field duplicate sample is collected using the same collection method. Care should be taken to collect the field duplicate sample as close to the location of the original sample as possible. Field duplicate samples can measure how sampling and field procedures influence the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. One field duplicate groundwater sample will be collected (sequentially) at a frequency of one for every 10 well samples. A minimum of one field duplicate sample should be taken, even if less than 10 well samples are collected. Blind (laboratory does not know identity) duplicates should be collected from sampling points, which are known or suspected to contain elevated levels of a particular constituent. The duplicate(s) should be analyzed for the same required monitoring parameters as the well samples.

Laboratory Quality Control Procedures

The laboratory QC elements including laboratory spikes and blanks will be performed in accordance with the latest versions for EPA analytical methods SOPs and EPA Region 7 SOP No. 2430.12, "Regional Laboratory Quality Control Policy", or equivalent SOP supplied by the facility.

The facility should describe the QC program that will be used in the laboratory that conducts the analyses of the groundwater samples. Laboratory blanks, standards, duplicates, and spiked samples should be used for calibration and identification of potential matrix interferences. Statistical procedures can be used to monitor and document performance and to implement an effective program to resolve analytical testing problems. Analytical data from QC samples (e.g. blanks, spiked samples) should be used as a measure of performance or as an indicator of potential sources of cross-contamination, but should not be used by the laboratory to alter or correct analytical data. Chapter One of SW-846 provides guidance for laboratory QC programs.

The laboratory QC data should be submitted with the groundwater monitoring results. Laboratory QC data should include method blanks, matrix spike/matrix spike duplicate, and surrogate spikes. Minimum laboratory QC results should include:

- Internal lab spikes complete with true value, measured value, and percent recovery to be used during the data review process to provide a measure of accuracy.
- Internal lab duplicate results in the form of Percent Relative Difference to provide an additional measurement to field duplicate data for precision.
- The results of the internal lab blank to provide additional information on representativeness of the data.

• **Practical Quantitation Limits (PQLs)**

Laboratory analytical data sheets should include the Method Detection Limits (MDLs) and Practical Quantitation Limits (PQLs) for each analyte. For constituents that have designated Maximum Contaminant Levels (MCLs) or health-based levels, the PQL should be below the MCL or health-based level for the respective constituent.

Laboratory-specific PQLs should be used as the reporting limits of applicable low-detection analytes (especially organics).

Establishing Background Water Quality

• **Sampling Objectives**

The goal of establishing background water quality is to obtain the true range of ambient concentrations of targeted water quality parameters in the groundwater system. It should eliminate or minimize statistical variability in groundwater chemistry that is not attributable to the monitored facility. For accurate background data, a sufficient number of upgradient wells is necessary for inter-well comparisons. For intra-well comparisons, wells downgradient of facility should not be previously impacted by the solid waste disposal area.

In order to meet the goal of establishing background water quality, the following objectives should be met:

- Collect the minimum number of samples that meet the requirements of the statistical method being used.
- Incorporate seasonal or temporal variability into the background data being collected.
- Incorporate the spatial component of variability into the background data set. This is the variability that comes with collecting samples from different locations within the same groundwater zone. Research has shown this variability to be the largest source of variability in statistical methods for analyzing groundwater quality. Eliminating this source of variability

is important in developing an effective detection monitoring program. This can be accomplished through the use of intra-well comparisons or use of multiple upgradient wells to develop an adequate background dataset for inter-well comparisons.

- **Sampling Parameters**

The following parameters should be sampled for during background groundwater monitoring:

- Title 132 Appendix I constituents (for Option 1 and Option 2 Detection Monitoring)
- The “leachate indicator parameter list”: Ammonia as Nitrogen, Chemical Oxygen Demand (COD), Chloride, Iron, Sodium, Total Dissolved Solids (TDS), Total Organic Carbon (TOC), and Total Organic Halogen (TOX) (for Option 2 Detection Monitoring)
- An alternative list of sampling parameters proposed by a qualified groundwater scientist or hydrogeologist

Establishing background water quality applies to all solid waste disposal areas accepting municipal solid waste, industrial waste, delisted waste and fossil fuel combustion ash. A facility may request an alternate list of sampling parameters based on waste and leachate characteristics in accordance with Title 132, Chapter 7 §004.01B and §004.01C.

Background monitoring should be consistent with the Sampling and Analysis Procedures and Reporting and Recordkeeping Requirements of this guidance document. For example, it is important that field measurement data (i.e. specific conductance, pH, temperature, groundwater elevation, etc.) be collected during background water quality sampling.

- **Sampling Frequency**

The number and frequency of samples collected for establishing background water quality at a site is determined by the statistical methodology proposed and detailed in Title 132, Chapter 7 §003.06, §003.07 and §003.08.

If inter-well comparisons are to be used at the site, quarterly sampling for a minimum of two years should be performed at all facility monitoring wells in order to incorporate seasonal variability into the background database. This approach accounts for seasonal/temporal variability as well as the spatial component of variability that are necessary requirements of the statistical methods being used.

For facilities that use intra-well statistics, quarterly background sampling should consist of eight sampling events at all monitoring wells prior to beginning statistical analyses. Eight events should ensure an adequate data set for statistical analyses and account for seasonal/temporal variability. Upgradient wells should be included in the sampling program as they are useful for detecting off-site migration of groundwater from an upgradient source to the facility.

Quarter one is defined as the months of January, February, and March. Quarter two is defined as the months of April, May, and June. Quarter three is defined as the months of July, August, and September. Quarter four is defined as the months of October, November, and December.

Reports from each quarterly sampling event must be submitted within thirty (30) days of the end of the quarter in accordance with Title 132, Chapter 2, §007.05.

Detection Monitoring Program

Once the background water quality sampling has been completed, the facility must select one of the following options as its detection monitoring program:

- **Option 1:** The facility should sample groundwater from all facility monitoring wells for Title 132, Appendix I parameters semiannually in accordance with Title 132 Chapter 7 §004.
- **Option 2:** The facility should sample groundwater from all facility monitoring wells for Title 132, Appendix I parameters annually and the leachate indicator parameter list semiannually.
- **Option 3:** The facility may propose alternative monitoring frequency and/or list of parameters for Department to review in accordance with Title 132, Chapter 7 §004.01B, §004.01C and §004.02C. An alternative monitoring program can be proposed by a qualified groundwater scientist or hydrogeologist based on waste, leachate and site hydrogeologic characteristics. It is suggested that the facility consult with the Department for guidance prior to proposing an alternative frequency and/or list of parameters. Guidance for proposal of an alternative monitoring frequency is provided in Alternative Detection Monitoring Sampling Frequencies.

Semiannual groundwater sampling events should be conducted during quarters two and four of each calendar year. Reports must be submitted by August 1 and February 1 of each calendar year for quarter two and four sampling events, respectively.

Detection monitoring applies to all solid waste disposal areas accepting municipal solid waste, industrial waste, delisted waste and fossil fuel combustion ash. Except as noted in this protocol, detection monitoring must be conducted according to Title 132, Chapter 7 §004 and the Sampling and Analysis Procedures and Reporting and Recordkeeping Requirements of this guidance document.

Statistical Analysis and Data Evaluation

The NDEE recommends that the regulated facility obtain the services of a professional consulting firm with expertise in statistical analyses and the use of landfill monitoring software packages. Guidance on statistical evaluation for landfills is available through USEPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance (USEPA, 2009) and the addendum to that guidance (EPA, 1992) as well as ASTM D 6312-98 Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs.

Intra-well monitoring is usually the preferred approach to statistical analysis of groundwater monitoring data as it eliminates the spatial component of chemistry variability from the statistical evaluation. However, intra-well comparisons are appropriate only if it can be demonstrated that wells have not been impacted by site disposal activities. Intra-well is the preferred monitoring strategy when there is:

- No definable groundwater gradient
- No pre-existing contamination
- Too few upgradient wells
- Radial groundwater flow patterns
- Low groundwater flow rate (e.g. 50 ft/year)

In the semi-annual monitoring reports, the qualified hydrogeologist should assess the potential for sample contamination by examining the results of measurements of the field, lab, and equipment blank samples. It is assumed that any analytes which occur in the field or laboratory, which might add to the

concentration of the analyte in the sample, will be picked up by the blank samples and measured. When analytes of interest are found in the blank samples, it indicates the potential contamination of the unknown sample.

Assessment Monitoring

Assessment monitoring must be conducted in accordance with Title 132, Chapter 7 §005 if during detection monitoring a statistically significant increase (SSI) over background has been detected and verified for one or more of the detection monitoring program constituents (Figure 1).

Examples of assessment monitoring schedule options for a given monitoring well are shown in Figures 2 and 3. Conducting assessment monitoring applies to all solid waste disposal areas accepting municipal solid waste, industrial waste, delisted waste and fossil fuel combustion ash. A qualified groundwater scientist or hydrogeologist may propose an alternative monitoring frequency and/or list of parameters based on waste, leachate and site hydrogeologic characteristics in accordance with Title 132, Chapter 7 §005.02D and §005.03.

Figure 1 – Ground Water Monitoring and Remedial Action for Solid Waste Disposal Areas

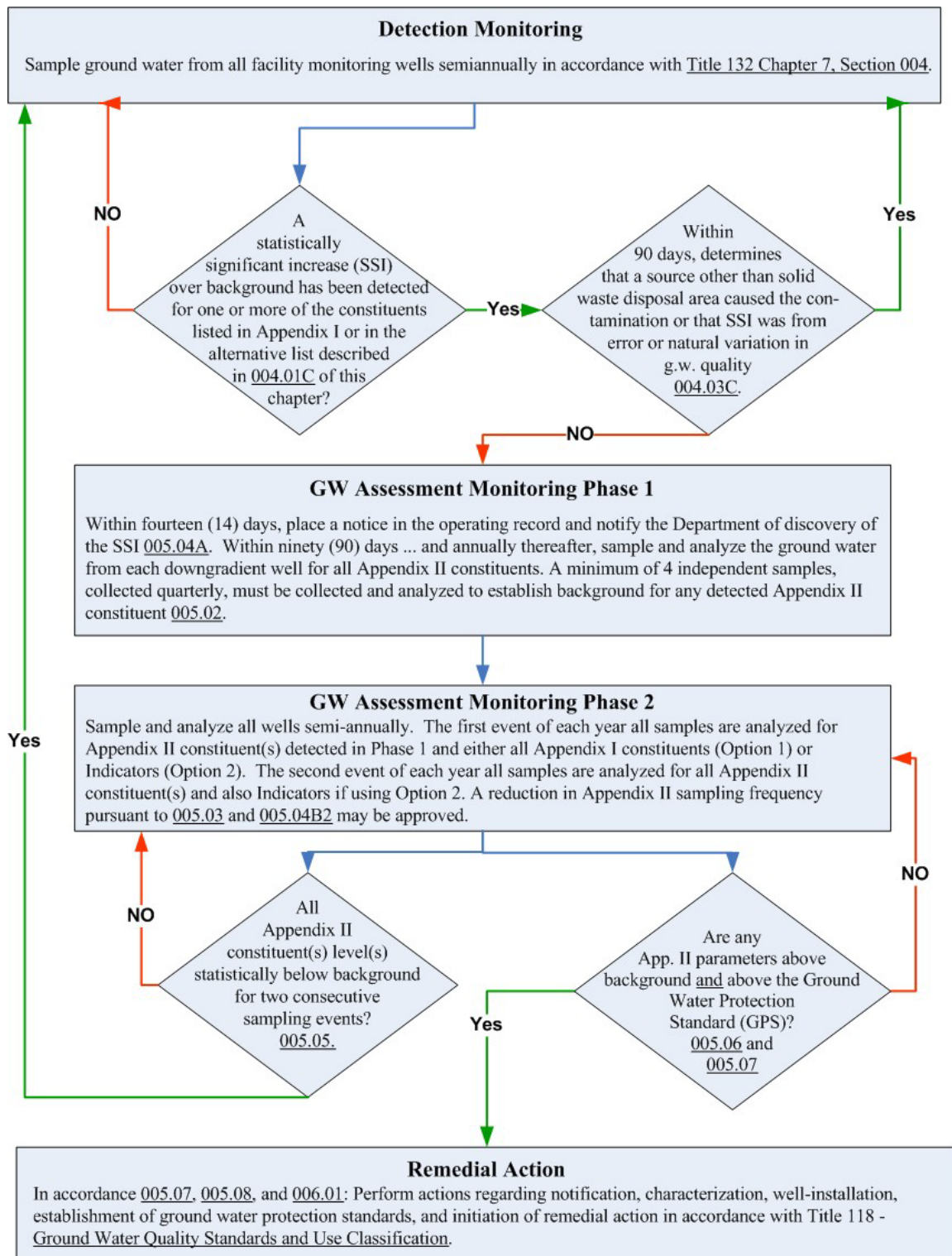


Figure 2 – Example of Assessment Monitoring Schedule Option 1

	4 th Quarter 2009	1 st Quarter 2010	2 nd Quarter 2010	3 rd Quarter 2010	4 th Quarter 2010	1 st Quarter 2011	2 nd Quarter 2011	3 rd Quarter 2011	4 th Quarter 2011**
MW-1A	Complete Appendix II	Appendix II detects*	Appendix I & Appendix II detects*	Appendix II detects*	Complete Appendix II*		Appendix I & Appendix II detects		Complete Appendix II

* Recommended sampling events to establish background levels of Title 132, Appendix II detects.

** Monitoring schedule continues beyond 4th quarter 2011

Figure 3 – Example of Assessment Monitoring Schedule Option 2

	4 th Quarter 2009	1 st Quarter 2010	2 nd Quarter 2010	3 rd Quarter 2010	4 th Quarter 2010	1 st Quarter 2011	2 nd Quarter 2011	3 rd Quarter 2011	4 th Quarter 2011**
MW-1A	Complete Appendix II & Indicators	Appendix II detects*	Indicators & Appendix II detects*	Appendix II detects*	Complete Appendix II* & Indicators		Indicators & Appendix II detects		Complete Appendix II & Indicators

• Recommended sampling events to establish background levels of Title 132, Appendix II detects.

** Monitoring schedule continues beyond 4th quarter 2011

Reporting and Record Keeping Requirements

Groundwater sampling reports must be submitted according to Title 132 Chapter 2 §007.05, and should be consistent as outlined previously in this guidance document.

The groundwater monitoring report should include the following:

- Site map with monitoring well locations, groundwater elevations and water table and/or potentiometric surface contour map(s), groundwater flow direction, estimated groundwater flow velocity.
- Chain of custody, analytical reports, and field and laboratory QC data.
- Name and NDHHS-issued license number of each Water Well Monitoring Technician or Pump Installation Contractor, as appropriate,
- Statistical Analyses in accordance with Title 132 Chapter 7 §003.07 and §003.08. For guidance on statistical analyses, refer to USEPA Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities – Unified Guidance (USEPA, 2009) and the addendum to that guidance (EPA, 1992) as well as ASTM Designation D 6312-98: Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs.
- Hand-entered field notes for each monitoring well, which include all of the elements listed above in “Sample Preservation and Handling”. In addition to the hand-entered notes, the facility may also submit retyped field notes.
- Discussion and evaluation of significant findings, including observation of SSIs during detection monitoring and contamination of samples (see last paragraph of “Statistical Analyses and Data Evaluation” above).
- Additional actions taken or planned to address significant findings. Significant Operation and Maintenance issues and actions (i.e. monitoring well damage, destruction, repair, replacement, or redevelopment).

Electronic and hardcopies of the original report should be submitted.

The name and license number of sampler(s)/supervisor(s) should be specified in the SAP and in the groundwater monitoring reports.

RESOURCES:

- NDEE Home Page <http://dee.ne.gov/>
- DHHS Home Page <http://dhhs.ne.gov/>

Contacts:

- NDEE Main Line (402) 471-2186
- NDEE Toll Free Number (877) 253-2603
- NDEE Hazardous Waste Compliance Assistant (402) 471-8308
- Email questions to: NDEE.moreinfo@nebraska.gov

NDEE Publications:

- [Title 118 – Groundwater Quality Standards and Use Classifications](#)
- [Title 128 – Nebraska Hazardous Waste Regulations](#)
- [Title 132 – Integrated Solid Waste Management Regulations](#)

Titles are available on the NDEE Home Page under “Laws/Regs & EQC”, “Rules & Regulations”

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