Approved by:	[signature]	[signature]
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.16
GROUNDWATER SAMPLING

1.0 OBJECTIVE

To establish groundwater sampling and analysis procedures that will provide quality data for evaluation of waste treatment and disposal unit integrity and environmental quality. The plan is consistent with and will run concurrently with the groundwater-monitoring program defined in the State RCRA Permit.

2.0 SCOPE

This procedure applies to all environmental monitoring samples collected from the groundwater monitoring wells and the secure cell leachate collection system, leak detection system and permanent sumps as well as the leak detection system in the treatment building.

3.0 POLICY

All Clean Harbors Deer Trail (CHDT) activities that could result in discharges of radioactive materials to groundwater or effluents are subject to the groundwater-monitoring program.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), the facility Compliance Manager, and other CHDT management and staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GROUNDWATER SAMPLING PROCEDURE

5.1 Container Preparation

5.1.1 The containers will be constructed of a material compatible and non-reactive with the expected sample aliquots. Consult Section 6.0, Table 4.0, Recommended Sample Handling, Preservation, and Instrumentation, to determine the number, type and volume of containers needed. Metal lids should not be utilized. Plastic lids with polyethylene or Teflon liners are acceptable in most cases.

5.1.2 Individual aliquot containers are not required for each determination or test. If two or more tests require the same container and preservation, and a container of sufficient size is available, the sample aliquots may be combined.

5.1.3 Generally the analytical laboratory will supply the sample containers. The laboratory will clean the containers before shipment to the Facility in accordance with the laboratory's quality assurance program. The Laboratory will provide documentation certifying the containers to be analyte-free. Alternatively, the laboratory may provide sample containers that have been purchased from a vendor, provided the vendor can provide documentation certifying the containers to be analyte-free. If the Laboratory and/or vendor do not supply sample containers the containers shall be cleaned in accordance with Section 5.6.

5.1.4 If the sample locations and tests are known prior to collection, the container labels may be partially completed and the chemical preservatives added to the containers (where applicable) before sampling.

5.1.5 The Laboratory will generally supply sample shuttle kits (each) consisting of an insulated cooler, pre-cleaned containers, labels, seals, and Chain-of-Custody, field log, and shipping forms. The sampling crew will supply refrigerant at the time of sampling.

5.2 Well Inspection

The monitoring wells shall be inspected prior to each groundwater-sampling event. During the well inspection, water levels will be measured to determine which wells contain water and which wells are dry. The depth to water, if any, and total well depth shall be measured during the inspection. These data will be recorded on the form provided in Section 7.0. Personnel will also note well conditions, as appropriate, on this form.

5.3 Well Evacuation

Prior to purging the well in preparation for sampling, the groundwater personnel will perform the following tasks:

- Measure depth to water.

The procedures to perform these tasks are described in Section 5.4.

6 CCR 1007-3 264.97 (a)(2) requires that groundwater samples must represent the quality of water passing the point of compliance to ensure that the water sampled is not stagnant and therefore representative of the surrounding groundwater conditions. To meet this requirement, the following protocol shall be followed for purging or evacuating wells:

5.3.1 Rapidly recovering wells are defined as those wells, which recover at least 90% of one well volume in less than 12 hours.

- Rapidly recovering wells shall have approximately three well volumes removed prior to sampling.
- Sampling of these wells shall be completed within 24 hours from the time that the last well volume is purged.

5.3.2 Low yield or slowly recovering wells are those wells, which take longer than 12 hours but less than 48 hours to recover at least 90% of one well volume of water. Sampling of low yield wells will be following the Groundwater Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure contained in Section 8.0.

- Low yield wells shall be totally evacuated (to the extent practicable) only one time prior to sampling.
- Sampling of these wells shall be completed within 48 hours of the well evacuation.

5.3.3 Dry wells are defined as a well, which contains no water or requires longer than 48 hours to recover after evacuation. These wells shall not be sampled.

5.3.4 During each sampling event each previously dry well shall have been checked during the well inspection procedure to determine if water is present in the well. If water is present, it shall be purged as described above.

5.3.5 During the first sampling event all inspection and detection monitoring wells shall be classified as a rapidly recovering, low yield or no-yield well.

- The first sampling event classifications and measurement of well recovery data shall be recorded on the form in Section 7.0. The form presents a protocol for classifying the wells relative to recovery. The results of this well recovery classification shall be included in the Monitoring Report.
- During the second sampling event each well will be evacuated and sampled in accordance with the procedures applicable to that well's recovery classification, which was determined in the first sampling event. Well evacuation procedures and data for those semiannual events will be recorded on the form presented in Section 7.0.

5.3.6 In order to prevent well contamination, one of the following well purging procedures will be utilized:

- A dedicated bailer, constructed of the same material as the well casing, Teflon, or stainless steel, attached to the reel with a single strand of stainless steel wire or a monofilament line, shall be used. If necessary, the reel will be mounted on a tripod and set directly above the well opening. The bailer and cable should only contact the internal well casing. The reel's monofilament line will be wiped with a clean towel moistened with de-ionized water as the bailer line is retrieved. As the last bailer-full is pulled, the cable will be wiped away from the well casing opening with a freshly prepared reagent grade methanol/D.I. water saturated cloth. Care must be exercised not to permit excessive methanol/water to drop into the well, possibly resulting in contamination of the well. Well water will be evacuated from the uppermost part of the water column to assure that fresh water moves upward from the screen.
- A dedicated system composed of either an electrically powered submersible pump, a gas operated positive displacement (bladder or piston) pump, or a gas lift purge pump may be used. The pump intake will be located approximately a foot above the bottom of the screened area to minimize the potential for electrically powered submersible pumps to burnout upon total evacuation. Electrically powered submersible pumps will not be operated when the water level in the well drops below the pump intake.

5.3.7 If non-dedicated equipment is used in well purging, that equipment will be cleaned before evacuating each well. The equipment shall be cleaned and stored per the procedures outline in Section 5.6. (Note: All groundwater wells at the Deer Trail Facility, except the dry wells, utilize dedicated purging and sampling equipment.)

5.3.8 All dedicated bailers will be inspected at the time of well purging for cleanliness and functionality.

5.3.9 All dedicated equipment temporarily removed from its well for repair (i.e. Maintenance Building or Off-site) shall be decontaminated as described in Section 5.6. Equipment blank samples shall be taken on all dedicated equipment that has been temporarily removed from the well for repairs in Maintenance Building or Off-site and after it has been decontaminated.

5.3.10 All purge water shall be collected in a calibrated container to determine evacuation rate and volume. Well water not used for sampling will be transferred to a central collection point (portable collection tanks), and evaluated for proper wastewater management.

5.4 Field Records (Evacuation)

A separate evacuation field log for each well shall be maintained to record all pertinent information regarding the evacuation and sampling of monitoring wells. Sample forms are presented in Section 7.0. The form will be utilized during the first sampling event for classifying wells according to their recovery characteristics. The form in Section 7.0 will be utilized for all other sampling events. This recorded information is necessary to maintain well sampling data and becomes part of the analytical report. The sample collector shall sign and date each page of the field log (see Section 7.0). The following data shall be determined and recorded upon the evacuation of each well:

- Sample collector's name, date and time that evacuation was initiated and completed.
- Site and Location
- Event and Year
- Well Identification - i.e., monitor well number, code or name.
- Well Depth - Measure from a marked reference point at the top of the casing to the bottom of the well to the nearest 0.01 foot with a clean weighted measuring tape or a calibrated water level indicator. Wells with dedicated pumps will be re-developed at a minimum once a year during the second quarter, or at any time should excessive silting occur. Well depth will be measured after re-development and recorded on the sampling log.
- Water Level Depth - Measure from the marked reference point at the top of the well casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator. The water level indicator shall be calibrated and any correction factors noted on the meter, and the factor, if any, will be applied to the water level depth measurements. Each well shall have a marked measurement reference point at the top of the casing from which its water level is taken. An elevation/location reference point shall be established in relation to mean sea level by a licensed surveyor for each well, the marker is typically located on the concrete well pad. The reference point shall be established in relation to mean sea level and the survey shall also note the well location coordinates.

The tape or water level indicator shall be cleaned following each measurement of well and water level depth. The equipment shall first be washed with non-phosphate detergent and potable water, using a bristle brush made from inert material to help remove visible dirt. The equipment will then be rinsed with potable water, and then rinsed again with deionized water. Air dry thoroughly before using the cleaned equipment.

- Record total gallons evacuated - Well yield
- Record water level (in feet) following evacuation.
- Record method of evacuation - type of bailer, pump, etc.
- Comments - Any deviation from standard sampling procedures, unusual conditions, damage or problems encountered at each well should be recorded completely, clearly and concisely.

5.5 Sampling the Monitoring Wells

Refer to Table 5.0 for a list inspection and detection monitoring wells. Each well listed in this table requires an inspection at each sampling event. Wells which require the collection of sample aliquots are designated here as detection wells and shall be evacuated according to the procedures listed in this document. After the wells have been evacuated, the containers and sampling equipment shall be prepared and the initial log data entered. Those wells that meet the recovery criteria specified in Section 5.3 shall be sampled as follows:

5.5.1 Re-measure the water level depth to the nearest 0.01-foot and record on the field sampling log (Section 7.0).

5.5.2 All non-dedicated equipment used to sample the well (e.g., bailer, funnel, etc.) must be cleaned and stored per the procedures outlined in Section 5.6.

5.5.3 During the normal course of sampling equipment blanks will not be taken from wells utilizing dedicated sampling equipment. If the dedicated equipment is removed from the well for any reason other than the normal course of sampling or well purging, then the equipment will be decontaminated and an equipment blank will be collected from the final rinse of the decontamination process which was performed in accordance with Section 5.6.

5.5.4 If the well is equipped with a dedicated submersible pump, it will be used to sample the well. Wells shall be sampled within the time periods specified in Section 5.3.

5.5.5 Wells not equipped with a pump system will be sampled utilizing a bailer. The bailers will be constructed of stainless steel, Teflon or of the same material as the well casing, attached to a reel with a clean single strand stainless steel wire or a monofilament line. The reel will be mounted on a tripod if necessary and set directly above the well opening. Except as specified in Section 5.3.7 the first bailer-full collected shall be used to rinse the bailer and managed as described in paragraph 5.3.10. If the well has recharged sufficiently to collect all samples required. If the well contains insufficient water to generate the necessary aliquots, then the first bailer-full may be used to collect the sample, rather than discarding it as rinse water. Samples will be transferred, with as little agitation as possible, from the bailer to the sample containers and immediately preserved according to the specific test requirements. Upon withdrawing the last bailer-full, the cable will be wiped away from the well casing opening with a fresh clean cloth saturated with deionized water and reagent grade methanol. Care must be taken not to allow any excess methanol/water mixture to enter the well.

5.5.6 All samples collected for transport to the Laboratory shall be chemically preserved (if applicable). See Section 6.0, Table 4.0, for specific requirements.

5.5.7 The following determinations will be made in the field at the time of sampling and recorded on the field logs:

- pH
- Specific Conductance
- Temperature
- Redox Potential
- Calibration checks
- Turbidity

Field monitoring instruments including pH, specific conductance, and turbidity meters, shall be calibrated each day of sample collection prior to sampling. In addition, the calibration of these instruments shall be verified using certified standards prior to the sampling of each well. All calibration verifications will be recorded in the designated logbook.

5.5.8 Sample Shipment - Samples will be shipped in sealed insulated shipping containers, ice chests or coolers supplied by the analytical laboratory conducting the analyses. Shipment and receipt of samples must be coordinated with the laboratory to minimize time in transit. To insure arrival at the laboratory in good condition, the samples will be sent in sturdy insulated ice chests (coolers). An air courier or equivalent overnight courier service will be utilized, if necessary.

5.5.9 One well field duplicate will be obtained for 20 wells (batch) in each scheduled sampling event. Duplicated sampling of wells will be determined by the random sampling method discussed in Appendix 8 of this plan. Only those wells that have traditionally produced a sufficient volume of water to fill a complete Background Parameters (Groundwater Protection Program Table 2.0) or Detection Monitoring (Groundwater Protection Program Table 3.0) bottle set will be included as potential duplicate well candidates. Duplicate sample aliquots (except for volatile analysis samples) will be collected in quarter-bottle increments to ensure inter-sample homogeneity.

5.6 Decontamination of Non-Dedicated Evacuation and Sampling Equipment and Non-Laboratory Supplied Sampling Equipment

The cleanliness of the containers, evacuating and sampling equipment is most important.

5.6.1 Bottles and lids to contain samples must be hand washed with a liquid hand dishwashing detergent, rinsed in hot tap water, rinsed with chemically pure or reagent grade nitric acid, rinsed at least four times with tap water and four times with distilled or deionized water and allowed to air dry.

5.6.2 Glass bottles used to collect samples for analysis shall be washed with a liquid hand dishwashing detergent, rinsed with hot tap water, rinsed with reagent grade methanol, finished with D.I. water (at least six rinses), and kiln baked at 300^{o} C. Caps and teflon liners, shall be prepared in the same manner, except without the kiln bake. When the bottles are cool and the caps and liners are completely dry, cap the bottles and store them in a clean and dry environment.

5.6.3 All non-dedicated equipment used to bail or sample a well must be cleaned in the same manner prescribed for cleaning the bottles and lids for conventional analysis described in A. above, and stored in a clean and dry environment. Clean bailers must be wrapped in new aluminum foil with the bright side out, or high-grade paper for storage.

5.7 Field Records (Sampling)

5.7.1 It is most important to maintain an accurate and thorough field log in case one is required to recall particular detailed information concerning the evacuation and sampling of a monitor well. As mentioned earlier, these logs become part of the analytical report. In addition to the information recorded during the purging process, the following information will be also be recorded on the field log at the time of sampling:

- Sample collector's name, date and time of sampling.
- Water Level Depth - Measure from the reference point at the top of casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator.
- Reason for sampling - e.g., semi-annual sampling, special problem
- Initiator requesting the well sampling.
- Sample identification number for each set of samples taken from a single sample source.
- Sample pH, specific conductance, temperature, turbidity, Redox Potential and calibration documentation.
- Method of sample collection - type of bailer, pump, etc.
- Sample characteristics such as color, odor, sediment, surface oil, etc.
- Sample volume, containers, and preservatives.
- Test to be performed on each sample (if known).
- The weather conditions at the time of sampling.
- Sample sequence number - Order in which well was sampled with respect to other wells onsite. If more than one sampler or sampling team are participating in the sampling event, each sampler or team shall record the sequence or order in which each well was sampled with respect to the other wells they have sampled.

- Any additional field observations, comments or recommendations - e.g., split sampling (with whom), re-sampling, equipment failures, condition of the well, etc.
- Sample Custody Statement - If the samples are transferred to the receiving laboratory by the collector and are in his or her possession at all times, a statement to this effect shall be noted.

5.7.2 The samples must be sealed to protect their value. If the sample shuttle kit (cooler) does not employ a tamper proof seal, the collector is to date, sign and identify each sample on a seal and attach it to each sample container and lid. A waterproof adhesive seal and pen must be used.

5.7.3 Prepare a sample label for each sample container employing a waterproof pen and adhesive label. The following is to be indicated on the label -

- Collector's name, date and time of sampling.
- Sample source.
- Sample identification number.
- Sample preservatives.
- Test(s) to be performed on the sample, if known.

5.8 Chain-of-Custody

Chain-of-Custody records will be used to insure the integrity of the sampling event and the analyses.

5.8.1 The sample collector will complete a Chain-of-Custody record (Section 7.0 or equivalent) for all monitoring well samples.

5.8.2 The sample collector will retain a copy of the Chain-of-Custody record, and forward the original with the sample to the laboratory performing the analyses.

5.8.3 Upon receipt of the samples, the laboratory manager or representative will complete the Chain-of-Custody record, make a copy for his or her files, and return the original with the analytical data.

5.9 Instructions to the Laboratory

The results of the analysis of the blanks should not be used to correct the groundwater data. If contaminants are found in the blanks, the source of the contamination must be identified and corrective action, including re-sampling, must be initiated. Other quality control samples (e.g., standards, spikes, performance evaluation samples) must be prepared and analyzed as part of the laboratory operation.

5.10 Laboratory Requirements

The laboratory shall have the capabilities to analyze for most monitor well parameters. Some samples submitted to the laboratory for analysis may be subcontracted to another independent commercial laboratory. Any samples submitted to the Lab must be properly preserved, accompanied with completed Chain-of-Custody records. If an independent, subcontracted laboratory is utilized, the procedures recommended for sample preservation will be followed, Chain-of-Custody records, and a completed Sample Analysis Request form will accompany the samples.

5.10.1 Laboratory: Laboratory QA/QC plan applicable to the Groundwater Analysis performed by CHDT will be in accordance with the facilities approved QA/QC plan and standard operating procedures. These standard operating procedures will include, but are not limited to, the following:

- The use of Standard Reference Materials, intra-laboratory samples, laboratory blanks, duplicate and spike samples for calibration and matrix interference identification.
- Statistical procedures and accuracy control charts to monitor and document laboratory performance and define analysis acceptance criteria.
- Programs for instrument calibration and maintenance control.
- Sample receipt and documentation.

5.10.2 Outside Laboratory – CHDT will submit to the Department a QA/QC plan or verification of independent laboratory certification for each outside laboratory contracted to perform groundwater analysis. The outside laboratories QA/QC plan and/or certification shall meet or exceed those required of CHDT by the Colorado Department of Public Health and Environment.

5.11 Analytical Parameters

The analytical parameters to be analyzed for in groundwater samples collected at the facility are given in Section 6.0 - Tables 2.0 and 3.0. Listed are each parameter, their respective analytical methods and levels of Reporting Detection Limits and if they are background or detection monitoring parameters, or both. The parameters pH, specific conductance and turbidity will be determined in the field

6.0 TABLES

Table 1.0 – Frequency of Data Collection and Evaluation

Table 2.0 – Background Monitoring Parameters

Table 3.0 – Detection Monitoring Parameters

Table 4.0 – Sample Handling, preservation, and Instrumentation

Table 5.0 – Inspection and Detection Monitoring Wells

7.0 FORMS

7.1 - Monitoring Well Field Log – Sampling

7.2 - Monitoring Well Field Log – Evacuation and Recovery Classification (1st event)

7.3 - Monitoring Well Field Log – Evacuation and Recovery Classification (2nd event)

7.4 - Sample Chain –of – Custody

8.0 ATTACHMENTS

Attachment 1 - Groundwater Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure, U.S. EPA Region II, March 16, 1998

TABLE - 1.0
Frequency of Data Collection and Evaluation

Monitoring Location	Monitoring Program	Data Collection Frequency		Data Evaluation Frequency	
		Hydraulic Measurements	Sampling and Lab Analysis (if appropriate)	Descriptive Statistics	Combined Shewart-CUSUM Control Charts
Closed Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Annually	NA	NA
Active Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Annually	NA	NA.
Secure Cell LDS	Secure Cell Performance Monitoring	Weekly	Semiannually	NA	NA.
Secure Cell Permanent Sump	Secure Cell Performance Monitoring	Weekly	Semiannually	NA	NA
Treatment Building LDS	Surface Impoundment Performance Monitoring	Weekly	Semiannually	NA	NA
Level 3 Wells	Inspection	Semiannually	NA	Semiannually	NA
Level 4A Wells	Inspection	Semiannually	NA	Semiannually	NA
Level 4 Wells	Detection	Semiannually	Semiannually	Semiannually	Semiannually
Level 5 Wells	Detection	Semiannually	Semiannually	Semiannually	Semiannually
Level 6 Wells	Detection	Semiannually	Semiannually	Semiannually	Semiannually

TABLE 2.0
Background Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit (pCi/L)	CDPHE Groundwater Standard (pCi/L)
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0	15 (excludes U and Rn)
Gross Beta	A or G	4.0	50 (pCi/L) (screening level)
Lead-210	E	3.0	
Thorium-228	H	1.0	
Thorium-230 and 232	H	1.0	60
Uranium-234	H	1.0	30 (ug/l) (Total)
Uranium-235	H	1.0	See above
Uranium-238	H	1.0	See above
Radium-226 and 228	A, B, D, or G	1.0	5.0
H-3 (Tritium)	E	500	20,000
C-14	E	20	
K-40	C	250	
Co-60	C	30	
Cs-137	C	20	80 (as Cs-134)
Sr-90	A or G	3.0	8.0
Pu-238	E or H	0.1	
Pu-239	E or H	0.1	0.15 (Pu-239 and Pu240)
Pu-241	E or H	5.0	
Am-241	H	0.1	0.15

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

TABLE 3.0
Detection Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit	CDPHE Groundwater Standard
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0 (pCi/L)	15 (pCi/L) (excludes U and Rn)
Gross Beta	A or G	4.0 (pCi/L)	50 (pCi/L) (screening level)
Uranium-Total	F	1.0 (ug/l)	30 (ug/l) (Total)
Radium-226 and 228	A, B, D, or G	1.0 (pCi/L)	5.0 (pCi/L) (combined)

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

Table 4.0
Sample Handling, Preservation, and Instrumentation

Parameter	Preservative [1]	Container [2]	Maximum Holding Time [3]	Instrumentation [4]
Gross Alpha	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, or G
Gross beta	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-89	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-90	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Radium-226	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, D or G
Radium-228	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Cesium-134	Conc. HCl to pH <2[5]	P or G	90 Days	A, C or G
Iodine-131	None	P or G	8 Days	A, C or G
Tritium	None	G	90 Days	E
Uranium	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, F, H
Photon emitters	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	C

[1] It is recommended that the preservative be added to the sample at the time of collection unless suspended solids activity is to be measured. If the sample has to be shipped to a laboratory or storage area unpreserved, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

[2] P = Plastic, hard or soft; G = Glass, hard or soft.

[3] Holding time is defined as the period from time of sampling to time of analysis. In all cases, samples should be analyzed as soon after collection as possible. Exceptions will require approval by CDPHE.

[4] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

[5] If HCl is used to acidify samples, which are to be, analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

Table 5.0
Inspection and Detection Monitoring Wells

Monitoring Zone	Well	Detection Monitoring[1]	Monitoring Zone	Well	Detection Monitoring[1]	Monitoring Zone	Well	Detection Monitoring[1]
Level 3	L3-10		Level 4	L4-1		Level 4	L4-4	
	L3-11			L4-10			L4-40	
	L3-12			L4-11			L4-41	Yes
	L3-13			L4-12			L4-42	Yes
	L3-15			L4-13			L4-43	
	L3-16			L4-14			L4-44	
	L3-17			L4-16	Yes		L4-45	
	L3-19			L4-17			L4-46	
	L3-2			L4-18			L4-5	
	L3-22			L4-19			L4-6	
	L3-24			L4-2			L4-8	Yes
	L3-25			L4-20			L4-8N	Yes
	L3-26			L4-21			L4-9	Yes
	L3-27			L4-22			L4-9N	Yes
	L3-28			L4-23			L4-9S	Yes
	L3-29			L4-24			L4-9W	Yes
	L3-3			L4-25		Level 4A	L4-32A	
	L3-30			L4-26	Yes		L4-32EA	
	L3-31			L4-27			L4-32WA	
	L3-32			L4-28	Yes		L4-33A	
	L3-33			L4-29	Yes		L4-33EA	
	L3-34			L4-3			L4-33WA	
	L3-35			L4-30	Yes		L4-7A	
	L3-36			L4-31	Yes	Level 5	L5-10A	Yes
	L3-37			L4-32	Yes		L5-3	Yes
	L3-38			L4-32E	Yes		L5-4	Yes
	L3-39			L4-32W	Yes		L5-5	Yes
	L3-40			L4-33	Yes		L5-6	Yes
	L3-41			L4-33E			L5-7	Yes
	L3-42			L4-33W	Yes		L5-8	Yes
	L3-43			L4-34			L5-9	Yes
	L3-44			L4-34E		Level 6	L6-1	
	L3-46			L4-34W	Yes		L6-2	
	L3-47			L4-35			L6-3A	
	L3-6			L4-36				
	L3-7			L4-37				
	L3-8			L4-38				
	L3-9			L4-39				

[1] All wells that are not designated "Yes" as detection monitoring wells are inspection monitoring wells.

CLEAN HARBORS (DEER TRAIL), LLC.
MONITORING WELL FIELD LOG - SAMPLING

Event #_____ Year_______ Well Identification_________

SAMPLING:

Date_________Time___________ Collector/Operator___________

Sample Sequence_______________________________________

Water Level Depth, Ft.______________

Method of Collection_______________________________________

Method of Filtration_______________________________________

Completed(date)___________(time)__________

Reason for Sampling_______________________________________

*Field Sample Analysis

Analysis	Instrumentation	Calibration Information		Sample Values
Specific Conductance @25°C (μmhos/cm)		std.	det.	
pH (S.U.)		std.	det.	
Temperature (°C)				
Turbidity (NTU)		std.	det.	

GENERAL INFORMATION

Weather Conditions at time of sampling: _______________________________________

____

Sample Characteristics _______________________________________

____

Sample Information (Container, volume, preservatives, test): ___________________

____

Comments and Observations _______________________________________

____

Temp. of shuttle when shipped:_________Temp. of shuttle when received at Lab_________

Certification: _______________________________________

Sample received by Lab: _______________________________________

Certification: _______________________________________

Sample received by Lab: _______________________________________

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CLEAN HARBORS (DEER TRAIL), LLC.

MONITORING WELL FIELD LOG - EVACUATION AND RECOVERY CLASSIFICATION
(to be utilized during First Sampling Event)

Well Identification__________

Event #__1__ Year______ Sample Collector/Operator____________

PRE-EVACUATION:

Organic Vapor Detected (Measured required only if detected during well inspection) ☐ Yes ☐ No ☐ Not Required

Method of Detection____________________________________

Concentration, ppm____________as______________

Calibration, ppm Std.____________ppm Det.______________

Immiscible Layer Detected ☐ Yes ☐ No

Sample Collected ☐ Yes ☐ No ☐ N/A

Depth (Measured from Casing Reference Point)

to Top of layer(s), Ft.____________(to 0.01)

to Bottom of layer, Ft.____________(to 0.01)

Method of Sample Collection____________________________________

Sample Reference #____________________________________

EVACUATION:

Method of Evacuation____________________________________

Before Evacuation:

a. Water Level Depth, Ft.____________(to 0.01)

b. Well Depth, Ft.______________(to 0.01)

c. Inside Well Casing Dia.______(inches)

Calculate Well Volume, Gal.: (Casing 6" Dia.) 1.33 x (b - a) = __________Gallons (A)

(Casing 4" Dia.) 0.65 x (b - a) = __________Gallons (A)

Initial Well Volume:

- Evacuate One Well Volume (to the extent practible)
  Volume evacuated__________gallons Time Completed___________(TI)
- Measure water Level within 12 to 24 hours of initial completed evacuation.
  ____________Ft. (0.01) Time of measurement___________
- Calculate recovered well volume____________gallons (B)

Classify Well: (Check applicable box and follow the indicate directions.

☐ Rapid Recover Well: Recorded Well Volume (B) is 90% or more of original Well Volume (A)
If a Rapid Recovery Well, sample within 24 hours.

☐ Low Yield Well: Recorded Well Volume (B) is less than 90% of original Well Volume (A).
Remeasure the water level after 24 hours of initial well evacuation.
____________Ft. (0.01) Time of measurement___________
Remeasure the water level within 48 hours of initial well evacuation.
____________Ft. (0.01) Time of measurement___________

- Calculate recovered well volume____________gallons (B)

Check the applicable box:

☐ The recovered well volume (C) is at least 90% of the initial well volume (A). Sample the well within 48 hours of the initial well evacuation time (TI).

☐ The recovered well volume (C) is less than 90% of the initial well volume (A) do not sample and classify the well as non-recoverable.

CLEAN HARBORS (DEER TRAIL), LLC.

MONITORING WELL FIELD LOG - EVACUATION AND RECOVERY CLASSIFICATION
(to be utilized during Second Sampling Event)

Well Identification__________

Event #_____ Year______ Sample Collector/Operator____________

PRE-EVACUATION:

Organic Vapor Detected (Measured required only if detecting during well inspection) ☐ Yes ☐ No ☐ Not Required

Method of Detection______________________________

Concentration, ppm__________ as______________

Calibration, ppm Std.__________ppm Det.____________

Immiscible Layer Detected ☐ Yes ☐ No

Sample Collected ☐ Yes ☐ No ☐ N/A

Depth (Measured from Casing Reference Point)

to Top of layer(s), Ft.__________(to 0.01)

to Bottom of layer, Ft.__________(to 0.01)

Method of Sample Collection____________________________________

Sample Reference #____

EVACUATION:

Method of Evacuation____________________________________

Before Evacuation:

a. Water Level Depth, Ft.__________(to 0.01)

b. Well Depth, Ft.____________(to 0.01)

c. Inside Well Casing Dia.______(inches)

Calculate Well Volume, Gal.: (Casing 6" Dia.) 1.33 x (b - a) = ________Gallons (A)

(Casing 4" Dia.) 0.65 x (b - a) = ________Gallons (A)

For Rapid Yield Well: Evacuate completely (to the extent practical) three times prior to sampling.

Evacuation:

Volume evacuated________gallons Time Completed________

Sample within 24 hours.

For Low Yield Well: Evacuate completely (to the extent practical).

One time:

Volume evacuated________gallons Time Completed________(A)

Sample within 48 hours of time (A).

St. Louis
13715 Rider Trail North

Earth City, MO 63045
phone 314.298.8566 fax 314.298.8757

Chain of Custody Record

TestAmerica Laboratories, Inc.

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
	Tel/Fax:	Lab Contact:	Carrier:	_______ of ______ COCs
	Analysis Turnaround Time			Job No.
	Calendar (C) or Work Days (W) __________			
Phone	TAT if different from Below _________			
FAX	☐ 2 weeks			SDG No.
Project Name:	☐ 1 week			
Site:	☐ 2 days			
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For __________ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: <u>DNAPL Site Evaluation</u> (Cohen & Mercer, 1993) and the <u>RCRA Ground-Water Monitoring: Draft Technical Guidance</u> (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.

- Polyethylene sheeting.

- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

- Interface probe or equivalent device for determining the presence or absence of NAPL.

- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).

- Sample bottles.

- Sample preservation supplies (as required by the analytical methods).

- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

<u>Pre-Sampling Activities</u>

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water

level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):
    - ±0.1 for pH
    - ±3% for specific conductance (conductivity)
    - ±10 mv for redox potential
    - ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5

minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

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