APPENDIX B

POST-CLOSURE PERIOD EXPANDED GROUNDWATER DETECTION MONITORING PLAN

POST-CLOSURE PERIOD
EXPANDED GROUNDWATER DETECTION MONITORING PLAN

Page-Trowbridge Ranch Landfill

Pinal County, Arizona

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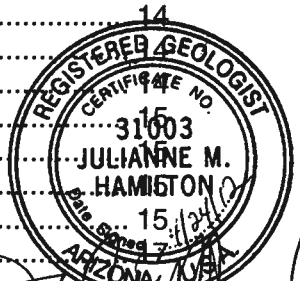

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EXPANDED GROUNDWATER DETECTION
MONITORING PLAN

Page-Trowbridge Ranch Landfill
Pinal County, Arizona

1. INTRODUCTION

1.1 GENERAL

This Expanded Groundwater Detection Monitoring Plan (EGDMP) outlines the sampling and analysis procedures that will be utilized during the post-closure period at the Page-Trowbridge Ranch Landfill (PTRL) in Pinal County, Arizona (Figure 1). The EGDMP was originally prepared by Hydro Geo Chem, Inc. (HGC) on October 13, 2004, and has been revised by AMEC Earth & Environmental, Inc. (AMEC). All groundwater and soil vapor samples will be collected by personnel of the University of Arizona (UA) Department of Risk Management Services or their designee.

1.2 EXPANDED GROUNDWATER MONITORING SYSTEM

The Post-Closure Permit included a component to expand the existing monitoring network to off-site locations. Property immediately adjacent to the PTRL to the west and south (downgradient of the site) is owned by Robson Communities (Robson). Robson would not agree to allow monitoring wells to be installed on their property. Although they have agreed to permit access to the Robson Irrigation Well #1 (Arizona Department of Water Resources number 55-595243), this well was not added to the monitoring network because:

- This well is not located directly downgradient of the facility;
- This well is screened over multiple depths that do not correspond to those of the on-site monitoring wells;
- This well is not designed for sample collection as purging cannot be controlled; and
- Chemicals potentially used by the well owner to clean the well and pump cannot be controlled by UA.

Interim Measures Investigations (IMI; HGC, 2004) indicate that soil vapor concentrations decrease rapidly with depth below the PTRL and at the deepest sampling point (approximately 40 feet [ft] above the groundwater table), soil vapor concentrations are too low to cause groundwater concentrations that exceed water quality standards (U.S. Environmental Protection Agency [EPA] maximum contaminant levels or Arizona aquifer water quality standards), in agreement with existing groundwater sampling results. Estimated groundwater concentrations in equilibrium with soil vapor

concentrations are between 1/50th and 1/700th of water quality standards. The existing soil vapor extraction (SVE) system and on-site soil vapor monitoring points are used to supplement existing groundwater monitoring wells. Incorporation of on-site soil vapor monitoring through the SVE system and soil vapor monitoring points will allow early detection of increasing vapor concentrations, allowing mitigation to be conducted prior to creating an impact to groundwater below the PTRL site.

The expanded groundwater monitoring system at the PTRL consists of groundwater monitoring and soil vapor sampling. Groundwater monitoring consists of collecting groundwater samples from four groundwater monitoring wells (MW-2, MW-3, MW-4, and MW-5). Soil vapor sampling consists of collecting soil vapor samples from MW-2 and MW-5, collecting soil vapor samples from soil vapor monitoring wells (SGS-SP, SGS-Well, SGD-SP, SGD-MP, SGD-DP, and SGD-Well), and monitoring the SVE system influent when the SVE system is in operation. Monitoring locations are shown on Figure 1 and well construction details are summarized in Tables 1 and 2. A complete description of the on-site monitoring well system is contained in the following reports:

- May 17, 1985 Memorandum Data Report from Errol L. Montgomery & Associates, Inc., titled, "Results of Monitor Well Construction, Monitor Wells, MW-1, MW-2, MW-3, and MW-4, Page Trowbridge Ranch Disposal Facility, Pinal County, Arizona";
- August 20, 1991 report by Environmental Engineering Consultants, Inc, titled, "Page Ranch Replacement Well, Monitoring Well MW-5"; and
- June 8, 2004 report by HGC, titled, "Interim Measures Investigation Report".

1.3 SAMPLING FREQUENCY, ANALYSES, AND FIELD MEASUREMENTS

1.3.1 Sampling Frequency

Groundwater and soil vapor samples will be collected semi-annually, typically in the spring and fall, in accordance with the requirements of the Post-Closure Permit. SVE influent will be sampled when the SVE system is in operation at a frequency no less than twice annually, which may be adjusted as needed to guide timing of carbon change out events.

1.3.2 Groundwater Sampling

Groundwater samples are collected from four groundwater monitoring wells (MW-2, MW-3, MW-4, and MW-5). Groundwater from each monitoring well will be pumped to the surface using a dedicated five-horsepower submersible pump. Power must be supplied by a generator (480 volt, three-phase) from off-site. A power panel consisting of breaker and fuse box is shared by the four wells. The power panel is moved from well to well during sampling, and is stored off-site when not in use. A locked vandal cover is installed over each wellhead. An electrical harness assembly is installed at each

wellhead for connection to the generator. The discharge pipe connection point and the sounder tube are also located inside the vandal cover.

1.3.3 Soil Vapor Sampling

Soil vapor samples are collected from two groundwater monitoring wells (MW-2 and MW-5) and six soil vapor monitoring points: SGS-Well, SGD-Well, SGS-SP, SGD-SP, SGD-MP, and SGD-DP. Groundwater monitoring wells MW-2 and MW-5 have been equipped with downhole inflatable packers that are used to isolate the screened interval above the water table and thus enable these wells to be used as soil vapor sampling points. SGD-Well will not be sampled if this well is used for air injection. Otherwise, soil vapor samples will be collected from MW-2, MW-5, and all six soil vapor monitoring points.

The soil vapor probes and wells will be purged using a portable vacuum pump. The vacuum pump operates on battery power. The sampling ports will be equipped with shut-off (ball) valves and hose barbs. The sample port will provide an air-tight connection to both the purge pump and the sample canister. For the soil vapor probes, all of the fittings will be sealed in the protective casing with a locking cover at the wellhead. For the soil vapor wells, the fittings will be sealed in a below-ground vault with locking cover.

1.3.4 Sample Analyses

Groundwater samples are analyzed for drinking water parameters, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and organochlorine pesticides using the following analytical methods as specified in the Post-Closure Permit:

- Drinking water parameters:
    - Manganese (Mn): EPA Method 200.7
    - Sodium (Na): EPA Method 200.7
    - Chloride (Cl): EPA Method 300.0
    - Sulfate (SO4): EPA Method 300.0
- Volatile organic compounds (VOCs): EPA Method 524.2
- Semi-volatile organic compounds (SVOCs): EPA Method 8270C
- Organochlorine pesticides: EPA Method 8081

Groundwater samples will also be analyzed for radionuclides in accordance with Arizona Radiation Regulatory Agency (ARRA) Radioactive Material License 10-24.

Soil vapor samples will be analyzed for VOCs using EPA Method TO-15. Analytical laboratories conducting the analyses will be licensed by the State of Arizona Environmental Laboratory Licensure Program.

1.3.5 Field Measurements

Depth-to-water measurements will be taken prior to purging the groundwater monitoring wells. During the groundwater purge period, the following field measurements will also be performed:

- pH
- Temperature
- Specific conductance
- Visual appearance

During purging of the soil vapor probes, a portable photoionization detector (PID) will be used to monitor total organic vapors. Purging will continue until organic vapor readings are stable prior to sample collection, typically between 3 and 5 well volumes. If concentrations are too low to be detected by PID, a minimum purging volume of 3 well volumes will be used.

1.4 Groundwater Monitoring System Inspection and Maintenance

Details concerning the inspections and maintenance of the groundwater monitoring system as required by Part IV of the Post-Closure Permit are contained in the Page Ranch Landfill Post-Closure Inspection and Maintenance Plan. This document appears as Appendix D to the permit application.

2. SAMPLING TRIP PREPARATION

Prior to going to the site to collect samples, several preparatory steps are required. These include gathering and calibrating equipment, obtaining sample containers from a laboratory, and laboratory scheduling.

2.1 Groundwater Sampling Trip Preparation

2.1.1 Equipment List

Sampling Equipment:

- PTRL gate/well keys/spare lock/chain/bolt cutters;
- Pickup truck with towing ball;

- Generator (480-volt, three-phase, 15 or 18 kilowatt) with enough fuel for at least 12 hours of operation (rented from a vendor in Tucson) and an 110-volt outlet if used to power vacuum pump;
- Connecting wire, three conductor;
- Tool box to include: crescent and pipe wrenches, screwdrivers, electrical tape, wire cutters, and heavy gloves;
- Horizontal discharge pipe with flow meter and support block;
- Calibrated water depth-sounder;
- Engineer's steel measuring tape marked in 0.01-ft increments;
- Wristwatch with stopwatch;
- 3- to 5-gallon (gal) polyethylene bucket;
- Pocket calculator;
- pH/temperature meter with spare batteries;
- Squirt bottle with distilled water;
- Fresh buffer solutions for pH meter calibration;
- Specific conductance meter;
- Sample containers for all parameters and duplicates;
- Vacuum pump (portable or 110-volt);
- Rotameter (gas flow meter);
- Portable organic vapor monitor (PID) with 11.7 eV lamp;
- Preservatives in containers (as required);
- Field blanks;
- Latex examination gloves;
- Sampling data log book/spare sampling log sheets;
- Chain-of-custody forms;
- Field copy of groundwater detection monitoring plan;
- Pencils and waterproof markers;
- Sample labels/clear waterproof tape; and
- Cooler and ice.

2.1.2 Sample Containers/Trip Blanks

Each sample will be collected in pre-cleaned, appropriately sized containers prepared by the laboratory. Sample containers will not be reused. The type of container used for each parameter will be consistent with the requirements of the EPA Analytical Method for that particular parameter. Sample containers for VOC analyses must have a Teflon-lined cap and must be new. Chemical preservatives required by the analytical method are placed in the sample containers by the laboratory; preservatives to be used for each sampled parameter are summarized in Table 3.

Trip blank containers are prepared by the laboratory in the same manner as the sample containers prior to filling them with the blank material. This blank material would consist of organic-free laboratory water in the case of groundwater samples. A trip blank is required for groundwater VOC analyses to verify if any detected contamination in the sample is an actual groundwater contaminant or the result of contamination during handling, storage, or transport. To be considered a valid blank, the trip blank must be carried into the field and handled in precisely the same manner as the sample containers, but without discharged groundwater contact.

2.2 Soil Vapor Sampling Trip Preparation

2.2.1 Equipment List

The collection of soil vapor samples from permanent sample points requires the use of reusable equipment, disposable materials, and field documentation forms. The following equipment is reusable.

- Vacuum pump.
- Six stainless steel ¼-inch hose barbs with nuts.
- Two adjustable crescent wrenches.
- A box cutter, knife, or other cutting tool for cutting plastic tubing.
- 1 can of leak detection compound, for example Dust Remover (by 3M) that contains 1,1-difluoroethane as an ingredient.
- Sealable plastic baggies – gallon size.
- Watch to monitor purge times.
- Air pump with pressure gauge for packers.

The following materials are for single use and should be discarded after use:

- Approximately 20 feet of 3/8-inch outside diameter, ¼-inch inside diameter clear polyethylene tubing.

- Clean cloth rags (have not been used previously).
- Small plastic zip ties.

2.2.2 Sample Containers/Trip Blanks

Prior to sampling, sample containers, flow controllers, vacuum gauge, and duplicate tees will be ordered from the laboratory. Upon receipt of order and at least one day prior to field sampling, the sample containers will be checked for integrity as instructed by the laboratory. For Summa canisters, the vacuum in each canister will be checked with a vacuum gauge supplied by the laboratory.

1. Attach gauge to the top of the canister, ensuring the seal is tight (the gauge should not wiggle or otherwise move if tightened properly).
2. Open valve on canister completely and note vacuum reading (generally inches Mercury [in Hg]) on label card attached to the canister. Typically the canister holds 30 in Hg and a good canister will have a reading between 26 in Hg and 30 in Hg.
3. If the vacuum is less than 20 in Hg, set the canister aside and order another canister from the lab. Place loose hose barbs with nuts on baking sheet and bake in oven at 350° for 30 minutes to decontaminate the barbs. Allow barbs to cool and place in sealable plastic bag.

2.3 LABORATORY SCHEDULING

The analytical laboratory will be consulted prior to sampling to ensure that adequate cold storage space will be available for those samples requiring it, and that their analysis schedule will permit timely analysis within specified holding times. The laboratory will be provided with a list of all analytical parameters, so that equipment and/or reagents necessary for particular analytical methods are available, when needed.

2.4 CALIBRATION AND EQUIPMENT CHECKS

Several types of equipment used in the sample collection process require calibration as follows:

- The sounder's battery and cable can be checked by watching the indicator needle for movement while the probe is held in a cup of water. The needle should hold steady at full conductance during this test. If the needle begins to fade after several seconds, the battery is most likely weak.
- The pH/temperature meter has no low battery indication, so spare batteries are always carried.
- The pH buffer solutions are changed prior to every use, so that the pH probe can be accurately standardized.
- The specific conductance meter is zeroed with deionized water prior to each field use.
- The PID will be calibrated to an isobutylene standard each day.

3. SAMPLING PROCEDURES

3.1 INTRODUCTION

This section outlines in detail the actual process of sample collection so that methods and techniques are consistent, thereby ensuring that sampling results are valid representations of groundwater quality and soil vapor chemistry. Sampling procedures are discussed below. Soil vapor samples will be collected first, followed by groundwater depth determination and groundwater sample collection.

3.2 GROUNDWATER SAMPLING PROCEDURES

3.2.1 Groundwater Depth Determination

Prior to purging or pumping the on-site monitoring wells, the depth to groundwater must be determined in the four operative on-site wells. The sounder is tested at the surface in a cup of water prior to lowering it down the well. Once proper function is verified, the sounder cable is slowly lowered into the polyvinyl chloride sounder tube, which is installed parallel to the discharge pipe in the well casing. When the water level is reached, the indicator needle will peg to the right, indicating conductance through the cable. The cable should be pulled up several feet and then lowered again to verify that the water level has indeed been reached. When pulled up, the needle will drop off and then peg again upon being lowered to the surface of the groundwater. The sounder cable should be lowered just until the needle pegs, and no lower.

The measurement point at all wells is the top of the opening into the sounder cable tube. The elevation of this water measurement point has been established by a licensed surveyor (Table 1). When the probe is at the surface of the water, a thumbnail should be placed against the cable at the top of the sounder tube to lock its position for measurement. While holding the thumbnail against the measurement point on the cable, the cable is pulled up several feet until one of the calibrated cable markings is above the sounder tube opening.

Using an engineer's steel pocket tape, the distance between the measurement point and closest calibrated cable marking is measured to the nearest 0.01 ft. The measured value is then added to or subtracted from the calibrated cable marking to determine depth to groundwater. If applicable, a sounder calibration value must be added or subtracted at this time. The measurement process described above is repeated two or three times to ensure that the obtained value is consistent. If there is variation, then an average of the values is considered as the depth value. This value is recorded in the field sampling data log.

3.2.2 Generator/Groundwater Pump Connection and Operation

The pump motor is connected to the generator with the 3-conductor wire. A wiring harness assembly has been developed that prevents an incorrect electrical connection from the generator to the pump motor. To avoid electrical shock, all work in and around the electrical boxes or connections should be performed with the generator turned "off". When selecting the location of the generator, wind direction is noted and the unit is parked downwind from the sampling location with the exhaust pipe facing away from the well area. This minimizes the possibility of samples being contaminated by diesel exhaust components.

3.2.3 Groundwater Discharge Pipe/Flow Meter

A horizontal discharge pipe is used to direct the pumped discharge away from the concrete well pad. A flow meter is installed in the discharge pipe to verify the pumping rate. The discharge pipe and flow meter should be supported at its end by an appropriate board or block to avoid stressing the tee connection at the top of the well. The pumping rate is determined by timing rotations of the flow meter. This information is recorded in the groundwater sampling log.

3.2.4 Groundwater Field Measurements

Several water quality measurements are required during well purging. Measurements will be collected every 5 minutes starting at 10 minutes after pumping commences. These include:

- pH
- Temperature
- Specific conductance
- Visual appearance

To make these measurements, a sample of water is collected in a polyethylene bucket and the various probes of the instruments are placed in the water. Readings are recorded in the groundwater sampling log. Sample collection can commence after a minimum of three well volumes plus the discharge pipe volume have been discharged and the field parameters have stabilized, or after a total of five well volumes have been discharged even if the field parameters have not stabilized. Field parameters are considered stabilized when two consecutive measurements meet the following criteria: pH measurements are within ±0.3 units, temperature is within ±1.0º C, and specific conductance is within ±10%. The required minimum and maximum purge volumes for each monitoring well are given in Table 4.

At a pumping rate of 15 gpm, 400 gal will be discharged in slightly less than 27 minutes.

3.2.5 Groundwater Sample Collection Order

Samples are collected from the wells in the following order: MW-5, MW-3, MW-2, and MW-4. Should contamination be detected in any of these wells during the previous sampling event, the sampling order should begin with the well showing the least contamination and end with the well showing the most contamination. The order of sample collection by parameter is as listed below:

- VOCs
- SVOCs
- Organochlorine pesticides
- Metals (manganese, sodium)
- Anions (sulfate and chloride)
- Radionuclides

3.2.6 Groundwater Sample Collection into Containers

The sample collection location is a stainless steel discharge valve and pipe located at the top of each well's vertical discharge pipe. This location allows a much slower flow of water to be discharged into sample containers, thereby minimizing agitation and potential volatilization of samples. To avoid potential contamination from skin oils, latex or polyethylene gloves are worn during the sample collection process. Containers are filled by holding the open container under the discharge stream and are capped immediately upon removal from the water stream. Non-volatile sample containers are filled to within 1 centimeter of the top prior to capping.

Samples for VOC analyses are collected in 40-mL vials with Teflon-lined caps. These samples must be collected in a manner that minimizes agitation and/or the generation of air bubbles, either of which may result in inaccurate results. The 40-mL vial is filled as close to the top as possible in the discharge water stream. If necessary, an additional sample can be collected in the inverted cap, which is then poured slowly into the sample vial. The goal is to have a reverse meniscus of sample water extending above the opening of the vial. To check that the sample is air-free, the container will be inverted and the cap gently tapped. The absence of entrapped air indicates a successful seal. When air is evident in the container, the entire sample will be discarded and another sample will be collected. Sample containers are never allowed to touch the discharge pipe.

3.2.7 Groundwater Field Duplicates

A blind duplicate will be collected and analyzed for each sampling parameter at one of the four on-site wells. The field duplicate will be labeled as “MW-6”. The well chosen for this purpose will rotate each time groundwater monitoring is conducted, and the location will be documented on the groundwater sampling form (Attachment A).

3.2.8 Groundwater Sample Labels

When collected, each sample and field duplicate is labeled with information that will thoroughly identify the sample origin while it is in the laboratory. Label information will include the date, well number, and analysis requested. Blind field duplicates are labeled as "MW-6". All label information is written with an indelible marker, which will remain legible even if wet. In addition, the label itself is covered with clear waterproof plastic tape to protect the writing from damage during transit and storage. Sample seals are not utilized, since sampling personnel retain full custody of the samples until they are delivered to the laboratory.

3.2.9 Groundwater Sample Packing, Transportation, and Delivery

Filled and labeled sample containers are packaged in a cooler with ice until they are transferred via chain-of-custody to the laboratory and placed in the laboratory refrigerator. Sample bottles are placed in the cooler in such a way to avoid breakage and to maximize ice contact for quick cooling of the samples. Trip blanks and duplicates are also placed in the cooler at the time of sample collection. Samples are transported in a UA vehicle directly to the analytical laboratory after each day of sampling.

If the laboratory is closed following field activities, the samples will be over-packed in ice and kept in a secure area accessible only to the staff of the UA Department of Risk Management Services. The samples will be delivered to the laboratory on the following work day.

3.3 Soil Vapor Sampling Procedures

This section describes the sampling procedures for the soil vapor monitoring points and the monitoring wells MW-2 and MW-5. Soil vapor sample collection at the effluent and between the treatment vessels of the SVE treatment system is described in the Operation and Maintenance Manual for the SVE system.

At each sample location, monitoring probes are first examined for any loss of structural integrity, such as cracks facilitating an air leak. If visual evidence of an air leak is observed, repairs must be made prior to sampling. Soil vapor samples are collected from soil vapor monitoring probes or the air exhaust line from soil vapor wells, which are equipped with an air-tight sampling port. VOC vapors are measured during purging using a portable PID. Samples are collected for laboratory analysis sample containers provided by the analytical laboratory. The sampling procedures below assume that pre-evacuated, pre-cleaned, 1-L stainless-steel Summa canisters are used. Sampling procedures will be updated if other types of sample containers are used. Leak test using leak detection compound (1,1-difluoroethane, pentane, isopropanol, isobutene, propane, or butane) will be conducted at each soil vapor sample location.

Since soil vapor samples are collected from two different types of monitoring points, dedicated soil vapor sampling points (SGS-Well, SGD-Well, SGS-SP, SGD-SP, SGD-MP, and SGD-DP) and groundwater monitoring wells (MW-2 and MW-5), two separate sampling procedures are followed. Soil vapor samples are collected in the following order: MW-2, MW-5, SGD-Well, SGD-MP, SGD-SP, SGD-DP, SGS-Well, and SGS-SP.

3.3.1 Sampling Procedures for Soil Vapor Monitoring Points

1. Remove well vault cover.
2. Put on nitrile gloves.
3. Open 3/8-inch outside diameter, ¼-inch inside diameter tubing baggie and cut approximately 2-3 feet of tubing for each sample point, if more than one present.
4. Attach one end of tubing to well (well should be equipped with a hose barb), and the other end to the vacuum pump (on the suction hose barb). Note: If sampling the monitoring points in the SGD-well, a second piece of tubing should be cut and attached to the sampling port not connected to the purge pump. The “loose” end of the tubing should be folded over on itself approximately 2-inches and secured with a zip-tie. This is done to protect the sampling port from cross contamination when the leak detection compound is introduced into the well (step 6).
5. Attach flow controller to summa canister and attach a previously decontaminated ¼-inch hose barb to the top of the flow controller. Set summa canister with flow controller aside.
6. Standing 10-feet downwind of sampling locations, hold the can of dust-off upside down and apply the leak detection compound onto the clean rag, place the rag in a plastic baggie, and insert the baggie into the well vault, with the open portion of the baggie facing the well and valve. Change gloves immediately.
7. Open valve on well with purge pump connected.
8. Start purging with vacuum pump. Table 5 presents the purge volumes for each well and the recommended purge times at differing well volumes purged. Typically, the minimum purge volume is 3 well volumes and the maximum not more than 5 well volumes. Record the time purging started and determine time to stop purging.
9. At completion of purging, close valve on well, stop vacuum pump, and remove tubing from pump only.
10. Connect Summa canister with flow controller to tubing connected to well.
11. To begin collection of sample, open valve on well and valve on Suma canister.
12. Monitor the vacuum gauge on the flow controller, if it is calibrated to 200 ml/min, it should take approximately 5 minutes to collect the sample.
13. To ensure a good sample, some vacuum must be left on the canister. Once the vacuum gauge reaches approximately 3 in Hg, close the valve on the canister, followed by the valve on the well. Note the final canister vacuum on the canister label.

14. Remove the tubing from the well, the flow controller and remove the flow controller from the canister. Replace brass cap onto canister.

15. Completely fill out label on canister: sample name, sample time, samplers name, analysis (TO-15), etc.

16. Log the sample on the Chain-of-Custody (COC) form. Make sure all required information is supplied on the COC.

17. Store the canister and flow controller in the boxes used to ship the sample containers. Do not re-use the flow controller.

18. Discard the tubing and all gloves used during sampling.

19. Move to next location and repeat 2 through 19.

3.3.2 Soil Vapor Sampling Procedure at Monitoring Wells MW-2 and MW-5

1. Attach air pump with gauge to air line to packers.

2. Inflate packers to 25 psi, and allow the pressure to stabilize for 30 minutes by monitoring the pressure in the packers periodically. Document measurements in field notes.

3. Complete above items 4 through 18.

4. To use leak detection compound while sampling from MW-2 and MW-5, place the baggie with the leak detection rag at the base of the well and a second rag with applied leak detection compound will be lain across the top of the well (on top of the well valve and tubing).

3.3.3 Duplicate Sample Collection Procedure

1. The duplicate tee is generally shipped in two pieces. Connect the two pieces ensuring the seal is tight.

2. Attach each of the tee attachments to the two flow controllers.

3. Following completion of purging, attach the tubing to the tee.

4. Open both valves simultaneously, if possible. If not, open first canister then the second as soon as possible.

5. Follow above steps 11 through 18 for collection of the duplicate samples.

3.3.4 Field Blank Collection Procedure

1. Attach the flow controller to the canister.

2. While standing over one of the well vaults and prior to sample collection at that location, open the valve to the canister to retrieve a sample of the ambient air.

3. Follow above steps 11 through 18 for collection of the field blank sample, omit leak detection compound.

3.3.5 Soil Vapor Sample Packing, Transportation, and Delivery

Filled and labeled sample containers are packaged in cardboard boxes (the same boxes used by the laboratory to send the sample containers), until transferred via chain-of-custody to the laboratory. Refrigeration of soil vapor sample is not necessary. Samples are transported in a UA vehicle directly to the analytical laboratory after each day of sampling.

If sample shipment is not possible immediately following field activities, the samples will be kept in a secure area accessible only to the staff of the UA Department of Risk Management Services. The samples will be delivered to the laboratory the following work day.

4. RECORDKEEPING

4.1 GROUNDWATER AND SOIL VAPOR SAMPLING LOGS

Permanent groundwater sampling logs and soil vapor sampling logs are maintained for data collected during the sampling process (Attachments A and B). The recorded data includes, but is not limited to:

- sample dates,
- sampling personnel name(s) and signature(s),
- groundwater depth measurements,
- groundwater and soil vapor purge information,
- groundwater field measurements (pH, temperature, and specific conductance),
- soil vapor field measurements (PID readings, vacuum pressure and flow rate),
- visual appearances and odor,
- field duplicate sample location, and
- notes of sampling conditions, such as the weather and pump operation.

A complete copy of this EGDMP is carried into the field as a reference. The groundwater and soil vapor sampling logs are considered part of the permanent sampling record and are stored in the UA Department of Risk Management Services office.

4.2 CHAIN-OF-CUSTODY

A chain-of-custody procedure is utilized to ensure that samples are accounted for at all times. This process greatly decreases the chance of samples being lost and provides accountability as to the proper storage and handling of the samples prior to analysis. A copy of the chain-of-custody form is included as Attachment C. Typically, custody will be limited to the sampler and the laboratory. In the event that the laboratory must ship a sample elsewhere for special analysis, the same chain-of-

custody procedures will be followed. Completed forms are kept on file in the UA Department of Risk Management Services, along with groundwater analytical results. Copies of the chain-of-custody forms will be submitted with analytical results as part of the reporting process outlined in the Quality Assurance Project Plan (QAPP; HGC, 2004b).

4.3 Laboratory Quality Assurance/Quality Control

The analytical laboratory is required to analyze all submitted samples within prescribed holding times and to conform to the individual requirements of the analytical methods. A critical part of any laboratory operation must be a well-designed quality assurance/quality control (QA/QC) plan. Laboratory QA/QC is discussed in the QAPP. The quality assurance plans for the analytical laboratories are included as Attachments D and E. Radiochemistry screening analyses will be performed by the UA Office of Radiation, Chemical and Biological Safety (ORCBS).

The UA will periodically need to solicit new competitive bids for non-radiochemical analytical services; thus, the vendor may change over time. Any selected analytical laboratory will be required to be licensed by the Arizona Environmental Laboratory Licensure Program for groundwater analysis and to have an acceptable QA/QC plan. The review and selection process will also include a review of laboratory certification inspection reports and site visits.

4.4 Laboratory Reporting

Upon completion of all requested analyses, analytical results will be summarized in tabular form and submitted to the UA Department of Risk Management Services. The laboratory report will include each constituent analyzed by each analytical method, along with their corresponding detection limits. The report will also include results of all laboratory duplicates, system blanks, and laboratory spikes, including recovery percentages and relative percent differences. Additionally, trip blank results, analysis date for each sample, and any other information pertinent to the interpretation of the results or specified in the QAPP will also be reported.

4.5 Filing Storage of Analytical Results

All analytical results from groundwater sampling are kept in a permanent file in the UA Department of Risk Management Services. Groundwater and soil vapor monitoring results will be kept on file at least through the post-closure monitoring period of the site.

4.6 Groundwater Monitoring Reports

Results of the groundwater and soil vapor monitoring will be included in a written semi-annual groundwater monitoring report for submittal to ADEQ. The report will be prepared by UA personnel or

its designee and will be due within 90 days of each semi-annual sampling event. The following will be included in each groundwater monitoring report:

- A narrative that summarizes the groundwater and soil vapor monitoring events and results in the previous six months. Summary of results will include a description of all verified detections, tentative detections, exceedance of alert levels in groundwater samples (if any), exceedance of soil vapor thresholds in soil vapor samples (if any), and results of statistical tests (if necessary). Soil vapor monitoring results will include all soil vapor samples, including monitoring points, SVE influent, between lead and lag adsorbent vessels, and SVE effluent. The narrative will also include any deviations from the EGDMP (if any) and any unusual conditions (if encountered).
- A narrative that summarizes operation of the SVE system (including runtime, downtime, flow rates)
- A description of maintenance activities, problems encountered, and corrective action implemented.
- QA/QC assessment of laboratory results and field measurements.
- Data from all groundwater and soil vapor sampling events presented in tabular or graphical format, including:
    - groundwater and soil vapor field parameters (depth to groundwater, pH, temperature, specific conductance, PID readings, vacuum pressure and flow rate),
    - analyses results (including all QA/QC samples),
    - graphs of concentrations at each soil vapor monitoring locations for the previous five years.
- Field documents and laboratory reports for all monitoring events.
    - sampling logs,
    - chain-of-custody forms,
    - Laboratory analytical reports.
- Certification by UA or UA's authorized agent.

5. REFERENCE

Hydro Geo Chem, Inc., 2004a, Interim Measures Investigation Report, June 8.

Hydro Geo Chem, Inc., 2004b, Post-Closure Expanded Groundwater Detection Monitoring Quality Assurance Project Plan, October 18.

Table 1. Groundwater Monitoring Well Construction Summary
Page-Trowbridge Ranch Landfill
Pinal County, Arizona

Well ID	Completion Date	Northing	Easting	Total Depth Drilled/Cased (ft bgs)	Casing Material	Casing Diameter for Screened Interval (in)	Screend Interval (ft bgs)	Measuring Point Elevation (ft amsl)
MW-1	9/26/1984	586359.08	1014625.54	842/840	steel	4.125	772 - 840 [6]	3640.91
MW-2	1/12/1985	585936.26	1013980.26	800/800	steel	4.125	632 - 800 [7]	3629.73
MW-3	1/18/1985	586332.77	1014143.73	800/800	steel	4.125	632 - 800 [7]	3632.45
MW-4	3/8/1985	585842.57	1014583.06	800/800	steel	4.125	632 - 800 [7]	3631.96
MW-5	9/24/1990	586409.13	1014625.05	755/750	steel	6	640 - 740 [8]	3642.28
Notes:								
1. Source of survey data: Urban Engineering, Inc., 2/28/01 (reproduced from HGC, 2003).								
2. Source of data for MW-1 through MW-4: EMA, 1985.								
3. Source of data for MW-5: EEC, 1991.								
4. Well MW-1 was replaced by well MW-5 in 1990.								
5. Measuring point is the top of sounder tube.								
6. Perforations are 3-inch by 0.125-inch vertical machine cut slots, 24 slots per foot.								
7. Perforations are 3-inch by 0.100-inch vertical machine cut slots, 12 to 24 slots per foot.								
8. Perforations not specified in report.								

Abbreviations:
ft = feet
bgs = below ground surface
amsl = above mean sea level

Table 2. Soil Vapor Well Construction Summary
Page-Trowbridge Ranch Landfill
Pinal County, Arizona

Well ID	Completion Date	Northing	Easting	Total Depth Drilled (ft bgs)	Casing Diameter and Material	Screen	Screend Interval (ft bgs)	Steel Casing Elevation (ft amsl)
SGS-SP	12/5/2003	12976.08	10378.00	255	0.5-inch PVC	0.02-inch mill-slotted	75 - 80	3633.77
SGS-Well	12/5/2003	12976.08	10378.00	255	4-inch PVC	0.08-inch mill-slotted	100 - 220	3633.77
SGD-SP	12/9/2003	12934.99	10175.80	605	0.5-inch PVC	0.02-inch mill-slotted	100 - 120	3629.69
SGD-MP	12/9/2003	12934.99	10175.80	605	0.5-inch PVC	0.02-inch mill-slotted	195 - 215	3629.69
SGD-Well	12/9/2003	12934.99	10175.80	605	2-inch PVC	0.08-inch mill-slotted	480 - 540 560 - 600	3629.69
SGD-DP	12/13/2003	12934.75	10156.28	355	0.5-inch PVC	0.02-inch mill-slotted	330 - 350	3629.14

Notes:
1. Source of data: HGC, 2004
2. Survey information is for steel casing at each borehole.

Abbreviations:
ft = feet
bgs = below ground surface
amsl = above mean sea level

Table 3. Sample Containers and Preservtives
Page-Trowbridge Ranch Landfill
Pinal County, Arizona

Parameter	Container Type/Size	Preservative
VOCs in water	3@40-mL glass, Teflon cap	pH<2 with HCl; cool to 4°C
Metals	250-mL polyethylene	pH<2 with HNO_3; cool to 4°C
Anions (SO_4^{2-}, Cl^-)	250-mL polyethylene	cool to 4°C
SVOCs	2@1-L amber glass	cool to 4°C
Organochlorine Pesticides	1-L amber glass	cool to 4°C
Radionuclides	1-L plastic	pH<2 with HNO_3; cool to 4°C
VOCs in air	1-L Summa canister	None

Abbreviations:
°C = degree Celsius
HCl = Hydrochloric acid
HNO_3 = Nitric acid
L = liter
mL = milliliter
SVOCs = semi-volatile organic compounds
VOCs = volatile organic compounds

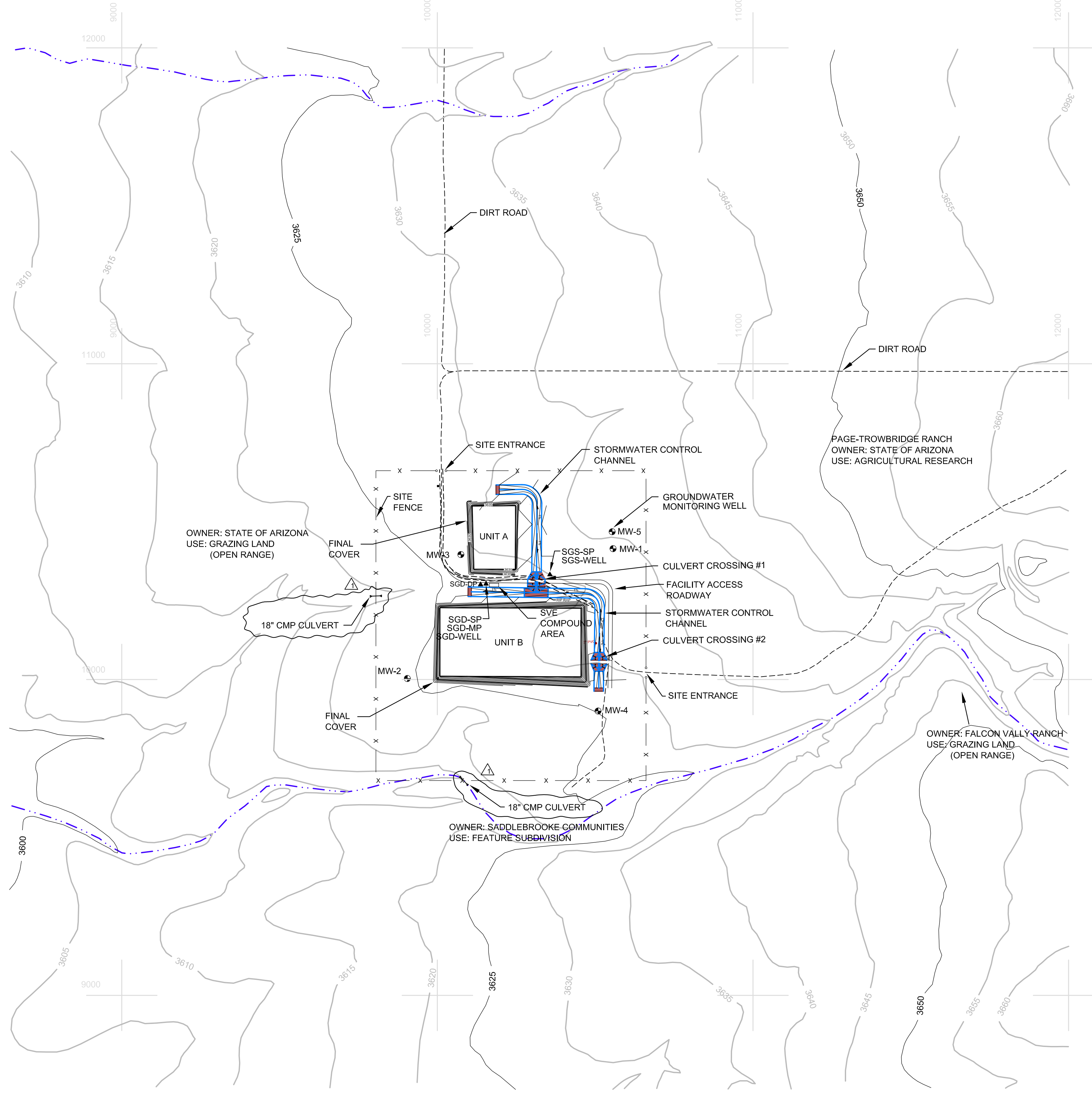
Table 4. Purge Volumes for Groundwater Sampling
Page-Trowbridge Ranch Landfill
Pinal County, Arizona

Monitoring Well	Minimum Purge Volume (gallons)	Maxiumum Purge Volume (gallons)
MW-2	412	617
MW-3	409	612
MW-4	409	611
MW-5	481	730

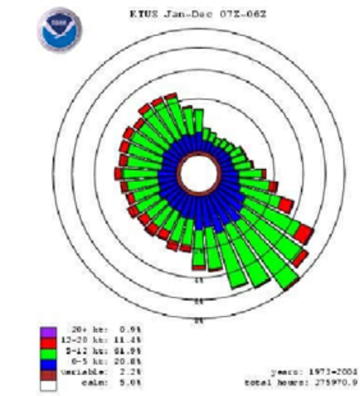
Table 5. Purge Volumes and Purge Times for Soil Vapor Sampling
Page-Trowbridge Ranch Landfill
Pinal County, Arizona

Monitoring Well	1 Well Volume Purge (ft^3)	3 Well Volumes Purge (ft^3)	5 Well Volumes Purge (ft^3)	1 Well Volume Purge Time (min)	3 Well Volumes Purge Time (min)	5 Well Volumes Purge Time (min)	Assumed Flow Rate for Calculting Purge Times (scfm)
MW-2	1.98	5.94	9.90	11	33	55	0.18
MW-5	2.02	6.05	10.09	11	33	55	0.18
SGD-SP	0.17	0.51	0.85	0.5	1.5	2.5	0.37
SGD-MP	0.30	0.90	1.50	0.5	1.5	2.5	0.57
SGD-DP	0.49	1.47	2.46	1.6	5	8	0.30
SGS-SP	0.12	0.35	0.57	0.3	0.7	1.5	0.47

Abbreviations:
ft^3 = cubic feet
min = minutes
scfm = standard cubic feet per min

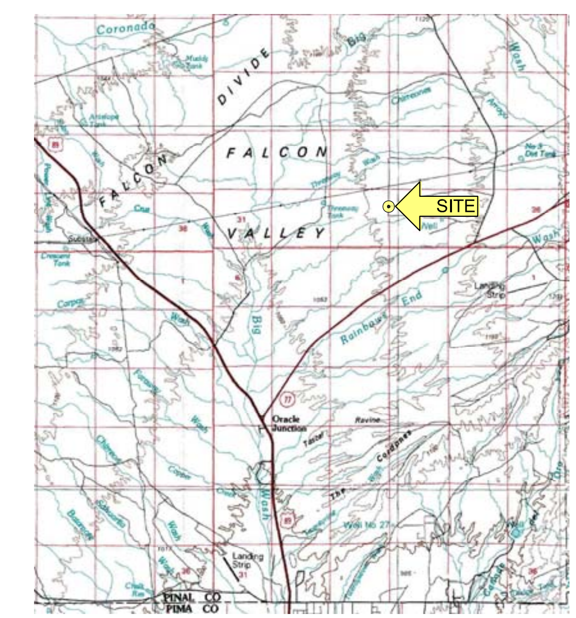


ALL WEATHER WINDROSE



SOURCE: U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER RECORD CENTER FOR YEARS JANUARY 1973 TO DECEMBER 2004.

LOCATION MAP



SOURCE: USGS MAMMOTH, ARIZONA 1986 1:100000 SCALE

SOURCE: STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, PHOENIX, ARIZONA DECEMBER 12, 1997.

REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.
A	17	06	2011	ISSUED FOR PERMIT APPLICATION	X.X.	M.Z.

Client Logo:

Client: UNIVERSITY OF ARIZONA
P.O. BOX 210460
TUCSON, AZ. 85721-0460

AMEC Earth & Environmental
1405 West Auto Drive
Tempe AZ 85284-1016

www.amec.com/earthandenvironmental

DATUM: –
PROJECTION: –
DRAWN BY: APS
REVIEWED BY: S. MIKELICH
ORIGINAL SCALE: AS SHOWN

PROJECT: PAGE - TROWBRIDGE RANCH LANDFILL
RCRA PART B POST CLOSURE PERMIT APPLICATION
(EPA ID AZ98066584)

TITLE: VICINITY MAP AND SITE MAP WITH MONITORING WELL LOCATIONS

PROJECT NO.: A00377
REVISION NO.: A
DATE: JUNE 2011
DRAWING NO.: FIGURE 1
SHEET NO.: _ of _

Attachment A

PAGE RANCH LANDFILL POST-CLOSURE PERIOD
GROUNDWATER DETECTION MONITORING

GROUNDWATER SAMPLING LOG

Date: _____ Well Number: _____

Sampling Personnel (Print): _____

Signature(s): _____

Depth to Groundwater

Trial 1	Trial 2	Trail 3	Average Depth
_____	_____	_____	_____

Well depth = 800 feet (ft)
Static water depth (typical) = 650 ft
Casing Diameter = 4 inches (150 ft of water in casing)

Casing volume = area x height = (0.0873 ft^2) x (150 ft) = 13.1 ft^3
13.1 ft^3 x 7.48 gallons/ft^3 = 98 gallons
3 casing volumes = 294 gallons

Discharge pipe volume = area x height = (0.0218 ft^2) x 650 ft) = 14.2 ft^3
14.2 ft^3 x 7.48 gallons/ft^3 = 106 gallons

Total volume of 3 casing volumes + discharge pipe = 400 gallons

Beginning Purge Time: _____ Ending Purge Time: _____

Purge Flow Rate: _____ Total Volume Purged: _____

Color: _____ Clarity: _____

pH/Conductivity/Temperature (see reverse side)

Samples Collected for (in order of collection):

1. VOCs (Method 524.2) ____
2. Semi-VOCs (Method 8270C) ____
3. Organochlorine Pesticides (Method 8081A) ____
4. Mn, Na (Method 200.7) ____
5. SO_4/Cl (Method 300.0) ____
6. Gross Alpha/Beta ____

Laboratory: _____

TIME	TEMPERATURE	CONDUCTIVITY	PH	APPEARANCE

Remarks:

Attachment B

Page Trowbridge Ranch Landfill

Soil Vapor Monitoring

Date: _____

Sampling Location: _____

Begin Purge Time: _____ End Purge Time: _____

Packer Pressure: _____ Sampled At: _____

Canister #: _____ Canister #: _____

Original “Inches Hg”: _____ Final “Inches Hg”: _____

Sampler: _____

Print Name Signature

Date: _____

Sampling Location: _____

Begin Purge Time: _____ End Purge Time: _____

Packer Pressure: _____ Sampled At: _____

Canister #: _____ Canister #: _____

Original “Inches Hg”: _____ Final “Inches Hg”: _____

Sampler: _____

Print Name Signature

Page Trowbridge Ranch Landfill

Soil Vapor Monitoring

Date: _____

Sampling Location: _____

Begin Purge Time: _____ End Purge Time: _____

Packer Pressure: _____ Sampled At: _____

Canister #: _____ Canister #: _____

Original “Inches Hg”: _____ Final “Inches Hg”: _____

Sampler: _____

Print Name Signature

Date: _____

Sampling Location: _____

Begin Purge Time: _____ End Purge Time: _____

Packer Pressure: _____ Sampled At: _____

Canister #: _____ Canister #: _____

Original “Inches Hg”: _____ Final “Inches Hg”: _____

Sampler: _____

Print Name Signature

Attachment C

TURNER LABORATORIES INC.
2445 N. Coyote Drive, Suite 104
Tucson, Arizona 85745
(520) 882-5880
Fax: (520) 882-9788
www.turnerlabs.com

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

TURNER WORK ORDER #_____ DATE _____ PAGE_____ OF_____

PROJECT NAME_____ # _____

CONTACT NAME_____

COMPANY NAME _____

ADDRESS_____

_____ PHONE_____ FAX_____

SAMPLER'S SIGNATURE _____

SAMPLE I.D.	DATE	TIME	LAB I.D.	SAMPLE MATRIX*	NUMBER OF CONTAINERS	Base Neutrals ☐ Acids ☐ 625/8270	Volatile Organics 624/524.2/8260	TTHMS ☐ HAA5 ☐	Pesticides ☐ PCB's 8081	NO_2 ☐ NO_3 ☐ TKN ☐	Oil and Grease Grav. 1664A ☐	TCLP Analysis VOA ☐ Semi-VOA ☐ Pest. ☐	Metals TCLP ☐ Dissolved ☐ Total ☐ RCRA8 ☐	Cyanide Total ☐ Amen. ☐ WAD ☐	SDWA-INORGANICS PRIMARY ☐ SECONDARY ☐	Coliform MPN ☐ Colilert ☐	pH ☐ Cr_6 ☐ Cl_2 ☐	COD ☐ TSS ☐ BOD ☐				

CIRCLE ANALYSIS REQUESTED AND/OR CHECK THE APPROPRIATE BOX

1. RELINQUISHED BY:

Signature

Printed Name

Firm

Date/Time

2. RECEIVED BY:

Signature

Printed Name

Firm

Date/Time

TURNAROUND REQUIREMENTS:

____ **Standard (approx. 10 days)***

____ Next Day ____ 2 Day ____ 5 Day*

____ Email Preliminary Results To:

_____

* **Working Days**

REPORT REQUIREMENTS:

____ I. Routine Report

____ II. Report (includes DUP, MS, MSD, as required, may be charged as samples)

____ III. Date Validation Report (Includes All Raw Data) Add 10% to invoice

INVOICE INFORMATION:

Account ____ Y ____ N

P.O. # _____

Bill to: _____

_____

_____

SAMPLE RECEIPT:

_____

_____

Total Containers _____

Temperature _____

☐ Wet Ice ☐ Blue Ice

3. RELINQUISHED BY:

Signature

Printed Name

Firm

Date/Time

4. RECEIVED BY:

Signature

Printed Name

TURNER LABORATORIES, INC.

Firm

Date/Time

* LEGEND

DW = DRINKING WATER
GW = GROUNDWATER
SD = SOLID
SG = SLUDGE
SL = SOIL
ST = STORMWATER
WW = WASTEWATER

SPECIAL INSTRUCTIONS/COMMENTS:

Compliance Analysis: ☐ Yes ☐ No	**Custody Seals** ☐	**Preservation Confirmation** ☐
ADEQ Forms: ☐ Yes ☐ No	**Container Intact** ☐	**Appropriate Head Space** ☐
Mail ADEQ Forms: ☐ Yes ☐ No	**COC / Labels Agree** ☐	**Received Within Hold Time** ☐

Chain-of-Custody Record

Sample Transportation Notice

Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection handling or shipping of these samples. Relinquished signature also indicated agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922.

AIR TOXICS LTD.
180 BLUE RAVINE RD, SUITE B
FOLSOM, CA 95630-1020
916-985-1000 main line
916-985-1020 fax line

Contact Person Company Address City State Zip Phone FAX Collected By: (Signature)	Project Information: P.O. # Project # Project Name	Turn Around Time: ☐ Normal ☐ Rush Specify	Pressurized by: Date: Press. Gas: N2 He

Lab I.D.	Field Sample I.D.	Canister I.D.	Date & Time	Analysis Requested	Canister Pressure/Vacuum Initial	Final	Receipt	Final (psi)
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

Lab Use Only	Shipper Name	Air Bill #	Opened By	Temp ©	Condition	Custody Seals	Work Order #
						Yes No None	

Attachment D

(on CD)

Quality Assurance Plan

Revision #22

November 11, 2011

Turner Laboratories, Inc.
2445 N. Coyote Drive
Tucson, Arizona
(520) 882-5880 / (520) 882-9788

Arizona License #AZ0066

Copy #: _____

Issued to: _____

Date Issued: _____

Approved by:

_____ _____
Terri Garcia, Technical Director Date

_____ _____
Nancy D. Turner, President Date

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Table of Contents

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Section 1 Introduction

Turner Laboratories, Inc. (Turner Laboratories) is a professional, independent, full-service laboratory that performs chemical and microbiological testing on a wide variety of sample matrices, including ground and surface water, wastewater, soils, sediments, sludges, industrial and hazardous wastes, and other materials.

This Quality Assurance Plan (QAP) has been developed to provide information on the general procedures, practices, and methods of compliance that Turner Laboratories implements to assure that the highest achievable standards are met.

The information in this QAP has been organized to conform to the requirements specified in the Arizona Administrative Register, A.A.C. R9-14-601 et seq. (December 2006), and the Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Edition, EPA 815-R-05-004, (January 2005).

Section 1.1 Quality Policy

It is the policy of Turner Laboratories to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the materials tested. This is accomplished by implementing quality control procedures that are monitored and assessed during the entire analytical process. Personnel shall be fully qualified to perform the analyses through the combination of education, training and experience. The equipment and supplies shall be obtained as needed to provide for the utilization of established technology and methodology. The performance of personnel and equipment will be continuously monitored and documented. Corrective action must be implemented and documented immediately if a quality problem arises.

Implementation of this QAP is the responsibility of all employees within Turner Laboratories.

Section 1.2 Quality System

The purpose of the Quality Assurance (QA) program at Turner Laboratories is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended to the general business operations of Turner Laboratories.

The objective of the quality assurance program at Turner Laboratories is to assure the accuracy and precision of all analytical results. Turner Laboratories has established specific quality assurance objectives for accuracy and precision that are used to determine the acceptability of the data. These objectives are method and matrix dependant and are provided in the standard operating procedures. Verification that these objectives have been achieved is recorded in the supporting documentation (raw data) and/or in the final report.

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Section 2.0 Organization

Section 2.1 Facility

Turner Laboratories features over 8,400 square feet of laboratory equipped with state-of-the-art analytical and administrative support equipment. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Turner Laboratories also ensures that good housekeeping and facilities maintenance are performed.

In addition, the laboratory work areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving.
- Sample Management Office, including controlled-access sample storage areas .
- Metals Sample Preparation Area.
- Metals Laboratories: ICP-AES, GFAA, CVAA, ICP/MS.
- General Chemistry Laboratory.
- Semi-Volatile Organics Sample Preparation Area
- Semi-Volatile Organics Laboratory: GC, GC/MS, GC/ECD.
- Volatile Organics Laboratories: GC/MS (3).
- Microbiology Laboratory.
- Laboratory Management, Client Service, Report Generation and Administration.
- Data Archival, Data Review and support functions areas.
- Information Technology (IT) and Laboratory Information Management System (LIMS)

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix C lists all the major analytical equipment illustrating the laboratory's overall capabilities and depth.

Turner Laboratories Contingency Plan consists of, but is not limited to the following:

- Analysis of samples on back-up instrumentation
- Subcontract samples to a certified laboratory
- Qualified cross-trained staff members are available to perform the necessary work

Section 2.2 Responsibilities

Turner Laboratories is committed to the excellence of data quality and providing an environment that fosters such quality. Every person employed at Turner Laboratories is responsible for improving and maintaining the quality of our analytical services. Responsibilities of key positions within the laboratory are described below. A chart showing the laboratory organization and lines of responsibility is included in Appendix A.

- The Technical Director has overall responsibility for all elements of the laboratory's technical operations, implementation of the QAP, updating laboratory policy and ensuring that all data reported by the laboratory meets the objectives of the QAP. The Technical Director performs regular, random reviews of data generated by the laboratory, ensures that audits of the laboratory are conducted, ensures that the laboratory remains in compliance, ensures that control charting of QC data occurs and that limits are updated regularly where required, and ensures that personnel complete the proper documentation for tests they perform (i.e. MDL studies, initial demonstration of capabilities, etc.).This technical director or his/her designee performs a final quality assurance review on all final reports issued by the laboratory.

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- The Project Manager acts as the interface between clients and the laboratory to ensure the details of the clients' needs are met, including management of permits and subsequent reporting requirements and keeping abreast of regulatory changes. Additionally, the project manager is responsible for supervising sample receiving personnel and performs some quality control duties as designated by the Technical Director.

- **Senior Inorganics Analysts** and the **Senior Organics Analysts** supervise and train analysts. They also ensure that the quality of all data reported by their laboratories meets the objectives of the QAP, and they ensure the accuracy, completeness, and timely review of standard operating procedures (SOP) for all procedures used.

- The **Sample Management Officer** ensures that sample management procedures meet our QAP objectives and ensures the accuracy, completeness, and timely review of SOPs for all sample management procedures. The sample management officer is responsible for the login of samples into LIMS, client bottle orders, container preservation and sample disposal.

- The **Administrative Assistant** supervises and schedules the work of the field sampling personnel. This employee also maintains contracts and technical records, and holds selected project management responsibilities including distribution of client reports and fielding client inquiries.

- **Analysts** perform testing according to established SOPs and methods and ensure that the data quality meets specified criteria. All analysts are required to provide a summary of their education and experience relevant to the compliance testing they will perform. The summaries are retained in their personnel training record and are subject to inspection by regulatory agencies. Documentation must include academic training, experience, specific qualifications for the position, certifications, and other specialized training.

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Section 3 Personnel Qualifications

3.1 Personnel Training

The employees' quality assurance orientation must be performed at the start of employment. The training is documented in the personnel training file. The orientation includes, but is not limited, to the review of the following:

- Orientation to the facility and facility policies;
- Review of the Turner Laboratories' Safety Manual;
- Review of the Quality Assurance Plan (QAP); and
- Review of the data integrity, applicable methods and Standard Operating Procedures (SOP) for the testing to be performed.

Before reporting results, the analyst must document that he/she has completed the following:

- Training in the use of the instrumentation and appropriate techniques used for compliance testing. The training may be in-house, classroom experience, or manufacturer's training. Records must indicate the place, date and length of training;
- Completion of all activities as required in the method criteria for initial demonstration of capability;
- Successful analysis of unknown quality control sample and/or proficiency evaluation sample. (Sample may be prepared in-house as a blind sample to the analyst or may be purchased from an external source).

Documentation of these training requirements are maintained in the employee's personnel training record, as outlined in the Turner Laboratories Policy Statement, Policy No. 4 pertaining to the maintenance of personnel training records.

Section 3.2 Laboratory Ethics

One of the most important aspects of the success of Turner Laboratories is the emphasis placed on the integrity of the data provided and services performed. To promote product quality, employees are required to comply with certain standards of conduct and ethical practices. Examples of Turner Laboratories' policy that are representative of these standards include, but are not limited to, the following:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action. Unless specifically required in writing by a client; alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.

- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible. Employee discipline is progressive in its severity and each situation is handled individually in that the discipline is designed to fit the circumstances. Potential disciplinary actions may include a verbal warning, written warning, a second written notice (more severe and more strongly worded than a warning), and suspension without pay, demotion, or termination.

- It is the responsibility of all Turner Laboratories employees to safeguard sensitive company and client information. The nature of our business and the well being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All

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information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action.

As part of this commitment, every employee at Turner Laboratories signs and abides by a fraud-disclosure form that reads as follows:

> "If I should become aware of any of the following conditions or events by anyone during my employment at Turner Laboratories, I agree to notify the principals of Turner Laboratories immediately:
>
> 1. Short-cutting of any procedural steps, or QA/QC falsification;
> 2. Altering data in any manner whatsoever;
> 3. Altering time records to avoid missed holding times;
> 4. Any condition that would, if known, result in the rejection of any analytical report by any regulatory agency - federal, state or local.
>
> "Should it become known that any information has been suppressed by any employee that could endanger the State operating license of Turner Laboratories or affect the ability to produce accurate scientific measurements, counsel will be retained by Turner Laboratories for possible legal action."

Turner Laboratories makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work.

Section 3.3 Client Confidentiality

Turner Laboratories professional ethics require that each employee maintain the highest degree of confidentiality when handling client affairs. Turner Laboratories shall ensure that all client documents and test results are confidential. In order to maintain this professional confidence, no employee shall disclose client information to outsiders, including other clients or third parties and members of one's own family.

Turner Laboratories has instituted procedures for protecting client confidentiality. A unique internal control number is assigned to individual samples by the LIMS. The assigned number is the primary mechanism for tracking a given sample through the laboratory system.

Under no circumstance will outside requests for client material be fulfilled unless prior written permission is received from the client to the Technical Director.

All employees at Turner Laboratories have signed a confidentiality agreement form regarding the information provided in this section that reads as follows:

"If I become aware of any of the above mentioned events during my employment at Turner Laboratories, I agree to notify the principals of Turner Laboratories immediately. Should it become known that any information has been disclosed by an employee, the employee will be terminated and counsel will be retained by Turner Laboratories for possible legal action."

Uncontrolled

Section 4 Documents and Records

Section 4.1 Controlled Documents

Turner Laboratories has an established document control system that forms part of the quality system. Controlled documents are those documents and data that are required for the operation of the quality system. These documents must be controlled by being replaced in whole when revised. The controlled documents include, but are not limited to:

- Quality Assurance Plan (QAP)
- Standard Operating Procedures (SOPs)
- Instrument Run/Maintenance Logbooks
- Nonconformance/Corrective Action Documents

Copies of controlled documents that are released, such as the Quality Assurance Plan and Standard Operating Procedures will be marked "Uncontrolled" and are not numbered. The control of the controlled documents is documented in an access log.

Section 4.2 Document Signatures

Controlled documents must have approval signatures. The Quality Assurance Plan will have the signature of the President and Technical Director. The Standard Operating Procedures will have the signatures of the Technical Director, Quality Assurance Officer, and analyst. Final reports that are issued by the laboratory will have the signature of the technical director or his/her designee that performs a final quality assurance review.

Section 4.3 Document Review and Revisions

The QAP is reviewed on an annual basis unless regulatory change necessitates an earlier revision. The SOPs are reviewed on an annual basis. Other QA documents that may require revision are reviewed and are revised as needed.

Any revisions to controlled QA documents are prepared by the Technical Director. The QA Officer will review the document. All changes to records are signed or initialed by the responsible staff. Corrections are indicated by on-line mark through with a signature or initials.

Section 4.4 Document Retention & Disposal

The original observations, calculations and derived data, calibration records, audit reviews and the client reports are retained for a minimum of five (5) years. The files are archived in boxes according to department, instrument and/or client with inclusive dates. After 5 years of archival (unless the client or contract specifies otherwise), eligible archives (not including SOPs or QAP) are purged and destroyed. Disposal of purged materials is accomplished by shredding/destruction of the material.

Turner Laboratories archiving system includes all of the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis.
- Instrument parameters (or reference to the data acquisition method).
- Sample analysis sequence.
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns.
- Electronic log ID number for the appropriate standards.
- Electronic copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

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Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

In the event that Turner Laboratories should go out of business or be bought by another company, all clients will be notified immediately. Client records will be handled by one of the following:

- If the client wishes to have control of their data, they will be given the original copies.
- If another company buys Turner Laboratories and the client wishes to have control of their data, they will receive the original copies and an exact copy (with proper documentation) will be retained by the purchaser. The purchaser will be responsible for retaining the data for the remainder of the applicable time.

Section 4.5 Computer Hardware & Software

Turner Laboratories utilizes the commercially purchased Element DataSystem by Promium, LLC Laboratory Information Management System (LIMS). The LIMS is a secure, password protected database. The Technical Director monitors the analytical activities and database performance. Changes to the LIMS are controlled by the Technical Director. The electronic instrument files, LIMS and server system are electronically backed-up on a daily basis.

All purchased software must be used in accordance with the terms of its software license.

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Section 5 Processes & Operations

Section 5.1 Sampling

The quality of analytical results depends largely upon the quality of procedures used to collect and transport samples. Turner Laboratories does not sample substances, materials or products for subsequent environmental testing under the accreditation program. Turner Laboratories recommends to their clients to follow appropriate methodology and regulations, such as the requirements specified in 40 CFR Part 136 or the US EPA's SW-846.

Turner Laboratories suggests to clients to consider the following:

- Sample matrix;
- Quantity of sample needed for testing;
- Type of container;
- Type of sample preservation;
- Transport time;
- Storage (holding) time; and
- Complete documentation for chain-of-custody purposes.

At the clients' request, Turner Laboratories provides the following:

- Sample containers with the appropriate preservatives as specified in the applicable standard operating procedure;
- Shipping containers;
- Chain-of-custody forms; and
- Custody seals.

Where obtaining sample aliquots from a submitted sample is carried out as part of a test method, Turner Laboratories follows the appropriate procedures and techniques to obtain representative sub samples. Any deviation from standard procedures is recorded on the data package.

Section 5.2 Handling of Samples

The chain-of-custody is a system for tracing the possession of a sample from collection to final disposition. This system is implemented to protect the interests of the laboratory and the client. Changes to the sample custody must be recorded on a chain-of-custody form and must accompany the sample at all times.

Turner Laboratories requires clients to submit a completed chain-of-custody form with each sample or group of samples for analysis.

The chain-of-custody program consists of the following:

- The established protocol for sampling will be followed for all chain-of-custody samples. Sample containers and preservatives should adhere to EPA and/or other appropriate requirements.

- At the time of sampling, the sampler completes the information on the chain-of-custody form, including date, time, client's name, sample name, sample matrix, number of containers, required tests, and signature.

- At all times after sampling, the sample must be in either the actual physical possession of the currently responsible individual or under laboratory control.

- When a client delivers the sample to Turner Laboratories, Turner Laboratories staff documents all subsequent changes of possession that occurs.

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- Responsibility for a particular sample concludes for one party at the point when delivery is documented to the next responsible party (the receiving laboratory or commercial carrier).

- If the sample is to be transported to another laboratory (for testing not performed by Turner Laboratories), the carrier is selected based on holding time criteria. The delivery is documented and transfer of possession to the carrier on the chain-of-custody form or by retention of applicable shipping documents.

Complete sample handling procedures are available in Turner Laboratories SOP SC-1.

Section 5.3 Sample Receipt and Management

Established standard operating procedures for receiving samples ensure that the samples are received and logged into the laboratory that all associated documentation (including chain-of-custody forms) is complete and consistent with the samples received, and that storage and tracking are conducted so that the samples' integrity is maintained.

Verification of sample integrity is documented upon sample receipt on the chain-of-custody form and requires the following conditions:

- The sample is clearly identified and matches the description on the chain-of-custody form.
- The condition of samples and sample containers meets method specifications.
- A sufficient quantity of sample is available so that all required tests can be performed.
- The sample is received within the specified holding time, and temperature requirement.
- Preservation is confirmed by the analyst conducting the method.
- Custody seals, if used, are present and intact.

If there is doubt as to the suitability of a sample or when the sample does not conform to the description provided, or the environmental test required is not specified in detail, Turner Laboratories will consult the client for further instructions before proceeding and the discussion shall be recorded in LIMS or on the chain-of-custody form.

At Turner Laboratories, each sample is logged into the laboratory information management system (LIMS), a secure, password-protected database that facilitates tracking and reporting of samples. The LIMS assigns a unique chronological laboratory identification number to each sample, and the sample management officer adds pertinent information concerning collection date and time, matrix, container, preservation, and required tests. All sample receipt documentation is retained with the sample work order through to final reporting and then retained electronically.

The sample management officer affixes labels to the sample container(s) with the unique laboratory identification number and places the sample in the appropriate storage area until analysis (under refrigeration if required). Samples with expedited turn-around times or whose tests have short holding times are given directly to the appropriate analysts. The technical director or qualified designee reviews the work order for completeness and indicates approval electronically in the LIMS system.

Turner Laboratories retains samples for thirty days after all analyses have been completed and the work order has been reported (unless other arrangements have been made) and then disposes of them using approved disposal practices (QAP Section 4.4). Complete sample receipt and management procedures are available in Turner Laboratories SOPs SC-1, SC-2 and SC-3.

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Section 5.4 Standard Operation Procedures (SOPs)

Turner Laboratories employs methods and analytical procedures from a variety of sources. The primary method references are USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, and III for hazardous wastes and USEPA 600/4-79-020, 600/4-88-039, 600/R-93-100, 600/R-94-111 and supplements and Standard Method for the Examination of Water and Wastewater. Other published procedures such as state-specific methods or in-house methods may be used. The implementation of methods by Turner Laboratories is described in the SOPs for each specific method. A list of the Turner Laboratories' SOPs and methods are provided in Appendix E.

Turner Laboratories maintains standard operating procedures (SOPs) and policies for all analytical procedures used at Turner Laboratories, including compliance and non-compliance methods. The protocols to monitor quality control and the acceptance criteria are provided for each method in each SOP.

All current and previous versions of SOPs and policies are retained in the technical director's office. The current SOPs are also available in the Technical Director's office and in each of the laboratories.

SOPs are reviewed at least once a year by the analysts, the quality assurance officer, and the Technical Director. Minor changes, additions, and deletions are annotated on the procedure itself, and before changes are put into use for testing, the quality assurance officer approves them. A finalized copy of a SOP should be completed within 30 days for any major modifications.

Review of a SOP is documented by the reviewer's signature on the cover page; review of a policy is documented by the reviewer's signature at the bottom of the policy. These signatures document the SOPs or policy's acceptability as of the review date. New procedures are reviewed, dated, and signed when they are implemented. Each SOP refers to the mandated methodology.

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Section 6 Calibration Procedures

All equipment used for environmental testing at Turner Laboratories is operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files.

Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Records are maintained to provide traceability of reference materials.

Any component of equipment which has been subjected to overloading or mishandling, or has been shown by verification or otherwise to be defective; is taken out of service until it has been repaired or is replaced by new equipment. The equipment is placed back in service only after verifying by calibration that the equipment performs satisfactorily. An evaluation of the effect of this defect on previous calibrations or tests is made and documented appropriately. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in the appropriate SOP. Documentation of calibration verification is maintained in appropriate reference files.

Section 6.1 Chemical Standards

Analysis standards prepared from stock solutions are stored in containers consistent with their stability. The containers are labeled with the standard number, expiration date, concentration of analyte(s) and the preparers' initials. Only the highest quality chemicals are used as reference materials. Whenever possible, standard solutions will be traceable to national standards such as NIST or EPA certified reference materials. The type and standard preparation information is provided in the specific method SOP.

The LIMS is used to electronically document the sources of primary standards, lot numbers of primary standards, date of receipt, expiration date, method of preparation of working stock standards, date of preparation of working standard, and the preparer. The procedure used for preparation of reagents is also documented in LIMS and includes weights, volumes, dilutions, and source of the stock solution or chemical reagent and lot numbers. Certification of manufacturer's analysis and/or traceability of primary standards/sources to EPA certified standards are retained in the laboratory either electronically attached or on paper.

Section 6.2 Temperature Control Devices

Temperatures are monitored and recorded for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators. Temperature record sheets contain daily-recorded temperatures, identification and location of equipment, and acceptance criteria.

All thermometers are identified according to location and serial number, and the calibration of these thermometers is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer should be recalibrated at least every 5 years or whenever the thermometer has been exposed to temperature extremes.

Infrared (IR) temperature detection devises should be verified semiannually using a NIST certified thermometer. Each day of use, a single check of the IR should be made by checking the temperature of a bottle of water at the temperature of interest that contains a calibrated thermometer. The temperature check is to be recorded on Temperature record sheets.

Section 6.3 Analytical Balance

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The calibration of the analytical balance is performed daily, monthly and annually. All balances are checked on the day of use. The specific procedures for analytical balance calibration are provided in Turner Laboratories' Policy No. 1.

Section 6.4 Pipets

The calibration of autopipettors used in the preparation of primary and secondary standards must be performed on the day the standards are prepared within +2 % of the set value. The pipets must be calibrated at the highest and lowest settings used. The results of all calibration verifications are recorded on worksheets and retained in the laboratory.

Section 6.5 Fume Hoods

All fume hoods are velocities are measured on an annual basis.

Section 6.6 Instruments

The accuracy of a chemical analysis depends on the quality of reference standards and reagents used during the preparation and analysis of the sample. The calibration procedures, frequency of initial and continuing verification and criteria for evaluation of calibration data are described in the individual methods. Detailed requirements are contained within the applicable SOP. All instrument calibrations are documented in logbooks or data packages.

Section 6.7 Calibration models

The options for calibration models or a single calibration model used for an analysis may be stipulated by the specific method. Where it is not, the instrument manufacturer's recommendations should be followed. Since there are many methods that follow the same calibration models, a compilation of the detailed calculations for all models used throughout the laboratory is presented in the administrative standard operating procedure, ADM-6.

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Section 7.0 Quality Control

Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the established requirements. Individual methods require certain quality control criteria and acceptance, and are described in detail in the associated SOP.

Section 7.1 Method Detection Limit

The Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. An MDL study requires that all sample processing steps of the analytical method be included in the determination of the method detection limit. Turner Laboratories establishes MDL's for each applicable method and analyte reported by the laboratory. Turner Laboratories evaluates these MDL's based on method-set time frames or every two years, whichever is more frequent.

Turner Laboratories follows the procedures as described in 40 CFR, Part 136, Appendix B, Definition and Procedures for the Determination of the Method Detection Limit. This is also the referenced procedure in Manual for the Certification of Laboratories Analyzing Drinking Water, 5th edition, Chapter IV, section 7.2.11; however, the Drinking Water Manual includes the additional requirement of preparing and analyzing MDL samples over a period of at least three days to include day to-day variation as an additional source of error. Thus, MDL determinations for drinking water analyses must be performed over at least three days.

Section 7.2 Practical Quantitation Limit

The Practical Quantitation Limit (PQL) is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. It is generally 2 to 10 times the MDL.

Section 7.3 Initial Demonstration of Capability

Each analyst must initially analyze 4 replicates of a standard/Laboratory Control Sample prior to the analysis of samples. The analyte(s) shall be diluted in a volume of clean quality system matrix. The mean recoveries and standard deviations for each analyte is calculated and compared with method or in-house limits as appropriate.

The Demonstration of Capability must be completed at any time there is a significant change in instrument type, personnel or test method.

The analysis of actual samples only begins if all parameters meet the acceptance criteria. If one or more of the tested parameters fail the acceptance criteria, the analyst will either determine the source of the problem and repeat the test for all parameters or repeat the test for the parameters that failed. Repeat failure will initiate the review of the methodology, correction of the problem and repeat analysis of all parameters.

Section 7.4 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures. In each specific SOP, the sample types and frequencies are described in detail and brief descriptions are provided below.

Section 7.4.1 Method Blank (Laboratory Reagent Blank)

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The method blank is analyte-free water (or other sample-like matrix), subjected to the entire analytical process. The method blank is analyzed to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the Practical Quantitation Limit (PQL). Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

Section 7.4.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve.

Section 7.4.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater.

Section 7.4.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard solutions that are, in turn, prepared from stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

Section 7.4.5 Initial Calibration Verification Standards

Initial calibration verification standards (ICVs) are standards that are analyzed after calibration with newly prepared standard(s) but prior to sample analysis, in order to verify the validity and accuracy of the standards used in the calibration. Once it is determined that there is no reference material defect or systematic error in preparation of the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

Section 7.4.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are mid-range standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

Section 7.4.7 Low-Level Standards

When the method requires, a standard is analyzed to demonstrate that the analyte can be recovered at the PQL concentration. The frequency of the low-level standard is once per analytical run.

Section 7.4.8 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample following sample preparation or extraction. Internal standards are generally used for GC/MS, GC/ECD, ICP and ICP-

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MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by certain matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

Section 7.4.9 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample.

The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance. The percent recovery is compared to the acceptance criteria per the method. Where criteria are not established the acceptance criteria shall be based upon internal criteria. If the surrogate recoveries are outside of acceptance criteria, appropriate corrective action should be followed.

Section 7.4.10 Laboratory Control Samples (Laboratory Fortified Blanks)

The laboratory control sample (LCS) is an aliquot of analyte-free water to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. The LCS sample is prepared and analyzed in the same analytical batch, and in exactly the same manner, as the other routine samples per the method or regulatory requirements. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent.

The percent recovery of the target analytes in the LCS is compared to the acceptance criteria per the method. The percent recovery assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to batch precision and accuracy. Acceptance criteria for LCS analyses are obtained through the use of control charts. Comparison of results between LCS and MS is important in assessing matrix interferences.

The LCS is prepared in duplicate as the LCSD. The relative percent difference between an LCS and LCSD is a measure of the precision for a given method and analytical batch. LCS/LCSD samples are performed at a minimum frequency of one per batch or per 20 samples or as required by the specific method.

Section 7.4.11 Matrix Spikes (Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) has been added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as the routine samples. The stock solutions used for spiking the sample(s) are purchased and prepared independently of calibration standards. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. For the appropriate methods, matrix spiked samples are prepared and analyzed at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per 20 samples or as required by the specific method.

Depending on the method of analysis, a matrix spiked sample and duplicate matrix spiked sample (MS/MSD) are analyzed. The relative percent difference between an MS and MSD is a measure of the precision for a given method and analytical batch.

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Section 7.4.12 Interference Check Samples

An interference check sample (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and inter-element correction factors in metals analyses. The ICS is prepared to contain known concentrations of interfering elements that will provide an adequate test of the correction factors. The ICS is spiked with the elements of interest at concentrations of approximately ten times the instrument detection limits. The ICS is analyzed at the beginning and end of an analytical run or every eight hours, whichever is more frequent, and the results must be within ± 20% of the true values.

Section 7.4.13 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the instrument detection limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

Section 7.4.14 Representativeness

Representativeness is the degree to which the field sample represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. Analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

Section 7.4.15 Reagent Water

Laboratory water used for the preparation of reagents and standards is pivotal in the generation of quality reliable data. Various specific analytical methods make recommendations for quality guidelines pertaining to reagent water. Turner Laboratories uses ion exchange to produce in-house on-demand water for most applications. All mixed bed tanks are inspected for proper tank type and 1M indicator lights before being installed by the technician. Reagent water is prepared in the Metals Department using ASTM Type I protocol per EPA method 200.8. Reagent water is tested for ASTM D1193 parameters semi-annually during the lab-wide standard and reagent review. Limits set by SM 1080B medium grade specifications must be met.

Section 7.5 Calculations

The Standard Operating Procedures include equations for the calculations that are applicable to each particular method. Several common calculations follow:

Section 7.5.1 Accuracy

Accuracy is the closeness or nearness of a data point or analytical result measured by the test method to the true value. Accuracy is expresses as a percentage of recovery (R) of the true value.

Accuracy of the Laboratory Control Samples is as follows:

$$\%\ R = \left(\frac{\text{Value of Spike in Pure water}}{\text{Value of Added Spike}} \right) \times 100$$

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The matrix spike recovery is calculated according to:

$$\%\ R = \left(\frac{\text{Value of Spike Sample - Value of Unspiked Sample}}{\text{Value of Added Spike}} \right) \times 100$$

Section 7.5.2 Precision

Precision is the reproducibility of an analytical procedure resulting from replicate analyses of homogeneous sample regardless of the true value. The precision of a matrix spike sample (MS) and a matrix spiked duplicate (MSD) or by the analysis of replicate aliquots of a sample. Duplicates are used for those tests that are not amenable to spiking.

Precision is determined by calculation the Relative Percent Difference (%RPD) between the MS and MSD as follows:

$$\%RPD = \left(\frac{(X_1 - X_2)}{\left(\frac{X_1 + X_2}{2} \right)} \right) \times 100$$

Section 7.5.3 Control Limits and Charting

The generation of control charts is routinely performed at Turner Laboratories for surrogate, MS and LCS recoveries and new control limits are generated periodically for analyses without set limits as required by the specific method. Control charts are used to monitor the data generated to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s).

Control limits are also calculated for methods that do not have prescribed quality control limits. After review of the data by the Quality Assurance Officer, the new acceptance limits determined from the control charting replaces the previous limits and data is assessed using the new values. These control limits are updated when new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change.

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Section 8.0 Data Reduction, Validation, and Reporting

Section 8.1 Data Reduction and Validation

All analysts performing testing must use the established, approved procedures and quality control mechanisms required by the procedure. If any aberrant or non-compliance results appear for the analyses or for the quality control, the analyst must follow the steps outlined in the QAP Section 13.

Results are generated by the analyst who performs the analysis and works up the data. All observations, data and calculations are recorded at the time they are made. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are provided in the applicable analytical SOPs. The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form in LIMS or brought over electronically from the instrument. The hardcopy version of the analytical report is then reviewed by the analyst for accuracy and forwarded to Quality Assurance Officer, for secondary review. For organics analyses, selected analytical runs are peer reviewed by a second organics analyst for adherence to method and SOP requirements and specifically for appropriateness and accuracy of manual integrations before being submitted to a Quality Assurance Officer for secondary review.

All data calculations are written on printed data forms or provided on computer printouts, using the unique sample identification number assigned to the sample(s). When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the designated laboratory staff.

The technical director is responsible for all testing conducted in the laboratory, including the day-to-day analytical results and quality control practices. The data's integrity is reviewed based on the quality control parameters listed in the standard operating procedures. To ensure that the following five requirements have been met, the technical director or designee reviews analytical results and the accompanying quality control documentation before releasing the final reports.

- The established monitoring programs have been conducted as required;
- All documentation is complete for sample test results and the associated quality control;
- Test results are reasonable according to historical data or special conditions for the sample;
- The quality control data are acceptable according to established ranges and other criteria; and
- The results have been transcribed without error.

The integrity of data is verified using a variety of measures, including method blanks, duplicate sample analyses, matrix spikes, and laboratory control samples. The calibration data, accuracy of check standards, system sensitivity, preventive maintenance documentation (equipment integrity), data transcriptions, and calculations are also reviewed. The quality control parameters vary per method and are provided in the individual SOPs.

Final, signed reports are issued only after they have been completely reviewed for accuracy, completeness, and appropriateness. Any exceptions from common practice or anomalies in the test results or accompanying quality assurance program are provided in the Case Narrative section of the final report.

Section 8.1 Reporting Procedures

The results of each test or series of tests carried out by Turner Laboratories are reported accurately, clearly, unambiguously and objectively and in accordance with the method conducted. The final reports are generated using the LIMS following the procedures in SOP- ADM-4. The final reports format includes the following:

- laboratory name, address, contact information,
- the assigned unique laboratory identification number,

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- name and address of client,
- identification of method(s) used,
- client identification,
- date of sample receipt,
- sampling date and time,
- the environmental test result, unit of measurement, analysts initials, analysis date and time
- narrative clearly identified for any nonconformance, deviations, interpretations
- name, function and signature authorizing report, and date of issue
- a statement that the report shall not be reproduced except in full without written approval of the laboratory
- laboratory accreditation

Test results performed by subcontractors shall be clearly identified in the report and provided to the client on the signed subcontractor's stationary.

In the case of electronic transmission of results by facsimile or email, Turner Laboratories assures that all the responsible steps are taken to preserve confidentiality.

Amendments to the final report after issuance shall be made in the form of a "Revised Report" and will be clearly identified as such.

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Section 9 Procurement of Quality Products

Quality products are products used in the laboratory that must meet a minimum quality requirement, such as gases, water, solvents, standards and sample/laboratory containers. Turner Laboratories purchases products that have certificates of analyses, certificates of cleanliness, etc. from reputable vendors. All certificates are retained on-site for a minimum of five years.

The procedure for the purchase, reception and storage of reagents and consumables can be found in the Turner Laboratories' Policy No 8.

Section 9.1 Subcontract of Laboratory Services

Turner Laboratories will subcontract laboratory services for analyses that Turner Laboratories is not certified to report or in situations where the instrument is not conforming to Quality Control Protocol. Only Arizona or NELAP accredited laboratories will be used for subcontract services. The laboratory performing the subcontracted work shall be indicated in the final report and non-NELAP accredited work shall be identified.

A subcontractor registry is maintained by the laboratory.

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Section 10 Project Requirements

Turner Laboratories reviews all projects that are procured. The President, Project Manager or Technical Director review all materials associated with the project prior to quoting the project. When it is necessary to use methods not covered by standard methods, these methods are subject to agreement with the client.

When a customer requests a modification (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the project chemist handling that project must discuss the proposed deviation with the Project Manager or Technical Director to obtain their approval to accept the project. The project chemist is responsible for documenting the approved or allowed deviation from the standard operating procedure by placing a detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

The goal is to ensure that Turner Laboratories can meet the client requirements before project initiation. Project correspondence is retained by the Project Manager or in project notes in LIMS.

Section 10.1 Client Services

Continuous improvement is a process in which management philosophy and operating methodology are committed to quality improvement in the organization. The following elements are essential to management:

- A focus on the needs of the customer or client
- Effective communication of customer needs among all participants
- Top management commitment, support and direction
- Reliance on standards and measures of performance to demonstrate satisfaction of customer needs.

Client complaints are received through the Technical Director, Project Manager or President and are recorded in the client files. The Technical Director, Project Manager or President communicates with the client to determine the details of the inquiries, including technical data problems, turn around time issues, etc.

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Section 11 Audits

Quality audits are an essential part of the Turner Laboratories' quality assurance program. Audits of laboratories are performed to assess the degree of compliance to policies, procedures, and standards. There are two types of audits: System Audits are conducted to qualitatively evaluate the operational details of the QA program, and Performance Audits are conducted by analyzing performance evaluation samples in order to quantitatively evaluate the outputs of the various measurement systems.

Section 11.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of Turner Laboratories are conducted regularly by various regulatory agencies and clients. Additionally, internal system audits of Turner Laboratories are conducted regularly. The internal audit procedures are described in Turner Laboratories' Policy No. 6. Additionally, ongoing auditing is performed by data validation on a daily basis.

The results of each audit are reported to the Technical Director for review and comment. Any deficiencies noted by the auditor are summarized in the audit report and corrective action is identified to correct each deficiency within a specified time period. All audit and review findings, and corrective actions are documented and retained by the Laboratory Director. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification if not already provided.

Electronic data audits may be performed in conjunction with hardcopy data audits following the procedures outlined in SOP ADM-5. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices and files, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Section 11.2 Performance Audits

Turner Laboratories also participates in the analysis of inter-laboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory, to assess the accuracy and precision of the laboratory procedures and results. Turner Laboratories participates in performance evaluation programs, including the Water Pollution (WP) and Water Supply (WS) programs. A summary of our performance in these programs is included in Appendix D. All proficiency testing raw data and reports are retained by the Technical Director.

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Section 12 Preventative Maintenance Activities

Preventative maintenance is a crucial element of Turner Laboratories' quality assurance program. The major instruments such as GC/MS systems, atomic absorption spectrometers, analytical balances, inductively coupled plasma emission and MS spectrophotometers, and gas chromatographs are maintained either by qualified in-house personnel or under commercial service contracts. All instruments are operated and maintained according to the instrument operating manuals.

All routine and special maintenance activities pertaining to the instruments are recorded in instrument logbooks. The logbooks used at Turner Laboratories contain extensive information about the instruments used at the laboratory. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

If equipment has been subjected to overloading or mishandling or has been shown to be defective or outside specified limits, the equipment is considered to be out of service until it has been repaired and shown by calibration or testing to be performing correctly.

The instrument maintenance activities are recorded in instrument run logs or maintenance logs. All instruments are operated and maintained according to the instrument operating manuals, method requirements, and specific Turner Laboratories policies where applicable.

Specific preventative maintenance procedures and schedules are discussed in the applicable SOPs.

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Section 13 Nonconformance and Corrective Action Procedures

Turner Laboratories does not use any equipment, instrumentation, or reagents until these have been validated with the appropriate checks. However, at some time the laboratory may need to address anomalous results. A nonconformance is defined as any unapproved or unplanned deviation from standard operating procedure or policy. If there is failure to meet established quality assurance objectives, immediate corrective action is initiated.

Specific control limits and corrective action activities are described in the standard operating procedures and/or in the references listed therein.

The steps in the corrective action process are as follows:

- Identify the problem. When check results do not fall within the established criteria, if a sample gives an unexpected result or if a deviation from the method or SOP is identified; the situation is defined as out-of-control. In such a case, the analyst must identify the reason for the disparity before any test results can be considered valid;
- Determine the cause of the problem;
- Implement corrective action;
- Verify that the problem has been corrected; and
- Document the problem, the action taken, and the subsequent in-control situation.

Corrective action may take several forms, including calculation checks, instrument maintenance and operation checks, review of analytical technique and methodology, and re-analysis of controls and samples. Corrective actions for specific instrumentation and equipment are indicated in the manufacturers' maintenance requirements. Corrective action for procedural quality assurance checks is delineated in the methodology.

Problems in analysis and corrective actions are documented on the raw data (chromatograms or reports), laboratory benchsheets, or instrument logs. If problems develop in any testing procedure that cannot be resolved through the corrective action performed, the samples for that test are referred to another laboratory until the problem is brought under control. If the analyses have been affected, the laboratory will notify the client immediately.

No sample results should be released until the test system is shown to be operating correctly. If it is not possible to correct the problem within established time frames, all test samples should be sent to an appropriately licensed, contract reference laboratory until the problem has been resolved.

The Quality Assurance Officer, Technical Director or President has the necessary authority to stop work in the event of an out-of-control situation.

All nonconformance and corrective action activities are documented by the QA Officer or the Technical Director and retained by the Technical Director.

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Section 14 Licensed Parameters

A copy of our current Arizona Department of Health Services "Environmental Laboratory License" and the list of licensed parameters and approved methods can be found in the office of the Technical Director and in the Laboratory Licensure file in the administrative office. These documents can also be accessed by the administrative staff electronically on the laboratory server. This list demonstrates our capability for compliance testing. Additional capabilities may exist for non-compliance testing. The list can be appended to this document electronically or in printed form upon request.

The laboratory license is prominently displayed at the laboratory facility.

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Attachment E

(on CD)