



ANDREWS, TEXAS

March 30, 2015

VIA EMAIL AND FEDERAL EXPRESS

Charles Maguire, Director
Radioactive Material Licensing Section
Radioactive Materials Division
Texas Commission on Environmental Quality
Mail Code - 233
P.O. Box 13087
Austin, Texas 78711-3087

References: (1) Radioactive Material License No. R05807, Amendment No. 09
CN600616890, RN101702439
(2) Radioactive Material License No. R04100, Amendment 28, CN600616890,
RN101702439 (3)

**Subject: Annual/Semi-Annual Radiological Environmental Monitoring Plan Report for
January - December of 2014**

Dear Mr. Maguire:

Waste Control Specialists LLC (WCS) is submitting the attached Radiological Environmental Monitoring Plan (REMP) Report in accordance with the following License Conditions:

Radioactive Material License No. R05807, License Condition 77 (Reference 1):

77. The Licensee shall submit to the Executive Director each year, no later than September 30 for the period of January 1 through June 30 and March 31 for the period of July 1 through December 31, a report specifying the quantity of each principle radionuclide released to unrestricted areas in liquid and in gaseous effluents (including particulates) during the specified semi-annual period of operations.

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Radioactive Material License No. R04100, License Condition 158.H.9 (Reference 2):

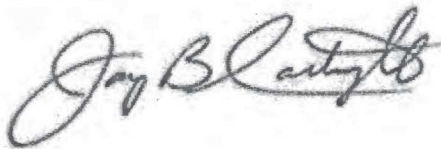
158.H.9 The Licensee shall provide a semi-annual environmental monitoring report to the executive director to be submitted before March 31 and September 30 of the preceding six (6) months. The semi-annual report shall include the results of all environmental media samples for all facilities at the Waste Control Specialist LLC, Andrews County site. The Annual Meteorological Report should be submitted prior to or included in the March 31 semi-annual environmental monitoring report. The Licensee shall follow the requirements of 30 TAC Chapter 25 (Environmental Testing Laboratory Accreditation and Certification,) and provide the executive director with acceptable analytical data provided by and accredited environmental testing laboratory unless extenuating conditions exist as specified under 30 TAC §25.6 (Conditions Under Which the Commission May Accept Analytical Data).

The attached CD contains all the pertinent appendices as per the following list and submitted in electronic format only:

- Appendix A. Comparison Values
- Appendix B. Summary of Fauna Data
- Appendix C. Summary of Soil Data
- Appendix D. Summary of Sediment Data
- Appendix E. Summary of Vegetation
- Appendix F. Summary of Air Data
- Appendix G. Summary of Groundwater Data
- Appendix H. Summary of Surface Water Data
- Appendix I. Summary of Leachate and Leak Detection Data
- Appendix J. Summary of Septic Data
- Appendix K. Summary of CWF and FWF Contact Water Tank Data
- Appendix L. Summary of Pre-Discharge Sump Data

WCS requests that a copy of all correspondence regarding this matter be directly emailed (jcartwright@wcstexas.com) to my attention as soon as possible after issuance. If you have any questions or need additional information, please call me at 432-525-8698.

Sincerely,



Jay B. Cartwright
Radiation Safety Officer and Director of Radiation Safety

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A N D R E W S , T E X A S

**All Facilities
Annual / Semi-Annual Radiological Environmental
Monitoring Report**

January 1 – December 31, 2014

Andrews County, Texas Site

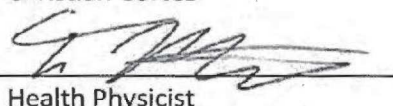
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Date

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**Waste Control Specialists LLC
Semi-Annual Radiological Environmental Monitoring Program Report
For January 1 – December 31, 2014**

Executive Summary

Purpose

This report summarizes the radiological results for environmental and effluent monitoring samples collected in and around the Waste Control Specialists LLC (WCS) site in Andrews, County, Texas, for the period of January 1 through December 31, 2014. These data are collected under the Radiological Environmental Monitoring Program (REMP) documents and in accordance with groundwater and effluent monitoring programs of the following permits, licenses, or authorizations:

- RML No. R05807, Amendment 9, for the Byproduct Material Disposal Facility;
- RML No. R04100, Amendment 28, for the Low-Level Radioactive Waste Disposal Facility, including the Federal Facility Waste Disposal Facility (FWF) and the Compact Waste Disposal Facility (CWF) and for the radioactive waste processing and storage facility;
- Hazardous waste permit No. 50358 for the Resource Conservation and Recovery Act (RCRA) treatment, storage and disposal facility (TSDF), including the East + West Landfill;
- Hazardous waste permit No. 50397 for the FWF;
- The Toxic Substances Control Act (TSCA) authorization for the site, including the radioactive waste processing and storage facility, the RCRA TSDF, and the FWF; and
- The outfalls and evaporation ponds associated with Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0004857000, TPDES Permit No. WQ0004038000, and Texas Land Application Permit (TLAP) No. WQ0004948000.

All of these authorizations have been issued by the Texas Commission on Environmental Quality (TCEQ), with the exception of the TSCA authorization that has been issued by the U.S. Environmental Protection Agency (EPA).

The results collected under these monitoring programs are used to demonstrate compliance with the radiation protection and environmental standards specified in Title 30 of the Texas Administrative Code (30 TAC), Chapter 336, §336.313, *Dose Limits for Individual Members of the Public* and §336.1133, *Maximum Values for Use in Groundwater Protection*. This report enables a comprehensive annual review and evaluation of potential migration of radiological contaminants from the WCS site.

This report is also intended to fulfill the requirements in License Condition (LC) 158.H.9) of RML No. R04100 (Amendment 28), LC 77 of RML No. R05807 (Amendment 9), LC 92.B of RML No. R05807 (Amendment 9). LC 158.H.9) of RML No. R04100 states, "The Licensee shall provide a semi-annual environmental monitoring report to the executive director to be submitted before March 31 and September 30 of the preceding six (6) months. The semi-annual report shall include the results of all environmental media samples for all facilities at the WCS, Andrews County site." LC 77 of RML No. R05807 requires WCS to "submit to the Executive Director each year, no later than September 30 for the period of January 1 through June 30 and March 31 for the period of July 1 through December 31, a report specifying the quantity of each principle radionuclide released to unrestricted areas in liquid and in gaseous effluents (including particulates) during the specified semi-annual period of operations." LC

92.B of RML No. R05807 states "Annual environmental monitoring reports shall be submitted to the Executive Director no later than April 1 of the year following the monitoring period."

Summary of the Environmental and Effluent Monitoring Programs

WCS conducts the environmental and effluent monitoring programs to provide indicators of potential impact to human health and the environment and to demonstrate compliance with applicable regulatory limits. Under these programs, WCS monitors air, groundwater, surface water, wastewater, soil, sediment, vegetation, and fauna. WCS also operates a meteorological monitoring program that supports several of the environmental monitoring requirements. Environmental media and effluent samples were routinely collected for the reporting period of January 1 through December 31, 2014 in and around the WCS site. The analyses of these samples yielded approximately 34,000 radiological results.

A fauna sample was collected during this reporting period. All values were below the established ILs and ALs.

Soil samples were collected during this reporting period. Although these results do not show any significant differences from historical soil data, one of the data points for a naturally occurring radionuclide exceeded the current applicable comparison value. This exceedance is common and is not the result of a release; rather, it is due to ILs and ALs that are inappropriately low when compared against natural conditions. The soil sample at station 22 was reported with a concentration of thorium-230 greater than the respective Byproduct IL. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807.

Sediment samples were collected during this reporting period. Station GW-2 exceeded the thorium-230, radium-226 and radium-228 Byproduct ILs. These exceedances are not the result of a release. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807.

Vegetation samples were collected during this reporting period when sufficient leafy vegetation was present. The vegetation results are consistent with the established background. The vegetation result for station 6 was greater than the byproduct IL for radium-226. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807. This result was not indicative of a release, but is instead attributable to natural variability of naturally-occurring radionuclides.

Direct radiation monitors at the facility boundary (stations 13, 6, 7, 16, 26, 17, 34) were consistent with historical data. This background dose is attributed to naturally occurring terrestrial and cosmic radiation and averaged 2.1 mrem for TLDs and 1.9 mrem for OSLs over the reporting period.

The air radiological monitoring results for the reporting period of January 1 through June 30 were consistent with those of previous years. One air particulate result, the April result for station 9, exceeded its associated Byproduct Investigation Limit (IL) for uranium-238; however, it was well below the Action Limit (AL). This result was reported to the TCEQ within four hours of confirmation in accordance with LC 92.K of RML No. R05807. This result was not indicative of a release, but is instead

attributable to dust overloading of a naturally-occurring radionuclide. All other air results were below the established Investigation Limits (ILs) and Action Limits (ALs). Those ILs and ALs have been previously provided to the TCEQ in REMP documents associated with RML Nos. R05807 and R04100.

Groundwater monitoring results for the reporting period of January 1 through June 30 were consistent with those of previous years. Groundwater was sampled from 69 wells and radiological analyses were performed when water sufficient for all analyses was present. These results show no significant differences from background.

Surface water was collected during this reporting period. All values were below the established ILs and ALs.

Liquids that may collect in the Leachate Collection System (LCS) and Leak Detection System (LDS) of the byproduct material landfill are pumped into tanks for consolidation and storage prior to pre-release verification sampling and analysis. Pursuant to RML No. R05807, LC 37.B, Table 37.B, liquid samples are also collected directly from the LCS and LDS sumps and analyzed semi-annually. The analytical results were compared with the discharge limit for gross alpha and the reporting limit for beta/gamma emitters (15 pCi/L and 50 pCi/L) respectively, under TPDES Permit No. WQ0004857000. All results were below these limits.

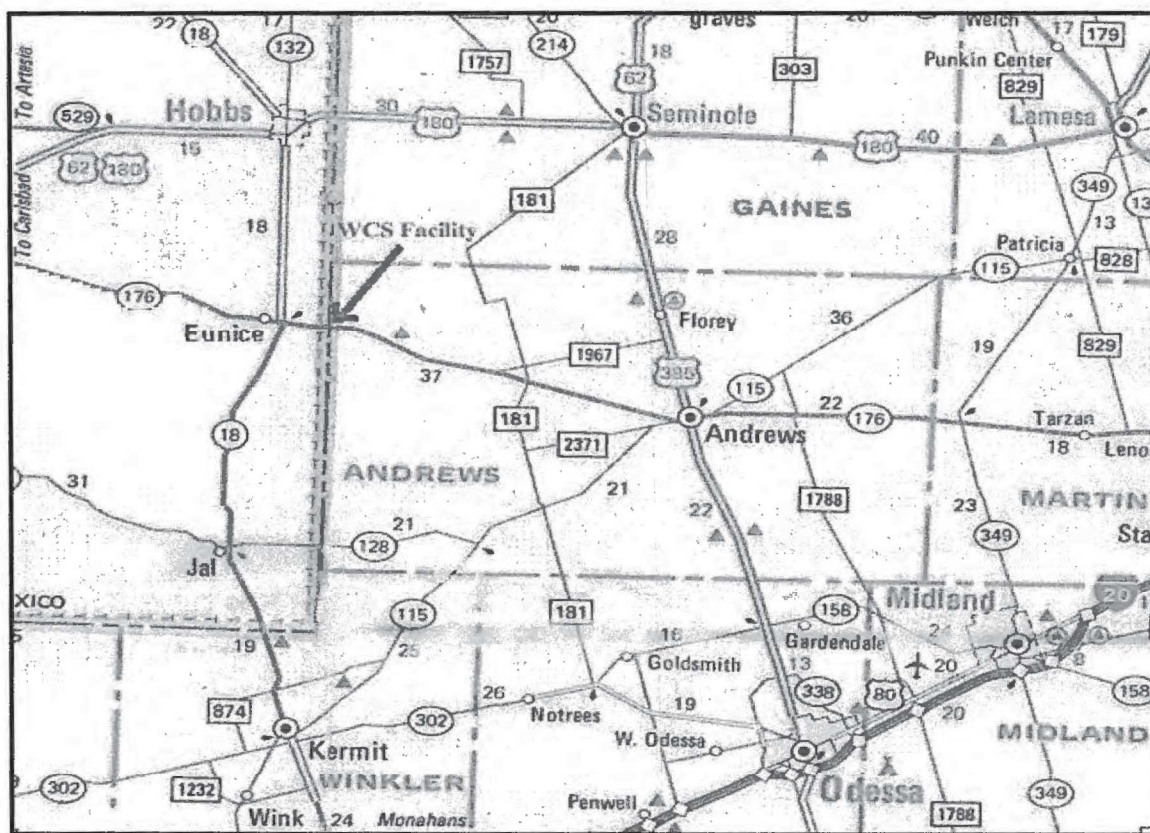
Sanitary wastewater generated at the WCS site is collected in above ground tanks and transported to a Publicly Owned Treatment Works (POTW) in Andrews, Texas. All septic results for the reporting period for carbon-14 and tritium were below the Minimum Detectable Concentration (MDC). All calculated results were below the release limits and total quantities in 30 TAC §336.215, *Disposal by Release into Sanitary Sewerage*, allowing release to the POTW in Andrews, Texas. Each radionuclide was below the monthly discharge concentration level, and the total discharge to the POTW was less than 1% of the 1 curie annual limit.

Permit-required sampling of wastewater and storm water was conducted for radiological constituents. Sampling at the WCS Andrews County site was conducted at outfalls and evaporation ponds in accordance with TPDES Permit No. WQ0004857000, TPDES Permit No. WQ0004038000 and TLAP No. WQ0004948000. Results of permit-required sampling are reported in monthly effluent reports submitted to the TCEQ and are not repeated in this document, but are incorporated herein by reference.

In summary, none of the results in any of the media or effluent tested is indicative of an unauthorized waste or effluent release. All are consistent with natural conditions at WCS.

Waste Control Specialist LLC (WCS) is a Texas-based waste management firm that operates state-of-the-art facilities in Andrews County, Texas. The WCS site is licensed by the Texas Commission on Environmental Quality (TCEQ) for the treatment and storage of radioactive waste and for the disposal of byproduct material, low-level radioactive waste (LLRW), and mixed waste¹. The site is authorized for land disposal of a large array of radioactive materials under the regulation of the TCEQ. The site can dispose of Class A, B and C low-level radioactive waste. WCS is also authorized for treatment, storage and disposal of hazardous and non-hazardous industrial wastes and polychlorinated biphenyls (PCBs).

The WCS facility is located on Texas Highway 176 adjacent to the Texas-New Mexico border, approximately 30 miles west of Andrews, Texas (see Figure 1), and about 70 miles east of the DOE Waste Isolation Pilot Plant (WIPP) site which is near Carlsbad, New Mexico.



The licensed and permitted facilities are situated on approximately 1,338 acres of land on the north side of Highway 176 that is surrounded by another approximately 14,900 acres controlled by WCS. The area is very sparsely populated. The closest community is Eunice, New Mexico, 5 miles to the west of the

Waste Control Specialists, LLC
Annual Radiological Environmental Monitoring Report
January 1-December 31, 2014

facility, and the nearest residence is over 3 miles from the facility. The WCS facility shares a fence line that is one half mile west of the Texas border with the URENCO uranium enrichment facility (formerly Louisiana Energy Services National Enrichment Facility). A municipal landfill occupies land to the south of Highway 176 in New Mexico.

1.2 Overview of Geology

The Andrews County setting is arid, receiving about 16 inches of rainfall annually on the average with an evaporation potential exceeding 63 inches annually. Temperatures are characterized as hot in the summer and relatively mild to cool in the winter. The annual mean temperature is 63°F. The prevailing wind direction is from the south and southeast with occasional shifts to the southwest during the winter months.

The facility is situated near the southwestern edge of the Southern High Plains, a stable geomorphic and relatively featureless landscape with very subtle topographic relief. There are no perennial surface waters, prominent natural drainage features, major aquifers, wetlands, or food crops within 3 miles of the facility.

The facility sits on a thick (about 800 to 1,000 feet) layer of impermeable red-bed clay (Triassic Dockum group) that comes to within about 20 feet of the surface in the vicinity of the land disposal units. All waste that is authorized for disposal is placed in disposal cells with engineered liner systems that include leachate collection and leak detection systems. The bottoms of these cells extend well into the natural clay formation. The first usable groundwater below the clay layer is not used at or near the site, and there is no evidence that any migration of waterborne materials near the site has ever reached this groundwater.

1.3 Overview of Processes, Permits, and Licenses

WCS is authorized, licensed, or permitted to treat, store, and/or dispose of waste containing PCBs, hazardous and non-hazardous waste, LLRW, mixed waste, exempt radioactive waste, and byproduct material under the following permits, licenses, or authorizations:

- RML No. R05807, Amendment 9, for the Byproduct Material Disposal Facility;
- RML No. R04100, Amendment 28, for the LLRW disposal facility, which includes the Federal Facility Waste Disposal Facility (FWF) and the Compact Waste Disposal Facility (CWF), and for the radioactive waste processing and storage facility;
- Hazardous waste permit No. 50358 (hereinafter, HW-50358) for the Resource Conservation and Recovery Act (RCRA) treatment, storage and disposal facility (TSDF), including the East and West Landfill;
- Hazardous waste permit No. 50397 (hereinafter, HW-50397) for the FWF;
- The Toxic Substances Control Act (TSCA) authorization for the site (U.S. Environmental Protection Agency (EPA) I.D. No. TX988088464), including the radioactive waste processing and storage facility, the RCRA TSDF, and the FWF; and
- The outfalls and evaporation ponds associated with Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0004857000, TPDES Permit No. WQ0004038000, and Texas Land Application Permit (TLAP) No. WQ0004948000.

All of these authorizations have been issued by the Texas Commission on Environmental Quality (TCEQ), with the exception of the TSCA authorization that has been issued by the EPA.

The radioactive waste processing and storage facility and the RCRA TSDF are integrated facilities, with most of the storage and treatment units being authorized under RML No. R04100 and HW-50358, as well as the TSCA authorization. The RCRA TSDF/radioactive waste processing and storage facility, the Byproduct Material Disposal Facility, the FWF, and the CWF are adjacent to each other, but are separate facilities segregated by fencing.

All non-radiological sampling requirements are governed by HW-50358, HW-50397, TLAP No. WQ0004948000, Byproduct TPDES WQ0004857000 and TSDF TPDES WQ0004038000, and are reported separately from this document.

1.3.1 Waste Receipt and Testing Facilities

WCS receives each specific type of waste at the site in accordance with the governing license(s), permit(s) and/or authorization(s). There is rail access directly to the site, with railcar unloading capabilities for bulk and containerized waste shipments, as well as easy truck access to the site from nearby major interstate highways. WCS has on-site analytical facilities for performing various chemical and radiological testing to confirm the identity of incoming waste shipments and control/verify treatment processes. Separate areas for receiving and testing incoming wastes are maintained within the RCRA TSDF/radioactive waste processing and storage facility and at the LLRW disposal facility. A separate receiving area within the Byproduct Material Disposal Facility has been designated for a later developmental stage.

1.3.2 Waste Treatment/Processing and Storage

As noted above, the radioactive waste processing and storage facility and the RCRA TSDF are integrated facilities with shared storage and treatment units authorized under RML No. R04100, HW-50358, and the TSCA authorization. There are no storage or processing units authorized by RML No. R05807 for the Byproduct Material Disposal Facility other than the tanks for storage of contact water removed from the landfill. At the LLRW facility, staging buildings are primarily used for receipt and transfer of incoming waste shipments to the landfills, although capacity is also provided in these buildings for limited storage of wastes requiring intrusive sampling as part of the incoming waste verification process.

RML No. R04100 allows WCS to possess a broad range of radionuclides in various forms; authorized wastes include LLRW and mixed waste, including greater than Class C waste, transuranic waste (TRU), and sealed sources in authorized areas. The current storage capabilities include a container storage building (CSB) and two storage areas known as bin storage units (BSU-1 and BSU-2) that can accommodate larger containers, such as rolloff bins and tanker trucks. A portion of BSU-1 is enclosed within a building; the remainder of BSU-1 and BSU-2 are open storage areas. These units are also authorized by HW-50358 for storage of hazardous and non-hazardous industrial waste, including virtually all types of hazardous wastes identified and listed in 40 Code of Federal Regulations (CFR) Part 261 and non-hazardous industrial wastes. The CSB and the enclosed portion of BSU-1 are also authorized under TSCA for storage of wastes containing PCBs. Another open storage area known as the Low Specific Activity (LSA) Pad is authorized by RML No. R04100; this unit is not authorized for storage of industrial wastes or wastes containing PCBs.

Processing capabilities authorized by RML No. R04100, HW-50358, and the TSCA authorization are housed within the Mixed Waste Treatment Facility/Stabilization Building (MWTF/Stab Building). This building contains two separate and distinct treatment areas isolated from one another by a fire wall and separate ventilation systems. The portion of the building comprising the Stab Building is used for treatment of a variety of bulk and containerized RCRA/TSCA wastes to render them physically and chemically stable in accordance with the Land Disposal Restrictions (LDRs) of RCRA. The MWTF is dedicated to the treatment of LLRW and mixed waste, including wastes containing regulated levels of PCBs, in bulk and containerized form. Treatment processes authorized within the MWTF include physical and chemical stabilization, waste sizing (shredding and compacting), consolidation, and repackaging. Limited storage capacity is also provided in the MWTF/Stab Building.

1.3.3 Waste Disposal

The East + West Landfill was the first disposal unit constructed at the WCS site. The landfill is authorized by HW-50358 for disposal of virtually all types of hazardous and non-hazardous industrial wastes, including most hazardous wastes identified and listed in 40 CFR Part 261, that have been treated as necessary to comply with the RCRA LDRs. Wastes that are not authorized for receipt include: (1) explosive material, as defined by the Department of Transportation under 49 CFR Part 173; (2) compressed gases except aerosol cans; and (3) putrescible wastes as defined in Title 30 of the Texas Administrative Code (30 TAC) §330.2(108) [unless specific prior authorization is obtained from TCEQ]. In addition, WCS does not currently accept special waste from health care-related facilities as defined in 30 TAC §335.2(138), hereinafter referred to as "regulated medical waste".

WCS can dispose of low activity radioactive materials in the East + West Landfill that are classified as exempt² from licensing under Texas regulations. These materials include: (1) source material from licensed or unlicensed facilities in any physical or chemical form in which the uranium and thorium content is < 0.05% by weight; (2) rare earth metals, compounds, mixtures, or products containing less than 0.25% by weight Thorium (Th) or Uranium (U); (3) any finished product or part containing metal thorium alloys with Th < 4% by weight; (4) depleted U in counterweights removed from aircraft, rockets, projectiles, missiles, or previously used as a shielding material; and (5) Naturally Occurring Radioactive Materials (NORM) containing technologically enhanced Radium-226 (²²⁶Ra) or Radium-228 (²²⁸Ra) at less than 30 pCi/g, or any other NORM radionuclide less than 150 pCi/g. Waste exempted through the RS-5.0.0 process is also disposed in this facility.

RML No. R05807 allows WCS to handle and dispose of containerized byproduct material; currently, authorized wastes are limited to the stabilized residues from Fernald Silos 1 and 2 that are contained in custom steel canisters. The Fernald canisters were emplaced within the byproduct material landfill in October and November of 2009. No other byproduct materials have been placed in the byproduct material landfill either before or after the placement of the Fernald Silo canisters. No waste management operations were conducted at the Byproduct Material Disposal Facility during this reporting period.

² Materials are classified as "exempt" due to their relative low radioactivity levels; control for purposes of protecting the public health and safety is not considered necessary.

WCS has completed construction of the initial portion of the LLRW authorized by RML No. R04100, including the CWF and the FWF. The CWF can accept LLRW commercially-generated in the Texas Compact party states of Texas and Vermont. WCS can also accept LLRW that has been commercially-generated in other states for disposal at the CWF if pre-approved to do so by the Texas Low Level Radioactive Waste Compact Commission. The FWF can accept LLRW and mixed waste generated at federal facilities. No waste management operations were conducted at the CWF until April 27, 2012, and no waste management operations were conducted at the FWF until June 6, 2013.

1.3.4 Stormwater/Wastewater Management

At the RCRA TSDF/radioactive waste processing and storage facility, stormwater and wastewater is managed in accordance with TPDES Permit No. WQ0004038000 and RML No. R04100. Stormwater potentially contacting waste (contact water) in the active area of the landfill (the area without final or interim cover) is segregated from stormwater falling outside the active area (non-contact water). Stormwater falling within uncovered containment areas is normally non-contact water since containers must be maintained in good condition and kept closed except when necessary to inspect and/or sample the waste or to add or remove materials. However, if a spill or similar release of waste materials were to occur during or prior to a rainfall event, and the spill had not yet been fully cleaned up, the resultant stormwater would be considered contact water. Contact water, leachate, and fluids from the leak detection system for the East + West landfill are either routed to the Leachate Treatment Unit (LTU) for treatment and discharge through internal outfall 101 in accordance with TPDES Permit No. WQ0004038000 or are sampled and approved for dust suppression for the landfill. Treated wastewater would eventually reach Outfall 001 if the quantity were sufficient. Uncontaminated stormwater is routed through drainage features and, when the quantity is sufficient, drains to the permitted outfalls 001 and 002.

Each of the open container storage areas at the RCRA TSDF/radioactive waste processing and storage facility is designed with a catch basin to capture the first flush of rainfall runoff. Stormwater runoff collected in the catch basins is sampled and analyzed in accordance with RML No. R04100.

Stormwater and wastewater at the Byproduct Material Disposal Facility is managed in accordance with TPDES Permit No. WQ0004857000 and RML No. R05807. Contact water from the active area of the landfill is segregated from non-contact stormwater. Stormwater falling within the containment area for the contact water tanks is non-contact water unless contact water has been released into the containment and not yet fully cleaned up. In this unlikely scenario, the resultant stormwater would be considered contact water. Contact water, leachate, and fluids from the leak detection system for the byproduct material landfill are routed to the contact water tanks located to the north of the landfill. The water is typically held pending receipt of acceptable analytical results for a pre-discharge sample. Contact water is discharged through internal outfall 103 in accordance with TPDES Permit No. WQ0004857000. Uncontaminated stormwater is routed through drainage features that flow to the permitted outfalls 004 and 005. Contact water that discharges through internal outfall 103 will flow through internal outfall 005 to external outfall 002.

At the LLRW disposal facility, stormwater and wastewater are managed in accordance with TLAP No. WQ0004948000 and RML No. R04100. Stormwater and wastewater generated at the CWF are segregated from stormwater and wastewater generated at the FWF, and landfill contact water and other wastewater generated at each facility are segregated from non-contact stormwater generated at

that facility. Sources of wastewater at each facility include contact water from the landfills as well as other wastewaters that have the potential to have contacted waste (laboratory wastewater, decontamination water, and post-emergency wastewater from the laboratory shower water tank). All stormwater and wastewater generated at the LLRW disposal facility is disposed by evaporation in lined evaporation ponds, and/or, if necessary, by disposal off-site.

Non-contact stormwater runoff from the FWF and CWF is routed to the appropriate sedimentation pond dedicated to the facility from which the stormwater was generated. Collected stormwater from both of the sedimentation ponds is routed to a single evaporation pond located within the 1,338-acre facilities area, south of the active waste management operations.

All wastewater from each facility that is presumed or has the potential to have contacted waste is routed to the on-site waste water treatment plant (WWTP) located within each facility for treatment. Contact water, leachate, and fluids from the leak detection system for the FWF landfill are collected directly in two of the three FWF contact water tanks designated for untreated wastewater (the FWF pre-treatment contact water tanks). Wastewater from the Laboratory FWF Holding Tank and the FWF Decontamination Building Holding Tank is transferred to the FWF pre-treatment contact water tanks. Similarly, contact water and leachate from the CWF landfill³ are collected directly in the CWF contact water tank designated for untreated wastewater (the CWF pre-treatment contact water tank). Wastewater from the Laboratory CWF Holding Tank and the CWF Decontamination Building Holding Tank is transferred to the CWF pre-treatment contact water tank.

Wastewater is accumulated in a pre-treatment contact water tank at each facility until the quantity is sufficient for treatment in that facility's WWTP. The accumulated wastewater is then treated via the WWTP and routed to the treated contact water tank for each facility. The treated contact water tank is sampled, and the treated wastewater is held pending receipt of acceptable analytical results. Upon receipt of acceptable analytical results, the treated wastewater is discharged to the contact water evaporation pond designated for that facility. In the event that analytical results indicate the treated wastewater is not acceptable for disposal in the appropriate contact water evaporation pond, the wastewater may be sent to an appropriate off-site facility for disposal.

Results of stormwater and wastewater monitoring under the facility's TPDES and TLAP permits are provided to the TCEQ in monthly effluent reports and are not repeated in this document. Rather, the monthly effluent reports have been incorporated herein by reference.

1.4 Purpose

The permits, licenses and other authorizations under which the WCS site operates (see Section 1.3) establish numerous requirements for the monitoring of environmental media and effluents. The most comprehensive monitoring requirements are established in the RMLs, involving monitoring of effluents and all types of environmental media that may be present in the vicinity of the WCS site for radiological constituents. Due to the more comprehensive nature of the radiological monitoring requirements under the RMLs, the monitoring programs conducted at the site are commonly referred to as the Consolidated Radiological Environmental Monitoring Program (REMP).

³ Leak detection systems for the CWF consist of below-liner, remote sensing systems that do not produce liquids.

The results collected under these monitoring programs are used to demonstrate compliance with the radiation protection and environmental standards specified in 30 TAC §336.313, *Dose Limits for Individual Members of the Public* and 30 TAC §336.1133, *Maximum Values for Use in Groundwater Protection*. This report enables a comprehensive annual review and evaluation of potential migration of radiological contaminants from the WCS site.

This report is also intended to fulfill the requirements in License Condition (LC) 158.H.9) of RML No. R04100 (Amendment 28), LC 77 of RML No. R05807 (Amendment 9), LC 92.B of RML No. R05807 (Amendment 9). LC 158.H.9) of RML No. R04100 states, "The Licensee shall provide a semi-annual environmental monitoring report to the executive director to be submitted before March 31 and September 30 of the preceding six (6) months. The semi-annual report shall include the results of all environmental media samples for all facilities at the WCS, Andrews County site." LC 77 of RML No. R05807 requires WCS to "submit to the Executive Director each year, no later than September 30 for the period of January 1 through June 30 and March 31 for the period of July 1 through December 31, a report specifying the quantity of each principle radionuclide released to unrestricted areas in liquid and in gaseous effluents (including particulates) during the specified semi-annual period of operations." LC 92.B of RML No. R05807 states "Annual environmental monitoring reports shall be submitted to the Executive Director no later than April 1 of the year following the monitoring period."

2 Radiological Environmental Monitoring Program

As discussed in Section 1.5, WCS conducts a comprehensive program, commonly referred to as the REMP, at its Andrews County site. This program involves collection of samples for measurement of the concentrations of radiological constituents in various environmental media and effluents. Media and effluents monitored in accordance with this program include ambient gamma radiation, gases and vapor, air particulate, soil, sediment, fauna, vegetation, surface water, wastewaters, and ground water from multiple strata. These samples are analyzed for a variety of radionuclides, as described below. A comprehensive meteorological monitoring program is also maintained in support of the environmental monitoring program.

2.1 Environmental Monitoring Program Overview

Routine operations and Health Physics programs provide controls for limiting potential releases of radioactive material from the immediate facility during normal operations. Routine monitoring of work areas gives an early indication of any potential environmental concerns. The REMP serves as a primary confirmation of the adequacy of the active operational controls and the passive engineering and burial site controls for preventing releases outside the design basis for the facilities. This program also provides environmental data to demonstrate compliance with radioactive effluent release standards contained in 30 TAC §§336.304, .313 and .314. The WCS facility REMP encompasses procedures and planning documents addressing the types, frequency, and methodologies employed to acquire the requisite data.

The goals of the REMP are to:

- Verify the adequacy of facility design and operation to control radiological waste constituents and limit effluent releases to authorized levels;
- Assess the radiological impact of the facility on the surrounding environment; and
- Ensure compliance with regulatory standards established for the protection of the public and the environment.

These goals are achieved by:

- Measurement of direct radiation and radioactivity in effluents, air, soil, sediment, and, as available, groundwater, surface water, vegetation, precipitation, and fauna;
- Ensuring the quality of the measured data through planned decision-making processes, use of documented sampling and analytical procedures by trained personnel, and verification and validation of the collected data; and
- Evaluating the validated data against defined benchmarks using appropriate procedures so that true indicators of potential impacts will be recognized at the earliest practicable time, while minimizing unnecessary use of resources on erroneous indicators suggesting such impacts.

2.2 REMP Data Quality and Management

The REMP must track data throughout the program life. The data are used to support regulatory and legal basis for the WCS facilities, therefore, it must be of known and documented quality. Data are

generated during the sampling and laboratory analytical process and are then verified and validated to ensure data integrity.

All samples are collected in accordance with established procedures and shipped to an off-site laboratory for radiological analyses. The laboratory must be accredited by the National Environmental Laboratory Accreditation Program (NELAP) and the Texas Laboratory Accreditation Program (TLAP) administered by TCEQ, and analytical methods must be accredited by TCEQ, where such accreditation exists for a particular media/analyte/analytical method. Direct ambient gamma radiation is measured by either a device called a thermoluminescent dosimeter (TLD) or a device called an optically stimulated luminescence (OSL) dosimeter. Both devices convert ionizing radiation into visible light which is then measured and correlated to a corresponding radiation dose. The company supplying these dosimeters must be accredited by the National Volunteer Laboratory Accreditation Program (NVLAP).

After data validation, each measurement of environmental media is compared to applicable Investigation Levels (ILs), Action Levels (ALs), Analytical Decision Levels (ADLs), and Regulatory Limits (RLs) to determine if the current measurements exceed the existing limits computed from background data.

WCS has transitioned from individual REMPs and programs under the different RMLs to a consolidated, site-wide environmental monitoring program. Proposed consolidated IL, ADL, AL, and RL values for environmental media are listed in the DQO-B report. The Part-A DQO report⁴ contains the detailed statistical methods and procedures that are used for assessing and comparing new measured data for environmental media with background data distributions. Samples with measureable levels above an IL require follow up investigations that can include re-analysis, re-sampling and/or more detailed analyses. Sample measurements verified to exceed a Byproduct IL, or any AL, ADL or RL require notification to the TCEQ, follow-up investigations and potential corrective and/or mitigative actions.

Effluent monitoring data are directly compared to the applicable limits contained in the governing regulations and facility authorization(s). WCS conducts follow-up activities for effluent results outside of regulatory limits in accordance with the regulatory program having primacy.

WCS has established procedures to review all data to ensure sample data integrity prior to use of the data in any project. WCS's review is in addition to the data verification and validation that is performed by the analytical laboratory in accordance with the recommendations of Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP).

Upon receipt and before use of analytical data, the data and reports are reviewed and validated. Radiological data are reviewed according to procedure RS-1.9.2, *Approval of Offsite Radiological Data*. A copy of this procedure and the applicable data review form is available on-site and is provided in WCS' Quality Assurance Program Plan⁵ (QAPP).

WCS has implemented the use of a customized data management software program for electronic storage of various environmental records. The software securely stores the records and provides tools for reporting. The reports include the ability to view records related to a specific license or location

⁴ *Environmental Surveillance Data Quality Objectives Part A – Surveillance Objectives, Methods, and Decisions, Revision 3*, dated October 10, 2011.

⁵ *Quality Assurance Project Plan (QAPP) for WCS Radioactive Material Licenses, Revision 1*, dated October 10, 2011.

through time. The software supports importing electronic data files, which prevents data entry errors associated with the manual data entry process. Environmental records and analytical results may also be exported for use with other systems.

One of the goals of the electronic data management system is to minimize the manual entry process. The vast majority of the environmental monitoring data are generated by the contracted laboratory that performs the chemical and radiological analyses. In addition to the full analytical data packages provided by the laboratory, results of chemical and radiological analyses are provided to WCS as an electronic data deliverable (EDD). The EDDs are often provided in a comma-separated value (CSV) file format that has been employed for decades to move tabular data.

The environmental monitoring data system is backed up daily. All original analytical reports received will be kept in Document Control in accordance with the records disposition schedule.

2.3 Exposure Pathways and Analytes

All critical exposure pathways, as well as long-term indicator pathways, are monitored. These pathways include assessment of the internal and external mechanisms from airborne particulate releases, radon emanation, carbon-14 and tritium vapors and gases. These critical pathways were selected based on the evaluations and modeling included in the applicable licensing documents and applications. The following pathways were identified.

The airborne pathways include:

- Windblown dust from open bulk disposal areas;
- Windblown dust from processing, loading and transport of waste (where applicable);
- Airborne gases and vapors from waste cells, including evaporation (tritium, carbon-14, radon);
- Gas emanation through finished cover (tritium, carbon-14, radon);
- Air releases from a dropped or breached container; and
- Airborne gases associated with waste transport truck fire.

The groundwater pathways consider:

- Potential leaching of waste constituents from surface or near-surface accidental spills or releases into the undifferentiated Ogallala-Antlers-Gatuña (OAG) unit that overlies the red beds;
- Potential leaching of waste constituents to more transmissive saturated and unsaturated geologic strata beneath the disposal units (the 125-foot zone) and the uppermost, continuously saturated stratum beneath the disposal facilities (the 225-foot zone); and
- Surface water transport of ground-deposited waste particulate to playas or to the leachate collection systems within the disposal units.

Direct radiation monitoring addresses:

- Exposure to an off-site person from waste packages during operations;
- Exposure through the finished cover; and
- External radiation from soil contaminated by waste particulate deposition.

Soil, sediment, surface water, vegetation, and tissue sampling are not directly related to a key exposure pathway. However, these media provide measurements for evaluation of potential long-term accumulation in the environment concentrating mechanism.

The key radionuclides monitored by the REMP are shown in Table 1. WCS has selected these radionuclides based upon their radiological half-life, mobility, radio-toxicity and potential presence within radioactive wastes managed at WCS. The tracking of concentrations of these radionuclides in the environment will be used to evaluate the potential health and environmental impacts associated with the operation of the facility, as well as any possible long-term environmental impacts.

Table 1 : Key Radionuclides Monitored by the REMP

Radionuclide	Symbol	Radionuclide	Symbol	Radionuclide	Symbol
Carbon 14	¹⁴ C	Radium 228	²²⁸ Ra	Tritium	³ H
Cesium 137	¹³⁷ Cs	Strontium 90	⁹⁰ Sr	Uranium 234	²³⁴ U
Cobalt 60	⁶⁰ Co	Technetium 99	⁹⁹ Tc	Uranium 235	²³⁵ U
Iodine 129	¹²⁹ I	Thorium 228	²²⁸ Th	Uranium 238	²³⁸ U
Lead 210	²¹⁰ Pb	Thorium 230	²³⁰ Th	Radon-222	²²² Rn
Radium 226	²²⁶ Ra	Thorium 232	²³² Th		

Other radionuclides are analyzed on a routine or as processed basis and reported when appropriate. A listing of all radionuclides analyzed during the report period is given in Table 2.

Table 2 : All Radionuclides Analyzed for the REMP

Radionuclide	Symbol	Radionuclide	Symbol	Radionuclide	Symbol	Radionuclide	Symbol
Actinium-228	²²⁸ Ac	Cobalt-57	⁵⁷ Co	Mercury-203	²⁰³ Hg	Ruthenium-106	¹⁰⁶ Ru
Americium-241	²⁴¹ Am	Cobalt-58	⁵⁸ Co	Neodymium-147	¹⁴⁷ Nd	Silver-110m	^{110m} Ag
Americium-243	²⁴³ Am	Cobalt-60	⁶⁰ Co	Neptunium-237	²³⁷ Np	Sodium-22	²² Na
Antimony-124	¹²⁴ Sb	Curium-242	²⁴² Cm	Neptunium-239	²³⁹ Np	Strontium-90	⁹⁰ Sr
Antimony-125	¹²⁵ Sb	Curium-243	²⁴³ Cm	Nickel-59	⁵⁹ Ni	Technetium-99	⁹⁹ Tc
Barium-133	¹³³ Ba	Curium-243/244	^{243/244} Cm	Nickel-63	⁶³ Ni	Thallium-208	²⁰⁸ Tl
Barium-140	¹⁴⁰ Ba	Europium-152	¹⁵² Eu	Niobium-94	⁹⁴ Nb	Thorium-228	²²⁸ Th
Beryllium-7	⁷ Be	Europium-154	¹⁵⁴ Eu	Niobium-95	⁹⁵ Nb	Thorium-230	²³⁰ Th
Bismuth-212	²¹² Bi	Europium-155	¹⁵⁵ Eu	Plutonium-238	²³⁸ Pu	Thorium-232	²³² Th
Bismuth-214	²¹⁴ Bi	Tritium	³ H	Plutonium-239/240	^{239/240} Pu	Thorium-234	²³⁴ Th
Carbon-14	¹⁴ C	Iodine-129	¹²⁹ I	Plutonium-241	²⁴¹ Pu	Uranium-233/234	^{233/234} U
Cerium-141	¹⁴¹ Ce	Iridium-192	¹⁹² Ir	Plutonium-242	²⁴² Pu	Uranium-234	²³⁴ U
Cerium-144	¹⁴⁴ Ce	Iron-59	⁵⁹ Fe	Potassium-40	⁴⁰ K	Uranium-235/236	^{235/236} U
Cesium-134	¹³⁴ Cs	Krypton-85	⁸⁵ Kr	Promethium-144	¹⁴⁴ Pr	Uranium-235	²³⁵ U
Cesium-136	¹³⁶ Cs	Lead-210	²¹⁰ Pb	Promethium-146	¹⁴⁶ Pr	Uranium-238	²³⁸ U
Cesium-137	¹³⁷ Cs	Lead-212	²¹² Pb	Radium-226	²²⁶ Ra	Yttrium-88	⁸⁸ Y
Chromium-51	⁵¹ Cr	Lead-214	²¹⁴ Pb	Radium-228	²²⁸ Ra	Zinc-65	⁶⁵ Zn
Cobalt-56	⁵⁶ Co	Manganese-54	⁵⁴ Mn	Radon-222	²²² Rn	Zirconium-95	⁹⁵ Zr

In addition to the radionuclides monitored as part of the REMP, gross alpha and gross beta are also monitored.

2.4 Sampling Locations and Frequencies

The types of sampling media and sampling locations in the REMP have been selected to serve as operational and early warning indicators, which provide a measure of the routine operations within and around the facilities, and off-site environmental indicators, which monitor the potential impact of the facility operations on the environment outside of the facilities.

Environmental monitoring and sampling around the WCS facility can be divided into ten different types:

- Air particulates – atmospheric evaluation of airborne particulate radioactive materials to provide a measure of material that may become airborne at the site during material processing and/or disposal activities;
- Radioactive gases and vapors – measurements of krypton-85, carbon-14, tritium, iodine-129 and radon-222 to provide a measure of radioactive gases and vapors that may be released;
- Direct radiation – monitoring for the direct radiation exposure from radioactive materials on the site;
- Soil – providing a measure of radioactive materials in the soils around the facility to evaluate potential buildup in the environment over the duration of the facility operations;
- Groundwater – providing a mechanism for identification of impacts due to releases from the waste management units, primarily, the disposal units;
- Surface water – providing a measure of radioactive constituents in surface waters that accumulate from time to time in playas and other surface features;
- Storm water – providing a measure of pollutants carried by non-contact storm water runoff into site conveyances/ponds;
- Sediment – providing a method to monitor the potential accumulation of contaminants transported by surface water to playas and sedimentation ponds;
- Vegetation – providing for the monitoring of vegetative uptake via deposition of airborne particulates and from root uptake of soil/sediment accumulation and surface water runoff; and
- Fauna/Tissue– providing a method to detect bioaccumulation of radionuclides.

Effluent monitoring at the WCS site can be classified as follows:

- Tank sampling – collection of raw sanitary wastewater and treated and untreated industrial wastewaters from holding tanks of various sizes and configurations;
- Impoundment sampling – collection of impounded non-contact runoff water; treated, impounded wastewater; and any sediments associated with these waters;
- Outfall sampling – collection of non-contact storm water run-off, treated effluent, and mixtures thereof from internal release points and outfalls and from external outfalls; and
- Leachate/leak detection system sampling – collection of samples from the liquid detection and collection devices for these systems.

Environmental monitoring and effluent samples are collected in accordance with procedures developed and approved under the WCS Quality Assurance (QA) Program, WCS-QAP-100, *Quality Assurance Plan*. Table 3 identifies the current WCS sampling procedure by sample medium. Copies of the current revisions of the procedure are available on-site and are included in WCS' QAPP.

Table 3 : WCS Environmental Media and Effluent Sample Collection Procedures

Matrix	Current Matrix Code	WCS Procedure
Particulates	AP	EV-7.16 – High Volume Air Sampling
Radon	AR	
Tritium	AT	EV-7.1.2 – Low Volume Air Sampling
Cartridges	AC	
Ambient Radiation	ET	EV-7.1.6 – Thermoluminescent Dosimeters/Optically Stimulated luminescent Dosimeters
Soil	SS	EV-7.1.5 – Soil Sampling
Sediment	SE	
Vegetation	VE	EV-7.1.7 – Vegetation Sampling
Fauna	FA	EV-7.1.18 – Wildlife Sampling
Precipitation	WS	EV-7.1.13 – Surface Water Sampling
Surface Water	SW	
Groundwater	WS	EV-7.1.8 – Groundwater Sampling
Effluent Releases	SW	EV-4.5.1 – Effluent Releases
TSDf RCRA Groundwater	WS	EV-7.1.10 – RCRA Environmental Groundwater Sampling
FWF RCRA Groundwater	WS	EV-7.1.19 – Federal Facility RCRA Groundwater Sampling
Septic	SP	EV-7.15 – Managing Onsite Sanitary Systems

A brief summary of the sampling methodologies for each sample medium is provided below.

Air: The air sampling procedures include sampling for air particulates, vapors and gases. Air particulate samples are collected on filters using high-volume air pumps. Radon gas is measured using passive Track-Etch[®] canisters. Other gases and vapors (i.e., gaseous, krypton-85, iodine-129 and carbon-14) are collected using cartridges and low-volume air flow equipment; whereas tritium is collected using silica gel and low-volume air flow equipment.

Soil/Sediment: The soil procedure includes sampling for soil and sediment samples. Samples are collected with a hand auger, shovel/trowel, coring device or similar sampling equipment.

Flora: The flora procedure includes sampling for vegetation. Vegetation samples are collected by using manual cutting tools. Samples are collected of new growth; if new growth is not available samples are not collected.

Fauna: The fauna procedure provides instruction for collecting indicator species. Fauna samples are humanely collected on the WCS property.

Ambient Radiation: Gamma radiation measurements are collected using TLD and OSL dosimeters. Direct gamma radiation surveys are also conducted using real-time radiation detection instruments. Dosimeters are changed quarterly.

Water: The surface water sampling procedure includes collection of samples from surface water and precipitation. The groundwater procedure includes details on collection of samples using bailers, or low flow (minimal) purge and sampling equipment. Groundwater wells installed to monitor the

groundwater at the FWF RCRA and East + West landfills in accordance with HW-50397 and HW-50358, respectively, are sampled following their respective RCRA groundwater sampling procedure.

In addition to the sampling procedures identified above, other WCS procedures that support the implementation of the environmental monitoring program are listed in Table 4. Since the environmental monitoring program is conducted under the umbrella of the WCS QA program, corrective action is addressed as part of this QA program, which states:

“Conditions adverse to quality shall be identified promptly, reported to the appropriate levels of management and corrected as soon as practical. Such conditions shall be tracked and evaluated so that adverse trends can be identified and appropriate corrective action can be taken.”

Table 4 : WCS Supporting Procedures

WCS Procedure
EV-7.1.4 – Shipment of Environmental Samples
EV-7.17 – Calibration of Hi-volume Air Samplers
EV-7.19 – Calibration of Low-volume Air Samplers
Quality Assurance
QA-6.1 – Document Control
QA-7.1 – Supplier Qualification
QA-12.1 – Control of Measuring and Testing Equipment
QA-16.1 – Corrective Action Management
QA-17.1 – Quality Assurance Records
Offsite Lab
AL-1.1.4 – Procurement of Off-Site Analytical Work
RS-1.9.2 – Approval of Offsite Radiological Data

Implementing procedure QA-16.1, *Corrective Action Management* details how identified items are tracked, evaluated, resolved, documented and followed up by the management. Details on the WCS quality program are provided in WCS' QAPP.

Finally, when insufficient media is present for all required radiological analyses, the analyses are prioritized in the following order (1) gross alpha and beta; (2) gamma spectroscopy; (3) alpha isotopic spectrometry (including radon emanation for radium-226); and (4) liquid scintillation/gas flow proportion counting (radionuclide-specific).

The specific analytical methodologies used to analyze the environmental samples are generally based on US EPA analytical methods and the Department of Energy (DOE) Environmental Measurement Laboratory Manual. These sources are industry standard analytical methods, including both sample preparation and analysis.

Samples received by the laboratory are processed in accordance with the laboratory procedure. This procedure details the process followed by the laboratory sample receipt technician regarding chain-of-custody and confirmation of sample receipt conditions.

The following presents an overview of accepted radioanalytical methodologies. These methods are capable of detecting very low levels of radioactivity in their respective samples, which allows radiological

impacts to be assessed and maintained As Low As Reasonably Achievable (ALARA). Other methods are also acceptable, provided that they are subjected to review and approval with a laboratory QA/QC program for ensuring the quality of the results are consistent with recommendations in the MARLAP, and approved by the TCEQ.

Gross Alpha and Beta Analysis: For liquid samples, a sample aliquot is evaporated to dryness directly in a pre-weighed stainless steel planchet or in cases of high dissolved solids, is first ashed to reduce its mass of organic matter. The samples are counted with an appropriate low background alpha/beta counter, such as gas flow proportional counter. For vegetation, soil, and tissue, samples are ashed as necessary to reduce organic content and the resultant material is placed on a stainless steel planchet and counted with a low background alpha/beta counter. For air samples, the filter paper is counted directly from the inlet side with an appropriate low background alpha/beta counter, such as a gas flow proportion counter.

Alpha Spectrometry: An aliquot of the sample is processed by radiochemical methods for removal of key isotopes, such as those for uranium, thorium and different transuranic group isotopes. The sample is then counted on an alpha spectroscopy system (e.g., silicon surface barrier detectors with associated spectral analysis).

Gamma Spectrometry: A known weight or volume of sample (including soil, water, tissue, and filter media) is placed into a standard container (e.g., a Marinelli beaker). The sample is counted on a gamma spectroscopy system (e.g., Ge Detector) with associated spectral analysis. Samples may also be counted on a low-energy gamma spectroscopy system, which uses a thin-windowed carbon fiber or beryllium detector to allow penetration by low-energy gamma radiation.

Liquid Scintillation Counting: The sample is chemically processed, typically by dissolution and/or distillation. A small aliquot is then mixed with an appropriate scintillation cocktail for counting in a liquid scintillation counter in accordance with approved procedures.

WCS' contract laboratory participates in the TCEQ's NELAC accreditation program. Specific details regarding laboratory accreditation are provided in WCS's QAPP.

Sample locations are summarized in tables and figures provided in individual sections of this report. All operational monitoring locations associated with the waste processing and storage facility, the byproduct disposal facility and the low-level radioactive waste disposal facility appear in these summary tables and figures. Each table and figure provides sample location per media (i.e., all of the sample locations for surface water figure). Figures for ground water sample locations are also separated by the strata being monitored.

2.5 Regulatory Requirements

TCEQ regulations in 30 TAC Chapter 336 establish limits for radiation exposure to members of the public and require monitoring to demonstrate compliance. These are the primary regulations addressed by the REMP. The amounts of radiation and radioactive material that may be released from the facility to the environment are strictly controlled under these regulations. Key exposure pathways are monitored and sampled to verify compliance.

30 TAC Chapter 336 limits the total effective dose equivalent (TEDE) to individual members of the public from licensed and/or registered operation in three manners:

- a) A constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, restricts the TEDE to the individual member of the public to less than 0.01 rem (10.0 millirem, 100 microSievert [μSv]) in a year.
- b) The TEDE to individual members of the public from the licensed operations shall not exceed 0.1 rem (100 millirem, one millisievert) in a year.
- c) The dose in any unrestricted area from external radiation sources does not exceed 0.002 rem (2 millirem, 0.02 millisievert) in any one hour. This dose limit does not include sources of background radiation, medical administration of radioactive material, or voluntary participation in medical research programs.

These regulations also require licensees to perform surveys of radiation levels in unrestricted areas and monitor for radioactive materials in effluents that may be released to unrestricted areas to comply with the dose limits for individual members of the public. A licensee shows compliance with the annual dose limits by:

- Measurement or calculation that the TEDE to the individual likely to receive the highest dose from the licensed or registered operation does not exceed the annual dose limit;
- The average annual concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in 30 TAC Chapter 336; and
- By ensuring that if an individual was continuously present in an unrestricted area, the dose rate from external sources of radiation would not exceed 0.002 rem (2 millirem) in an hour and 0.05 rem (50 millirem) in a year.

2.6 Pre-Operational Program Overview and Data

Many of the radionuclides listed in Tables 1 and 2 are naturally present in our environment. The uranium and thorium isotopes (and their progeny) are primordial, having existed since the creation of the earth. Tritium and carbon-14 are created by cosmic radiation interactions in our upper atmosphere as well as from nuclear weapons testing during the 1950s and 60s. Strontium-90 and cesium-137 are also products remaining from weapons testing. It is important to establish baseline measurements of the natural background levels of radiation and radioactivity for the site so that any impact resulting from facility operations can be distinguished. Prior to receipt of LLRW materials at WCS, a pre-operational environmental monitoring program was performed to establish this baseline. Background levels of radiation and radioactive materials in the air, air particulate, soil, sediment, groundwater, surface water, fauna, vegetation, and other media were monitored and reported in the pre-operational monitoring report⁶.

2.7 Investigation Levels and Action Levels

WCS currently has two different sets of ILs and ALs corresponding to WCS' two primary radioactive materials licenses. The basis on which the ILs and ALs were derived vary between the two licenses. This

⁶ *Report of Completion of Modified Natural Radiation Monitoring Program and Pre-Operational Environmental Monitoring Program for RML No. R04100*, dated May 12, 2011.

report includes comparisons associated with WCS' two primary radioactive materials licenses. The IL/AL pairs for the two primary radiological licenses are described below.

In accordance with the deleted procedure BP-EV-1.1.0, *Radiological Environmental Monitoring Program*, associated with RML No. R05807, the ILs for the Byproduct Disposal Facility are set at a point above the baseline mean that is considered statistically significant; i.e., at a value that is considered above the background variation. ILs are established specifically for each radionuclide and type of environmental media sampled. For radionuclides where there is a measurable background level, the IL is currently set at three (3) standard deviations above the background average value.

The Action Levels for the Byproduct Disposal Facility are based on some percent of the applicable pathway regulatory standard. For most radionuclides, the AL is set at 10% of the applicable regulatory limit. There are, however, a few radionuclides where the background levels and/or variation approach or exceed the applicable limits. For these radionuclides, alternative basis have been developed for AL establishment. Two approaches have been taken. In one approach, the AL is based on the corresponding regulatory standard value plus a background contribution. This approach is suitable for most situations, but is impractical for radionuclides where the variation also exceeds the regulatory standard value. For example, the natural levels and variation of lead-210 in soil and groundwater are not readily distinguishable between the corresponding regulatory standard from background and its variation. For these situations, a precursor, or indicator radionuclide, is used for indicating potential level of concern. In the case of lead-210, the parent radionuclide, radium-226, is used.

The LLRW ILs are based upon prediction limits that have been calculated from pre-operational and baseline data. ILs based on prediction limits have been proposed for each LLRW REMP analyte in each applicable media at the site. Depending on the background population of the combined baseline and pre-operational data sets, either parametric or non-parametric prediction limits have been calculated. In most cases, the IL's are "site-wide" values, but in other cases ILs have been calculated from individual monitoring locations or groups of locations due to spatial variability. WCS will compare operational data to ILs. If the concentration of an analyte exceeds its IL during the operational period, one or more resampling events will be conducted to complete the statistical test. The number of resampling events is established for each IL to optimize the statistical performance of the test. If the concentrations of the initial sample and all necessary resampling events for a given statistical test exceeds the IL, there will be statistical evidence of a potential release. ALs for RML No. R04100 are not statistically derived. They are simply 10 times the IL⁷. They serve as an intermediate point between the IL and the regulatory limit.

Regulatory Limits form the third tier of the environmental monitoring system. Collectively, comparisons of operational data to the IL, AL, and RL will provide early warning of any conditions that could suggest a release and determine if a release has occurred. WCS' response to a potential release will be escalated based on the tier of the potential release (i.e., there will be a greater response to an RL exceedance than to an IL exceedance).

Table A-1 in Appendix A contains the ILs and ALs for the key radionuclides identified in Section 2.4 under the RML R05807. Proposed ILs, ADLs, ALs, and RLs for all of the radionuclides are provided in Tables A-2, and A-3.

⁷ Except for some special cases. An example would be for a non-radioactive metal whose background value is greater than its regulatory limit. In that case, the IL, AL, and RL for that metal would be the sample value. This relationship is described in much greater detail in WCS' DQO-A document.

3 Environmental Data Summary

The radiological data for the WCS Andrews County site collected for the reporting period of January 1, 2014 through December 31, 2014 are summarized in the following subsections and all data are located in the appendices.

Typically, figures that graphically plot analytical data over time and against comparison values (if applicable) are provided for analytes that:

1. Are gross alpha, gross beta, or a key radionuclide listed in Table 1 or 2, as determined by the preferred analytical method for the media (the most sensitive method, i.e., radium-226 by gamma spectroscopy for solid media, and by Lucas Cell for other media); and
2. Were detected during the reporting period; or
3. Are otherwise considered significant.

All of the data plots provided as figures in this document depict analytes that follow this convention and are referred to as "analytes of note". Solid icons on the data plots represent detected results⁸; hollow icons represent non-detect results.

In most cases, the LLRW IL's, AL's and ADL's are "site-wide" values, but in other cases these comparison values have been calculated from individual monitoring locations or groups of locations due to spatial variability. In cases where multiple LLRW comparison values exist, the most conservative comparison values are provided in summary statics tables and figures that graphically plot analytical data over time unless otherwise noted.

3.1 Radon Monitoring

Radon is monitored by the use of Track-Etch® detectors. These detectors are changed out quarterly and handled in accordance with procedure EV-7.16, *High Volume Air Sampling*. Table 5 lists the radon sampling requirements. The quarterly radon monitoring results for the calendar year of 2014 are provided in Table 6 and plotted in Figure 2. Sample results are compared against the radon IL to determine whether or not there is a change significant enough to warrant an investigation. All radon monitoring results received for this reporting period were below the corresponding radon IL (3000 picocuries per cubic meter of air (pCi/m³) for the Byproduct IL and 1500 pCi/m³ for the LLRW).

The Fernald Silo canisters represent the primary potential source of radon above background at the Andrews County, Texas site for the calendar year of 2014. The Fernald Silos were emplaced in the byproduct landfill during the months of October and November 2009. No other byproduct materials were placed in the disposal units either before or after the placement of the Fernald Silo canisters.

The radon monitoring results measured at the site for the calendar year of 2014 are representative of typical background concentrations. The historical average radon concentration⁹ is 1200 pCi/m³ with a standard deviation (1σ) of 600 pCi/m³. Sample locations are shown in Figure 3.

⁸ Detected results are those reported above the MDC.

⁹ The average radon concentration reported in the REMP documents for the LLRW and Byproduct Facilities is 1200 ± 600 pCi/m³. This value is more recent and encompasses more data than the average provided in the REMP document for the Waste Processing and Storage Facility and therefore is used in this report.

Table 5 : Air Radon Sampling Location Requirements

Sample Type	Byproduct Stations	REMP Stations
Air Radon	1, 3, 4, 6, 7, 8, 9, 11, 26, 27, 30, 31, and 32	1, 3, 4, 5, 6, 7, 8, 9, 11, 26, 27, 30, 31, 32, 50, 54, 55, 58, 59, 60, 61, 62, 63, 66

Table 6 : Quarterly Air Radon Concentration (picocuries/cubic meter of air [pCi/m³] $\pm 2\sigma$)

Station	Quarter 1 2014	IL%	Quarter 2 2014	IL%	Quarter 3 2014	IL%	Quarter 4 2014	IL%
1	300+/-30*	10.0%	300+/-40*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
3	300+/-30*	10.0%	300+/-30*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
4	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
5	300+/-30*	10.0%	300+/-30*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
6	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
7	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
8	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	400+/-30	13.3%
9	300+/-30*	10.0%	300+/-40*	10.0%	1000+/-80	33.3%	300+/-40*	10.0%
11	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
26	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
27	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	400+/-40*	13.3%
30	300+/-40*	10.0%	300+/-30*	10.0%	1200+/-90	40.0%	300+/-30*	10.0%
31	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	600+/-50	20.0%
32	300+/-30*	10.0%	300+/-40*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
50	300+/-40*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
54	300+/-40*	10.0%	300+/-40*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
55	300+/-30*	10.0%	300+/-50*	10.0%	300+/-50*	10.0%	300+/-50*	10.0%
58	300+/-30*	10.0%	300+/-30*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
59	1300+/-90	43.3%	300+/-40*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
60	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%
61	300+/-30*	10.0%	300+/-40*	10.0%	300+/-50*	10.0%	300+/-40*	10.0%
62	300+/-30*	10.0%	300+/-30*	10.0%	300+/-40*	10.0%	400+/-40	13.3%
63	300+/-30*	10.0%	300+/-40*	10.0%	900+/-70	30.0%	400+/-40*	13.3%
66	300+/-30*	10.0%	300+/-40*	10.0%	300+/-40*	10.0%	400+/-40	13.3%
Deployed	1-14-14		4-22-14		7-30-14		10-27-14	
Collected	4-22-14		7-30-14		10-27-14		1-22-15	

* Result is less than MDC

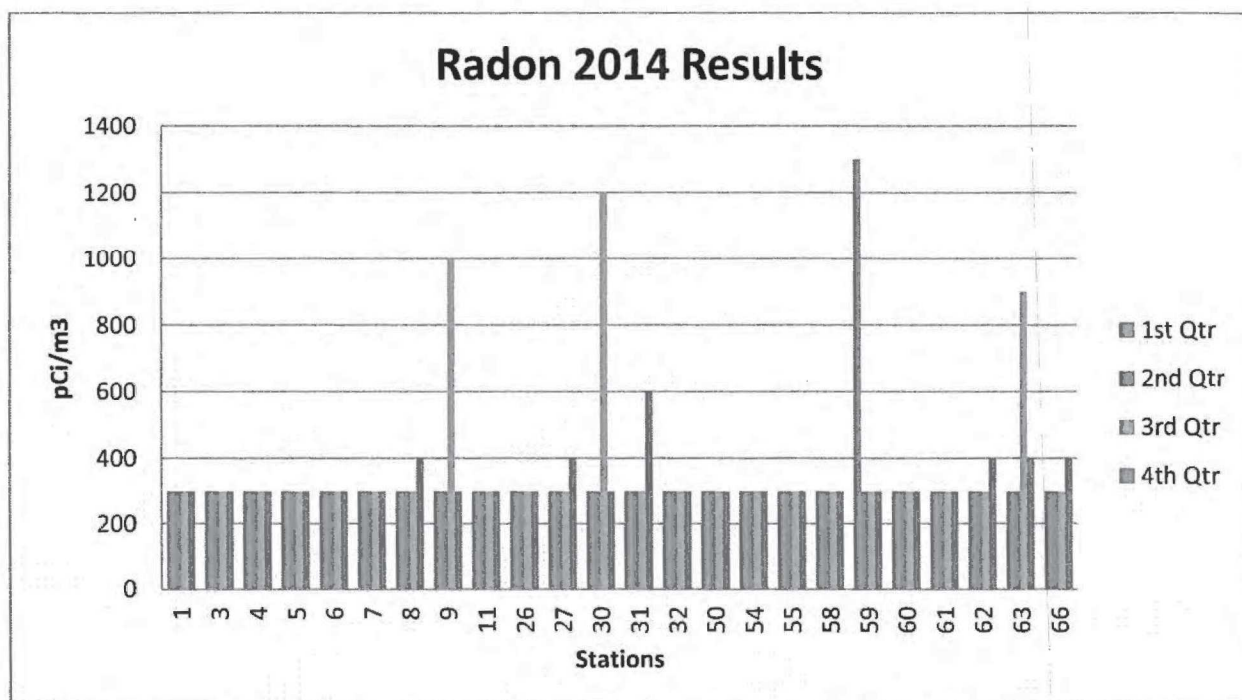


Figure 2 : Quarterly Air Radon Concentration (pCi/L)

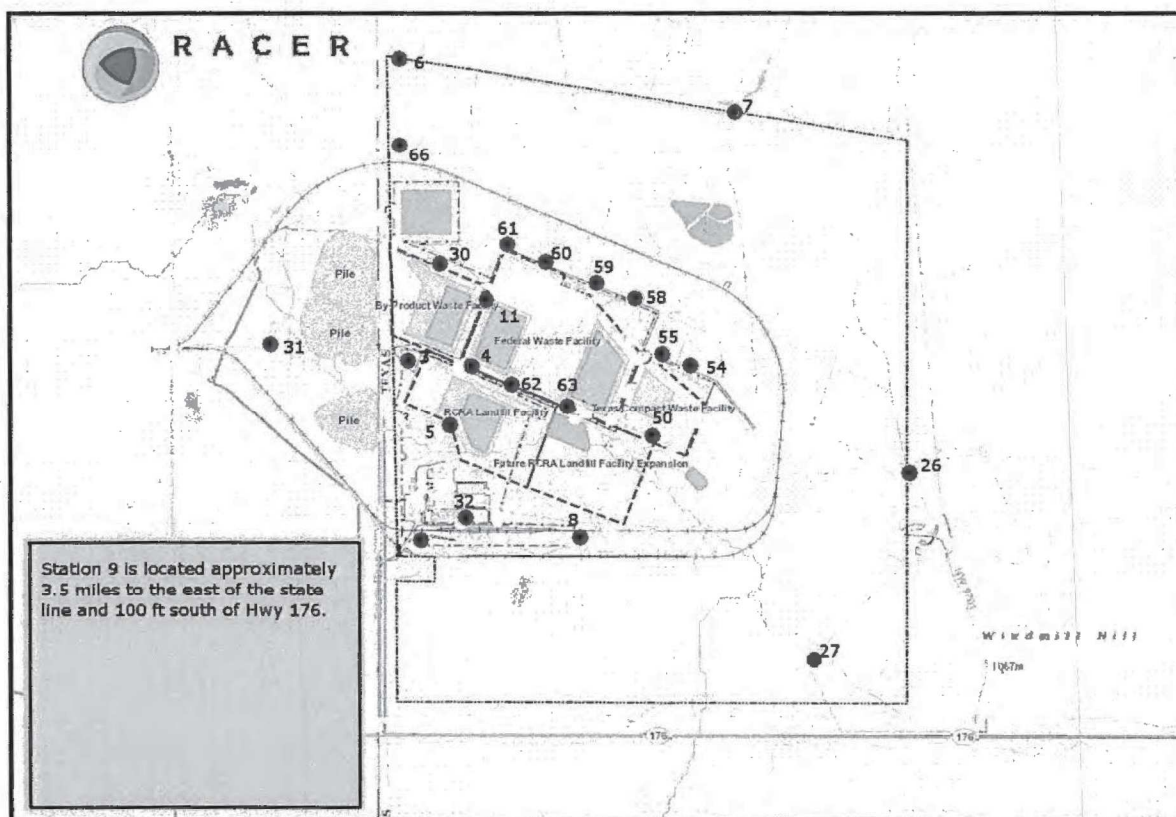


Figure 3 : Locations of Radon Air Monitors

3.2 Fauna

A fauna sample (primary herbivore) is collected annually in the general site area and handled in accordance with procedure EV-7.1.18, *Wildlife Sampling*. The sample is shipped to an offsite NELAP accredited laboratory and the target organ is analyzed as specified in RML No. R05807 and RML No. R04100. Table 7 lists the fauna sampling requirements. WCS collected one fauna sample during the reporting period. Table 8 displays the 2014 fauna results greater than MDC. The fauna results are consistent with natural background. Because fauna results only contain one result, graphs depicting these results are not included in this report. All 2014 fauna results are included in Appendix B.

Table 7 : Fauna Sampling Requirements

Sample Type	REMP
Fauna	Annual (small mammal)

Table 8 : Fauna Data Greater than the MDC, 2014

Sample Number	No. of Stations	Collect Date	Parameter	Result	TPU	Units	MDC
14-FA-07-017	Rabbit 1	6/16/2014	BETA	12.9	3.47	PCI/G	3.7
14-FA-07-017	Rabbit 1	6/16/2014	Lead-210	0.421	0.238	PCI/G	0.335
14-FA-07-017	Rabbit 1	6/16/2014	Lead-212	0.053	0.0363	PCI/G	0.0465
14-FA-07-017	Rabbit 1	6/16/2014	Lead-214	0.0899	0.0566	PCI/G	0.0659
14-FA-07-017	Rabbit 1	6/16/2014	Potassium-40	7.72	1.03	PCI/G	0.346
14-FA-07-017	Rabbit 1	6/16/2014	Thallium-208	0.0426	0.0383	PCI/G	0.0346

3.3 Soil

Soil samples are collected semi-annually from the WCS Andrews County site from composite samples collected from 0-2 inches below ground surface (bgs) in a 1 meter square area. Soil sample results are compared against their respective ILs to determine whether or not there is a change significant enough to warrant an investigation. Table 9 lists the soil sampling location requirements. Figure 4 displays the soil sampling locations.

Table 9 : Soil Sampling Location Requirements

Sample Type	Byproduct Stations	REMP Stations
Soil (0-2) bgs	3, 8, 9, 22, and 26	1, 3, 4, 7, 8, 9, 11, 13, 15, 17, 22, 26, 27, 31, 50, 55, 59

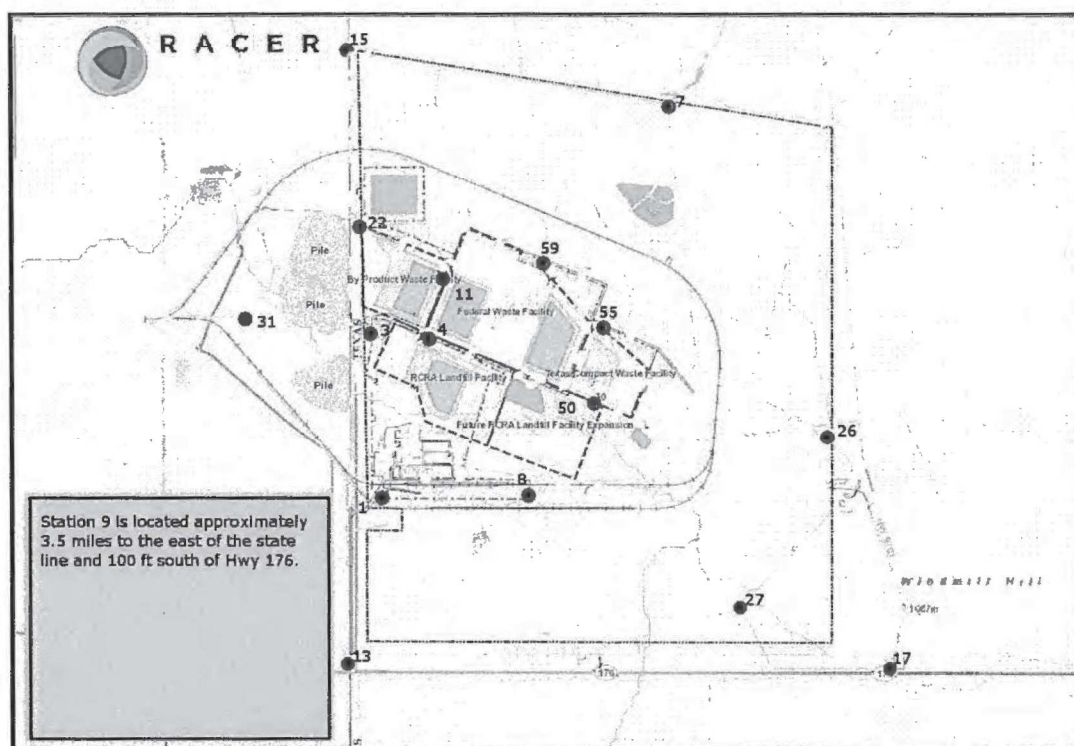


Figure 4 : Soil Sampling Locations

Surface samples, to a depth of no more than 5 centimeters (cm), are collected from within two (2) 1 square meter (m^2) areas located about 3 meters apart. Samples are collected from the center and corners of the grid and sieved through a screen to remove rocks and debris. Summary statistics for key radionuclides in samples from the 0-2 inch bgs stratum are presented in Table 10. Figure 5 through Figure 6 graphically depict the 0-2 inch bgs stratum soil monitoring results for gross alpha and gross beta, respectively. Complete soil sample results for the 0-2 inch bgs stratum are given in Appendix C. Soil sample results that exceeded their corresponding ILs are discussed in more detail in Section 4, Investigations.

Table 10 : Soil (0-2") Summary Statistics, 2014

Analytes	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	17	34	31	8.32E+00	2.35E+01	2.62E+00	pCi/g	1.60E+01	9.18E+00	9.18E+01	8.23E+01
BETA	17	34	34	1.16E+01	3.86E+01	5.53E+00	pCi/g	2.40E+01	1.98E+01	1.98E+02	1.77E+02
Carbon-14	2	2	0	8.40E-02	1.22E-01	4.59E-02	pCi/g	NA	1.48E+00	1.48E+01	1.33E+01
Cesium-137g	17	34	22	3.64E-02	2.50E-01	-9.08E-04	pCi/g	NA	2.98E-02	2.98E-01	2.55E-01
Cobalt-60g	17	34	0	-1.13E-03	8.67E-03	-1.15E-02	pCi/g	NA	2.11E-02	2.11E-01	1.81E-01
Iodine-129	2	2	0	-1.07E-02	2.10E-02	-4.23E-02	pCi/g	NA	1.98E-01	1.98E+00	1.78E+00
Lead-210	10	10	10	1.53E+00	3.63E+00	8.36E-01	pCi/g	4.20E+00	1.19E+00	3.69E+00	3.66E+00
Strontium-90	2	2	0	7.79E-02	8.29E-02	7.29E-02	pCi/g	NA	3.52E-01	3.52E+00	3.01E+00
Technetium-99	2	2	0	1.59E-02	6.20E-02	-3.02E-02	pCi/g	NA	1.11E+00	1.11E+01	9.49E+00
Thorium-228	10	10	1	3.21E-01	1.07E+00	-6.18E-02	pCi/g	1.10E+00	8.01E-01	3.30E+00	3.16E+00
Thorium-230	10	10	6	7.69E-01	1.57E+00	1.65E-01	pCi/g	7.80E-01	7.09E-01	7.09E+00	6.37E+00
Thorium-232	10	10	5	4.42E-01	8.81E-01	1.34E-01	pCi/g	1.00E+00	7.05E-01	7.05E+00	6.33E+00
Tritium	2	2	0	3.37E-02	1.32E-01	-6.46E-02	pCi/g	NA	9.36E-01	9.36E+00	8.40E+00
Uranium-233/234	10	10	10	5.11E-01	8.29E-01	2.20E-01	pCi/g	1.00E+00	5.56E-01	5.56E+00	4.99E+00
Uranium-235/236	10	10	2	4.33E-02	7.64E-02	1.73E-02	pCi/g	2.00E-01	9.36E-02	9.36E-01	8.40E-01
Uranium-238	10	10	10	5.00E-01	6.87E-01	3.09E-01	pCi/g	1.70E+00	5.26E-01	5.26E+00	4.72E+00

Notes: Obs = Number of Observations (data points)

MDC = Minimum Detectable Concentration

BP IL = Byproduct Investigation Level

LL IL = Low Level Radioactive Waste Investigation Level

LL AL = Low Level Action Level

LL ADL = Low Level Analytical Decision Level

g added to a radionuclide name signifies a gamma spectroscopy result.

NA = Not Applicable

pCi/g = picocuries per gram of material

pCi/L = picocuries per liter of material

Please note that because table conventions remain consistent throughout this document, table footnotes for summary statistic tables are only provided once.

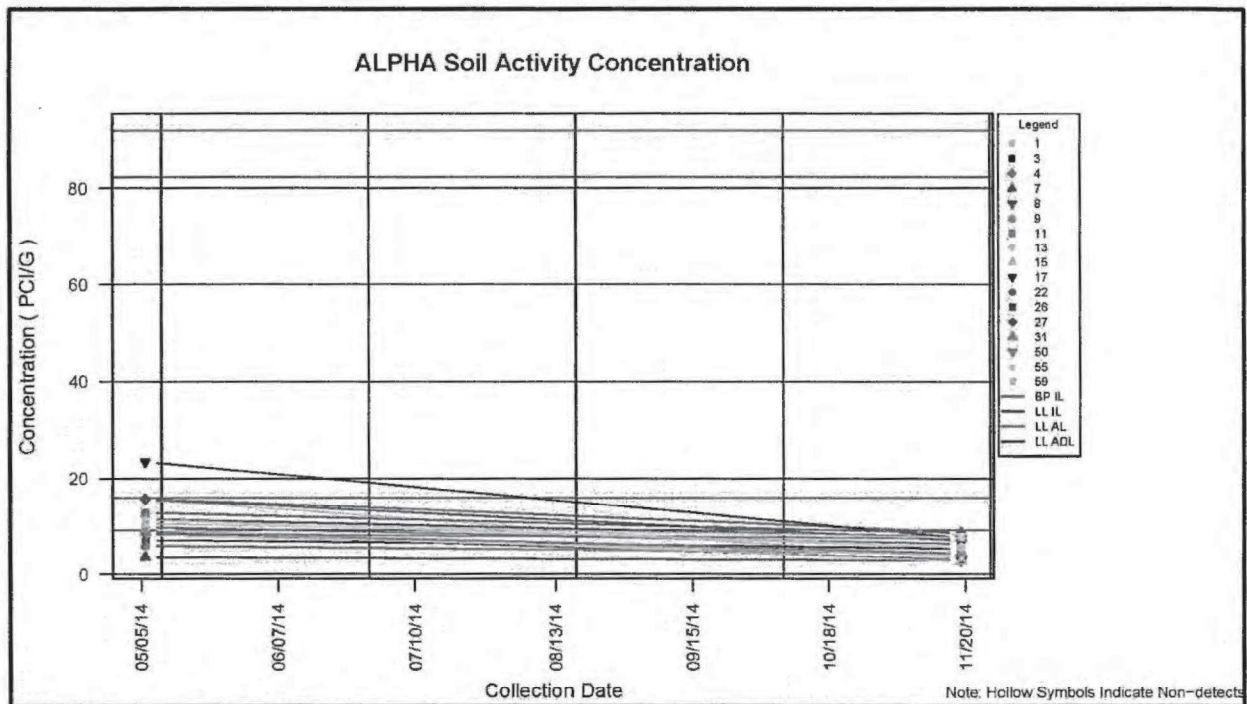


Figure 5: Gross Alpha Soil Activity Concentration

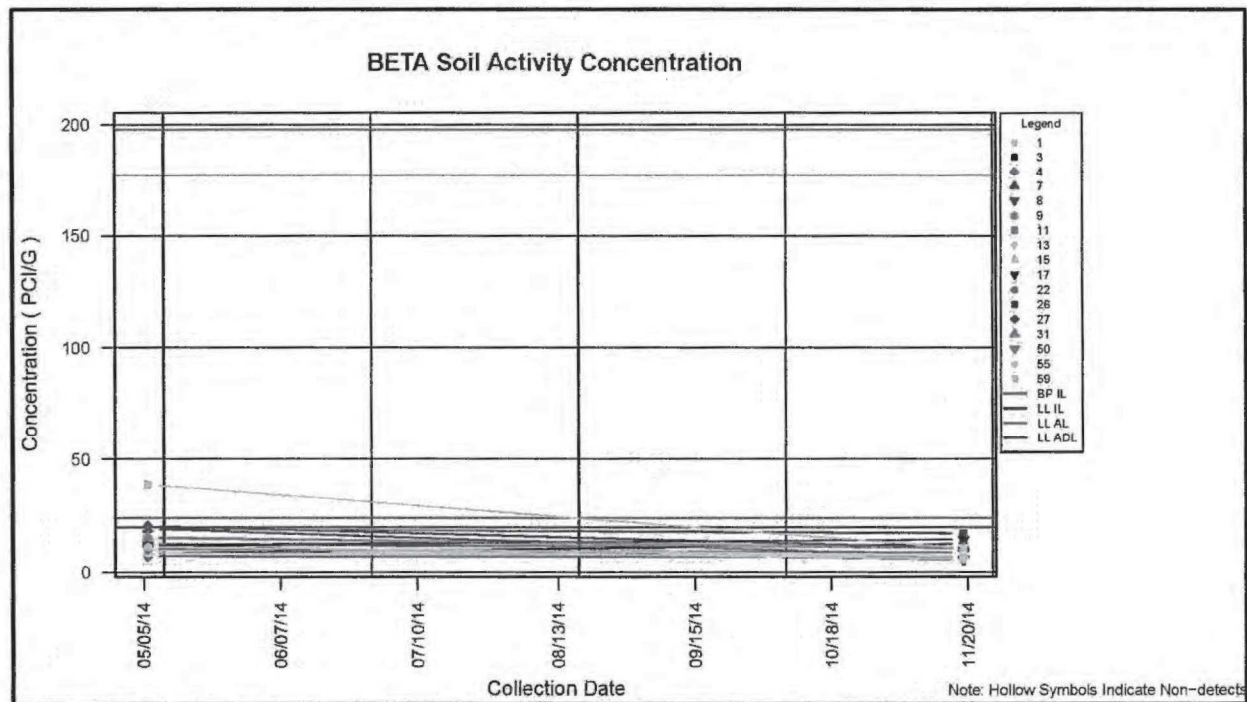


Figure 6: Gross Beta Soil Activity Concentration

3.4 Sediment

Sediment samples are collected annually from six stations in accordance with procedure EV-7.1.5, *Soil Sampling*. The samples are collected in an area prone to precipitation runoff and where runoff slows and begins to deposit sediment. Each sediment sample is taken from approximately the upper inch of newly deposited soil. Figure 7 displays the sediment sample locations and Table 11 lists the required sampling locations. Sample results are compared against their respective ILs to determine whether or not there is a change significant enough to warrant an investigation. Sediment sample results are summarized in Table 12. Complete sediment sample results are given in Appendix D. Because sediment results only contain one result per station, graphs depicting these results are not included in this report. Sediment sample results that exceeded their corresponding ILs are discussed in more detail in Section 4, Investigations.

Table 11 : Sediment Sampling Locations by Requirements

Sample Type	Byproduct Stations	REMP Stations
Sediment	GW-2 (18)	GW-1, GW-2 (18), GW-3, GW-4, GW-5, GW-6

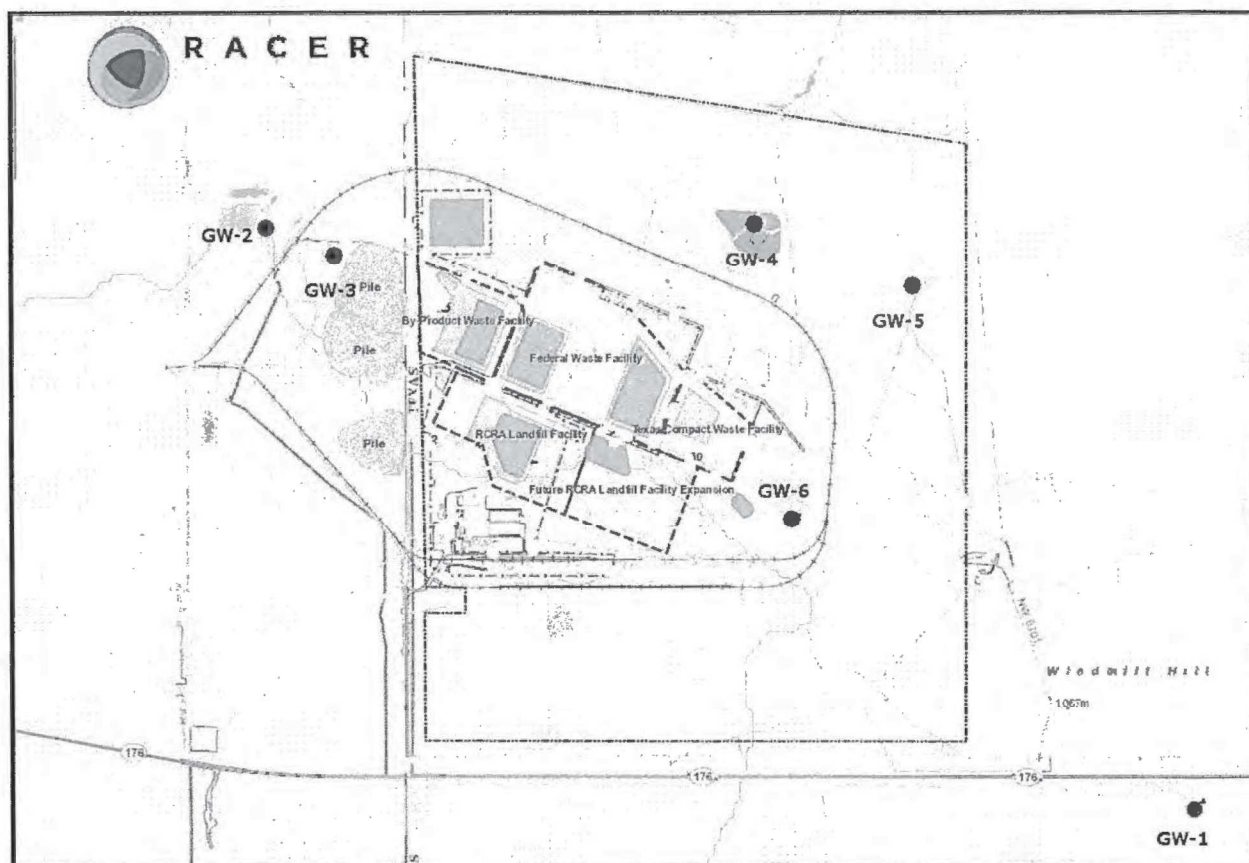


Figure 7 : Sediment Sampling Location

Table 12 : Sediment Sample Results, 2014

Analyte	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	6	6	6	1.77E+01	2.27E+01	1.16E+01	pCi/g	1.60E+01	3.23E+01	3.23E+02	2.90E+02
BETA	6	6	6	3.01E+01	3.97E+01	1.86E+01	pCi/g	2.40E+01	4.15E+01	4.15E+02	3.72E+02
Carbon-14	5	5	0	1.75E-01	2.93E-01	4.80E-02	pCi/g	NA	1.76E+00	1.76E+01	1.58E+01
Cesium-137g	6	6	6	2.43E-01	3.93E-01	8.07E-02	pCi/g	NA	9.01E-01	9.01E+00	7.70E+00
Cobalt-60g	6	6	0	6.56E-03	1.95E-02	-5.99E-03	pCi/g	NA	6.96E-02	6.96E-01	5.95E-01
Iodine-129	5	5	0	-3.70E-04	3.80E-02	-4.45E-02	pCi/g	NA	1.62E-01	1.62E+00	1.45E+00
Lead-210	5	5	5	4.14E+00	7.82E+00	2.18E+00	pCi/g	4.20E+00	7.94E+00	1.04E+01	1.23E+01
Radium-226g	6	6	6	1.11E+00	1.27E+00	7.30E-01	pCi/g	9.00E-01	1.61E+00	4.11E+00	4.20E+00
Radium-228g	6	6	6	1.18E+00	1.42E+00	7.42E-01	pCi/g	9.00E-01	1.53E+00	4.03E+00	4.10E+00
Strontium-90	5	5	0	1.12E-02	2.74E-01	-1.75E-01	pCi/g	NA	1.76E+00	4.36E+00	3.73E+00
Technetium-99	5	5	0	6.29E-02	1.59E-01	-1.87E-02	pCi/g	NA	4.61E-01	4.61E+00	3.94E+00
Thorium-228	5	5	5	1.20E+00	1.58E+00	9.05E-01	pCi/g	1.10E+00	2.77E+00	5.27E+00	5.69E+00
Thorium-230	5	5	5	1.42E+00	1.71E+00	1.16E+00	pCi/g	7.80E-01	1.61E+00	1.61E+01	1.45E+01
Thorium-232	5	5	5	1.14E+00	1.47E+00	5.83E-01	pCi/g	1.00E+00	2.20E+00	8.21E+00	7.95E+00
Tritium	5	5	0	3.00E-02	2.04E-01	-1.69E-01	pCi/g	NA	3.54E+00	3.54E+01	3.18E+01
Uranium-233/234	5	5	5	7.01E-01	7.79E-01	6.08E-01	pCi/g	1.00E+00	1.12E+00	1.12E+01	1.01E+01
Uranium-235/236	5	5	2	4.62E-02	6.56E-02	2.50E-02	pCi/g	2.00E-01	1.13E-01	1.13E+00	1.01E+00
Uranium-238	5	5	5	7.91E-01	8.79E-01	7.15E-01	pCi/g	1.70E+00	1.15E+00	1.15E+01	1.03E+01

3.5 Vegetation

Vegetation samples are collected annually in accordance with procedure EV-7.1.7, *Vegetation Sampling*. Two pounds of live leafy vegetation are collected, if available, from each of the sampling locations around the site. Vegetation samples are obtained within 100 feet of the station location, or, if insufficient vegetation exists within a 100-foot radius to obtain the minimum sample size at a sampling location, vegetation can be collected within 200 feet of the station. Table 13 displays the vegetation sampling requirements. Figure 8 displays the vegetation sample locations. Vegetation sample results are summarized in Table 14. All vegetation sample results are provided in Appendix E. Vegetation results only contain one result per station, therefore; graphs depicting these results are not included in this report. Vegetation sample results that exceeded their corresponding ILs are discussed in more detail in Section 4, Investigations.

Table 13 : Vegetation Sampling Locations by Requirements

Sample Type	Byproduct Stations	REMP Stations
Vegetation	6 and 9	6, 7, 9, 13, 26, 27, 31, GW-1, GW-2(18), GW-3, GW-4, GW-5, GW-6

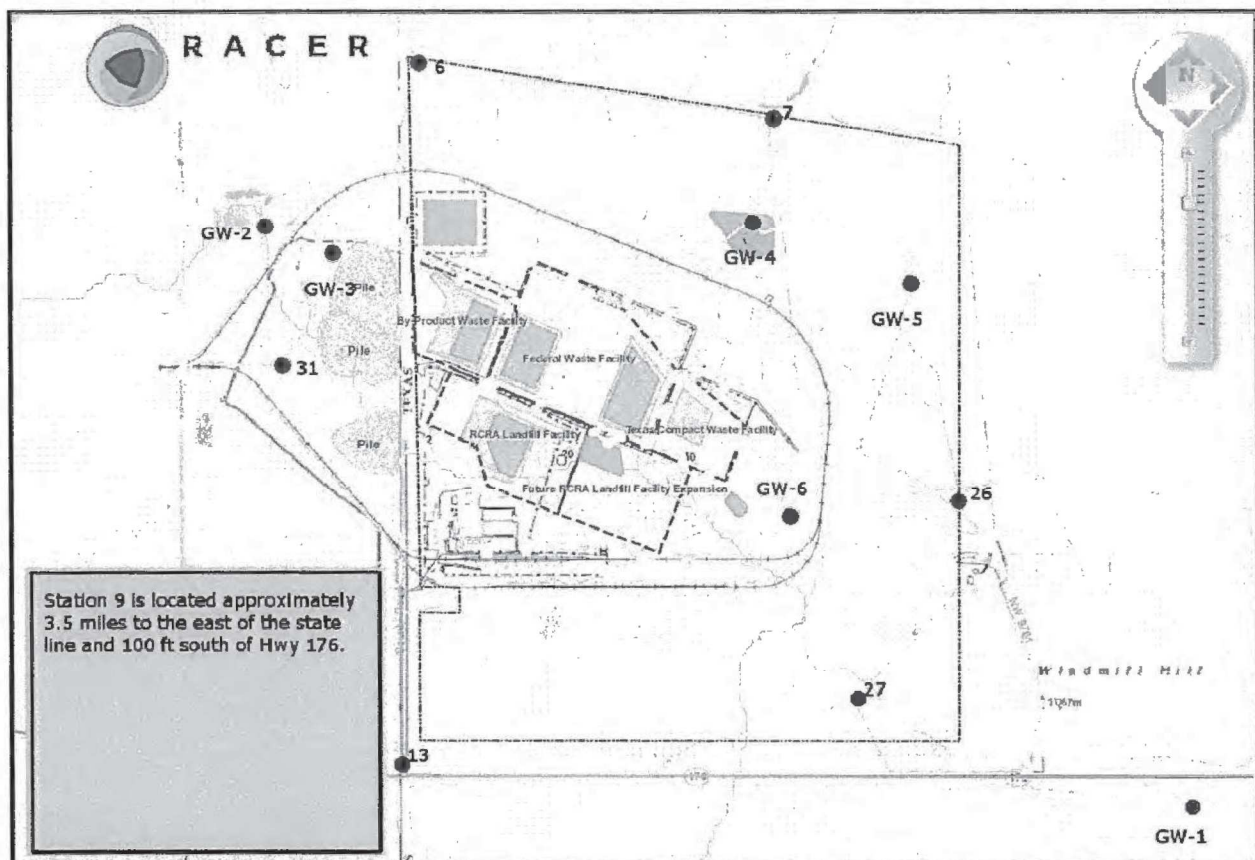


Figure 8 : Vegetation Sample Locations

Table 14 : Summary of Vegetation Sample Results, 2014

Analyte	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	12	12	5	3.83E+00	1.91E+01	-3.14E-01	pCi/g	2.60E+00	3.54E+00	3.54E+01	3.18E+01
BETA	12	12	12	3.55E+01	7.39E+01	1.57E+01	pCi/g	2.30E+01	8.87E+01	8.87E+02	7.96E+02
Carbon-14	7	7	0	6.62E-01	1.41E+00	-1.31E-02	pCi/g	NA	1.35E+00	1.35E+01	1.21E+01
Cesium-137g	12	12	0	-6.61E-04	2.61E-02	-2.46E-02	pCi/g	NA	8.93E-02	8.93E-01	7.63E-01
Cobalt-60g	12	12	0	1.10E-02	4.33E-02	-1.02E-02	pCi/g	NA	5.36E-01	5.36E+00	4.58E+00
Iodine-129	7	7	0	-1.13E-02	2.83E-02	-4.09E-02	pCi/g	NA	1.69E-01	1.69E+00	1.52E+00
Lead-210	9	9	9	2.57E-01	4.07E-01	9.28E-02	pCi/g	1.10E+00	1.27E+00	1.44E+00	1.77E+00
Radium-226g	12	12	4	5.25E-02	1.26E-01	-3.70E-02	pCi/g	1.00E-01	4.26E-01	4.26E+00	3.82E+00
Radium-228g	12	12	1	7.48E-02	1.67E-01	0.00E+00	pCi/g	3.90E-01	4.20E-01	4.20E+00	3.77E+00
Strontium-90	7	7	0	3.64E-03	6.76E-02	-3.16E-02	pCi/g	NA	1.56E-01	1.56E+00	1.33E+00
Technetium-99	7	7	0	-1.86E-01	1.49E-01	-9.59E-01	pCi/g	NA	5.58E-01	5.58E+00	4.77E+00
Thorium-228	5	5	0	1.41E-01	2.64E-01	3.57E-02	pCi/g	2.90E-01	2.57E-01	2.57E+00	2.31E+00
Thorium-230	5	5	0	1.93E-01	3.11E-01	6.57E-02	pCi/g	1.50E-01	4.48E-01	2.08E+00	1.97E+00
Thorium-232	5	5	0	5.24E-02	2.06E-01	-3.49E-02	pCi/g	2.00E-01	1.91E-01	5.19E-01	5.25E-01
Tritium	7	7	0	-9.93E-02	6.00E-03	-1.79E-01	pCi/g	NA	5.31E-01	5.31E+00	4.77E+00
Uranium-233/234	5	5	2	4.51E-02	8.11E-02	1.47E-02	pCi/g	2.20E-01	4.75E-01	4.75E+00	4.26E+00
Uranium-235/236	5	5	0	1.28E-03	1.18E-02	-4.65E-03	pCi/g	7.90E-02	8.80E-02	8.80E-01	7.90E-01
Uranium-238	5	5	1	2.36E-02	5.00E-02	6.29E-03	pCi/g	1.70E-01	1.40E-01	1.40E+00	1.26E+00

3.6 Ambient Radiation

Ambient radiation is monitored using Optically Stimulated Luminescent (OSL) dosimeters and thermoluminescent dosimeters (TLD). These dosimeters are placed one meter above the ground. TLDs and OSLs are exchanged on a quarterly basis and are handled in accordance with procedure EV-7.1.6, *Thermoluminescent Dosimeters / Optically Stimulated Luminescent Dosimeters*. Transit and deployment control dosimeters are maintained in a shielded storage box. Table 15 displays the ambient radiation monitoring requirements. Figure 9 contains a map showing the locations of the OSL and TLD stations. OSL sample results that exceeded their corresponding ALs are discussed in more detail in Section 4, Investigations.

Table 15 : Ambient Radiation Monitoring Location by Requirements

Sample Type	Byproduct Stations	REMP Stations
Ambient Radiation OSL	1, 3, 4, 6, 7, 8, 9, 11, 13, 14, 16, 17, 18, 22, 23, 26, 27, 28, and 30	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 16, 17, 18, 22, 23, 26, 27, 28, Andrews Office (29), 30, 34, 50, 51, 52, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64 and 66
Ambient Radiation TLD	N/A	4, 6, 7, 11, 13, 14, 16, 17, 18, 26, Andrews Office (29), 30, 34, 55 and 59

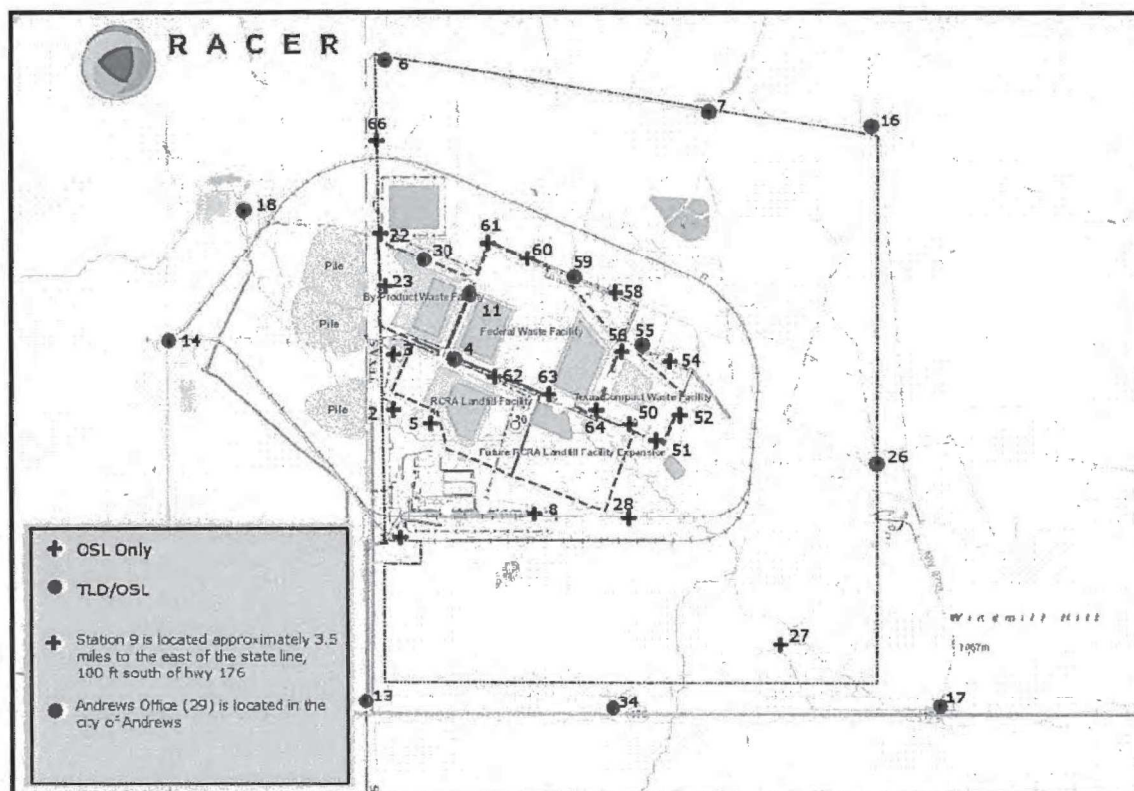


Figure 9 : OSL and TLD Locations

The ambient radiation results for calendar year 2014 are provided in Table 16 and Table 17 for measurements using OSL dosimeters and TLDs, respectively. Figure 10 and Figure 11 graphically display the TLD and OSL results respectively.

Table 16 : 2014 Quarterly OSL Direct Gamma Results

Station	1st Quarter 2014 (mrem)	2nd Quarter 2014(mrem)	3rd Quarter 2014(mrem)	4th Quarter 2014(mrem)
1	M	M	M	M
2	4	7	9	7
3	M	M	M	M
4	2	M	2	5
5	4	3	6	5
6	1	1	1	3
7	M	M	M	M
8	M	M	M	M
9	M	M	M	1
11	1	2	1	5
13	M	M	M	M
14	M	M	M	M
16	M	M	M	M
17	2	M	1	3
18	M	1	M	3
22	1	14	2	23
23	3	6	5	8
26	2	1	M	4
27	1	M	M	2
28	4	2	3	2
Andrews	4	3	4	5
30	M	7	1	13
34	M	M	M	M
50	6	7	16	16
51	4	2	11	9
52	11	7	21	13
54	5	3	8	8
55	4	3	10	16
56	4	3	7	23
58	M	M	M	2
59	M	M	M	2
60	M	M	1	M
61	2	3	1	5
62	1	M	2	3
63	2	M	1	2
64	5	3	10	11
66	3	2	M	4
Deployed	1-1-14	4-1-14	7-1-14	10-1-14
Collected	3-31-14	6-30-14	9-30-14	12-31-14

Notes: Landauer processes OSLs and only reports results greater than Minimal Detectable Level, therefore, M indicates the value was less than Minimal Detectable Level (1 mrem).

Table 17 : 2014 Quarterly TLD Direct Gamma Results

Station	1st Quarter 2014 (mrem)	2nd Quarter 2014 (mrem)	3rd Quarter 2014 (mrem)	4th Quarter 2014 (mrem)
4	3.2	3.9	8.5	5.7
6	4.6	4.5	4.7	5.6
7	1.4	0.3	0.7	2.6
11	4.5	6.7	5.9	9.8
13	1.4	2.1	1.4	1.9
14	0.2	0.8	0.5	-0.7
16	-0.3	-0.3	0.5	-0.5
17	2.6	4.5	3	2.9
18	4.1	5.1	3.9	7.3
26	3.1	3.2	4	4
Andrews	6.1	7.8	5.4	7.8
30	3.9	11.9	3.8	14.6
34	-0.2	1	-0.9	2.3
55	7.6	8.3	11.8	25.4
59	2	2.3	2.4	4.1
Deployed	1-1-14	4-1-14	7-1-14	10-1-14
Collected	3-31-14	6-30-14	9-30-14	12-31-14

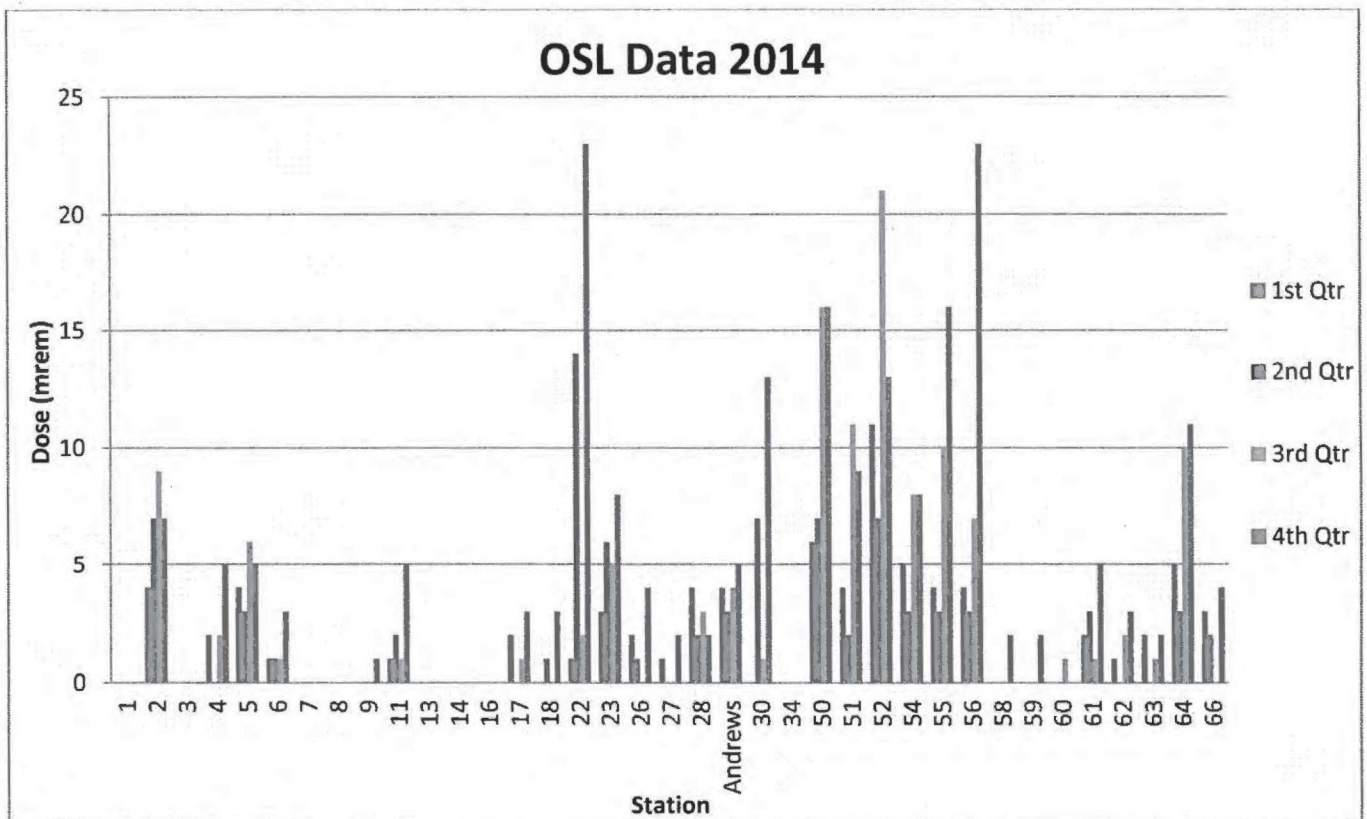


Figure 10 : OSL Results for 2014

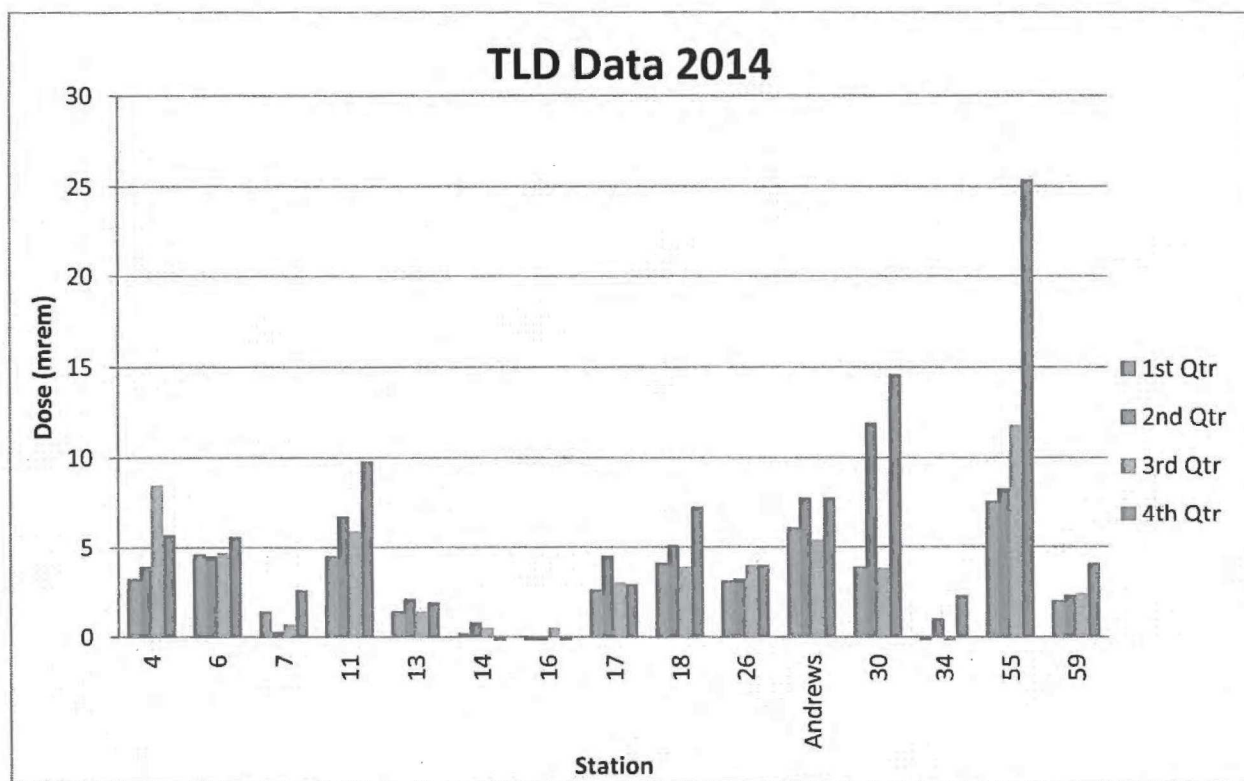


Figure 11 : TLD Results for 2014

3.7 Air Monitoring

As part of the REMP, air is sampled monthly from twenty-six locations for air particulates and twenty-four locations for tritium vapor. Nineteen stations are sampled for air vapors (air cartridge). Figure 12 displays all of the air monitoring locations.

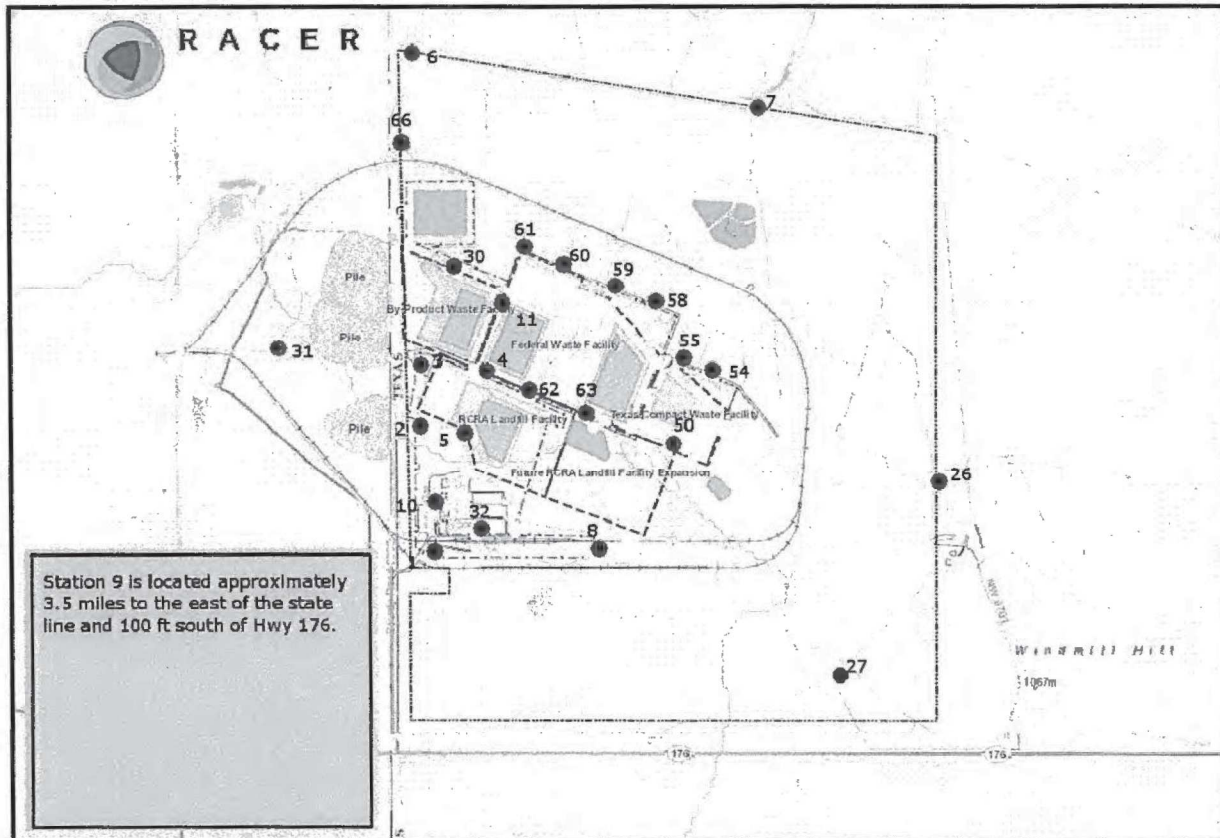


Figure 12 : Air Particulate Sample Locations

3.7.1 Air Particulate

High-volume air particulate samples were collected weekly, composited monthly, and sent to an offsite accredited laboratory for analysis in accordance with procedure EV-7.16, *High Volume Air Sampling*. Sample results are compared against their respective ILs to determine whether or not a change significant enough to warrant an investigation occurred. Table 18 displays all of the air particulate sampling requirements.

Table 18 : Air Particulate Sampling Location by Requirements

Sample Type	Byproduct Stations	REMP Stations
Air Particulate	1, 3, 4, 6, 7, 8, 9, 11, 26, 27, 30, 31, and 32	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 26, 27, 30, 31, 32, 50, 54, 55, 58, 59, 60, 61, 62, 63 and 66

A statistical summary for the 2014 air particulate data collected during the report period is provided in Table 19. The air particulate sample results for high volume air samples are given in Appendix F. Figure 13 through Figure 23 plot the air particulate results for analytes of note for the calendar year of with respect to time. Air particulate sample results that exceeded their corresponding ILs are discussed in more detail in Section 4, Investigations.

Table 19 : Summary of Air Particulate Results for 2014

Parameters	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	26	312	237	2.38E-03	7.74E-03	9.69E-06	pCi/m3	9.80E-03	3.30E-03	3.30E-02	2.96E-02
BETA	26	312	312	1.10E-02	2.14E-02	4.74E-03	pCi/m3	1.10E-01	1.67E-02	1.67E-01	1.50E-01
Carbon-14	21	37	0	-2.15E-03	3.42E-03	-7.10E-03	pCi/m3	NA	9.16E-03	9.16E-02	8.22E-02
Cesium-137g	26	312	0	1.11E-05	3.91E-04	-2.75E-04	pCi/m3	NA	4.88E-04	4.88E-03	4.17E-03
Cobalt-60g	26	312	1	7.37E-06	9.36E-04	-3.44E-04	pCi/m3	NA	2.66E-04	2.66E-03	2.27E-03
Lead-210	26	82	82	7.92E-03	2.21E-02	2.95E-03	pCi/m3	9.80E-02	1.17E-02	1.17E-01	1.05E-01
Radium-226	26	69	56	1.40E-04	4.68E-04	2.97E-05	pCi/m3	7.60E-03	5.89E-04	5.89E-03	5.29E-03
Radium-228	23	55	27	2.37E-04	1.44E-03	-8.07E-05	pCi/m3	7.00E-03	8.19E-04	8.19E-03	7.35E-03
Strontium-90	21	37	0	1.77E-05	1.25E-04	-7.04E-05	pCi/m3	NA	1.17E-04	1.17E-03	1.00E-03
Technetium-99	21	37	0	2.43E-03	1.20E-02	-7.75E-03	pCi/m3	NA	1.72E-02	1.72E-01	1.47E-01
Thorium-228	26	69	26	5.75E-05	1.74E-04	-8.37E-06	pCi/m3	6.20E-04	1.91E-04	1.91E-03	1.71E-03
Thorium-230	26	69	32	7.15E-05	2.62E-04	-2.00E-05	pCi/m3	1.00E-02	2.00E-04	2.00E-03	1.79E-03
Thorium-232	26	69	41	5.44E-05	1.55E-04	-4.34E-06	pCi/m3	3.40E-04	1.60E-04	1.60E-03	1.44E-03
Uranium-233/234	26	69	69	1.47E-04	3.45E-04	6.68E-05	pCi/m3	9.00E-04	3.57E-04	3.57E-03	3.20E-03
Uranium-235/236	26	69	2	8.76E-06	2.97E-05	-3.40E-06	pCi/m3	2.90E-04	3.88E-05	3.88E-04	3.48E-04
Uranium-238	26	69	69	1.48E-04	3.24E-04	8.41E-05	pCi/m3	3.20E-04	3.44E-04	3.44E-03	3.09E-03

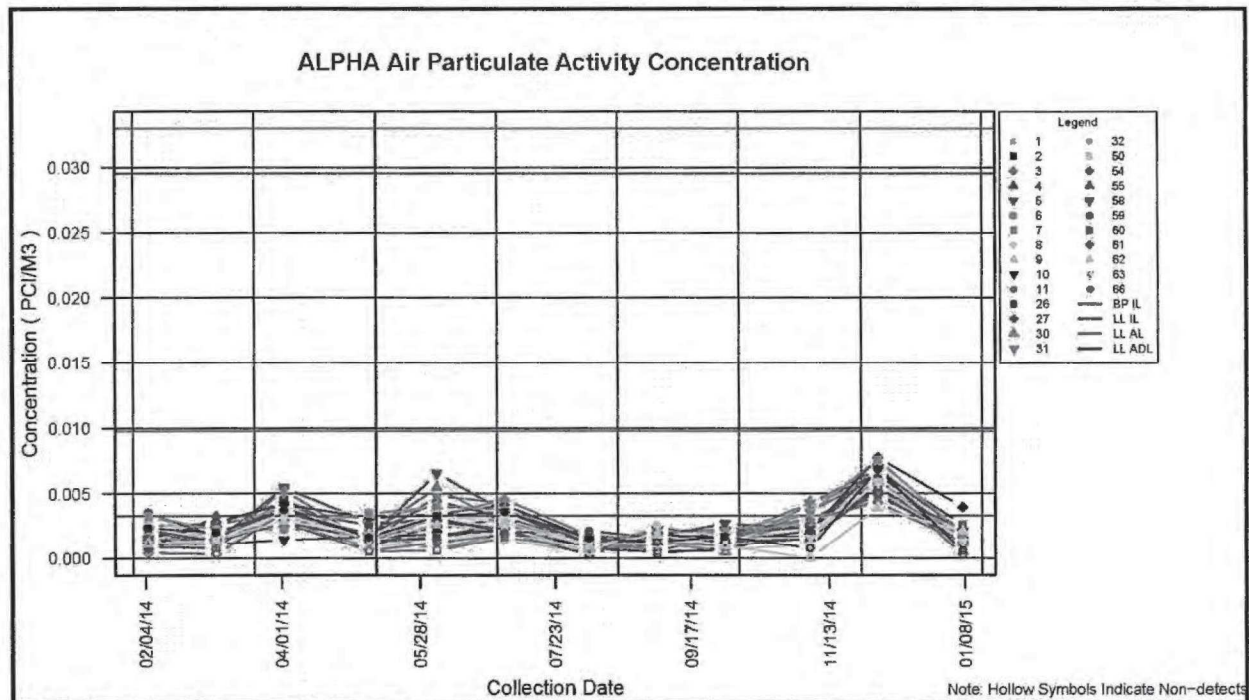


Figure 13 : Gross Alpha Air Particulate Activity Concentration

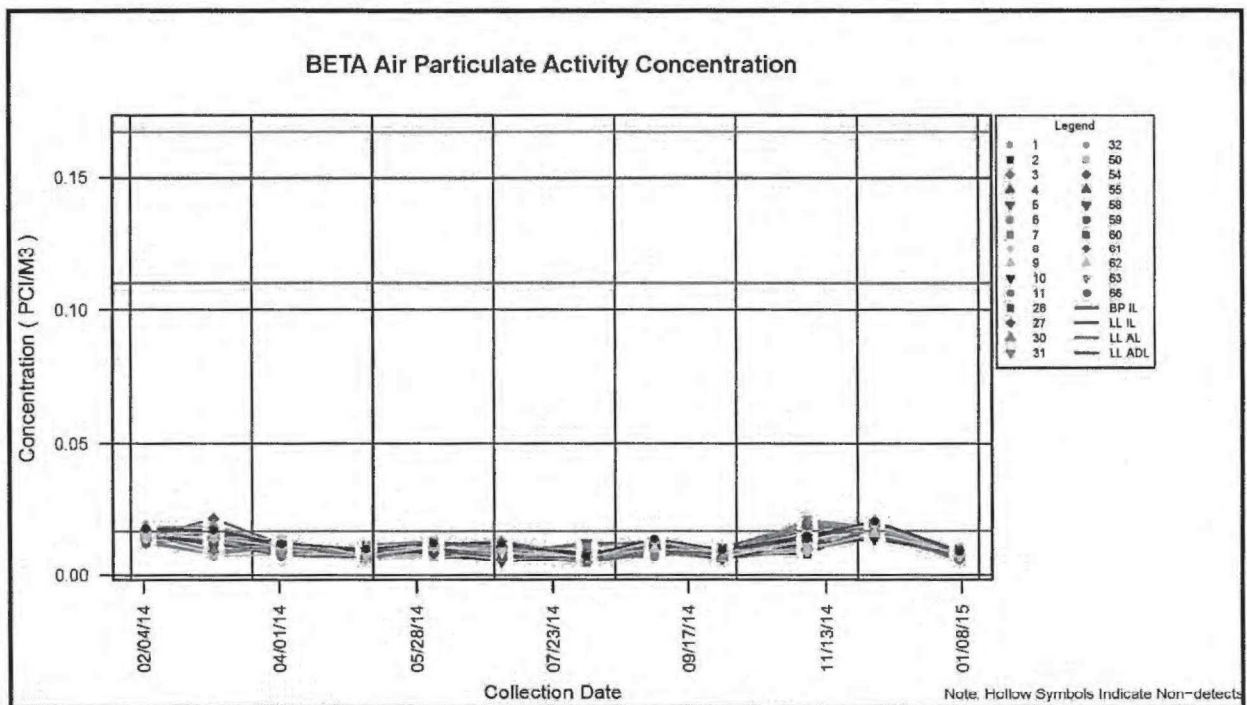


Figure 14 : Gross Beta Air Particulate Activity Concentration

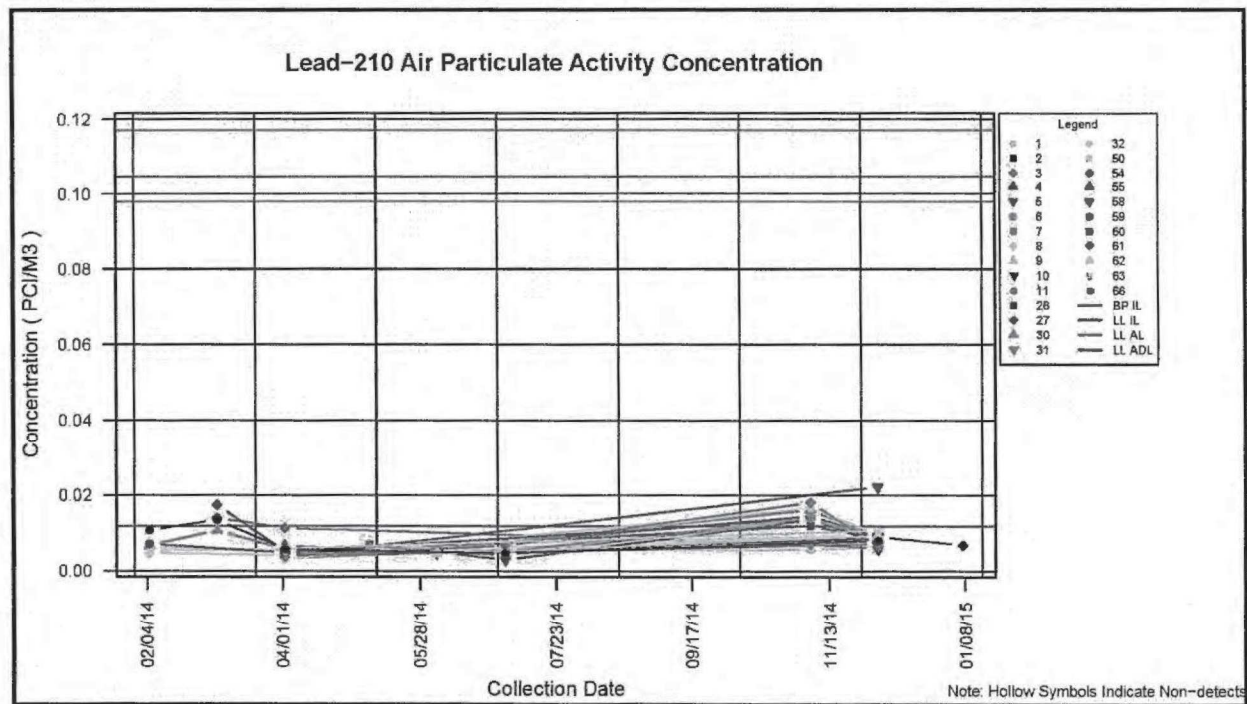


Figure 15 : Lead-210 Air Particulate Activity Concentration

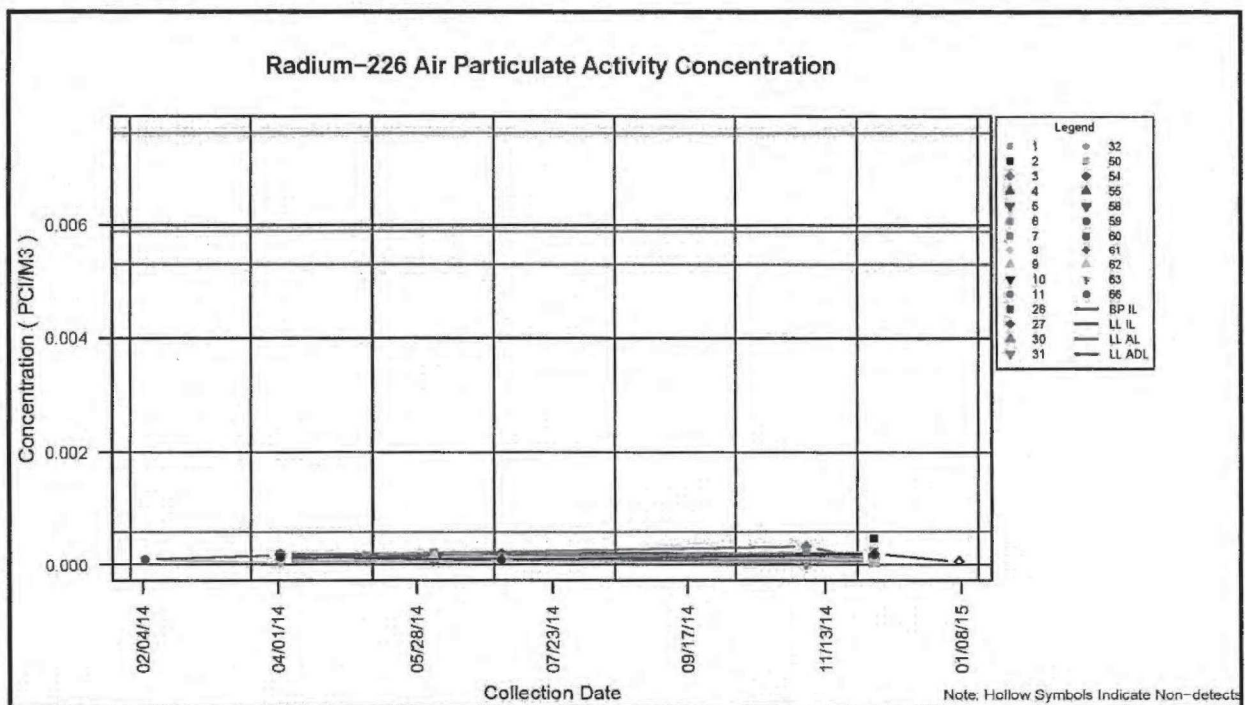


Figure 16 : Radium-226 Air Particulate Activity Concentration

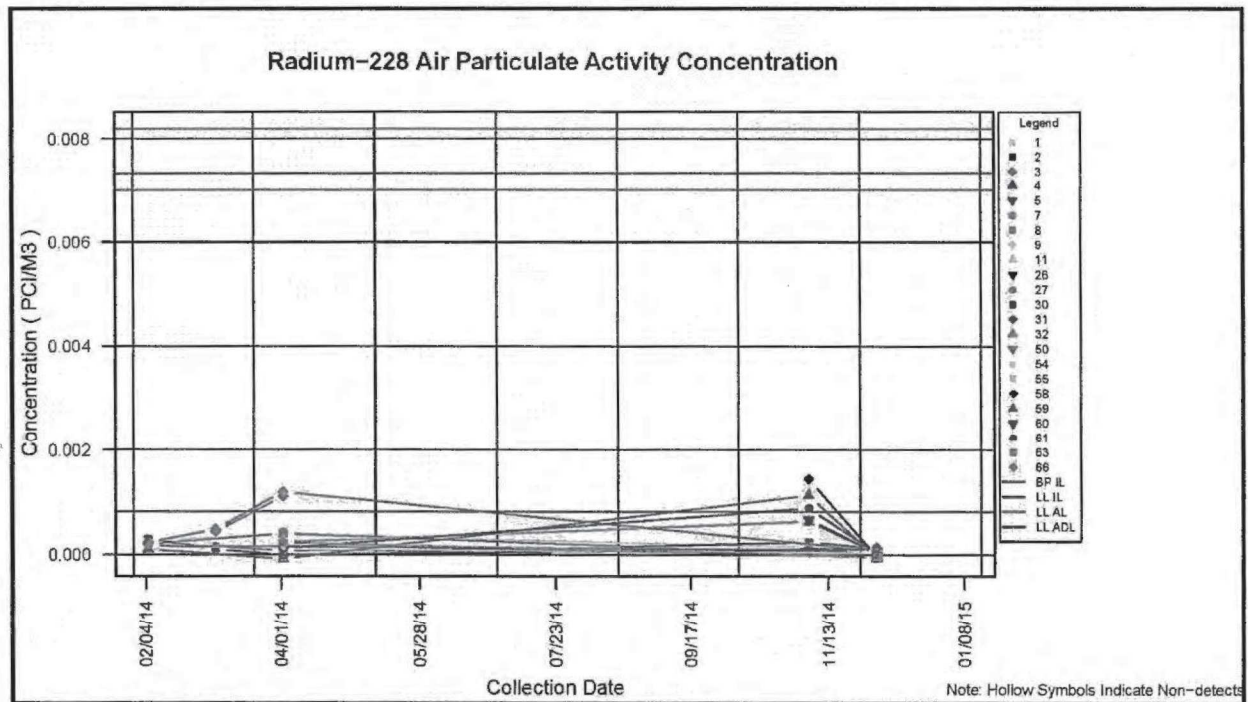


Figure 17 : Radium-228 Air Particulate Activity Concentration

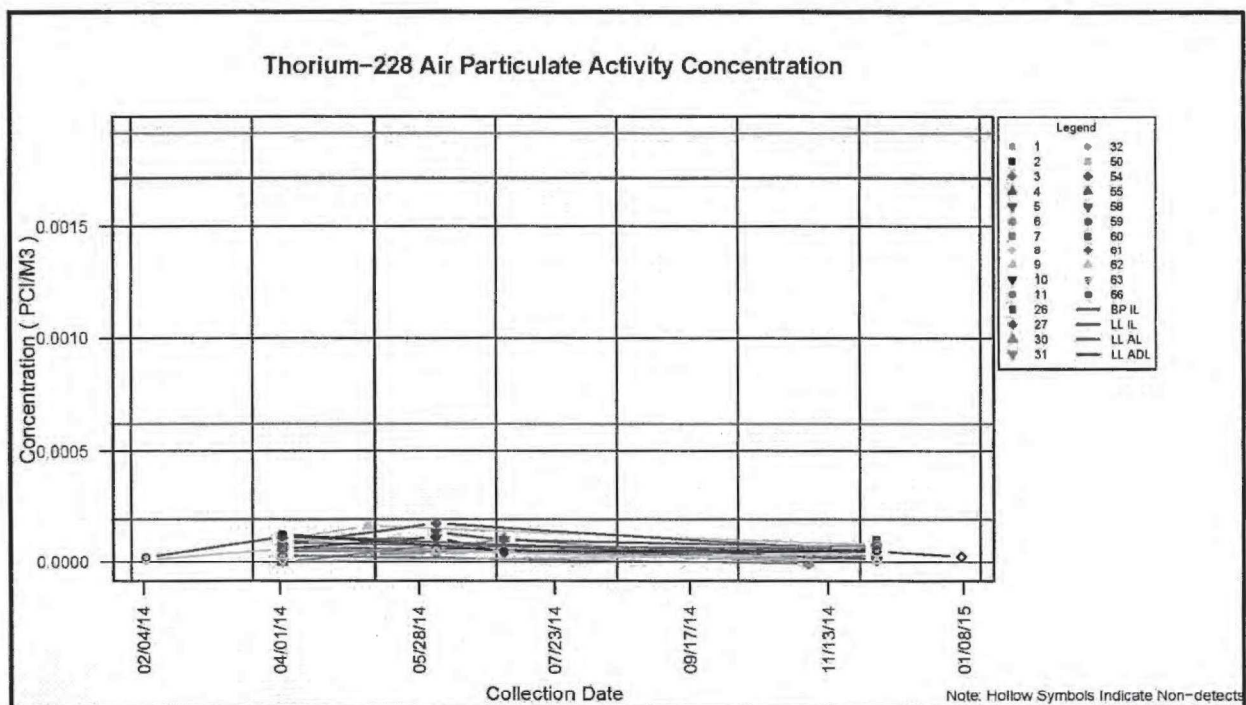


Figure 18 : Thorium-228 Air Particulate Activity Concentration

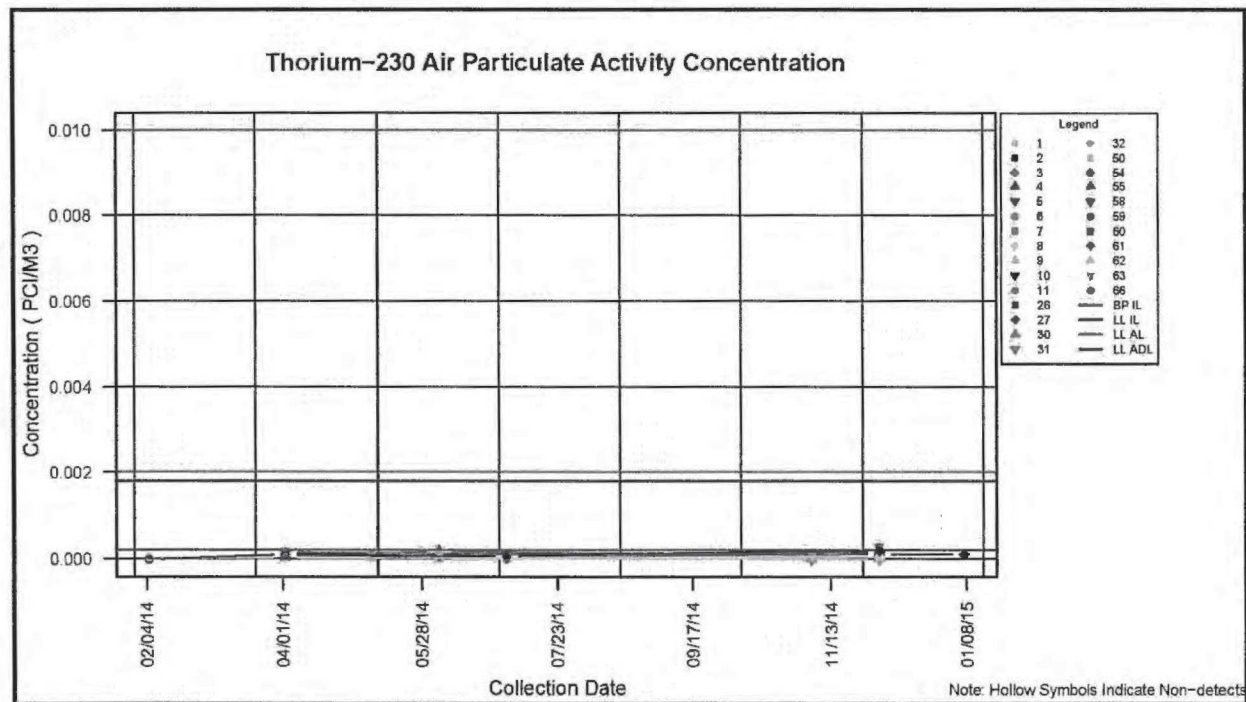


Figure 19 : Thorium-230 Air Particulate Activity Concentration

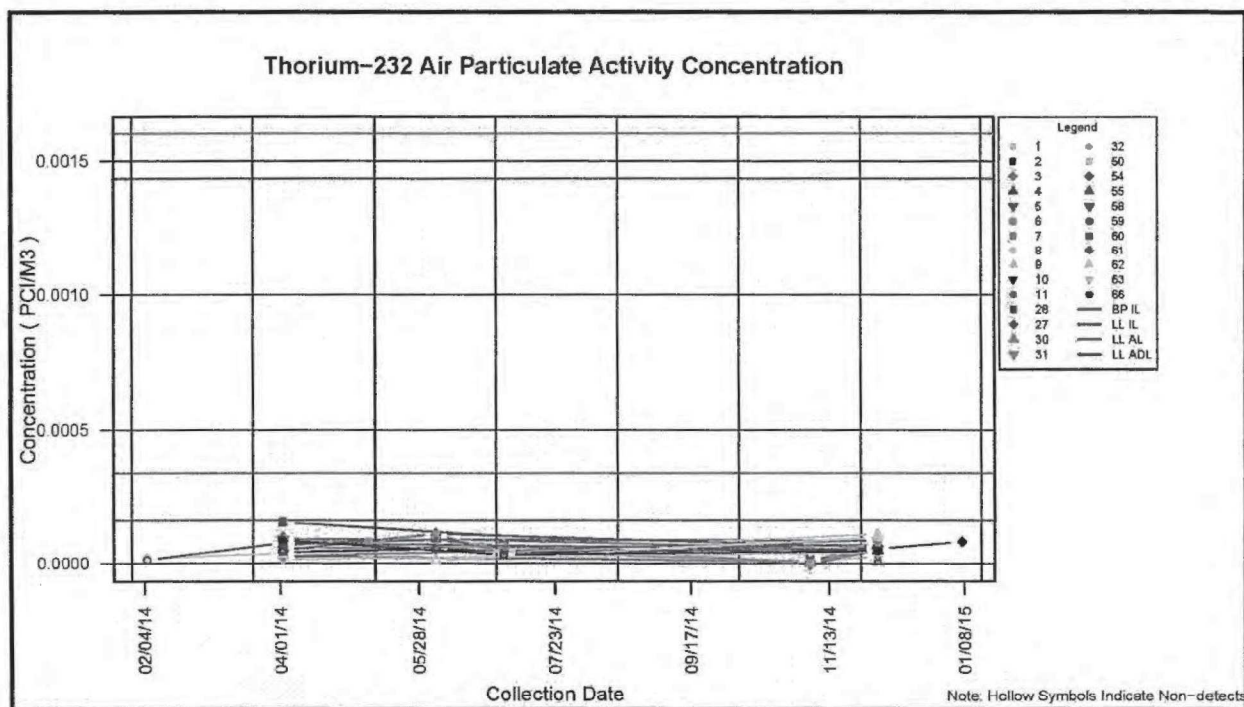


Figure 20 : Thorium-232 Air Particulate Activity Concentration

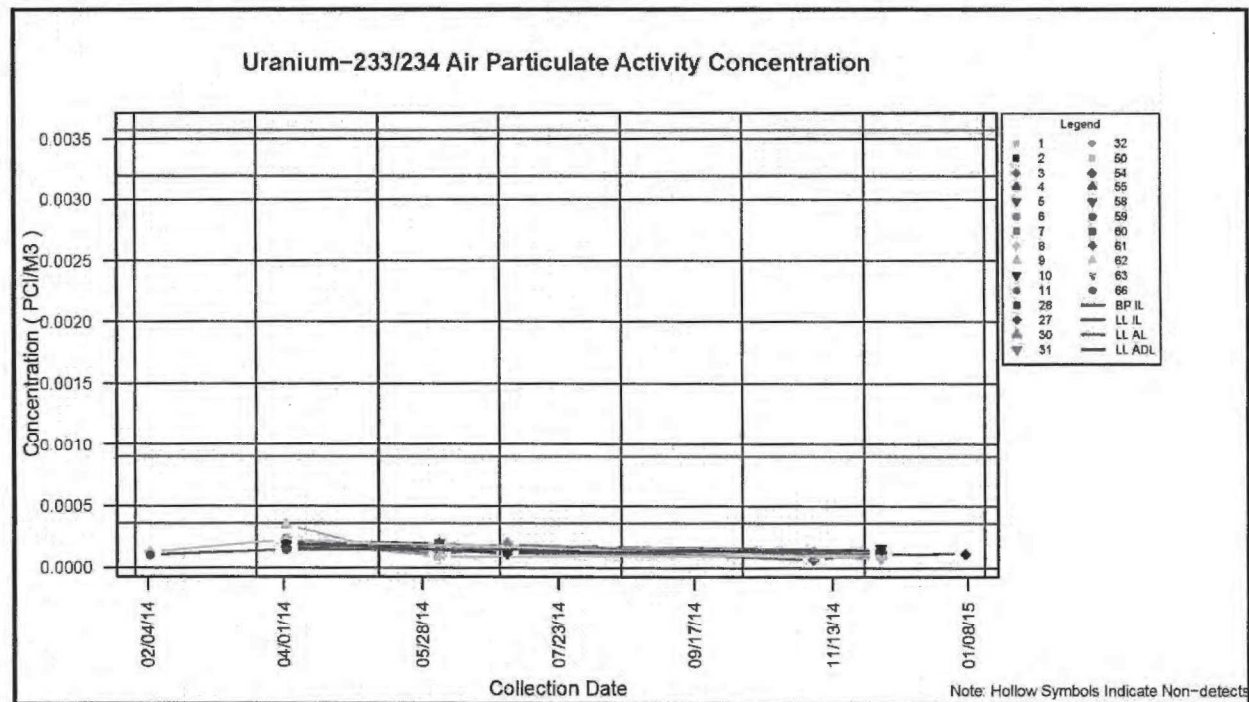


Figure 21 : Uranium-233/234 Air Particulate Activity Concentration

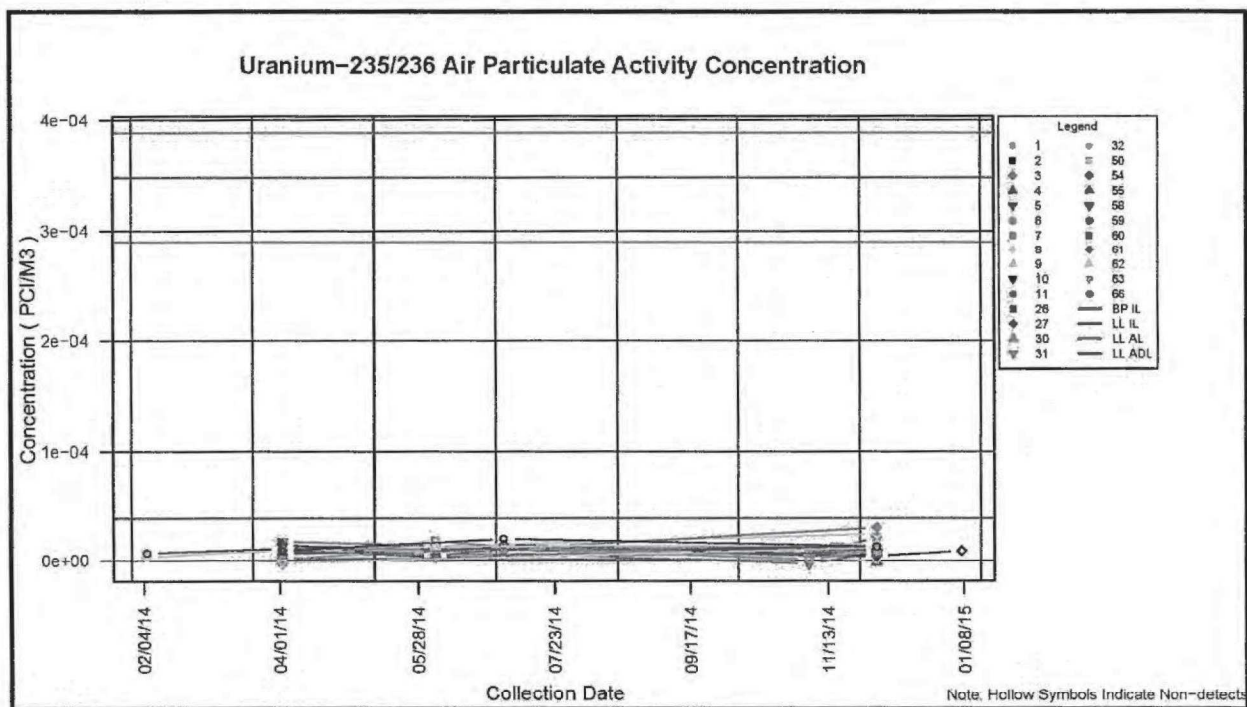


Figure 22 : Uranium-235/236 Air Particulate Activity Concentration

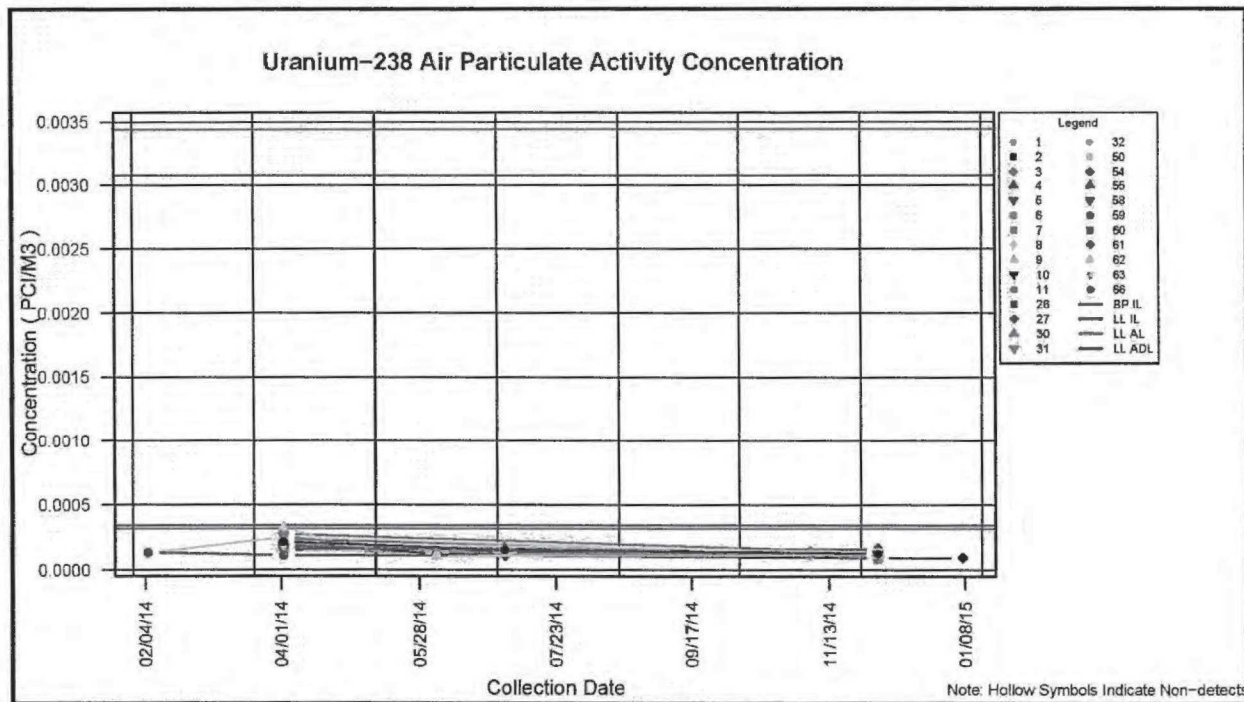


Figure 23 : Uranium-238 Air Particulate Activity Concentration

3.7.2 Air Tritium

Air tritium samples were collected at twenty-four stations and sent to an offsite accredited laboratory for analysis in accordance with EV-7.1.2, *Low Volume Air Sampling*. Table 20 displays the air tritium sampling requirements. Table 21 contains summary statistics for the air tritium results. All air tritium results were less than their respective ILs. All air tritium data are provided in Appendix F.

Table 20 : Air Tritium Sampling Locations by Requirements

Sample Type	Byproduct Stations	REMP Stations
Air Tritium	N/A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 26, 27, 31, 50, 54, 55, 58, 59, 60, 61, 62, 63, and 66

Table 21 : Summary of Air Tritium Results, 2014

Parameter	No. of Stations	Obs	Greater Than MDC	Mean	Max	Min	Units	LL IL	LL AL	LL ADL
Tritium	24	287	14	4.26E+00	3.65E+01	-7.28E+00	pCi/m3	8.05E+01	8.05E+02	7.22E+02

3.7.3 Air Cartridges

Air cartridge samples were collected weekly, composited monthly, and sent to an offsite accredited laboratory for analysis in accordance with procedure EV-7.1.2, *Low Volume Air Sampling*. Table 22 displays the air cartridge sampling requirements. Table 23 contains the results for air cartridge summary statistics for calendar year of 2014. Graphical depictions of air cartridge data with respect to time are not provided because carbon-14, iodine-129, and krypton-85 were not detected above the MDC in any of the samples. All air cartridge results were representative of background levels. Please note that there are no Byproduct ILs for these constituents. All air cartridge data are provided in Appendix F.

Table 22 : Air Cartridge Sampling Locations by Requirements

Sample Type	Byproduct Stations	REMP Stations
Air Cartridge	N/A	1, 4, 6, 7, 9, 11, 26, 27, 31, 50, 54, 55, 58, 59, 60, 61, 62, 63 and 66

Table 23 : Summary of Air Cartridge Results (pCi/m³), 2014

Parameter	No. of Stations	Obs	Greater Than MDC	Mean	Max	Min	Units	LL IL	LL AL	LL ADL
Carbon-14	19	228	0	3.22E-03	2.38E-01	-2.54E-01	pCi/m3	1.05E-01	1.05E+00	9.42E-01
Iodine-129	19	228	0	2.04E-04	5.87E-02	-4.49E-03	pCi/m3	2.22E-03	2.22E-02	2.00E-02
Krypton-85g	19	228	0	1.63E-01	2.35E+00	-3.39E+00	pCi/m3	2.06E+00	2.06E+01	1.76E+01

3.8 Water

WCS collects surface and groundwater samples in accordance with the *Radiological Environmental Monitoring Program, Waste Processing and Storage Facility*, EV-1.1.0, when sufficient water is present. WCS samples Baker Spring (also known as station 18 and station GW-2), 4 playa locations (GW-3, GW-4, GW-5, and GW-6), and a former stock pond (GW-1) on an annual basis. Groundwater samples are collected from the OAG unit and the 225-foot zone in the red bed clays of the Dockum Group. Dry wells are also completed in numerous locations in the 125-foot zone. All groundwater samples are collected on a semi-annual basis.

All water samples are shipped to an offsite laboratory for analysis. Sample results of environmental media are compared against their respective ILs (where applicable) to determine whether or not a change occurred significant enough to warrant an investigation.

3.8.1 Groundwater

Groundwater samples are collected in accordance with procedure EV-7.1.8, *Groundwater Sampling*. Groundwater sample results are compared against their respective ILs to determine whether or not a change significant enough to warrant investigation has occurred.

Groundwater is monitored in several different transmissive zones. The primary transmissive zones that are monitored for groundwater are described below.

- The undifferentiated Ogallala-Antlers-Gatuña (OAG) unit: This is the shallowest unconfined groundwater-bearing stratum that is sampled at the site. It is intermittently saturated at WCS. WCS sampled (or attempted to sample) 101 monitoring wells in the OAG for this reporting period. Eighty-five (85) of those 101 wells did not contain sufficient water for WCS to collect a sample. Of the remaining 16 OAG wells that were sampled, five did not yield a sufficient quantity of groundwater to allow analysis of all monitoring parameters during one or more monitoring events.
- The 125 foot (') zone: The 125'-zone is a discontinuous sand- and silt-stone stratum found in the Dockum Formation (the red beds), which underlies the OAG. It is unsaturated beneath the WCS site. WCS attempted to sample 40 monitoring wells completed in the 125'-zone for this reporting period. None of those wells contained sufficient groundwater to sample.
- The 225'-zone: This continuous sand and siltstone stratum is found in the Dockum Formation. It is the regulated uppermost continuously saturated stratum at WCS. WCS sampled 100 monitoring wells completed in the 225'-zone during this reporting period. The confined 225'-zone yielded samples from all but three of the 225'-zone wells. Partial analysis were performed on two of these three wells.

Figure 24 and Figure 25 display some of the locations of wells completed in the OAG, and 225'-zone, respectively. A complete mapping can be found in the REMP.

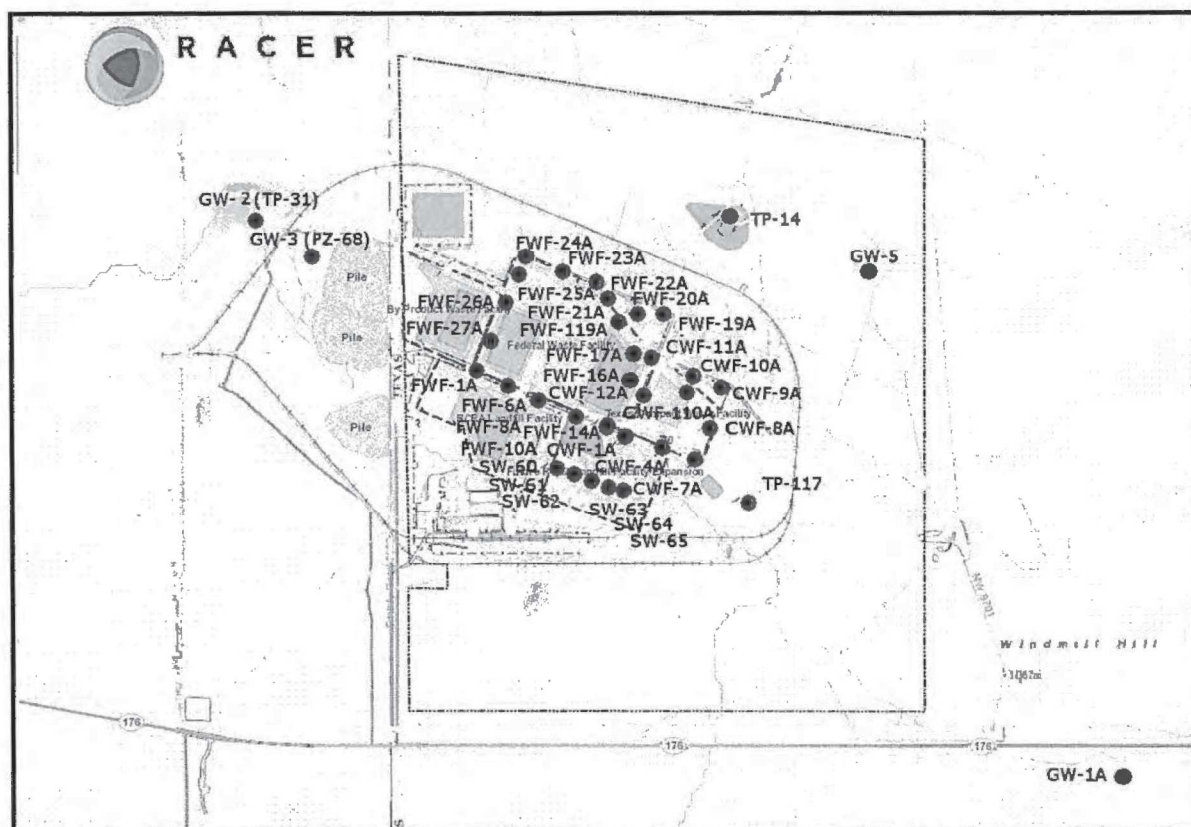


Figure 24 : OAG Groundwater Sampling Locations

NOTES: Values in Saturation Columns are:

Sufficient = Sufficient Groundwater is present in the well to collect a full sample.

Partial = Enough Groundwater is present to collect a sample for some, but not all, of the required analyses.

Dry = Insufficient groundwater to collect a sample.

Summary statistics for the OAG groundwater results are presented in Table 25. Figure 26 and Figure 27 graphically depict the OAG groundwater gross alpha and gross beta results, respectively. All OAG groundwater sample results are given in Appendix G. All OAG groundwater results were less than their respective ILS.

Table 25 : Summary of OAG Results, 2014

Analyte	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	9	16	13	3.71E+00	9.37E+00	1.10E+00	pCi/L	1.80E+02	1.22E+01	1.97E+01	2.20E+01
BETA	9	16	16	8.00E+00	1.69E+01	4.60E+00	pCi/L	1.60E+02	1.02E+01	1.02E+02	9.14E+01

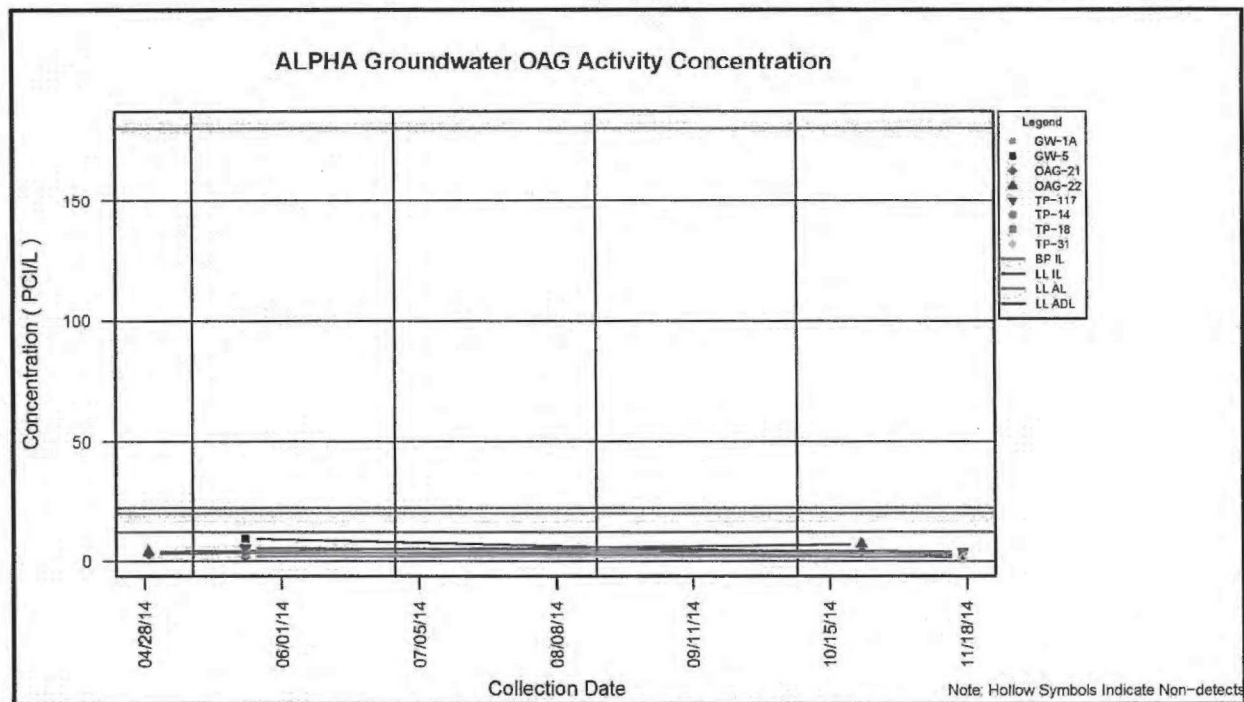


Figure 26 : Gross Alpha Groundwater OAG Activity Concentration

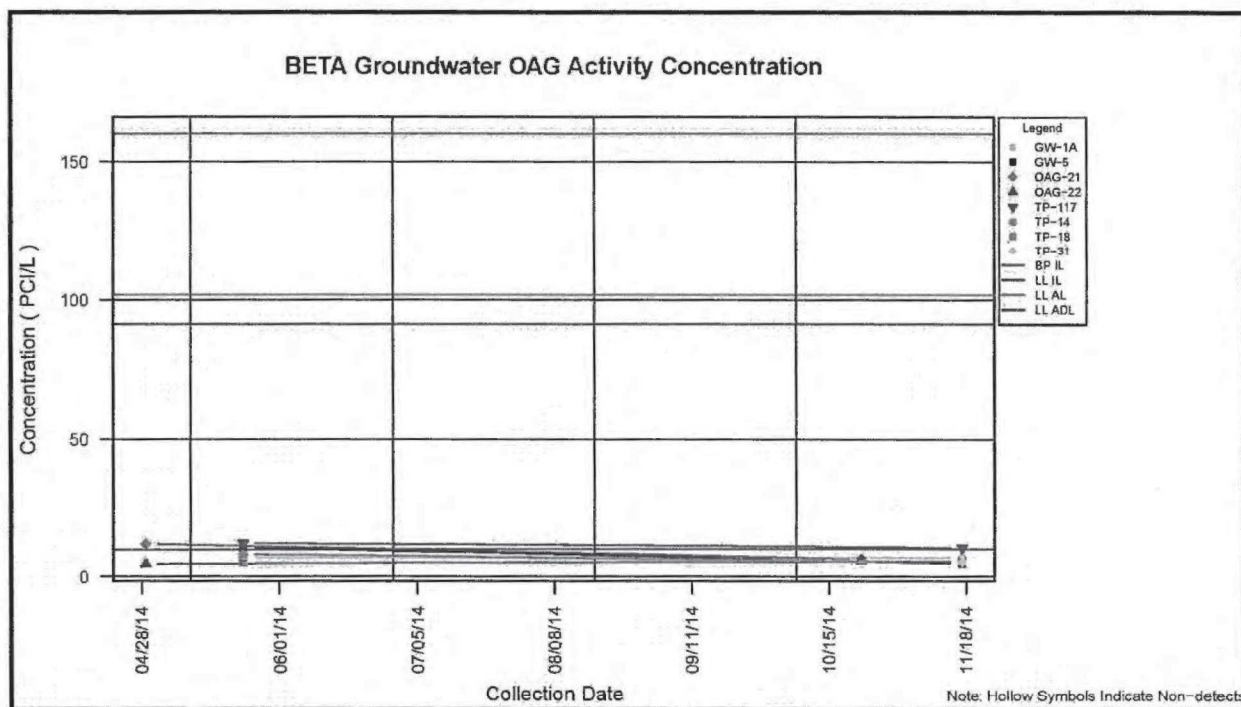


Figure 27 : Gross Beta Groundwater OAG Activity Concentration

3.8.1.2 125' Zone Groundwater Data

The following 125'-zone wells are currently in the radiological environmental monitoring program. As indicated in Table 26 below, all of the 125'-zone wells being monitored are dry, and no samples were obtained.

Table 26 : 125' Zone Sample Availability.

Well	Saturation	Well	Saturation	Well	Saturation	Well	Saturation
CWF-1B	Dry	CWF-11B	Dry	FWF-15B	Dry	FWF-26B	Dry
CWF-2B	Dry	CWF-12B	Dry	FWF-16B	Dry	FWF-27B	Dry
CWF-3B	Dry	CWF-13B	Dry	FWF-17B	Dry	FWF-6B	Dry
CWF-4B	Dry	CWF-110B	Dry	FWF-18B	Dry	FWF-9B	Dry
CWF-5B	Dry	FWF-10B	Dry	FWF-1B	Dry	SW32	Dry
CWF-6B	Dry	FWF-11B	Dry	FWF-21B	Dry	SW33	Dry
CWF-7B	Dry	FWF-119 B	Dry	FWF-22B	Dry	SW34	Dry
CWF-8B	Dry	FWF-12B	Dry	FWF-23B	Dry	SW35	Dry
CWF-9B	Dry	FWF-13B	Dry	FWF-24B	Dry	SW36	Dry
CWF-10B	Dry	FWF-14B	Dry	FWF-25B	Dry		

NOTES: Values in Saturation Columns are:

Dry = Insufficient Groundwater is present in the well to collect a sample.

3.8.1.3 225' Zone Groundwater Data

Table 27 below indicates whether the monitored 225' wells had sufficient water to sample as part of the radiological environmental monitoring program.

Table 27 : 225' Zone Sample Availability

Well	Saturation	Well	Saturation	Well	Saturation	Well	Saturation
SEA	Sampled	CWF-8D	Not Sampled	FWF-13D	Sampled	FWF-26D	Not Sampled
CWF-10C	Sampled	CWF-9C	Not Sampled	FWF-14C	Sampled	FWF-27C	Not Sampled
CWF-10D	Sampled	CWF-9D	Not Sampled	FWF-15C	Sampled	FWF-6C	Sampled
CWF-110C	Sampled	DW-32A	Sampled	FWF-15D	Sampled	FWF-9C	Sampled
CWF-110D	Sampled	DW-32B	Sampled	FWF-16C	Sampled	FWF-9D	Sampled
CWF-11C	Sampled	DW-33A	Sampled	FWF-16D	Sampled	MW-11AR	Sampled
CWF-11D	Sampled	DW-33B	Sampled	FWF-17C	Sampled	MW-11B	Sampled
CWF-12C	Sampled	DW-34A	Sampled	FWF-17D	Sampled	MW-11C	Sampled
CWF-12D	Sampled	DW-34B	Sampled	FWF-18C	Sampled	MW11-DR	Sampled
CWF-13C	Sampled	DW-35A	Sampled	FWF-18D	Sampled	MW-11E	Sampled
CWF-1C	Sampled	DW-35B	Sampled	FWF-1C	Not Sampled	MW-11F	Sampled
CWF-2C	Sampled	DW-36A	Sampled	FWF-21C	Not Sampled	MW-11G	Sampled
CWF-3C	Sampled	DW-36B	Sampled	FWF-21D	Not Sampled	MW-18R	Sampled
CWF-4C	Sampled	FWF-10C	Sampled	FWF-22C	Not Sampled	MW-2A	Sampled
CWF-4D	Sampled	FWF-10D	Sampled	FWF-22D	Not Sampled	MW-2B	Sampled
CWF-5C	Not Sampled	FWF-11C	Sampled	FWF-23C	Not Sampled	MW-3A	Sampled
CWF-5D	Not Sampled	FWF-11D	Sampled	FWF-23D	Not Sampled	MW-3B	Sampled
CWF-6C	Not Sampled	FWF-119C	Sampled	FWF-24C	Not Sampled	MW-4A	Sampled
CWF-6D	Not Sampled	FWF-119D	Sampled	FWF-24D	Not Sampled	MW-4B	Sampled
CWF-7C	Not Sampled	FWF-12C	Sampled	FWF-25C	Not Sampled	DW-60A	Sampled
CWF-7D	Not Sampled	FWF-12D	Sampled	FWF-25D	Not Sampled	DW-62A	Sampled
CWF-8C	Not Sampled	FWF-13C	Sampled	FWF-26C	Not Sampled	DW-64A	Not Sampled

Radiological summary statistics for radiological analytes in the 225' zone are presented in Table 28.

Figure 28 and Figure 29 graphically depict the 225' zone groundwater gross alpha and gross beta results,

respectively. All sample results for 225'-zone groundwater are given in Appendix G. All 225' groundwater results were less than their respective ILs.

Table 28 : Summary of 225' Zone Groundwater Results, 2014

Analyte	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	63	136	31	7.91E+00	5.32E+01	-2.92E+01	pCi/L	1.80E+02	1.96E+01	2.71E+01	3.15E+01
BETA	63	136	49	1.10E+01	9.61E+01	-9.81E+00	pCi/L	1.60E+02	3.34E+01	3.34E+02	3.00E+02

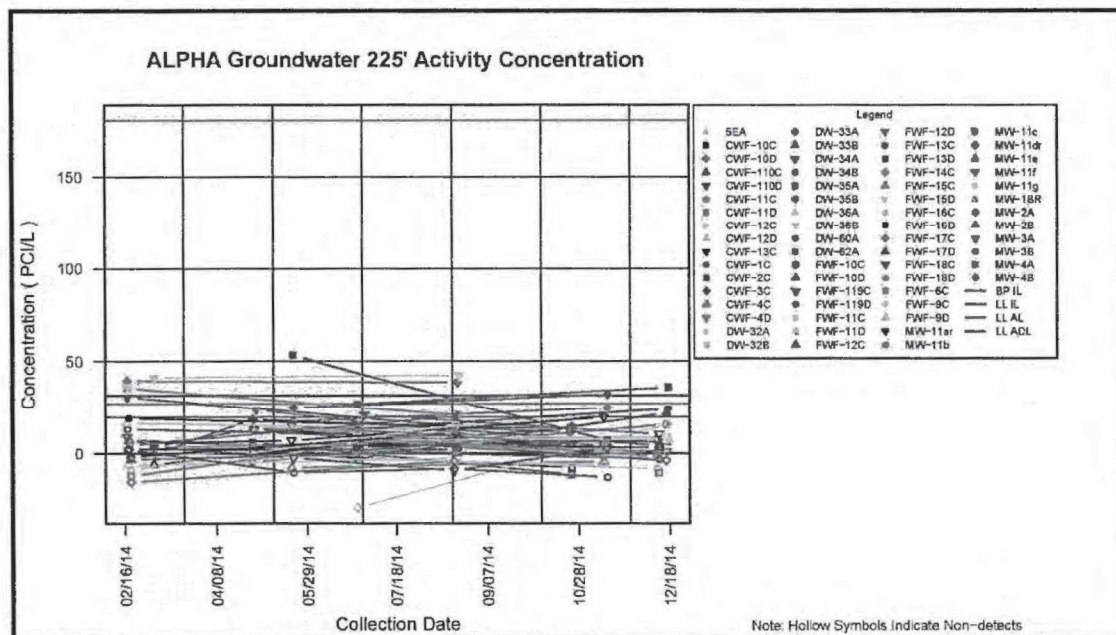
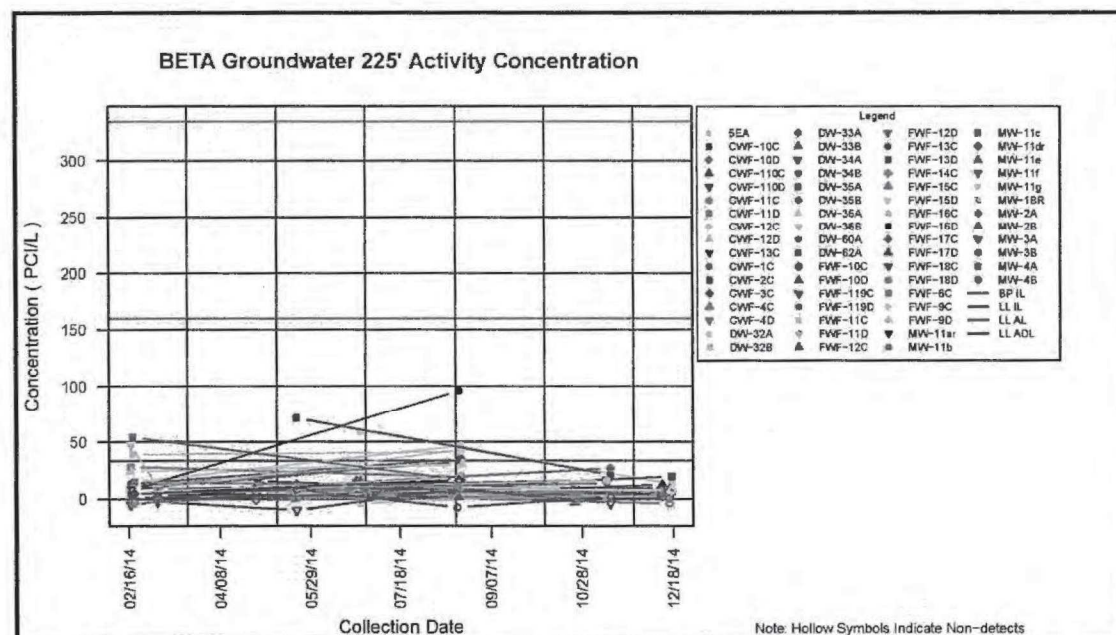


Figure 28 : Gross Alpha Concentration in 225' Zone Groundwater



3.8.2 Surface Water

Collection of surface water is required at six surface water stations. Surface water samples are collected in accordance with procedure EV-7.1.13, *Surface Water Sampling*. Figure 30 displays the location the surface water stations. Summary results for surface water samples collected are listed in Table 29 below. These data are consistent with historical results, and all of the surface water results for this reporting period are provided in Appendix H. Because these results only contain one result per station, graphs depicting these results are not included in this report.

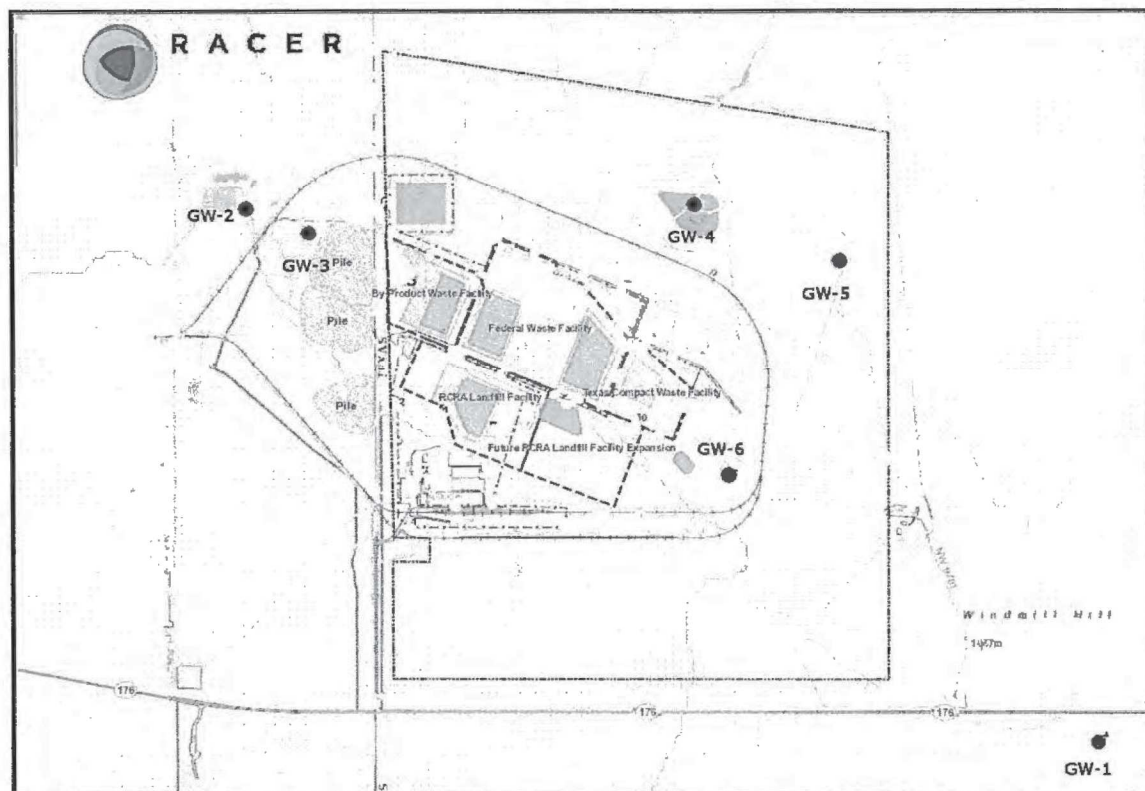


Figure 30 : Surface Water Sample Location

Table 29: Surface Water Summary Statistics, 2014

Parameters	No. of Stations	Obs	Above MDC	Mean	Max	Min	Units	BP IL	LL IL	LL AL	LL ADL
ALPHA	5	5	2	1.68E+00	3.89E+00	2.32E-01	pCi/L	1.80E+02	1.76E+01	2.51E+01	2.90E+01
BETA	5	5	5	1.34E+01	2.79E+01	4.51E+00	pCi/L	1.60E+02	7.03E+01	7.03E+02	6.30E+02

3.9 Industrial Stormwater and Wastewater

3.9.1 Byproduct Facility

Liquids that collect in the Byproduct Facility Leachate Collection System (LCS) and Leak Detection System (LDS) are pumped into 500,000-gallon tanks (BPCT-1 and BPCT-2) for consolidation and storage prior to pre-release verification sampling and analysis. However, pursuant to RML No. R05807, LC 37.B, Table 37.B, liquid samples are also collected directly from the LCS and LDS sumps and analyzed on a semi-annual basis. LCS and LDS samples are shipped to a NELAP certified laboratory for analysis. Samples were collected from the LCS and LDS sumps on February 18, 2014 and August 13, 2014. These results are provided in Appendix I. Table 30 contains a summary of the LCS and LDS results from this reporting period.

Table 31 and Table 32 contain gross alpha and gross beta results respectively for 2014 leachate samples. Appendix I contains detailed results including MDC and sample numbers. The analytical results were compared with the discharge limit for gross alpha and the reporting limit for beta/gamma emitters (15 pCi/L and 50 pCi/L) respectively, under TPDES Permit No. WQ0004857000. All results were below these reporting limits. These results are consistent with the historical data from 2010.

Table 30: Summary Results for Byproduct Leachate Collection System and Leak Detection System (pCi/L), 2014

	Alpha	Beta
Observations	8	8
No. of Stations	4	4
Less than MDC	7	0
Max. Value	1.63	15.2
Min. Value	-0.213	6.39
Mean Value	0.708	10.73
Standard Dev.	1.35	3.62
Mean $\pm$ Std*	2.49 $\pm$ 1.64	8.27 $\pm$ 4.37
*2010 Historical Average		

Table 31 : Alpha Results for Leachate Collection System and Leak Detection System (pCi/L), 2014

Location	18-Feb-14	13-Aug-14
Cell A Leachate	0.72 $\pm$ 1.07*	-0.213 $\pm$ 1.01*
Cell A Leak Detection	-1.70 $\pm$ 1.81*	0.158 $\pm$ 1.01*
Cell B Leachate	2.77 $\pm$ 1.36	1.54 $\pm$ 1.35*
Cell B Leak Detection	1.63 $\pm$ 1.56*	0.762 $\pm$ 1.14*

* Result is less than MDC

Table 32 : Beta Results for Leachate Collection System and Leak Detection System (pCi/L), 2014

Location	18-Feb-14	13-Aug-14
Cell A Leachate	7.88 $\pm$ 1.50	11.2 $\pm$ 2.29
Cell A Leak Detection	14.9 $\pm$ 2.87	8.64 $\pm$ 1.93
Cell B Leachate	15.2 $\pm$ 2.80	14.2 $\pm$ 2.85
Cell B Leak Detection	7.44 $\pm$ 1.52	6.39 $\pm$ 1.59

3.9.2 Sanitary Wastewater

During 2014, WCS has taken water recovered from the septic systems to a publicly owned treatment works (POTW) for disposal in Andrews, Texas. The waste water from the septic tanks are pumped into the above-ground sanitary holding tank (SHT) system for collecting and holding of the septic tank effluents so they may be tested prior to release to a POTW or other appropriate disposition pathway. Samples were collected from the following tanks: SHT-1A, SHT-2A, SHT-3A, SHT-1S, SHT-2S, SHT-1M, SHT-3M, SHT-4M, LL-SHT-1A, LL-SHT-3A, LL-SHT-7G, and LL-SHT-8G. WCS manages these systems in accordance with procedure EV-7.15 *Managing Onsite Sanitary Systems*.

Under 30 TAC §336.219, *Disposal by Release into Septic Tanks*, no person is authorized to discharge radioactive material into a septic tank system unless authorized by TCEQ. Therefore, removal of the waste to a POTW was the chosen alternative for sanitary waste.

The regulatory language for sanitary waste is reproduced below.

A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:

(1) the material is readily soluble in water, or is readily dispersible biological material;

(2) the quantity of licensed or other radioactive material that the licensee releases into the sewer in one month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table III of §336.359 of this title (relating to Appendix B, Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sanitary Sewerage);

(3) if more than one radionuclide is released, the licensee shall determine the fraction of the limit in Table III of §336.359 of this title represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table III of §336.359 of this title; the sum of the fractions for all of the radionuclides released shall not exceed one; and

(4) the total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage in a year does not exceed five curies (185 gigabecquerels) of hydrogen-3, one curie (37 gigabecquerels) of carbon-14, and one curie (37 gigabecquerels) of all other radioactive materials combined.

The sanitary waste from septic tanks was removed and transported to a POTW located in Andrews, Texas. In accordance with 30 TAC §336.215, *Disposal by Release into Sanitary Sewerage*, WCS monitors and tracks discharged radioactive material into the POTW. The release limits and total quantities are specified in 30 TAC §336.215 (4) and Table III of §336.359.

As stated above, the septic systems were pumped and taken to the POTW. There are 14 septic holding tanks; twelve hold approximately 7,500 gallons of liquid each and 2 hold approximately 750 gallons of liquid each. The quantity released to the POTW is monitored prior to each release and with the associated sample analysis. All positive activity results are maintained in a database. These positive

results are multiplied by the volume released to determine the total activity released per transfer. The results from the activities transferred are summed and used to calculate the total activity released during the report period for comparison to the regulatory limit of one Curie total for all radionuclides for a year. The total activity transferred to a POTW is calculated using:

$$A_{Total} = \sum_1^N A_d$$

$$A_d = \sum_1^n R_i * Vol$$

Where:

A_{Total} = Total activity released, Curies
 N = Number of water transfers in the year
 A_d = Activity discharged per single transfer event, Ci
 R_i = Activity of radionuclide i , pCi/L
 Vol = Volume released per transfer, in liters

Carbon-14 and tritium were monitored with each transfer for comparison to the regulatory limit. All septic results for the calendar year of 2014 for carbon-14 and tritium were below the Minimum Detectable Concentration. The total activity released is also monitored with the quarterly reports. The total activity that can be released to the POTW is given in 30 TAC §336.215 (4) such that "the total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage in a year does not exceed five curies (185 gigabecquerels, GBq) of hydrogen-3, one curie (37 GBq) of carbon-14, and one curie (37 GBq) of all other radioactive materials combined." The cumulative total activity for all other radionuclide released for this reporting period has been calculated to be 1.36E-06 curies (Ci), which is well below 1 % of the one curie limit for all other radionuclides.

All calculated results were below the release limits and total quantities in 30 TAC §336.215, *Disposal by Release into Sanitary Sewerage*, allowing release to the POTW in Andrews, Texas. Therefore, for this reporting period, the releases to the Andrews Texas POTW are below regulatory limits for the State of Texas and each nuclide is below the monthly discharge concentration level. The total discharge to the POTW is below the 1 curie annual limit. Table 33 contains the sample and released dates for the septic holding tanks for this reporting period. Appendix J summarizes the septic data collected during the reporting period.

Table 33 : Septic Holding Tanks Sample and Release Dates, 2014

Location	Sample Date	Released to the POTW	Location	Sample Date	Released to the POTW
SHT-3A	1/3/2014	1/24/14	LL-SHT-7G	7/7/14	7/23/14
SHT-4A	-	1/30/14	LL-SHT-8G	-	8/6/14
SHT-1A	-	1/31/14	LL-SHT-7G	-	9/9/14
SHT-2A	-	2/12/14	LL-SHT-8G	-	9/29/14
SHT-1A	-	2/17/14	SHT-1S	7/7/14	7/23/14
SHT-2A	-	3/4/14	SHT-2S	-	9/16/14
SHT-1A	-	3/11/14	SHT-2A	7/9/2014	7/24/14
SHT-2A	-	3/21/14	SHT-1A	-	7/24/14
LL-SHT-7G	1/8/14	1/25/14	SHT-3A	-	8/13/14
LL-SHT-8G	-	2/20/14	SHT-4A	-	8/27/14
LL-SHT-7G	-	3/21/14	SHT-3A	-	8/5/14
LL-SHT-1A	1/8/14	1/27/14	SHT-4A	-	9/25/14
LL-SHT-2A	-	1/29/14	LL-SHT-3A	7/17/2014	8/6/14
LL-SHT-3A	-	2/13/14	LL-SHT-4A	-	8/14/14
LL-SHT-2A	-	3/14/14	LL-SHT-1A	-	8/29/14
SHT-4M	1/30/14	2/17/14	LL-SHT-2A	-	9/25/14
SHT-1S	2/12/14	3/4/14	SHT-3M	8/19/2014	9/8/14
SHT-3A	4/1/14	4/24/14	LL-SHT-3A	10/6/2014	10/21/14
SHT-1A	-	4/24/14	LL-SHT-4A	-	10/23/14
SHT-4A	-	4/24/14	LL-SHT-1A	-	11/11/14
SHT-2A	-	5/1/14	LL-SHT-2A	-	12/4/14
SHT-1A	-	5/13/14	LL-SHT-3A	-	12/19/14
SHT-2A	-	5/23/14	SHT-1A	10/6/2014	10/21/14
SHT-3A	-	6/4/14	SHT-2A	-	10/21/14
SHT-4A	-	6/17/14	SHT-3A	-	10/27/14
SHT-1A	-	6/30/14	SHT-4A	-	11/7/14
LL-SHT-3A	4/1/14	4/24/14	SHT-1A	-	11/19/14
LL-SHT-4A	-	4/24/14	SHT-2A	-	12/1/14
LL-SHT-1A	-	5/12/14	SHT-3A	-	12/9/14
LL-SHT-2A	-	6/3/14	LL-SHT-7G	10/27/2014	11/11/14
LL-SHT-3A	-	6/24/14	LL-SHT-8G	-	12/4/14
LL-SHT-4A	-	6/30/14	SHT-4M	11/20/2014	11/15/14
SHT-1M	4/2/14	4/24/14	SHT-1S	11/24/2014	12/11/14
SHT-2M	-	6/17/14	SHT-2S	-	12/11/14
SHT-2S	4/15/14	5/1/14			
LL-SHT-8G	4/17/14	5/8/14			
LL-SHT-7G	-	5/19/14			
LL-SHT-8G	-	6/10/14			

3.9.3 LLRW Facility

WCS collects stormwater and wastewater samples when sufficient water is present in accordance with TLAP and TPDES permits. Samples are collected for radionuclide analyses from the CWF and FWF contact water evaporation ponds on a monthly basis and the CWF and FWF non-contact water sedimentation ponds prior to discharge. When sediment is present in sufficient quantity in these ponds, it is sampled at the same frequency and analyzed for the same analytes as the water samples. Leachate and other process wastewaters are sampled from each of the collection and holding systems as specified in the TLAP and TPDES permits. Figure 31 shows the locations of the various sedimentation and evaporation ponds with respect to the LLRW facility.

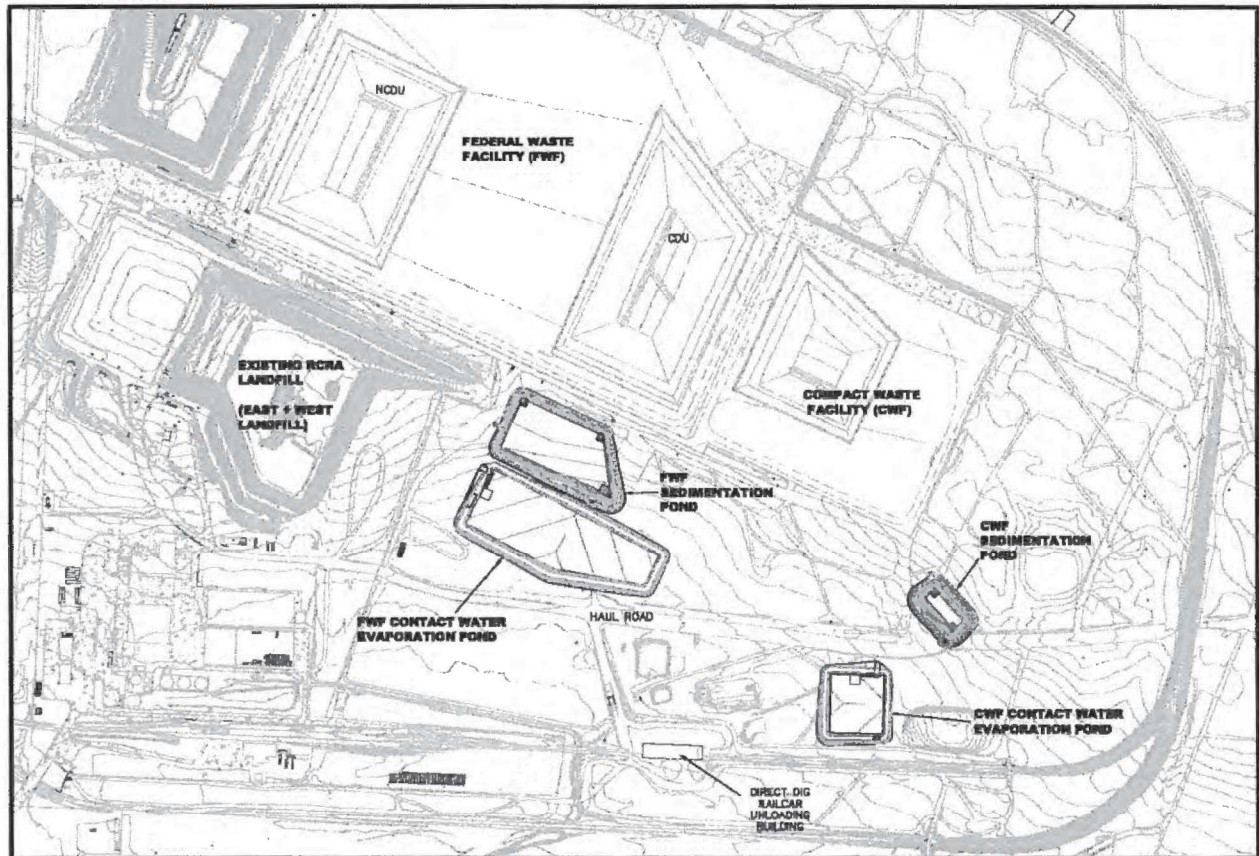


Figure 31 : Pond Locations

Water samples are collected and shipped to an offsite laboratory for analysis regardless of which license or permit is applicable. Effluent results are compared against applicable regulatory limits or other permit or license required standards.

Table 34 lists the dates the sedimentation and evaporation ponds were sampled in accordance with TLAP No. WQ0004948000. As mentioned previously, samples collected in accordance with the TLAP permits and have been summarized in annual TLAP report that has been submitted separately. Those documents are incorporated herein by reference, and the information that they provide is not duplicated in this report.

Table 34 : Sample Collection Dates for Sedimentation/Evaporation Pond Samples, 2014

Location	Dates Sampled
CWF Contact Water Evaporation Pond	14-Jan, 12-Feb, 17-Mar, 8-Apr, 9-May, 14-May, 18-Jun, 2-Jul, 5-Aug, 9-Sept, 22-Sept, 16-Oct, 10-Nov, 4-Dec
FWF Contact Water Evaporation Pond	16-Jan, 12-Feb, 17-Mar, 27-Mar, 8-Apr, 9-May, 18-Jun, 2-Jul, 5-Aug, 9-Sept, 16-Oct, 10-Nov, 4-Dec
CWF Sedimentation Pond	2-May, 29-Sept
FWF Sedimentation Pond	2-May, 29-Sept

Process wastewaters were generated at the LLRW facility during the report period. Rainfall occurred after waste placement in the CWF and FWF, and the cumulative amount of leachate generated was sufficient for transfer to the contact water tanks. The contact water tank results are summarized for this reporting period in Table 35. All contact water results are reported in Appendix K.

Table 35 : Contact Water Tank Results greater than the MDC for 2014

Tank	Sample Date	Analyte	Result	TPU	MDC	Units
FWF-CWT-2	1/16/2014	BETA	3.25	1.68	2.26	PCI/L
CWF-CWT-2	3/14/2014	BETA	13.9	2.53	1.21	PCI/L
CWF-CWT-2	3/14/2014	Tritium	71000	13800	177	PCI/L
FWF-CWT-1	7/22/2014	BETA	4.59	2.11	2.59	PCI/L
FWF-CWT-1	7/22/2014	Radium-226	0.605	0.272	0.287	PCI/L
CWF-CWT-1	8/4/2014	ALPHA	3.06	2.32	2.98	PCI/L
CWF-CWT-1	8/4/2014	BETA	7.86	2.47	2.25	PCI/L
CWF-CWT-1	8/4/2014	Bismuth-214	9.07	7.73	8.44	PCI/L
CWF-CWT-1	8/4/2014	Radium-228	0.43	0.244	0.325	PCI/L
CWF-CWT-2	9/22/2014	BETA	11.6	2.97	2.94	PCI/L
CWF-CWT-2	9/22/2014	Radium-226	0.578	0.288	0.311	PCI/L
CWF-CWT-2	9/22/2014	Radium-228	0.947	0.467	0.524	PCI/L
FWF-CWT-3	10/8/2014	BETA	20.3	4.21	3	PCI/L
FWF-CWT-3	10/8/2014	Bismuth-214	54.4	12.6	9.69	PCI/L
FWF-CWT-3	10/8/2014	Lead-214	32.3	12.1	18.2	PCI/L
FWF-CWT-3	10/8/2014	Radium-226	0.464	0.238	0.258	PCI/L
CWF-CWT-1	10/1/2014	BETA	9.43	2.76	2.51	PCI/L
CWF-CWT-1	10/1/2014	Radium-226	0.456	0.273	0.335	PCI/L
FWF-CWT-2	10/15/2014	BETA	30.7	5.17	1.08	PCI/L
FWF-CWT-2	10/15/2014	Radium-226	0.389	0.246	0.331	PCI/L

CWF tank sampling identified an increasing trend in tritium concentrations, but the tritium concentrations are still less than the regulatory limit of 50% of the 25 mrem per year stated in TLAP No. WQ0004948000. The annual dose to a member of the public at the observed concentration is 0.045 mrem. In an abundance of caution, WCS initiated an investigation, which was performed by WCS and Risk Assessment Corporation (RAC) and documented in *"Analysis of Reported Detections of Tritium in the WCS Compact Waste Facility Contact Water Tanks."* It was determined that the increase in tritium is a result of the release of tritium from its waste form. Tritium has been received in multiple waste streams that have been received at the CWF. The increased levels have only been detected in the CWF tanks and its discharge location of the CWF contact pond. Increased levels of tritium have not been detected in groundwater and no further proactive measures were recommended in the analysis report. Tritium levels continue to be monitored. Pre-Discharge/Discharge Samples

Permit-required sampling of wastewater and storm water was conducted for radiological constituents. As mentioned previously, samples collected in accordance with the TPDES and/or TLAP permits have been summarized in monthly effluent reports that have been submitted separately. Those documents are incorporated herein by reference, and the information that they provide is not duplicated in this report.

Table 36 displays the dates water samples were collected from the open container storage area sumps. All pre-discharge sump data are located in Appendix L.

Table 36 : Sampling Dates for Water Samples Associated with the TPDES Permits, 2014

Location	Sample Dates
BSU-2 Sump	5-May, 28-May, 20-Jun
LSA Sump	14-Jan, 5-May, 28-May, 10-Jul, 29-Sept

4 Investigations

Investigations are a necessary follow-up step when an exceedance of a by-product IL or a low level ADL or AL occurs. This section does not address the exceedances of gross alpha, gross beta or lead-210. The exceedances of gross alpha and gross beta results trigger additional isotopic analysis. The very low levels corresponding to the IL for lead-210 do not allow for it to be readily distinguished from background. Therefore, elevated levels of the parent radionuclide radium-226 are used as the primary indicator for evaluating potentially elevated levels of lead-210. For this reporting period, results that exceeded the levels mentioned previously for certain media triggered further analyses. Exceedances were attributable to variation in background, associated uncertainty in laboratory measurement techniques and operational activities. In this section, further discussion is provided addressing anomalies in results.

4.1 Soil

Results obtained for RML No. R05807 in soil at station 22 (0-2") bgs had a values in excess of the thorium-230 ILs and were investigated. Below, in Table 37, is a list of exceedances for soil in the second quarter of 2014. The result did not exceed its respective AL.

Table 37 : Soil IL Exceedance (pCi/g $\pm 2\sigma$), 2014

Sample Number	Station	Collection Date	Parameter	Result	MDC	BP IL	BP AL	Reported to TCEQ
14-SS-05-020	22	05/03/2014	Thorium-230	0.938 $\pm$ 0.606	0.566	0.78	1.8	July 21, 2014

WCS is tracking soil data over time at this location. The data does not appear to be significantly different from the soil backgrounds at a depth of 0-2" at station 22. These results are presented with historical data in Figure 32. WCS also conducted a walk-over survey at soil station 22 using a 2" x 2" NaI scintillation detector coupled with a Ludlum Model 3 rate-meter. Elevated levels of radioactivity were not observed during the survey.

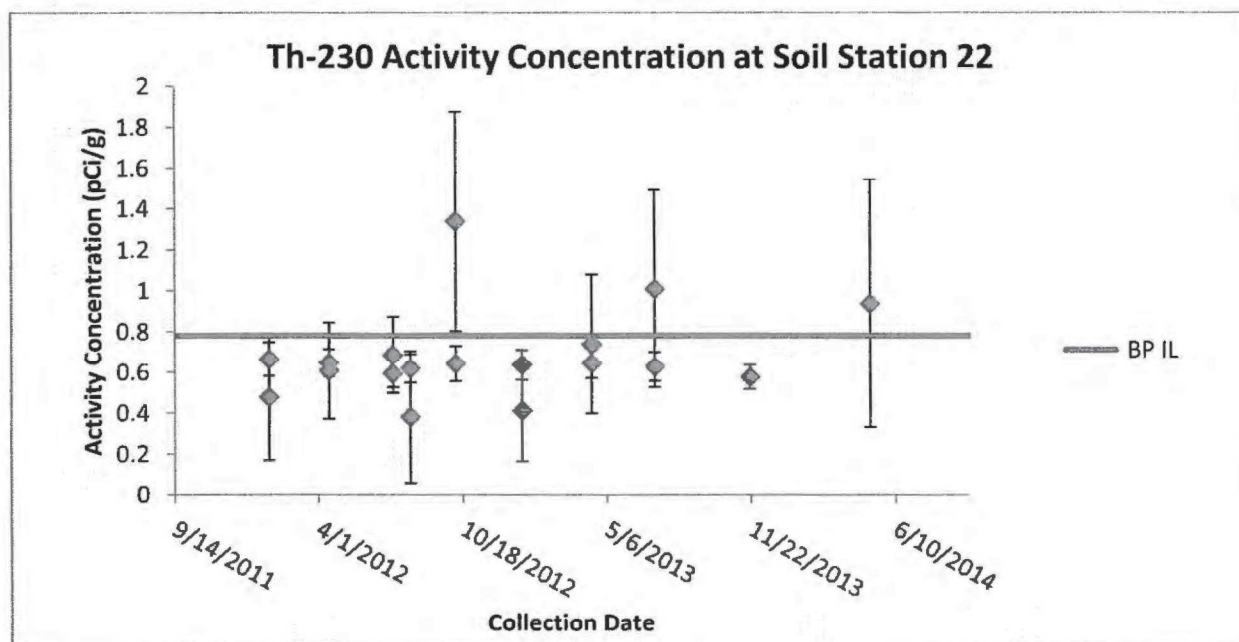


Figure 32 : Thorium-230 Activity Concentration at Soil Station 22 (0-2")

4.2 Sediment

Sediment results for station GW-2 was greater than the BP IL for thorium-230, radium-226 and radium-228 and were investigated. The results and their corresponding investigation levels are presented below in Table 38. The results were below the AL.

Table 38 : Sediment IL Exceedances (pCi/g $\pm 2\sigma$), 2014

Sample Number	Station	Collection Date	Parameter	Result	MDC	BP IL	BP AL	Reported to TCEQ
14-SE-09-003	GW-2	9/5/2014	Thorium-230	1.21 $\pm$ 0.349	0.212	0.78	1.8	December 9, 2014
14-SE-09-003	GW-2	9/5/2014	Radium-226	1.15 $\pm$ 0.13	0.0588	0.9	1.4	December 9, 2014
14-SE-09-003	GW-2	9/5/2014	Radium-228	1.01 $\pm$ 0.183	0.121	0.9	1.4	December 9, 2014

Figure 33 through Figure 35Figure 35 plots the sediment results discussed above with historical data. These plots illustrate that the result does not indicate any significant difference from historical data. WCS also conducted a walk-over survey at sediment station GW-2 using a 2" x 2" NaI scintillation detector coupled with a Ludlum Model 3 rate-meter. Elevated levels of radioactivity were not observed during the survey.

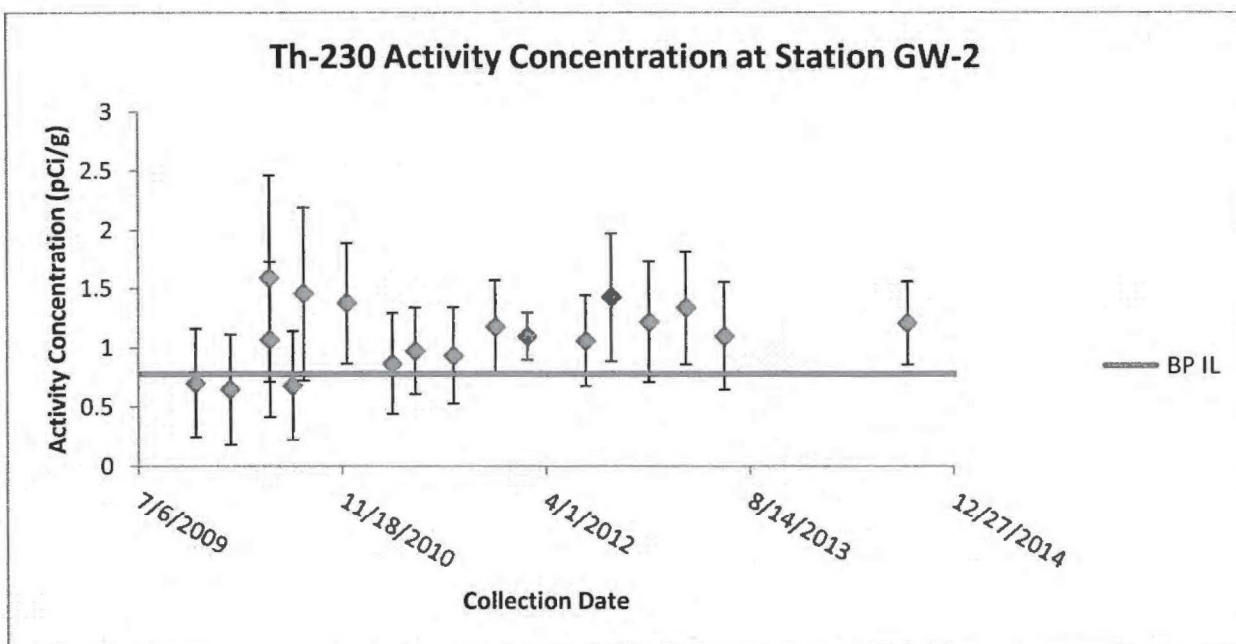


Figure 33 : Thorium-230 Activity Concentration at Sediment Station GW-2

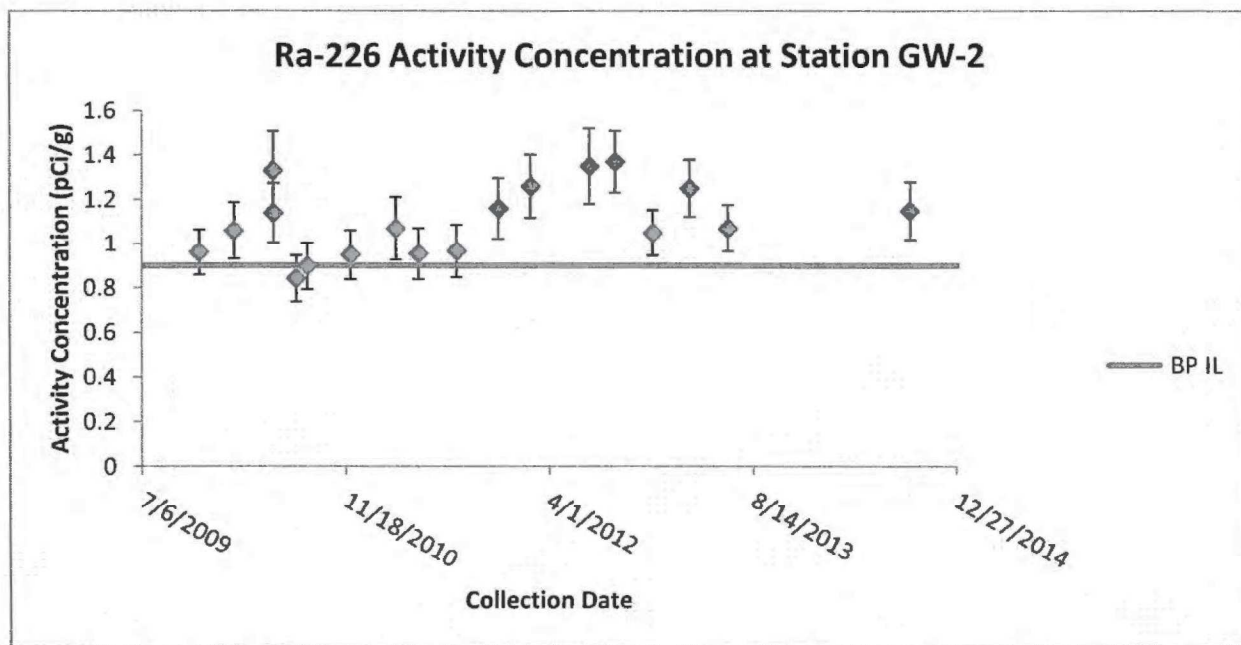


Figure 34 : Radium-226 Activity Concentration at Sediment Station GW-2

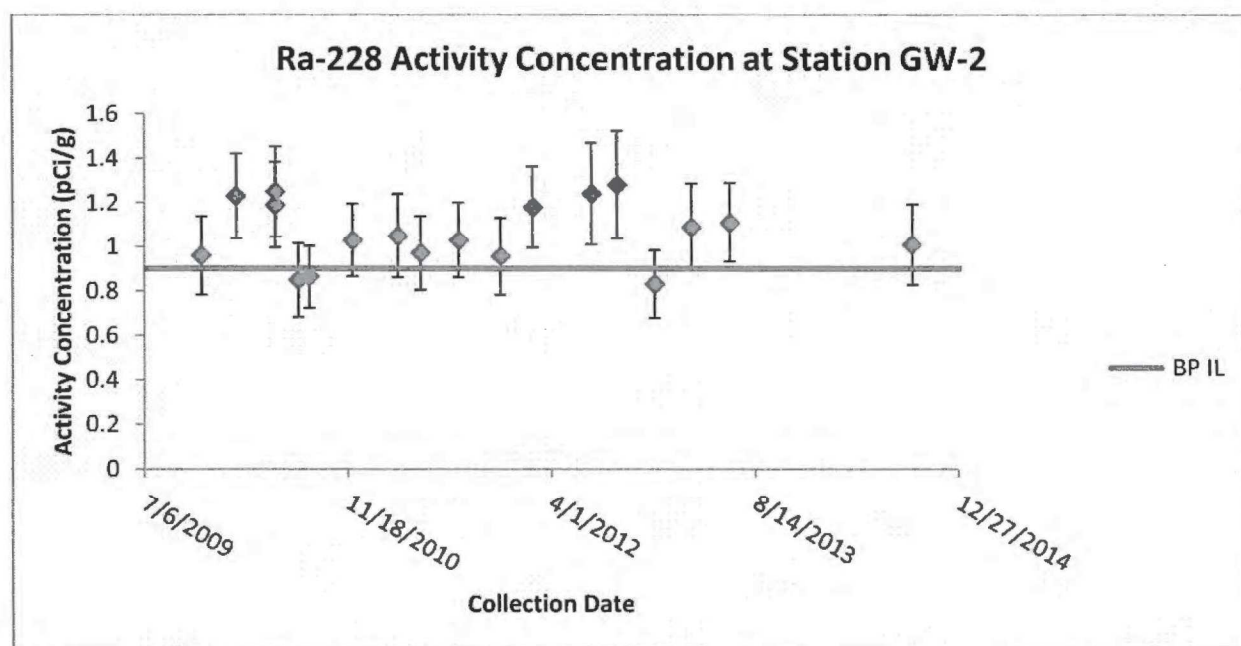


Figure 35 : Radium-228 Activity Concentration at Sediment Station GW-2

4.3 Vegetation

A vegetation result for station 6 was greater than the BP IL for radium-226 and was investigated. This result and the investigation level are presented below in Table 39. The result was well below the AL.

Table 39 : Vegetation IL Exceedances (pCi/g $\pm 2\sigma$), 2014

Sample Number	Station	Collection Date	Parameter	Result	MDC	BP IL	BP AL	Reported to TCEQ
14-VE-05-106	6	05/15/2014	Radium-226	0.117 $\pm$ 0.0745	0.0676	0.11	2.5	August 15, 2014

Figure 36 plots the vegetation result discussed above with historical data. This plot illustrates that the result does not indicate any significant difference from historical data. WCS also conducted a walk-over survey at vegetation station 6 using a 2" x 2" NaI scintillation detector coupled with a Ludlum Model 3 rate-meter. Elevated levels of radioactivity were not observed during the survey.

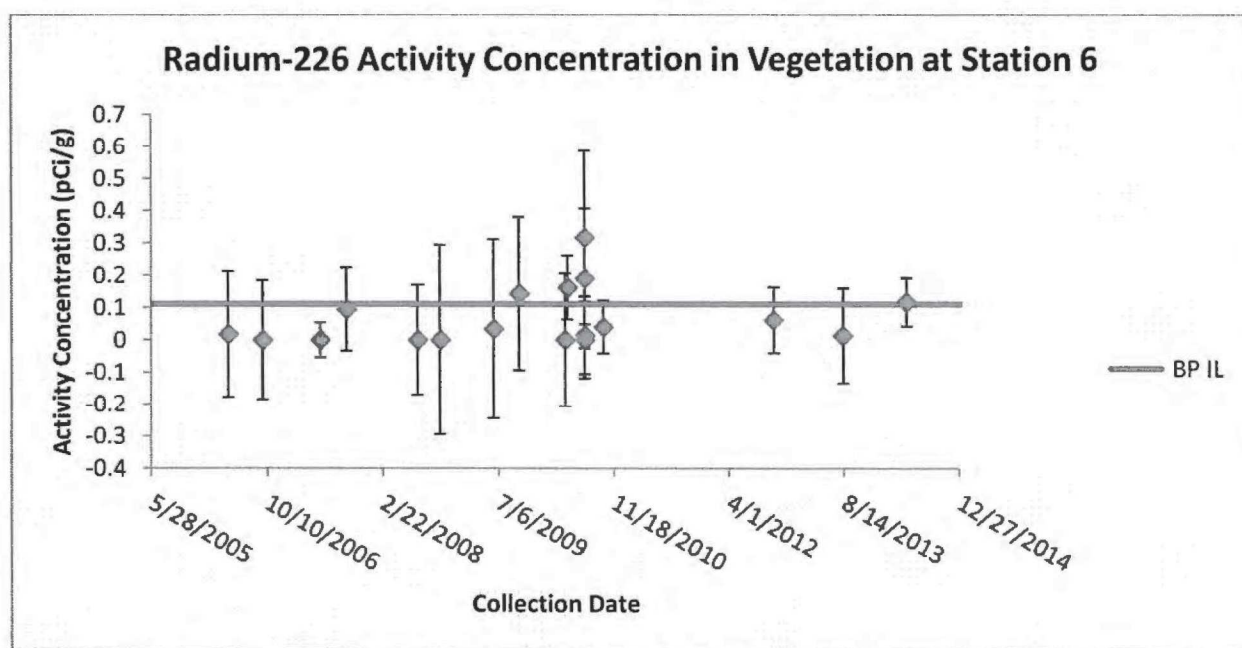


Figure 36 : Radium-226 Activity Concentration at Vegetation Station 6

4.4 Ambient Radiation

Ambient radiation results for stations 52 and 56 were greater than the low level AL and were investigated. These results and their respective action levels are presented below in Table 41.

Table 40 : Ambient Radiation Exceedances (mrem), 2014

Station	Parameter	Result	LLRW IL	LLRW AL	Reported to TCEQ
52	OSL	21	7	20	January 7, 2015
56	OSL	23	6	18.5	March 3, 2015

Assessments were performed for these exceedances and it was determined that the elevated results at these stations were due operational activities at the CWF facility. Specifically, storage of waste on the east side of the CWF, as well as the start of the second tier of the modular concrete canisters in the CWF impacted these results. Results at other stations in close proximity to these activities at the CWF were below the applicable action level, but were also affected by disposal operations. Due to the ongoing CWF disposal activities and the fact that a member of the public cannot access this area near the CWF cell, WCS has proposed relocating OSL/TLD environmental monitoring stations to the perimeter fence of the licensed facility footprint, which would better indicate abnormal events and potential exposure to the public.

These observations were not attributable to a release of radioactivity from the LLRW facility to the environment.

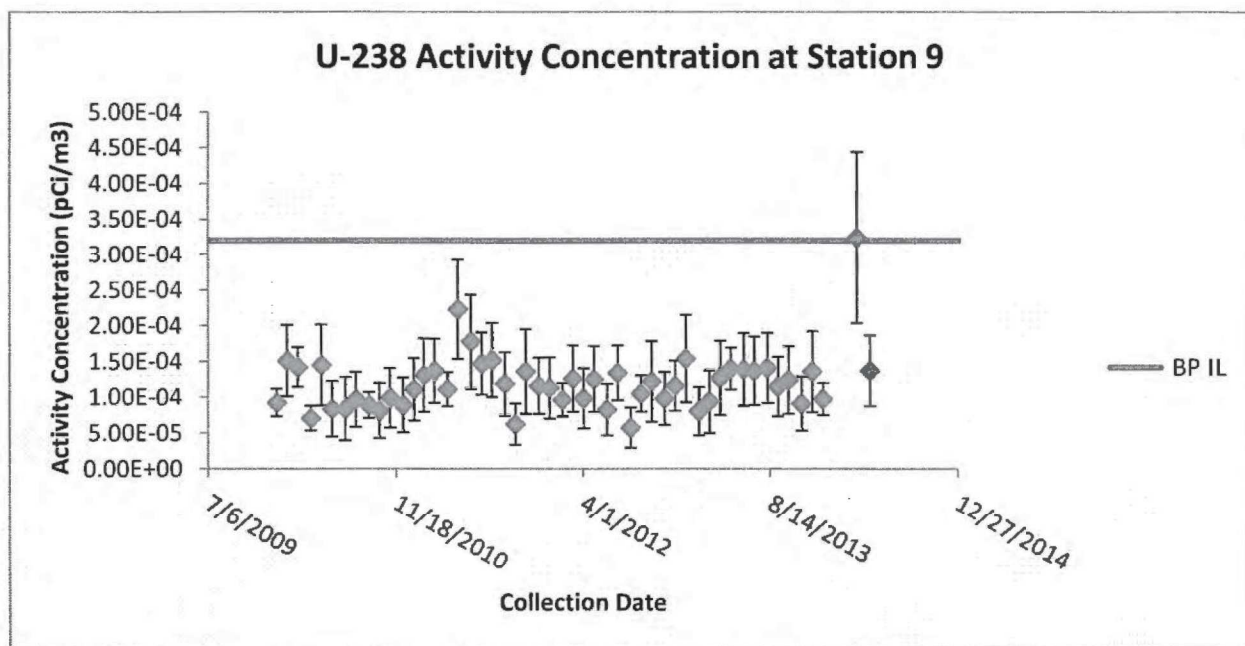
4.5 Air Particulate

An air particulate result for background station 9 was greater than the BP IL for uranium-238 and was investigated. This result and the investigation level are presented below in Table 41. The result was well below the AL.

Table 41 : Air Particulate IL Exceedances (pCi/m³±2σ), 2014

Sample Number	Station	Collection Date	Parameter	Result	MDC	BP IL	BP AL	Reported to TCEQ
14-AP-04-055	9	4/2/2014	Uranium-238	3.24E-04 ± 1.20E-04	5.76E-05	3.20E-04	3.00E-03	August 15, 2014

Figure 37 plots the vegetation result discussed above with historical data. These plots illustrate that the results do not indicate any significant differences from historical data. The result appears to be due to dust overloading at background station 9. The environmental field technician observed a large amount of dust on the filter. Uranium is naturally present in surface soils and can be suspended by increased wind speeds and mechanical movements of soil. Based on our review of the results described above, WCS believes that the IL exceedance was attributable to natural radiation and was not the result of any release of radioactive material to the site environment.



5 Reporting

License Condition 92.J of RML No. R05807 requires that WCS report when byproduct results exceed the ILs associated with the byproduct license to the TCEQ. License Condition 158 A (3) and (4) of RML No. R04100 requires WCS to report when the low level ADL or AL is exceeded. Table 42 and Table 43 contain all results WCS was required to report to the TCEQ for the calendar year of 2014.

Table 42 : 2014 BP Results Reported to the TCEQ

Station	Sample Number	Collection Date	Parameter	Result	Units	MDC	BP IL	BP AL	TCEQ Notification
22	14-SS-05-020	5/3/2014	Thorium-230	0.938 ± 0.606	pCi/g	5.66E-01	7.80E-01	1.80E+00	July 21, 2014
GW-2	14-SE-09-003	9/5/2014	Thorium-230	1.21 ± 0.349	pCi/g	2.12E-01	7.80E-01	1.80E+00	December 9, 2014
GW-2	14-SE-09-003	9/5/2014	Radium-226	1.15 ± 0.13	pCi/g	5.88E-02	9.00E-01	1.40E+00	December 9, 2014
GW-2	14-SE-09-003	9/5/2014	Radium-228	1.01 ± 0.183	pCi/g	1.21E-01	9.00E-01	1.40E+00	December 9, 2014
6	14-VE-05-106	5/15/2014	Radium-226	0.117 ± 0.0745	pCi/g	6.76E-02	1.10E-01	2.50E+00	August 15, 2014
9	14-AP-04-055	4/2/2014	Uranium-238	3.24E-04 ± 1.20E-04	pCi/m3	5.76E-05	3.20E-04	3.00E-03	August 15, 2014

Table 43 : 2014 Low Level Results Reported to the TCEQ

Station	Parameter	Result	Units	LLRW IL	LLRW AL	Reported to TCEQ
52	OSL	21	mrem	7	20	January 7, 2015
56	OSL	23	mrem	6	18.5	March 3, 2015

6 Dose to the General Public

The dose to a member of the general public potentially affected by operation of the Waste Processing and Storage license activities conducted at the WCS site during calendar year 2014 was calculated. The dose was based on results of air effluent data, and direct gamma monitoring performed. Groundwater, soil, and vegetation were not included in the dose assessment because there is not a credible dose pathway associated with these media. The results of groundwater, soil, and vegetation are considered in this report to evaluate trends, to ensure early identification, and to correct any conditions that could lead to the offsite migration of licensed radioactive material.

6.1 Airborne Dose Calculations

The effective dose equivalent (EDE) for low levels of airborne radioactive materials dispersed into the environment was calculated for the MWTF stacks, the CWF Sampling Room Stack, and the FWF Sampling Room Stack with midpoint distances of 100 meters (distance to site fence-line), 1000 meters (distance from site to LES) and 6000 meters (distance to the nearest resident). Meteorology data from the Midland/Odessa Airport were used to calculate annual dispersions for each midpoint. Facility-specific radionuclide release rates (in curies per year [Ci/yr]) were also used. The calculations were performed using the CAP88-PC computer code, which calculates total doses from the immersion and inhalation pathways. The dose and risk estimates were based on low levels of chronic intake of radionuclides. The maximum effective dose equivalent was $1.74\text{E-}05$ mrem/year at 100 meters north of the CWF Sampling Room Stack location. This is well below the TCEQ's air emissions limits of 10 mrem/year as specified in 30 TAC 336.304(d) since the EPA's limit does not apply to these operations.

6.2 Public Occupancy Times

Three public dose scenarios were evaluated for direct gamma exposure. The first is referred to as a bounding scenario that assumes exposure to a WCS worker that has not completed radiation worker training and is assigned to the site administrative area. The non-trained WCS worker was assumed to be a member of the general public and exposed for 2,000 hr/yr to direct gamma exposure.

The second scenario is referred to as the site-specific scenario and uses a more realistic definition of a member of the general public and corresponding potential occupancy times. As provided in correspondence between WCS and the Texas Department of State Health Services in 2002, the site-specific occupancy time for the member of the general public was assumed to be 442 hr/yr. This number was based on an assumption that a casual observer of the site would spend 0.5 hr/day at the site boundary. In addition, the same individual was assumed to spend 5 hr/week at a location inside the WCS owner-controlled area.

The third scenario is the continuous occupancy scenario where an individual is at the site boundary 365 days a year 24 hours a day for 8,760 hours.

6.3 Direct Gamma Dosimetry

The dose calculation for direct gamma exposure is based on OSL and TLD measurements for the locations that were reported. The net increased dose above background for each location was

determined by taking the total annual dose for each location and subtracting the dose from station 9. The OSLs and TLDs were in place continuously over the entire year resulting in 8,760 hours of exposure. Since the occupancy times for two of the general public dose scenarios evaluated were 2,000 and 442 hours, the general public dose was calculated by multiplying the annual dosimeter reading (background corrected) net TLD or OSL results by 2000/8760 and 442/8760, for the bounding and site-specific scenarios, respectively. Environmental OSL and TLD results for 2014 are given in Table 44 and Table 45, respectively.

The ambient gamma radiation readings from Stations 22, 50 through 64 (located near LLRW operations) were not utilized for dose to "members of the public." These stations do not represent dose to the general public because these areas are controlled by the WCS occupational radiological protection plan during transfers. For this reason, these stations are not accessible to a "member of the public" and were not considered for dose calculations to the public.

The highest OSL reading considered for this section was recorded at Station 2. The OSL dosimeters at Station 2 gave a background corrected dose of 3.9 mrem/year, 0.9 mrem/year, and 17 mrem/year for the bounding, site specific, and continuous occupancy scenarios, respectively. The Andrews office locations gave a background corrected dose of 1.4 mrem/year, 0.3 mrem/year, and 6 mrem/year for the bounding, site specific, and continuous occupancy scenarios, respectively.

The highest TLD reading considered for this section was recorded at Station 18. The TLD dosimeter at Station 18 gave a background corrected dose of 2.4 mrem/year, 0.5 mrem/year and 10.4 mrem/year for the bounding, site specific, and continuous occupancy scenarios, respectively. The Andrews locations gave a background corrected dose of 3.9 mrem/year, 0.9 mrem/year, and 17.1 mrem/year for the bounding, site specific, and continuous occupancy scenarios, respectively.

Table 44 : Direct Radiation Doses From OSLs with Background Subtracted (mrem/yr), 2014

Station	Before Background Subtraction				After Background Subtraction			
	Annual Total (mrem/y)	Public Dose Bounding (mrem/y)	Public Dose Site Specific (mrem/y)	Continuous Occupancy (mrem/y)	Annual (mrem/y)	Public Dose Bounding (mrem/y)	Public Dose Site Specific (mrem/y)	Continuous Occupancy (mrem/y)
1	0	0.0	0.0	0	0	0.0	0.0	0.0
2	27	6.2	1.4	27	17	3.9	0.9	17.0
3	0	0.0	0.0	0	0	0.0	0.0	0.0
4	9	2.1	0.5	9	0	0.0	0.0	0.0
5	18	4.1	0.9	18	8	1.8	0.4	8.0
6	6	1.4	0.3	6	0	0.0	0.0	0.0
7	0	0.0	0.0	0	0	0.0	0.0	0.0
8	0	0.0	0.0	0	0	0.0	0.0	0.0
9	1	0.2	0.1	1	0	0.0	0.0	0.0
11	9	2.1	0.5	9	0	0.0	0.0	0.0
13	0	0.0	0.0	0	0	0.0	0.0	0.0
14	0	0.0	0.0	0	0	0.0	0.0	0.0
16	0	0.0	0.0	0	0	0.0	0.0	0.0
17	6	1.4	0.3	6	0	0.0	0.0	0.0
18	4	0.9	0.2	4	0	0.0	0.0	0.0
22	40	9.1	2.0	40	30	6.8	1.5	30.0
23	22	5.0	1.1	22	12	2.7	0.6	12.0
26	7	1.6	0.4	7	0	0.0	0.0	0.0
27	3	0.7	0.2	3	0	0.0	0.0	0.0
28	11	2.5	0.6	11	1	0.2	0.1	1.0
Andrews	16	3.7	0.8	16	6	1.4	0.3	6.0
30	21	4.8	1.1	21	11	2.5	0.6	11.0
34	0	0.0	0.0	0	0	0.0	0.0	0.0
50	45	10.3	2.3	45	35	8.0	1.8	35.0
51	26	5.9	1.3	26	16	3.7	0.8	16.0
52	52	11.9	2.6	52	42	9.6	2.1	42.0
54	24	5.5	1.2	24	14	3.2	0.7	14.0
55	33	7.5	1.7	33	23	5.3	1.2	23.0
56	37	8.4	1.9	37	27	6.2	1.4	27.0
58	2	0.5	0.1	2	0	0.0	0.0	0.0
59	2	0.5	0.1	2	0	0.0	0.0	0.0
60	1	0.2	0.1	1	0	0.0	0.0	0.0
61	11	2.5	0.6	11	1	0.2	0.1	1.0
62	6	1.4	0.3	6	0	0.0	0.0	0.0
63	5	1.1	0.3	5	0	0.0	0.0	0.0
64	29	6.6	1.5	29	19	4.3	1.0	19.0
66	9	2.1	0.5	9	0	0.0	0.0	0.0

Table 45 : Direct Radiation Doses From TLDs with Background Subtracted (mrem/yr), 2014

Station	Before Background Subtraction				After Background Subtraction			
	Annual Total (mrem/y)	Public Dose Bounding (mrem/y)	Public Dose Site Specific (mrem/y)	Continuous Occupancy (mrem/y)	Annual (mrem/y)	Public Dose Bounding (mrem/y)	Public Dose Site Specific (mrem/y)	Continuous Occupancy (mrem/y)
4	21.3	4.9	1.1	21.3	11.3	2.6	0.6	11.3
6	19.4	4.4	1.0	19.4	9.4	2.1	0.5	9.4
7	5	1.1	0.3	5	0	0.0	0.0	0.0
11	26.9	6.1	1.4	26.9	16.9	3.9	0.9	16.9
13	6.8	1.6	0.3	6.8	0	0.0	0.0	0.0
14	0.8	0.2	0.0	0.8	0	0.0	0.0	0.0
16	-0.6	-0.1	0.0	-0.6	0	0.0	0.0	0.0
17	13	3.0	0.7	13	3	0.7	0.2	3.0
18	20.4	4.7	1.0	20.4	10.4	2.4	0.5	10.4
26	14.3	3.3	0.7	14.3	4.3	1.0	0.2	4.3
Andrews	27.1	6.2	1.4	27.1	17.1	3.9	0.9	17.1
30	34.2	7.8	1.7	34.2	24.2	5.5	1.2	24.2
34	2.2	0.5	0.1	2.2	0	0.0	0.0	0.0
55	53.1	12.1	2.7	53.1	43.1	9.8	2.2	43.1
59	10.8	2.5	0.5	10.8	0.8	0.2	0.0	0.8

6.4 General Public Dose Assessment Summary

WCS calculated an estimate of dose based on a general member of the public who spends half an hour a week at the site boundary in addition, the same individual was assumed to spend 5 hr/week at a location inside the WCS owner-controlled area. WCS estimated the dose to this general member of the public by adding the doses from the maximum airborne dose form CAP88 to the results from the highest TLD station accessible to a "member of the public." This is a conservative approach since the highest air dose and gamma monitoring stations are not at the same locations. The sum of these doses after background correction is 2.70E+00 mrem/year. This dose is well below the annual regulatory limit of 100 mrem and shows that WCS conducts operations in such a manner that provides reasonable assurance that the annual dose to any member of the public is maintained ALARA.

7 Conclusion

Waste Control Specialists (WCS) collected environmental samples to assess potential migration of radioactivity to unrestricted areas from the Andrews County Facility in accordance with RML Nos. R05807 and R04100. This program monitors air, groundwater, surface water, wastewater, soil, sediment, vegetation, and fauna. WCS also operates a meteorological monitoring program that supports several of the environmental monitoring requirements. Samples were routinely collected for the reporting period of January 1 through December 31 in and around the WCS site, and approximately 34,000 results were collected for radionuclides.

A fauna sample was collected during this reporting period. All values were below the established ILs and ALs.

Soil samples were collected during this reporting period. Although these results do not show any significant differences from historical soil data, station 22 exceeded the thorium-230 Byproduct IL. This exceedance is common and is not the result of a release; rather, it is due to ILs and ALs that are inappropriately low when compared against natural conditions. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807.

Sediment samples were collected during this reporting period. Station GW-2 exceeded the thorium-230, radium-226 and radium-228 Byproduct ILs. These exceedances are not the result of a release. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807.

Vegetation samples were collected during this reporting period when sufficient leafy vegetation was present. The vegetation results are consistent with the established background. The vegetation result for station 6 was greater than the byproduct IL for radium-226. This exceedance was reported to the TCEQ within four hours of confirmation as required by LC 92.K of R05807. This result was not indicative of a release, but is instead attributable to natural variability of naturally-occurring radionuclides.

Direct radiation monitors at the facility boundary (stations 13, 6, 7, 16, 26, 17, 34) were consistent with historical data. This background dose is attributed to naturally occurring terrestrial and cosmic radiation and averaged 2.1 mrem for TLDs and 1.9 mrem for OSLs over the reporting period.

The air radiological monitoring results for the reporting period of January 1 through June 30 were consistent with those of previous years. One air particulate result, the April result for station 9, exceeded its associated Byproduct IL for uranium-238; however, it was well below the AL. This result was reported to the TCEQ within four hours of confirmation in accordance with LC 92.K of RML No. R05807. This result was not indicative of a release, but is instead attributable to dust overloading of a naturally-occurring radionuclide. All other air results were below the established ILs and ALs. Those ILs and ALs have been previously provided to the TCEQ in REMP documents associated with RML Nos. R05807, and R04100.

Groundwater monitoring results for the reporting period of January 1 through June 30 were consistent with those of previous years. Groundwater was sampled from 69 wells and radiological analyses were performed when water sufficient for all analyses was present. These results show no significant differences from background.

Surface water was collected during this reporting period. All values were below the established ILs and ALs.

Stormwater collected in the Byproduct Facility LCS and LDS are pumped into tanks for consolidation and storage prior to pre-release verification sampling and analysis. Pursuant to RML No. R05807, LC 37.B, Table 37.B, liquid samples are also collected directly from the LCS and LDS sumps and analyzed on a monthly basis. The analytical results were compared with the reporting limits for gross alpha and beta/gamma emitters (15 pCi/L and 50 pCi/L), respectively, under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0004857000. All results were below these reporting limits.

Sanitary wastewater generated at the WCS site is collected in above ground tanks and transported to a POTW in Andrews, Texas. All septic results for the reporting period for carbon-14 and tritium were below the MDC. All calculated results were below the release limits and total quantities in 30 TAC §336.215, *Disposal by Release into Sanitary Sewerage*, allowing release to the POTW in Andrews, Texas. Each radionuclide was below the monthly discharge concentration level, and the total discharge to the POTW was less than 1% of the 1 curie annual limit.

Permit-required sampling of wastewater and storm water was conducted for radiological constituents. Sampling at the WCS Andrews County site was conducted at outfalls and evaporation ponds in accordance with TPDES Permit No. WQ0004857000, TPDES Permit No. WQ0004038000 and TLAP No. WQ0004948000. The results of TDPES and TLAP samples are provided to the TCEQ in monthly effluent reports and are not repeated in this document.

Radioanalytical results collected during this reporting period were indistinguishable from natural background. WCS will continue to monitor for potential releases of radioactivity, as required. These environmental monitoring activities document that the waste management operations at WCS are not inimical to public health or the environment.

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ANDREWS, TEXAS

03-30-2015 Annual-Semi Annual REMP Report for
RML R04100 LC158.H.9 and RML R05807 LC77

APPENDICES