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FINAL REPLY:

Thomas K. Fidler
Pennsylvania Department of
Environmental Protection

TO:

Chairman Diaz

FOR SIGNATURE OF : ** GRN ** CRC NO: 06-0045

Strosnider, NMSS

DESC:

Disposal and Licensing of Tritium Exit Signs

ROUTING:

Reyes
Virgilio
Kane
Silber
Dean
Cyr/Burns
Collins, RI
Schlueter, STP

DATE: 01/24/06

ASSIGNED TO: CONTACT:

NMSS Strosnider

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AFFILIATION:	PA		
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Pennsylvania Department of Environmental Protection

Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, PA 17105-2063
January 17, 2006

Office of Waste, Air and Radiation Management 717-772-2724

Nils J. Diaz, Ph.D.
Chairman
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Disposal and licensing of tritium exit signs

Dear Chairman Diaz:

The Commonwealth of Pennsylvania's Department of Environmental Protection (Department) would like to bring to your attention our concern regarding the improper disposal of generally licensed tritium exit signs in landfills within our state, as well as the rest of the United States. It is my understanding that on a regular basis, NRC receives official reports related to tritium exit signs being (presumably) inadvertently disposed of in RCRA Subtitle D landfills. For example, on December 23, 2005, the state of Wisconsin reported to the NRC (in Event Report No. 42225) that 56 tritium exit signs were lost, containing up to 1,680 curies (Ci) of tritium. This report concludes "...it appears they were sent to a landfill with the general trash." This is a very large quantity of radioactive material improperly disposed of in a landfill. The Department conducted a query of your event-reporting database (NMED) and found that there were roughly 390 such devices reported either lost, missing, stolen, or improperly disposed of between the years 2000 and 2006. However, considering the hundreds of thousands of these devices in use, we suspect the number of reported lost tritium exit signs grossly underestimates those actually lost and disposed of improperly.

Several years ago we promulgated solid waste regulations that required landfills to monitor incoming solid waste for radioactive material and that they develop site-specific response action plans. This very successful program has prevented many generally licensed and orphan gamma-emitting sources from being improperly disposed of in our 50-plus active landfills. However, given the beta decay emission involved, we knew tritium exit signs would not be detected in such monitoring. We, therefore, provided guidance to these facilities regarding recovery of tritium exit signs, should they be discovered visually. This new active radiation monitoring program at our landfills has also prompted us to perform a landfill leachate survey with subsequent radiological analysis of samples in late 2004. The radiological analysis of the collected leachate samples was comprehensive and included tritium.

Enclosed for your reference is a copy of a report our support contractor provided to us in October 2005. This report is also available on our Department's Bureau of Radiation Protection web site at http://www.depweb.state.pa.us, Keyword: "Radiation," go to the Radiation Control Division, and the sub-page on "Monitoring of Radioactive Materials in Solid Waste." A review of the data in this report indicates that radioactive materials normally occurring in the environment (i.e., natural and residual fallout) will account for all the gross radioactivity results except for tritium. As you will note from the first graphic in Attachment A of the report, tritium concentrations ranged from background to nearly 100,000 picocuries per liter (pCi/L). In the fall of 2004, over 90% of the landfill leachate samples had detectable tritium, with over 50% having levels above the U.S. Environmental Protection Agency's (EPA) community water systems Maximum Contaminant Level (MCL) of 20,000 pCi/L (40 CFR Chapter 1 Part 141.66). Another round of landfill leachate sampling and analysis was performed in late 2005 for tritium only, with similar preliminary results and one landfill above 180,000 pCi/L.

In view of the amount of tritium that is being detected by our Pennsylvania landfill leachate monitoring program, it is apparent to us that many licensees possessing tritium exit signs are not returning the devices to the manufacturer or otherwise providing for proper disposal. This conclusion is based on the fact that there is no other source of tritium in the private sector that could be causing such levels of tritium in leachate. That is, each exit sign can contain up to 20 Ci of tritium, or 20,000,000,000,000 pCi, thus, one improperly disposed of exit sign can easily cause the tritium in leachate concentrations we're observing. Further, it is our understanding that other states and countries outside the U.S. have seen similar tritium levels in landfill leachate. In fact, the EPA recently high lighted tritium exit signs as a disposal problem in its October 2004 training CD-ROM "Identifying Radioactive Sources at the Demolition Site."

In light of the fact that there are alternative methods available for emergency lighting, we feel that the NRC should re-evaluate the conditions of use for tritium exit signs as a generally licensed source. Specifically, an immediate evaluation of the safety criteria presented by manufacturers of these tritium exit signs would be prudent, as we believe the data in our report indicates the condition in 10 CFR32.23(a) may not be met, and the related dose limit in the organ dose table in 10 CFR32.24 (Column I) could be exceeded under reasonable leachate discharge exposure scenarios. It is also our opinion that the labeling requirements for these devices are inadequate to alert the licensee's personnel that it contains radioactive tritium, and the device requires proper disposal. The Department believes it would be reasonable for the NRC to issue a condition by order to all generally licensed users of tritium exit signs, indicating that they inventory and report to the NRC, on an annual basis, the number and location of tritium exit signs in their possession. It is apparent from the results of our landfill leachate survey report that the NRC's current regulatory program for these tritium exit signs is not adequate to prevent the improper disposal of these devices. Thus, with all due respect, we recommend the NRC promptly re-evaluate the regulatory and licensing aspects of these tritium exit signs.

Should you or your staff have any questions about our landfill leachate study, or other radiation protection matters in the Commonwealth, please contact me by e-mail at tfidler@state.pa.us or at the telephone number above, or contact Mr. David Allard, Director of the Bureau of Radiation Protection, by e-mail at djallard@state.pa.us or by telephone at 717-787-2480. Thank you for your consideration of our recommendations.

Sincerely,

Thomas K. Fidler
Deputy Secretary

Enclosure

cc: (with no enclosure)
Secretary McGinty
David J. Allard, BRP
Samuel J. Collins, NRC, Region I
George Pangburn, NRC, Region I
Robert Bores, NRC, Region I
Janet M. Schleuter, NRC, STP
Stephen L. Johnson, EPA Administrator
Donald Welsh, EPA, Region 3

Pennsylvania Department of Environmental Protection

Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, PA 17105-2063
January 17, 2006

Office of Waste, Air and Radiation Management 717-772-2724

The Honorable Stephen L. Johnson
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Re: Tritium Exit Signs

Dear Administrator Johnson:

The Commonwealth of Pennsylvania's Department of Environmental Protection (Department) has an ongoing concern regarding the disposal of tritium exit signs in landfills in the Commonwealth, as well as the rest of the United States. Enclosed please find a copy of our recent landfill leachate report, where the Department evaluated a number of radiological parameters. The results show findings as one would expect when sampling an environmental media (i.e., low levels of natural and man-made fallout radionuclides). However, unexpectedly, we find widespread and high levels of radioactive tritium (hydrogen-3) in the leachate of our 50-plus active RCRA subtitle D landfills. The Department believes the source of tritium contamination in landfill leachate is from improperly discarded tritium exit signs. We are also communicating detailed concerns to the Nuclear Regulatory Commission (NRC) regarding loss of control of this material, as the NRC authorizes distribution of these tritium exit signs under a "general license" regulatory framework. You have been copied on that correspondence.

As you will note from the first graphic in Attachment A of the report, tritium concentrations ranged from background to nearly 100,000 picocuries per liter (pCi/L). In the fall of 2004, over 90% of the landfill leachate samples had detectable tritium, with over 50% having levels above the U.S. Environmental Protection Agency's (EPA) community water systems Maximum Contaminant Level (MCL) of 20,000 pCi/L (40 CFR Chapter 1 Part 141.66). Another round of landfill leachate sampling was performed in late 2005 and analyzed for tritium only, with similar preliminary results, including one sample result greater than 180,000 pCi/L. It is apparent to the Department that many licensees possessing tritium exit signs are not returning them to the manufacturer or otherwise providing for proper licensed disposal as required by NRC. In fact, we believe this is a national problem that could potentially impact surface water supplies and community water systems.

In Pennsylvania, landfill leachate must be treated onsite or at a Publicly-Owned Treatment Works (POTW) prior to discharge into the environment. Given the chemical nature of the tritium, as tritiated water, this treatment will do nothing to remove the tritium. Thus, one must rely on dilution to reduce any potential radiological dose impact to the public. The Department has evaluated the conservative low-flow dilution factors of the receiving water bodies of treated landfill leachate in Pennsylvania and are satisfied for now that downstream, the EPA's MCL for tritium in community water systems would be met (i.e., will be below 20,000 picocuries per liter for tritium). However, this required site-specific evaluations.

We believe that EPA should alert the other states and territories to evaluate landfill leachate for tritium contamination, examine the effluent locations from onsite treatment or local POTW, and determine the subsequent dilution factor and calculated surface water tritium concentration. Should site-specific high tritium concentrations and low dilution factors be found, the regulator might consider modifying National Pollutant Discharge Elimination System (NPDES) monitoring requirements.

In closing, I would like to commend the EPA for their work in examining alternative methods available for emergency lighting through the Product Stewardship Institute (PSI). The PSI has compiled a great deal of information on their web site related to the management of tritium exit signs and the substitution of non-radioactive technology for certain radioactive sources. See http://www.productstewardship.us/prod_rad_exitsigns.html . I would also commend the EPA for an informational training CD-ROM entitled "Identifying Radioactive Sources at the Demolition Site" published in October 2004. This resource will no doubt aid in preventing improper tritium exit signs disposal.

Should you or your staff have any questions on our landfill leachate study, or other radiation protection matters in the Commonwealth, please contact me by e-mail at tfidler@state.pa.us or at the telephone number above, or contact Mr. David Allard, Director of the Bureau of Radiation Protection, by e-mail at djallard@state.pa.us or by telephone at 717-787-2480. Thank you for your attention to this matter.

Sincerely,

Thomas K. Fidler

Thomas K. Fidler
Deputy Secretary

Enclosure

cc: (with no enclosure)
Secretary McGinty, DEP
David J. Allard, BRP
Donald Welsh, Director, EPA Region 3
Bonnie Gitlin, EPA, Radiation Protection Division
Nils Diaz, Chairman, NRC
Janet R. Schleuter, NRC, Director, State and Tribal Programs
Donald Cool, NRC, NMSS
Samuel J. Collins, NRC, Region I
George Pangburn, NRC, Region I
Robert Bores, NRC, Region I

Radiological Investigation Results for Pennsylvania Landfill Leachate

Pennsylvania Department of Environmental Protection
Bureau of Radiation Protection
and
Bureau of Waste Management
Harrisburg, Pennsylvania

Project No. 040-195

October 3, 2005

Civil & Environmental Consultants, Inc.

333 Baldwin Road

Pittsburgh, PA 15205-9702

Table of Contents

Executive Summary

During the fourth quarter of 2004, the Pennsylvania Department of Environmental Protection (PADEP) implemented a sampling and analysis plan (SAP) to investigate radioactive material potentially present in landfill untreated leachate. The investigation included all active and permitted landfills in the Commonwealth of Pennsylvania having a leachate collection system (half of the 108 solid waste landfills in the Commonwealth met this selection criterion). Samples of raw, untreated leachate were collected at each of the 54 landfills (an additional 5 quality control sample sets were collected for a total of 59 sets) and sent to a commercial radioanalytical laboratory for analysis. During the initial analysis phase of the 59 sample sets, the following radioactivity concentration parameters were measured: gross alpha, gross beta, gamma emitters by spectroscopy, and tritium (^{3}H as HTO). A subsequent "follow-on" analysis phase was performed for landfills whose leachate gross alpha radioactivity concentration exceeded approximately a 5 picocuries per liter (pCi/L; 1 pCi = 0.000000000001 Ci) threshold. The follow-on analyses measured the radioactivity concentration of radium-226 (^{226}Ra, a member of the natural uranium decay series) and radium-228 (^{228}Ra, a member of the natural thorium decay series), as well as the mass concentration (micrograms per liter; µg/L) of total uranium.

The initial analysis phase results showed that tritium was the most prevalent (identified in 57 or 97% of the 59 samples analyzed) radionuclide present in leachate, ranging from 6.86 to 94,400 pCi/L, with a mean activity concentration of 25,200 pCi/L. Tritium is both a naturally-occurring and man-made radionuclide. The next most prevalent radionuclide measured was potassium-40 (^{40}K; identified in 53 samples), a completely naturally-occurring radioactive material whose identification was inconsequential. Other than tritium and some of the gross alpha radioactivity concentration results (those that exceeded the follow-on analysis threshold of 5 pCi/L), none of the initial phase measurements results warranted additional investigation or interpretation.

Because uranium and thorium are native constituent elements of landfill soil and daily cover material (and thus in leachate produced in contact with that soil) in concentrations that are readily detectable in the laboratory, the follow-on analysis of 18 archived samples whose gross alpha radioactivity concentration exceeded 5 pCi/L was inconsequential with a single exception. The ^{226}Ra activity concentration ranged from 0.18 to 24.2 pCi/L, with a mean activity concentration of 3.46 pCi/L (the median was 2.22 pCi/L). For ^{228}Ra, its activity concentration ranged from 0.71 to 42.0 pCi/L, with a mean activity concentration of 5.40 pCi/L (the median was 2.96 pCi/L). The total uranium mass concentration ranged from 0.00 to 2.50 µg/L, with a mean mass concentration of 0.53 µg/L (the median was 0.27 µg/L). The single exception

was a landfill in Lancaster County whose follow-on results were those reported above as the upper range. Those results exceed expected concentrations by a wide margin and are indicative of possible burials of technologically-enhanced naturally-occurring radioactive material (TENORM) e.g., foundry sand or bricks, coal-powered power plant ash, stack flyash and/or stack scrubber residue at that landfill.

Ignoring reasonable human exposure scenarios, some of the tritium activity concentrations measured exceed applicable or relevant and appropriate requirement (ARAR) standards postulated by the Commonwealth. However, when one considers the treatment and discharge processes leachate actually undergo, and dilution is factored into a human exposure scenario, none of the tritium results exceed ARAR levels. While it is not feasible or practical to confirm the exact sources of the observed tritium in leachate, the Commonwealth believes that gaseous tritium light source (GTLS) 'EXIT' signs have been, and continue to be, disposed in landfills. These GTLS devices contain significant quantities of tritium gas that, once ruptured in a landfill, are readily oxidized into tritiated water that is eventually captured as leachate.

The Commonwealth is planning to conduct a subsequent seasonal round of tritium sampling at the landfills included in this report during the fall of 2005.

1.0 Introduction

1.1 Scope

A radiological sampling and analysis plan (SAP) was implemented at active (permitted) solid waste landfills (LFs) in the state of Pennsylvania. The LF SAP was designed to investigate soluble and insoluble radiological constituents of concern (COCs) potentially present in LF untreated leachate. The sampling and analysis activities were conducted during the fourth quarter of 2004 at the direction of the Pennsylvania Department of Environmental Protection (PADEP) Bureau of Radiation Protection to obtain baseline radiological data for LF untreated leachate. This report documents this baseline data and how it was obtained.

1.2 Background

There are a total of 108 solid waste LFs in Pennsylvania designated for receipt of municipal waste (MW), residual waste (RW), sanitary waste, and construction/demolition (C/D) debris. Of this total, 54 LFs are permitted and active with the remaining 54 inactive or designated by the PADEP not to be included in this sampling event. Most of the active LFs (Table 1) feature a leachate collection system to capture liquids percolating through the LF for wastewater treatment facility processing. Active LF operators are required by PADEP regulations to periodically sample and characterize their leachate for a suite of non-radioactive COCs (radioactive COCs are not required).

1.3 Data Needs

The primary data needs fulfilled by the SAP were:

- Identification and quantification (radioactivity concentration) of gamma-emitting radionuclides that may be present above laboratory limits of detection (minimum detectable concentration or MDC).
- Tritium radioactivity concentration.
- Gross alpha/beta radioactivity concentration.

If prompted by a technical review of the primary data obtained, secondary data needs include some or all of the following COCs:

- ^{226}Ra radioactivity concentration.
- ^{228}Ra radioactivity concentration.

- Total uranium radioactivity concentration.

The technical review of the primary data performed by the LF leachate SAP team (see section 1.4) focused on resolving gross alpha/beta radioactivity concentration anomalies as well as unusual gamma-emitting radionuclide activity concentrations.

1.4 Project Organization and Responsibility

Specific individuals of the radiological SAP LF leachate team were assigned the following project positions during performance of the monitoring activities:

PADEP Bureau of Radiation Protection (BRP) Sponsor – David J. Allard
PADEP Bureau of Waste Management Point of Contact (POC) - Steve Socash
Sampling Surveillance/Laboratory Shipments – PADEP Regional Offices

1.4.1 PADEP Regional Office Solid Waste Managers

Region I (Southeast) POC – Ronald Furlan
Region II (Northeast) POC – William Tomayko
Region III (South Central) POC – John Krueger
Region IV (North Central) POC – James Miller
Region V (Southwest) POC – David Eberle
Region VI (Northwest) POC – Todd Carlson

1.4.2 SAP Operations and Data Management

Civil and Environmental Consultants, Inc. POC -- Rick Orthen

1.4.3 Laboratory Operations

Pace Analytical Services POC - Ed Forrai

2.0 Field Sampling Plan and Laboratory Analyses

2.1 Sampling Locations, Frequency, and Media

Sampling and sample packaging for shipment were performed by properly trained and qualified LF site representatives and/or authorized PADEP representatives. Representative samples of untreated leachate from each leachate management system were collected using sampling kit instructions provided to each LF. The LF facility and media to be sampled was determined by PADEP and specified on the Chain of Custody (COC) record (see below and Attachment C) accompanying each sampling kit. Additional details of each of these sampling methods are presented in the following subsections.

Table 1

Leachate Sample Collections at Active Pennsylvania Solid Waste Landfills

	SAP ID	Permit	Facility Name	City	County
Southeast RI	1	80	Bethlehem Steel Corp RWLF	Coatesville	Chester
	3	70	GROWS MWLF	Morrisville	Bucks
	4	72	Pottstown MWLF	Pottstown	Montgomery
	5	107	SECCRA MWLF	West Grove Kennett Square	Chester
	6	71	Tullytown Resource Recovery MWLF	Tullytown	Bucks
Northeast RII	11	1	Alliance Sanitary LF/MWLF	Taylor	Lackawanna
	12	3	Chrin Brothers Inc. MWLF	Easton	Northampton
	13	12	Commonwealth Environmental Systems MWLF	Foster Township Hegins	Schuylkill
	15	75	Grand Central Sanitary LF/MWLF	Pen Argyl	Northampton
	16	52	IESI Bethlehem LF/MWLF	Bethlehem	Northampton
	17	14	Keystone Sanitary LF/MWLF	Dunmore	Lackawanna
	18	53	Pine Grove LF/MWLF	Pine Grove	Schuylkill
Southcentral RIII	38	66	Cumberland County MWLF	Shippensburg / Newburg	Cumberland
	39	58	Conestoga MWLF	Morgantown	Berks
	40	16	Greater Lebanon Refuse Authority MWLF	Lebanon	Lebanon
	41	62	IESI Blue Ridge MWLF	Scotland	Franklin
	42	18	Lancaster County Solid Waste (Frey Farm) Resource Recovery LF/Transfer Station	Bainbridge / Conestoga	Lancaster
	43	86	Lanchester MWLF	Narvon	Lancaster
	44	64	Mifflin County SWA MWLF	Lewistown	Mifflin

Leachate Sample Collections at Active Pennsylvania Solid Waste Landfills

	SAP ID	Permit	Facility Name	City	County
Southcentral RIII	45	81	Milton Grove C/DLF	Mt. Joy Township	Lancaster
	46	56	Modern MWLF	York	York
	47	60	Mountain View MWLF	Greencastle	Franklin
	48	55	Pioneer Crossing MWLF	Birdsboro / Harleysville	Berks
	49	63	Rolling Hills MWLF	Boyertown	Berks
	50	65	Sandy Run MWLF	Hopewell	Bedford
	51	59	Western Berks RA MWLF	Birdsboro	Berks
Northcentral RIV	54	48	Allenwood MWLF	Brady Township	Lycoming
	56	51	Northern Tier MWLF #2	West Burlington Township	Bradford
	59	47	Wayne Township MWLF	Wayne Township	Clinton
	60	2	White Pines MWLF	Pine Township	Columbia
Southwest RV	64	33	Arden Inc. MWLF	Washington	Washington
	65	102	BFI Imperial MWLF	Imperial	Allegheny
	66	84	Brunner MWLF	Zelienople	Beaver
	67	68	Deep Valley C/DLF	North Fayette Township	Allegheny
	68	39	Evergreen MWLF	Coral	Indiana
	69	67	Greenridge Reclamation MWLF	Scottdale	Westmoreland
	70	74	J & J MWLF - CBF Inc.(Onyx Chestnut)	McClellandtown	Fayette
	71	61	Kelly Run Sanitation MWLF	Elizabeth	Allegheny
	72	69	Laurel Highland MWLF	Johnstown	Cambria
	73	35	MAX Environmental Tech (Noncaptive RW Disposal Impoundment)	South Huntington	Westmoreland
	74	57	Monroeville (Chambers Development) MWLF	Monroeville	Allegheny
	75	42	Mostoller MWLF	Somerset	Somerset
	76	77	Paris Flyash Noncaptive RWLF	Hanover Township	Beaver
	77	73	Westmoreland (Rostraver) MWLF	Belle Vernon	Westmoreland
	78	40	Shade MWLF	Caimbrook	Somerset
	79	41	South Hills MWLF	South Park / Library	Allegheny
	80	38	Southern Alleghenies MWLF	Davidsville	Somerset
	81	37	Valley MWLF	Irwin	Westmoreland

Leachate Sample Collections at Active Pennsylvania Solid Waste Landfills

	SAP ID	Permit	Facility Name	City	County
Northwest RVI	90	32	Clarion County MWLF	Leeper	Clarion
	91	105	McKean Kness MWLF	Kane	McKean
	92	44	Lake View MWLF	Erie	Erie
	94	45	Northwest Sanitary MWLF	West Sunbury	Butler
	95	43	Seneca MWLF	Evans City / Mars	Butler
	96	46	Superior Greentree MWLF	Kersey	Elk

2.1.1 Sample Collections and Analyses

Each LF facility received up to five sample containers: 1 grab composite Cubitainer® (a low-density flexible polyethylene cube-shaped insert) for the unfiltered liquid, 1 pre-preserved Cubitainer® for the filtered sample, 1 glass bottle for the filtered sample, and as necessary, 1 QC duplicate Cubitainer® and 1 QC duplicate glass bottle. Each Cubitainer® and glass bottle was appropriately marked or labeled with the sample identification code and the analysis required. A shipping box specifically designed for the Cubitainer® was also included. All containers except tritium (250 ml glass container) were pre-preserved with a small volume of nitric acid. Also included were two high-capacity canister *QuickFilters* (609 cm^2 area 0.45 micron polyethersulfone media) and a filtration pressure bottle for use with a hand pump. Two *QuickFilters* were supplied to each LF should the sample matrix be difficult to filter. However, sample filtration was discontinued early in the sampling phase of the project because the leachate matrix was found to be exceedingly difficult to filter in the field setting. Filtration by laboratory personnel also proved impossible; consequently, radiological data for only eight leachate residue samples was obtained.

Because sample filtration was not possible for all but eight samples, unfiltered samples were collected into unpreserved containers as a continuous grab composite. To comply with the 5-day holding time specified by the laboratory, the samples were expeditiously packaged for shipment to the laboratory after collection.

Each sample collected was analyzed per the following schedule:

Table 2

Liquid Sample Collection and Analysis Schedule			
Bottle ID[1]	Analysis	Sample Volume (ml)	Laboratory Analysis
A	Gross αβ	1,000	Gross alpha/beta radioactivity (EPA Method 900.0)
B	γ Spec	1,000	Gamma spectrometry (EPA Method 901.1)
C	^{3}H	250	Tritium (EPA Method 906.0) *glass container only*
D	Total U	1,000	Total uranium – KPA screen (ASTM-D5174)
E	^{226}Ra	1,000	Radium-226 (EPA Method 903.1)
F	^{228}Ra	1,000	Radium-228 (EPA Method 904.0)
X	--	--	Non-routine analyte to be specified on a case-by-case basis
1. Letter in position 9 of the sample identification (ID) code string marked or labeled on the sample bottle and the COC (see section 2.1.2 for ID code scheme).			

Note: Analyses for radium and total uranium were not performed ("Z" coded; see section 2.1.2 below) per direction from PADEP.

The gross alpha/beta analyses were conducted using a *Protean* MDS gas flow proportional counting (GFPC) System. The *Protean* MDS is a complete system consisting of three, quad-detector low-background MPC-9604 detector subsystems operated with ultra-high purity P-10 gas, plus a PC and *Protean* control software.

Gamma spectroscopy was conducted with a *Canberra* GC6020 high purity germanium (HPGe) gamma detector with a *Canberra* Genie 2000 VAX/VMS operating system. The HPGe detector is a high resolution, high efficiency (40%) gamma detector. The Genie 2000 spectroscopy software is a comprehensive environment for data acquisition, display, and analysis in personal computers. It provides independent support for multiple detectors, extensive networking capabilities, windowing interactive human interface and comprehensive batch procedure capabilities.

Tritium measurements were made with a *Packard* TriCarb 2900TR liquid scintillation counter. The TriCarb counter is an ultra low-background analyzer offering automatic window optimization to provide a high efficiency-to-background ratio. Internal quench correction is also provided to determine sample-specific detection efficiencies.

2.1.2 Sample Identification

Systematic 11-character sample identification (ID) codes were used to uniquely identify all samples. The ID code format was "AAbbCCCCdEf" meaning:

- AA – a two-digit LF identification number: 01 to 97 (see Table 1, column "SAP ID").
- bb – a two-letter sample matrix designator: LE (Untreated Leachate), GW (Groundwater), SW (Surface Water), PT (Precipitation), OT (Other).
- CCCC – a four-digit project sequential sample number beginning 0001
- d – a single letter sample analysis designator: A (Gross $\alpha\beta$), B (γ Spec), C (^{3}H), D (Total U), E (^{226}Ra), F (^{228}Ra), X (Other).
- E – a single-digit sample type designator: 1 (original), 2 (field QC duplicate).
- f – a single letter designating analysis turn around time: N (normal 15 day TAT), Z (archive without analysis).

All samples with an analysis designation "D", "E", or "F" had a "Z" in the last position of the ID code string pending direction from PADEP to retrieve the archived sample for initial analysis. For example, if the 25th project sample were an original sample collected to determine the tritium concentration in untreated leachate collected at the Monroeville MWLF, it would be designated "74LE0025C1N." An LF SAP Excel® Workbook was used to record and maintain all pertinent information associated with each sample ID code marked/labeled on sample bottles and COC records issued to field personnel.

2.2 Quality Control Samples

Quality assurance objectives were specified so that the data produced are of a known and sufficient quality for determining whether a risk to human health or the environment exists. Because this investigation was preliminary, all data was considered noncritical; accordingly, an extensive effort to validate the precision and accuracy of field sampling adversely affecting results produced in the laboratory setting was not warranted or justifiable. By design, the SAP assured representative sampling because all sample aliquots were taken from a single composite sample. In the field, precision was affected by sample collection procedures and by the natural heterogeneity encountered in the environment. Overall, both field and laboratory precision was evaluated by examining the results of field duplicate samples and laboratory quality control (QC) samples. Laboratory precision was based on the use of laboratory-generated duplicate samples or matrix spike/matrix spike duplicate samples. The field QC duplicate sample load used for this investigation was 10% of the total samples collected (i.e., five

duplicate sample sets). Each duplicate sample was analyzed for the same radiological parameters as the original paired sample.

Trip blanks were unnecessary since no volatile organic compound analyses were included in the SAP. Since sampling equipment was not reused, equipment rinsate samples were not obtained and analyzed to identify instances of sample cross-contamination.

The analytical laboratory chosen for this investigation has extensive experience analyzing the COCs and sample matrices required by this investigation. Further, the laboratory maintains and implements an approved quality assurance program (QAP) to provide objective evidence that all measurements satisfy specific quality assurance objectives. Accordingly, performance evaluation samples (e.g., samples spiked with known concentrations of radionuclides in levels similar to those expected in the actual samples or blanks) were not to be prepared beyond those included in the laboratory's QAP to further document the accuracy and precision of their measurements process.

2.3 Chain of Custody Record

The chain-of-custody record serves as a written record of sample handling from the field through laboratory receipt. When a completed sample changes custody, those relinquishing and receiving the sample signed the chain-of-custody record. Each change of possession was documented, from the sampler to sample courier, and finally from the courier to the laboratory. The completed chain-of-custody records are included with the laboratory analytical reports (Attachment C).

2.4 Handling and Disposition of Investigation-Derived Waste

All waste dispositions were coordinated with the appropriate LF site representative to ensure compliance with applicable waste storage, characterization, treatment, and disposal requirements. The investigation-derived waste produced during sampling included spent and unused sample material, personal protective equipment, miscellaneous sampling supplies, decontamination water, purge water, and samples. The LF site representative provided a determination for the disposition of all waste (including purge water) that is based on a waste determination.

2.5 Sample Handling, Packaging, and Shipping

All personnel handling samples wore personal protective equipment commensurate with the level of hazard and facility procedures. The exterior of the filled sample container(s) was decontaminated as appropriate. Sample containers were properly secured pending shipment. The sample custodian/shipper

was responsible for ensuring that bottle caps were checked for tightness, a tamper-evident seal placed across bottle caps, and samples were properly packaged for custody transfer and shipment to the laboratory. Samples for radioactivity analysis did not require refrigeration, but were shipped to the laboratory to comply with the five-day holding time requirement.

2.5.1 Field Screening for Radioactivity

Screening filled sample containers for radioactivity was not performed prior to sample shipment.

3.0 Leachate Analysis Results

Laboratory analyses were conducted in two phases: initial and follow-on. The initial phase results, discussed in Section 3.1, were obtained by measurements of gross alpha/beta radioactivity, tritium, and gamma emitters by gamma spectrometry. After interpretation of the initial phase results, additional measurements were made in an attempt to further reconcile some of the initial phase results. These 'follow-on' phase results are discussed in Section 3.2.

3.1 Initial Measurements Phase

The aqueous portion of the leachate samples collected at 54 landfills was initially analyzed for gross alpha/beta radioactivity, tritium, and gamma emitters by gamma spectrometry. There were five QC duplicate samples collected, for a total of 59 samples. The laboratory processed 6 method blanks to accompany the initial batch processing of the 59 samples. Additionally, the residue collected by filtration of eight samples (SAP ID's 1, 4, 18, 38, 74, 78, 92, and 94) was analyzed by gamma spectrometry. The gamma spectrometry measurements featured search libraries for two nuclide families: fission/activation products and naturally occurring. For the fission/activation products family, the following radionuclides were sought: ^{60}Co, ^{137}Cs, ^{154}Eu, and ^{241}Am. In the naturally occurring family, ^{40}K and the ^{235}U/^{238}U/^{232}Th-decay series' radionuclides were sought. The ^{235}U series was represented by ^{235}U in the gamma spectra. For the ^{238}U series, ^{234}Th, ^{214}Pb, and ^{214}Bi were the radionuclides identified. The ^{232}Th series was identified by ^{228}Ac, ^{208}Tl, ^{212}Pb, and ^{212}Bi.

A total of 1,048 initial radioactivity concentration measurements were performed on the 59 aqueous and 8 residue leachate samples: 944 measurements of aqueous fractions and 104 measurements of residue fractions. In the aqueous fraction measurement category, 275 (29%) of the 944 results obtained were positive determinations. For the remaining residue measurement category, 9 (9%) of the 104 results were positive determinations. A positive determination was concluded if the upper bound of the result (result and its 2σ counting uncertainty) equaled or exceeded the corresponding minimum detectable concentration reported by the laboratory for that measurement. The most prevalent radionuclides identified were ^{3}H (57 positive determinations) and ^{40}K (53 positive determinations). The prevalence of the remaining radionuclides sought declined dramatically – ^{214}Pb (26), ^{212}Pb (13), ^{137}Cs/^{241}Am (4 each), ^{154}Eu/^{235}U (2 each), and ^{60}Co (1). The summary of these initial analytical results is presented in sections

3.1.1 (gross alpha), 3.1.2 (gross beta), 3.1.3 (fission/activation product family), and 3.1.4 (naturally occurring family).

3.1.1 Gross Alpha Radioactivity Concentration

The gross alpha results ranged from -7.72 to 21.1 pCi/L, with a mean activity concentration of 3.37 pCi/L. The corresponding gross alpha MDC's ranged from 1.19 to 37.5 pCi/L with a mean of 6.29 pCi/L (37 or 63% of the 59 results were positive determinations). The gross alpha radioactivity concentration results are displayed in Attachment A.

The precision of the duplicate sample gross alpha analyses was evaluated by determining the relative percent difference (RPD) of duplicate measurements that resulted in paired positive determination results. The RPD is equal to the positive difference of the paired positive determination results multiplied by 100 and divided by the average of the two measured values. For the 5 duplicate samples submitted for gross alpha analysis, there were 3 positive determination result pairs. The RPD calculated for these result pairs ranged from 2.5% to 17.3%, with an average RPD of 10.1%.

Residue samples were not analyzed for gross alpha radioactivity.

3.1.2 Gross Beta Radioactivity Concentration

The gross beta results ranged from 7.25 to 564 pCi/L, with a mean activity concentration of 152 pCi/L. The corresponding gross beta MDC's ranged from 0.751 to 26.0 pCi/L with a mean of 3.48 pCi/L (all of the 59 results were positive determinations). The gross beta radioactivity concentration results are displayed in Attachment A. For the 5 duplicate samples submitted for gross beta analysis, there were 5 positive determination result pairs. The RPD calculated for these result pairs ranged from 19.6% to 59.1%, with an average RPD of 37.7%.

Residue samples were not analyzed for gross beta radioactivity.

3.1.3 Fission/Activation Product Radionuclide Concentrations

3.1.3.1 Tritium (^{3}H as Tritium Oxide or HTO)

The tritium results ranged from 6.86 to 94,400 pCi/L, with a mean activity concentration of 25,200 pCi/L. The corresponding tritium MDC's ranged from 275 to 512 pCi/L with a mean of 337 pCi/L (57 or 97% of the 59 results were positive determinations). The tritium concentration results are displayed in

Attachment A. For the 5 duplicate samples submitted for tritium analysis, there were 5 positive determination result pairs. The RPD calculated for these result pairs ranged from 0.6% to 12.8%, with an average RPD of 7.1%.

Residue samples were not analyzed for tritium.

3.1.3.2 Cobalt-60 (^{60}Co)

For the aqueous samples, the ^{60}Co results ranged from -4.24 to 3.81 pCi/L, with a mean activity concentration of -0.366 pCi/L. The corresponding ^{60}Co MDC's ranged from 2.78 to 9.16 pCi/L with a mean of 6.75 pCi/L (1 or 2% of the 59 results was a positive determination). For the 5 duplicate samples submitted for ^{60}Co analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{60}Co.

For the residue samples, the ^{60}Co results ranged from -2.73 to 2.87 pCi/g, with a mean activity concentration of 0.303 pCi/g. The corresponding ^{60}Co MDC's ranged from 4.00 to 9.83 pCi/g with a mean of 6.3 pCi/g (1 or 13% of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{60}Co analysis.

3.1.3.3 Cesium-137 (^{137}Cs)

For the aqueous samples, the ^{137}Cs results ranged from -7.91 to 4.23 pCi/L, with a mean activity concentration of 0.012 pCi/L. The corresponding ^{137}Cs MDC's ranged from 2.93 to 7.90 pCi/L with a mean of 6.29 pCi/L (4 or 7% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{137}Cs analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{137}Cs.

For the residue samples, the ^{137}Cs results ranged from -3.40 to 4.54 pCi/g, with a mean activity concentration of -0.385 pCi/g. The corresponding ^{137}Cs MDC's ranged from 3.62 to 10.5 pCi/g with a mean of 6.23 pCi/g (1 or 13% of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{137}Cs analysis.

3.1.3.4 Europium-154 (^{154}Eu)

For the aqueous samples, the ^{154}Eu results ranged from -14.2 to 15.2 pCi/L, with a mean activity concentration of -0.268 pCi/L. The corresponding ^{154}Eu MDC's ranged from 8.40 to 23.8 pCi/L with a mean of 18.0 pCi/L (2 or 3% of the 59 results were positive determinations). For the 5 duplicate samples

submitted for ^{154}Eu analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{154}Eu.

For the residue samples, the ^{154}Eu results ranged from -12.1 to 8.94 pCi/g, with a mean activity concentration of -1.66 pCi/g. The corresponding ^{154}Eu MDC's ranged from 10.9 to 29.1 pCi/g with a mean of 17.9 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{154}Eu analysis.

3.1.3.5 Americium-241 (^{241}Am)

For the aqueous samples, the ^{241}Am results ranged from -44.4 to 86.9 pCi/L, with a mean activity concentration of -1.60 pCi/L. The corresponding ^{241}Am MDC's ranged from 9.83 to 233 pCi/L with a mean of 31.6 pCi/L (4 or 7% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{241}Am analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{241}Am.

For the residue samples, the ^{241}Am results ranged from -28.5 to 2.47 pCi/g, with a mean activity concentration of -7.02 pCi/g. The corresponding ^{241}Am MDC's ranged from 9.54 to 49.1 pCi/g with a mean of 25.0 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{241}Am analysis.

3.1.4 Naturally-Occurring Radionuclide Concentrations

3.1.4.1 Potassium-40 (^{40}K)

For the aqueous samples, the ^{40}K results ranged from 16.3 to 1,080 pCi/L, with a mean activity concentration of 270 pCi/L. The corresponding ^{40}K MDC's ranged from 26.4 to 124 pCi/L with a mean of 66.9 pCi/L (53 or 90% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{40}K analysis, there were 4 positive determination result pairs. The RPD calculated for these result pairs ranged from 2.4% to 22.7%, with an average RPD of 14.0%.

For the residue samples, the ^{40}K results ranged from -55.7 to 105 pCi/g, with a mean activity concentration of 18.4 pCi/g. The corresponding ^{40}K MDC's ranged from 37.5 to 201 pCi/g with a mean of 104 pCi/g (1 or 13% of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{40}K analysis.

3.1.4.2 Uranium-235 (^{235}U) Decay Series

For the aqueous samples, the ^{235}U results ranged from -245 to 27.9 pCi/L, with a mean activity concentration of -25.7 pCi/L. The corresponding ^{235}U MDC's ranged from 19.5 to 430 pCi/L with a mean of 47.7 pCi/L (2 or 3% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{235}U analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{235}U.

For the residue samples, the ^{235}U results ranged from -73.8 to 2.77 pCi/g, with a mean activity concentration of -24.3 pCi/g. The corresponding ^{235}U MDC's ranged from 13.3 to 72.7 pCi/g with a mean of 35.2 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{235}U analysis.

3.1.4.3 Uranium-238 (^{238}U) Decay Series

3.1.4.3.1 Bismuth-214 (^{214}Bi)

For the aqueous samples, the ^{214}Bi results ranged from -27.3 to 35.1 pCi/L, with a mean activity concentration of 2.08 pCi/L. The corresponding ^{214}Bi MDC's ranged from 23.0 to 62.1 pCi/L with a mean of 47.4 pCi/L (4 or 7% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{214}Bi analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{214}Bi.

For the residue samples, the ^{214}Bi results ranged from -18.3 to 16.8 pCi/g, with a mean activity concentration of 0.43 pCi/g. The corresponding ^{214}Bi MDC's ranged from 28.0 to 75.3 pCi/g with a mean of 46.4 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{214}Bi analysis.

3.1.4.3.2 Lead-214 (^{214}Pb)

For the aqueous samples, the ^{214}Pb results ranged from -4.75 to 17.9 pCi/L, with a mean activity concentration of 4.53 pCi/L. The corresponding ^{214}Pb MDC's ranged from 6.70 to 18.1 pCi/L with a mean of 13.5 pCi/L (27 or 46% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{214}Pb analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{214}Pb.

For the residue samples, the ^{214}Pb results ranged from -3.74 to 7.98 pCi/g, with a mean activity concentration of 1.25 pCi/g. The corresponding ^{214}Pb MDC's ranged from 5.90 to 22.5 pCi/g with a mean of 12.2 pCi/g (3 or 38% of the 8 results were positive determinations). There were no duplicate residue samples submitted for ^{214}Pb analysis.

3.1.4.3.3 Thorium-234 (^{234}Th)

For the aqueous samples, the ^{234}Th results ranged from -1,420 to 141 pCi/L, with a mean activity concentration of -92.1 pCi/L. The corresponding ^{234}Th MDC's ranged from 92.3 to 2,500 pCi/L with a mean of 297 pCi/L (1 or 2% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{234}Th analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{234}Th.

For the residue samples, the ^{234}Th results ranged from -219 to 45.4 pCi/g, with a mean activity concentration of -94.6 pCi/g. The corresponding ^{234}Th MDC's ranged from 41.9 to 496 pCi/g with a mean of 202 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{234}Th analysis.

3.1.4.4 Thorium-232 (^{233}Th) Decay Series

3.1.4.4.1 Actinium-228 (^{228}Ac)

For the aqueous samples, the ^{228}Ac results ranged from -5.68 to 47.6 pCi/L, with a mean activity concentration of 4.84 pCi/L. The corresponding ^{228}Ac MDC's ranged from 9.41 to 29.7 pCi/L with a mean of 23.5 pCi/L (8 or 14% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{228}Ac analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{228}Ac.

For the residue samples, the ^{228}Ac results ranged from -7.46 to 12.8 pCi/g, with a mean activity concentration of 4.36 pCi/g. The corresponding ^{228}Ac MDC's ranged from 13.4 to 40.7 pCi/g with a mean of 23.7 pCi/g (2 or 25% of the 8 results were positive determinations). There were no duplicate residue samples submitted for ^{228}Ac analysis.

3.1.4.4.2 Thallium-208 (^{208}Tl)

For the aqueous samples, the ^{208}Tl results ranged from -4.18 to 5.04 pCi/L, with a mean activity concentration of 0.19 pCi/L. The corresponding ^{208}Tl MDC's ranged from 3.47 to 8.83 pCi/L with a mean

of 6.99 pCi/L (7 or 12% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{208}Tl analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{208}Tl.

For the residue samples, the ^{208}Tl results ranged from -1.41 to 6.30 pCi/g, with a mean activity concentration of 1.96 pCi/g. The corresponding ^{208}Tl MDC's ranged from 3.35 to 12.4 pCi/g with a mean of 6.42 pCi/g (3 or 38% of the 8 results were positive determinations). There were no duplicate residue samples submitted for ^{208}Tl analysis.

3.1.4.4.3 Bismuth-212 (^{212}Bi)

For the aqueous samples, the ^{212}Bi results ranged from -46.5 to 76.0 pCi/L, with a mean activity concentration of 10.1 pCi/L. The corresponding ^{212}Bi MDC's ranged from 38.2 to 127 pCi/L with a mean of 87.6 pCi/L (7 or 12% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{241}Am analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{212}Bi.

For the residue samples, the ^{212}Bi results ranged from -17.0 to 42.0 pCi/g, with a mean activity concentration of 12.7 pCi/g. The corresponding ^{212}Bi MDC's ranged from 50.2 to 146 pCi/g with a mean of 86.0 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{212}Bi analysis.

3.1.4.4.4 Lead-212 (^{212}Pb)

For the aqueous samples, the ^{212}Pb results ranged from -9.34 to 13.3 pCi/L, with a mean activity concentration of 2.33 pCi/L. The corresponding ^{212}Pb MDC's ranged from 5.97 to 43.4 pCi/L with a mean of 12.3 pCi/L (13 or 22% of the 59 results were positive determinations). For the 5 duplicate samples submitted for ^{212}Pb analysis, there were no positive determination result pairs. Consequently, RPD calculations were not performed for ^{212}Pb.

For the residue samples, the ^{212}Pb results ranged from -12.6 to 1.88 pCi/g, with a mean activity concentration of -2.25 pCi/g. The corresponding ^{212}Pb MDC's ranged from 5.02 to 19.8 pCi/g with a mean of 10.2 pCi/g (none of the 8 results was a positive determination). There were no duplicate residue samples submitted for ^{212}Pb analysis.

3.2 Follow-On Measurements Phase

Because 21[1] of the initial 37 positive determinations for gross alpha radioactivity concentration exceeded 5 pCi/L (a US EPA drinking water ARAR; refer to section 4.2.2.2), those samples were selected for additional analyses to identify total uranium content, ^{226}Ra, and ^{228}Ra activity concentrations. By doing so, the initial gross alpha measurement results could possibly be reconciled with the contribution of the alpha-emitting progeny of the natural uranium (^{238}U) and thorium (^{232}Th) decay series in the samples. The selected landfill samples, by SAP ID, were: 1, 4, 6, 12, 15, 16, 42, 44, 45, 46, 64, 68, 71, 72, 73, 75, 81, 95, and 96. The follow-on measurement results are summarized below.

[The Commonwealth is planning to conduct a subsequent seasonal round of tritium sampling at the landfills included in this report during the fall of 2005.]

3.2.1 Total Uranium

The total uranium results ranged from 0.00 to 2.50 microgram/liter (μg/L), with a mean mass concentration of 0.53 μg/L. The total uranium MDC was 0.200 μg/L for all analyses, making 11 or 58% of the 19 results positive determinations. With a single exception, the positive determinations were for landfills located in the southeast, northeast, south central geographic regions of the Commonwealth. Using an assumed mass-to-activity conversion factor of 0.67 pCi/μg total uranium[2], the activity-equivalent total uranium results ranged from 0.00 to 1.68 pCi/L, with a mean activity concentration of 0.36 pCi/L.

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[1] Only 19 of the 21 samples identified for follow-on analysis were measured because one of the samples was a duplicate and the other (SAP ID 18) was inadvertently disposed by the laboratory after the initial measurements phase.

[2] For reporting purposes, mass concentration results may be converted to activity concentration assuming a specific activity of 0.67 pCi total U alpha/μg total U. This conversion factor presupposes however that the natural relative abundance of ^{234}U to ^{238}U in these samples reflects secular equilibrium and equal solubility conditions, i.e., 1:1 (0.336 pCi/μg ^{238}U). The State of California and the USEPA have suggested other mass-to-activity conversion factors (0.79 pCi/μg and 1.3 pCi/μg, respectively) reflecting higher relative abundances of ^{234}U to ^{238}U. The mass of uranium in water is largely determined by ^{238}U, due to its longer half-life, while the total activity in the water is determined by the activity of all uranium isotopes. In natural water, the ^{234}U is slightly more soluble and the activity ratio of ^{234}U to ^{238}U varies from 1:1 to more than 20:1. Consequently, accurate conversion from mass to activity or vice versa requires knowledge of the concentration of each of the three uranium isotopes.

3.2.2 Radium-226 (^{226}Ra)

The ^{226}Ra results ranged from 0.18 to 24.20 pCi/L, with a mean activity concentration of 3.46 pCi/L. The corresponding ^{226}Ra MDC's ranged from 0.15 to 0.90 pCi/L with a mean of 0.62 pCi/L (18 or 95% of the 19 results were positive determinations).

3.2.3 Radium-228 (^{228}Ra)

The ^{228}Ra results ranged from 0.71 to 41.95 pCi/L, with a mean activity concentration of 5.40 pCi/L. The corresponding ^{228}Ra MDC's ranged from 0.79 to 3.03 pCi/L with a mean of 1.23 pCi/L (all of the 19 results were positive determinations).

4.0 Conclusions

Any conclusions about the leachate results are subject to the following principal limitations:

- The sampling campaign was performed as a single grab sample composite of raw leachate at each LF. Temporal compositing would provide a sample which would be representative of changes in leachate quality due to seasonal and operational influences.
- No LF-specific environmental control (precipitation, groundwater, surface water) samples were planned to be obtained as part of the sampling campaign. Consequently, it was not possible to establish a concurrent baseline against which these leachate results may be compared
- Nearly across the board, the LF leachate sample matrix obtained was a complex one with high amounts of dissolved and suspended solids. While this matrix did not adversely affect the quality of results obtained by liquid scintillation counting (tritium) and alpha/gamma spectrometry, it did pose difficulties for the gross alpha and beta determinations. Consequently, interpretation of the gross alpha and beta activity concentration results is considered useful only for relative (inter-sample) comparisons.

Despite these fundamental limitations, it is possible to interpret some of the results in a meaningful manner. With the exception of tritium and a single set of radium/total uranium analyses, all the leachate results support a finding that radioactive material is not present in concentrations sufficient to warrant further investigation. This does not rule-out that radionuclides other than tritium are not present in LF solid wastes; rather, their absence in this sampling campaign could also be attributed to insufficient partitioning of other waste radionuclides to the leachate phase. Specific areas of analytical interest are discussed below.

4.1.1 Uranium and Thorium

The follow-on analyses of samples exceeding about 5 pCi/L gross alpha radioactivity concentration revealed the presence of uranium and thorium decay series nuclides. This is not unexpected because of the way landfills are operated with native soil being used as cover. With the exception of a single landfill (SAP ID 42), all the uranium and thorium results are considered to be typical of water that has been in contact with soil. The results for SAP ID 42 (^{228}Ra, ^{226}Ra, and Total Uranium at 42, 24, and 2 pCi/L respectively) are far above any concentrations considered typical and may be evidence that burials of solid waste enriched in these nuclides has and/or continues to occur. Such burials may include technologically-enhanced naturally-occurring radioactive material (TENORM) e.g., foundry sand or

bricks, coal-powered power plant ash, stack flyash and/or stack scrubber residue. The PA DEP is investigating possible scenarios for discharge and dilution of leachate from the SAP ID 42 facility (the dilution is 110:1 at the point of discharge). This investigation did not evaluate the possible buildup in POTW solids, or fractional release of U/Th to the Susquehanna River after POTW filtration.

When comparing the data produced by the follow-on analyses with the corresponding gross alpha radioactivity concentrations reported during the initial analysis phase, a reliable relationship between the two is not apparent. The ratios of the summed $^{228}Ra/^{226}Ra$/Total Uranium results to the corresponding gross alpha results are inconsistent, ranging from 0.1 to 4 (8 of the 19 ratios exceeded 1). This is an unexpected observation that could be rooted in (1) the complex leachate matrix and the radioanalytical challenges it presents, as well as (2) radioactive disequilibrium or solubility phenomena invalidating the total uranium conversion factor. Nonetheless, this observation hints that gross alpha measurements of leachate may not be the most suitable indicator of ARAR compliance.

4.1.2 Tritium

As presented earlier, positive determinations for tritium were observed in 57 (97%) of the 59 samples analyzed. The corresponding tritium MDC range was 275 to 512 pCi/L, with a mean of 337 pCi/L. The 59-sample range was 7 to 94,400 pCi/L, with a mean activity concentration of 25,200 pCi/L[3] [31 (53%) of the 59 sample results exceeded 20,000 pCi/L, a limit discussed in section 4.1.3.2]. Despite the fact that tritium has ubiquitous environmental presence[4], most of the observed leachate tritium concentrations exceed typical environmental concentrations that are generally below an MDC of 200 pCi/L in surface water and precipitation samples. Possible sources of this leachate tritium include NRC "generally licensed" gaseous tritium light source (GTLS) devices that are unused and no longer needed or wanted ("disused sources") that are unknowingly disposed as a solid waste. It is a common occurrence for disused GTSL to be accidentally disposed in landfills. Most notable among these devices are GTLS

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[3] Tritium assay at the very low levels in the environment is often given in tritium units (TU), an absolute concentration requiring no reference standard. One TU represents a tritium/hydrogen atom ratio of 10^{-18}; in water of 1 TU, the specific activity is equal to 3.2 pCi/L. For comparison, groundwater seldom has more than 50 TU (160 pCi/L) and is typically in the <1 to 10 TU (<3 to 32 pCi/L) range.

[4] Tritium is produced naturally in the upper atmosphere by cosmic ray interaction with ^{14}N in air. Tritium is also produced artificially during nuclear weapons explosions, as a byproduct in nuclear power production, and in defense production reactors via neutron activation of ^{6}Li. In the atmosphere, tritium exists in low concentrations in three different chemical forms: hydrogen (HT), water vapor (HTO) and hydrocarbons (CH_3T). The steady-state global inventory is approximately 2.65 kilograms. By comparison, total U.S. tritium production since 1955 has been approximately 225 kilograms, an estimated 150 kilograms of which have decayed into helium-3, leaving a current (1996) artificial inventory of approximately 75 kilograms.

bricks, coal-powered power plant ash, stack flyash and/or stack scrubber residue. The PA DEP is investigating possible scenarios for discharge and dilution of leachate from the SAP ID 42 facility (the dilution is 110:1 at the point of discharge). This investigation did not evaluate the possible buildup in POTW solids, or fractional release of U/Th to the Susquehanna River after POTW filtration.

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[4] Tritium is produced naturally in the upper atmosphere by cosmic ray interaction with ^{14}N in air. Tritium is also produced artificially during nuclear weapons explosions, as a byproduct in nuclear power production, and in defense production reactors via neutron activation of ^{6}Li. In the atmosphere, tritium exists in low concentrations in three different chemical forms: hydrogen (HT), water vapor (HTO) and hydrocarbons (CH_3T). The steady-state global inventory is approximately 2.65 kilograms. By comparison, total U.S. tritium production since 1955 has been approximately 225 kilograms, an estimated 150 kilograms of which have decayed into helium-3, leaving a current (1996) artificial inventory of approximately 75 kilograms.

emergency 'EXIT' signs that are used to satisfy the National Fire Protection Association (NFPA) Life Safety Code 101 mandate for illuminated exit markers. For more information on the disused source problem, see the Product Stewardship Institutes' (PSI) background report[5].

GTLS 'EXIT' sign dimensions are nominally 13 × 8 × 1 inches and employ several sealed borosilicate glass tubes arranged to form the word 'EXIT.' The tubes are positioned in parabolic channels of a backing material that also serves as a reflector. Each tube is coated on the inside with a thin layer of a phosphor (e.g. zinc sulfide) and filled with up to 25 curies (Ci) of tritium gas. The typical amount is 10 Ci or 10,000,000,000,000 pCi. From a regulatory perspective, each GTLS sign manufacturer holds a 10 CFR 31.5 general license to load tritium per 10 CFR 32.51 in order to market GTLS signs for commercial use. Each purchaser is assigned to the manufacturer's general license at the time of sale and cannot transfer, resell, dispose or dismantle the sign. GTLS labeling is typically small and inconspicuous, thus not readily alerting the sign's owner to it's radioactive contents. Further, there is often insufficient financial incentive offered to end users to prompt return of a disused GTLS. However, the recent PSI[6] initiative prompts many manufacturers of GTLS exit signs and nuclear fixed gauges to take back their products at the end of the products' useful life.

It should be noted that the quantity of tritium in a GTLS 'EXIT' sign is significant and can be readily detected when GTLS tubes are broken, releasing tritium gas that eventually oxidizes as a vapor and condenses as tritiated water. In fact, the tritium gas released from building signs and aircraft instruments destroyed at the former World Trade Center[7] was readily detected in air samples. Laboratory experiments have shown[8] that the conversion of tritium gas ($^3H_2$) to tritiated water (^3H_2O or HTO) is a first-order reaction (a linear function of the concentration) at low (<10 Ci/m^3) and high (>10^4 Ci/m^3) $^3H_2$ concentrations and follows the equation:

$$N - N_0 e^{-At}$$

where N is the fraction as $^3H_2$ and A is the total conversion rate constant. At intermediate $^3H_2$ concentrations, the conversion proceeds through a second-order reaction. The oxidation of $^3H_2$ is controlled by the ions generated by radioactive decay that combine with atmospheric oxygen to form tritiated water. Some of the oxidation reaction rates reported are: 0.03%/day (dry air, no metal surfaces), 0.06% (photochemical reaction), 0.1%/day (isotopic exchange with moisture in air, no metal surfaces),

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[5] http://www.productstewardship.us/supportingdocs/RadMat_BkgrdRpt.doc accessed April 5, 2005.
[6] http://www.productstewardship.us/prod_radioactive.html accessed April 5, 2005.
[7] http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1678&context=lbnl accessed April 5, 2005.
[8] http://www.doeal.gov/laaoabt/Internet/novelideas/trit%20gas%20paper.pdf accessed April 5, 2005.

20%/min (soil with 32% water content), and 5%/min (soil with 28% water content). More information about the environmental fate of tritium is available elsewhere[9]. It is apparent, then, that the conversion of tritium gas released from broken GTLS tubes into tritiated water under compacted landfill cover would proceed relatively rapidly in the presence of moisture.

4.1.3 Applicable or Relevant and Appropriate Requirements Standard of Consideration

The introduction of above-normal concentrations of tritium to the environment from leachate effluent may have regulatory implications that are best understood in the context of applicable or relevant and appropriate requirement (ARAR) standards for radioactive effluents. Both the NRC and the EPA have promulgated ARARs for tritium in liquid effluents. The NRC's effluent limits apply to licensed operations and are contained in Appendix B to 10 CFR Part 20, *Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage.* Additionally, Appendix I to 10 CFR 50, *Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents*, establishes nuclear power plant design objectives and operational constraints to ensure radioactive effluent releases result in human exposures that are As Low As Reasonably Achievable (ALARA). Because Appendix I does not establish a limit *per se*, but rather effluent levels above which power reactor licensee ALARA evaluations are triggered, it is not considered an ARAR limit for landfill leachate.

The EPA limits the annual average concentration of tritium in drinking water under authority of the *National Primary Drinking Water Regulations* (NPDWR; 40 CFR 141). The EPA has also limited the total dose from nuclear fuel cycle operations at 40 CFR 190 (due to its specificity to the entire nuclear fuel cycle, this regulation is not considered an ARAR for landfill leachate). The NRC and EPA limitations and possible inferences prompted by the leachate results are discussed below.

4.1.3.1 NRC Limitations

[9] "Overview of Tritium: Characteristics, Sources, and Problems" by S. Okada and N. Momoshima in *Health Physics* 65(6):595-609; 1993.

In Subpart K of 10 CFR 20, the NRC authorizes licensees to dispose of licensed material in effluents (§20.2001(a)(3)) and to sanitary sewers ((§20.2001(a)(4)) within nuclide-specific effluent concentration limitations. The effluent concentration limits were established to ensure that the total effective dose equivalent (TEDE) to individual members of the public from all licensed operation radiation sources does not exceed 100 mrem (1 mSv) in a year (§20.1301(a)(1)). To accomplish this objective, the NRC derived annual average liquid effluent concentration limits (e.g., 1×10^6 pCi/L as ^3H) corresponding to a 'Reference Man' TEDE of 50 mrem/year. In contrast, the monthly average concentration sanitary sewer limits (e.g., 1×10^7 pCi/L as ^3H) were derived to correspond to a 'Reference Man' committed effective dose equivalent (CEDE) of 500 mrem. It is notable that §20.1301(a)(1) specifically excludes dose contributions attributed to radionuclides in sanitary sewer discharges from licensee compliance demonstrations with the 100 mrem/year public TEDE limit. The practice of radionuclide disposal by release into sanitary sewerage is limited by several §20.2003 conditions, most importantly that the:

- Released materials are readily soluble (or dispersible biological material).
- Quantity of material released in month, divided by the average monthly volume of water released into the sewer by the licensee, does not exceed the Appendix B, Table 3 monthly average sewer concentration limits (e.g., 1×10^7 pCi/L as ^3H).
- Total annual quantity of radioactive material released into sanitary sewerage does not exceed 5 Ci of ^3H, 1 Ci of ^{14}C, and 1 Ci of all other radioactive material combined.

All of the leachate tritium activity concentrations measured by this sampling campaign are below the NRC effluent and sewer concentrations limits discussed above, assuming those grab sample results are indicative of actual average monthly concentrations. As a conservative evaluation, if the observed highest leachate tritium activity concentration (94,400 pCi/L) persisted as a sanitary sewerage discharge over the course of a year, the total leachate volume released would have to approach 14 million gallons before the §20.2003 5 Ci limitation would be of concern.

4.1.3.2 US EPA Limitations

In a final rulemaking for Subpart G of the NPDWR (40 CFR 141) in 2000, the EPA established maximum contaminant levels (MCLs) for radionuclides (§141.66) in drinking water furnished by any community

water system (CWS)[10] including an MCL for 'beta particle and photon radioactivity' (§141.66(d)). This CWS MCL indirectly limits the beta particle and photon radioactivity in drinking water to annual average concentration not to exceed an annual dose equivalent to the total body or any internal organ of 4 mrem/year. For all radionuclides except ^{3}H and ^{90}Sr, conversion of activity concentration to dose equivalent must be performed assuming a drinking water ingestion rate of 2 L/day and the National Bureau of Standards (NBS) Handbook 69 (published 1959 and amended 1963; also referred to as NCRP Report 22) compilation of maximum permissible concentrations (MPCs) in water.

In Table A of §141.66, the EPA directly established 20,000 pCi/L as the annual average concentration of tritium in drinking water that was assumed to produce a total body or organ dose of 4 mrem/year, the MCL. The concentrations for these contaminants were derived from a historical dosimetry model (ICRP Publication 2) used at the time the Subpart G rule was promulgated in 1976. When these risks are calculated in accordance with the latest dosimetry models described in Federal Guidance Report 13 (FGR 13)[11], the risks associated with these concentrations, while varying considerably, generally fall within the EPA's current risk target range for drinking water contaminants of 10^{-4} to 10^{-6}. Accordingly, the EPA did not change the MCL for beta particle and photon radioactivity during its final rulemaking in 2000. Using contemporary ICRP Publication 30 dosimetry, the concentration of tritium needed to deliver the MCL 4 mrem in one year is approximately 86,000 pCi/L, over four times the concentration in the current NPDWS.

Thirty-one (53%) of the 59 leachate tritium activity concentrations measured by this sampling campaign are above 20,000 pCi/L, the EPA NPDWS assumed to equal the 4 mrem/year MCL. The highest measured tritium activity concentration exceeds the MCL by a factor of 4.7. It is apparent, then, that a potential exists for CWS to be adversely affected if the CWS influent is developed within the treated leachate 'watershed.' However, the scope of the leachate sampling campaign does not permit a determination of which, if any, CWS are vulnerable under the NPDWS and the implications for CWS distribution point radionuclide monitoring frequency pursuant to §141.26(b) and §141.26(c). These considerations should be pursued as a separate initiative.

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[10] Community water systems are privately- or publicly-owned and provide water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serve an average of at least 25 people year-round.

[11] http://www.epa.gov/radiation/docs/federal/402-r-99-001.pdf accessed April 7, 2005.

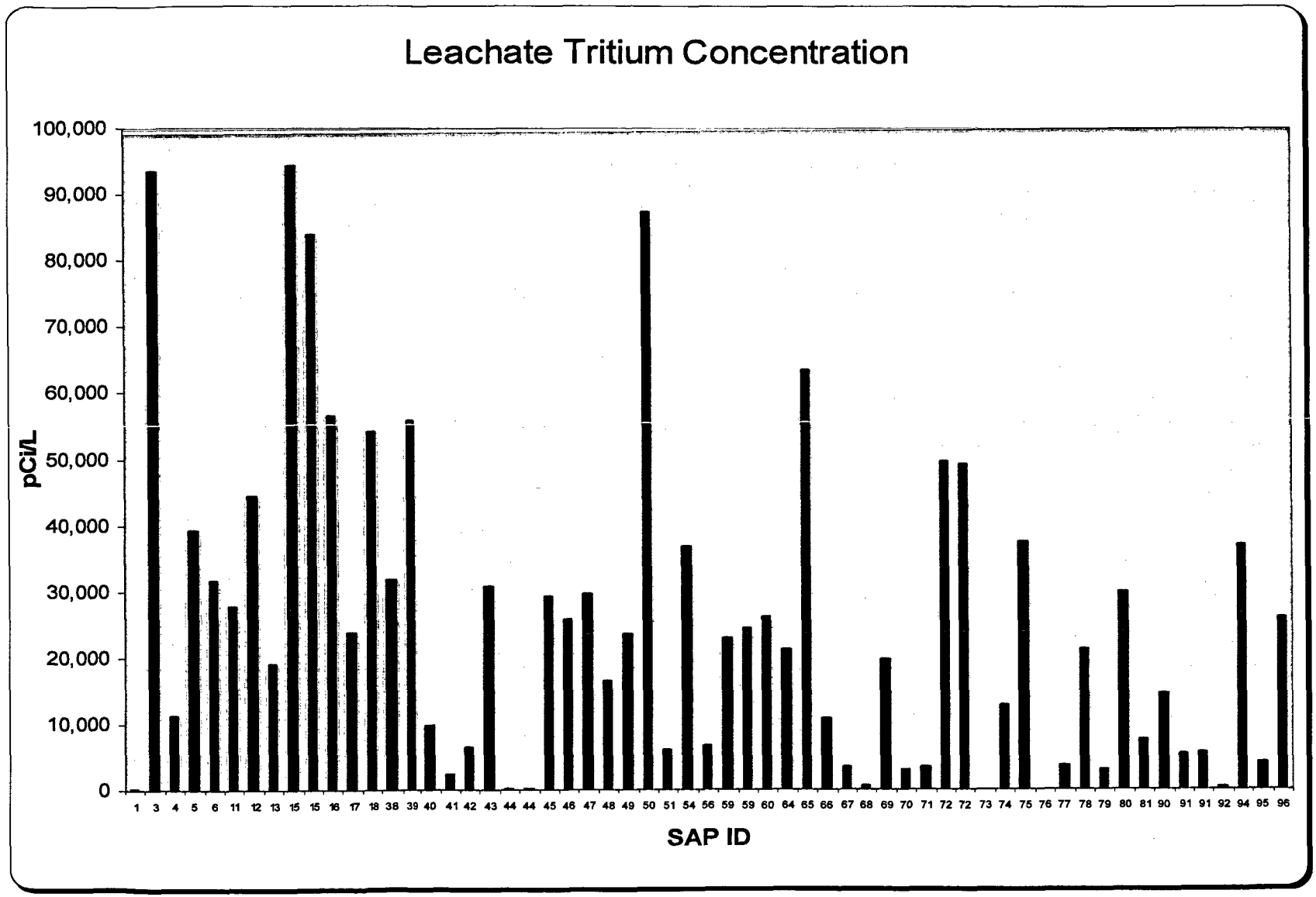
4.1.3.3 Dilution Factors

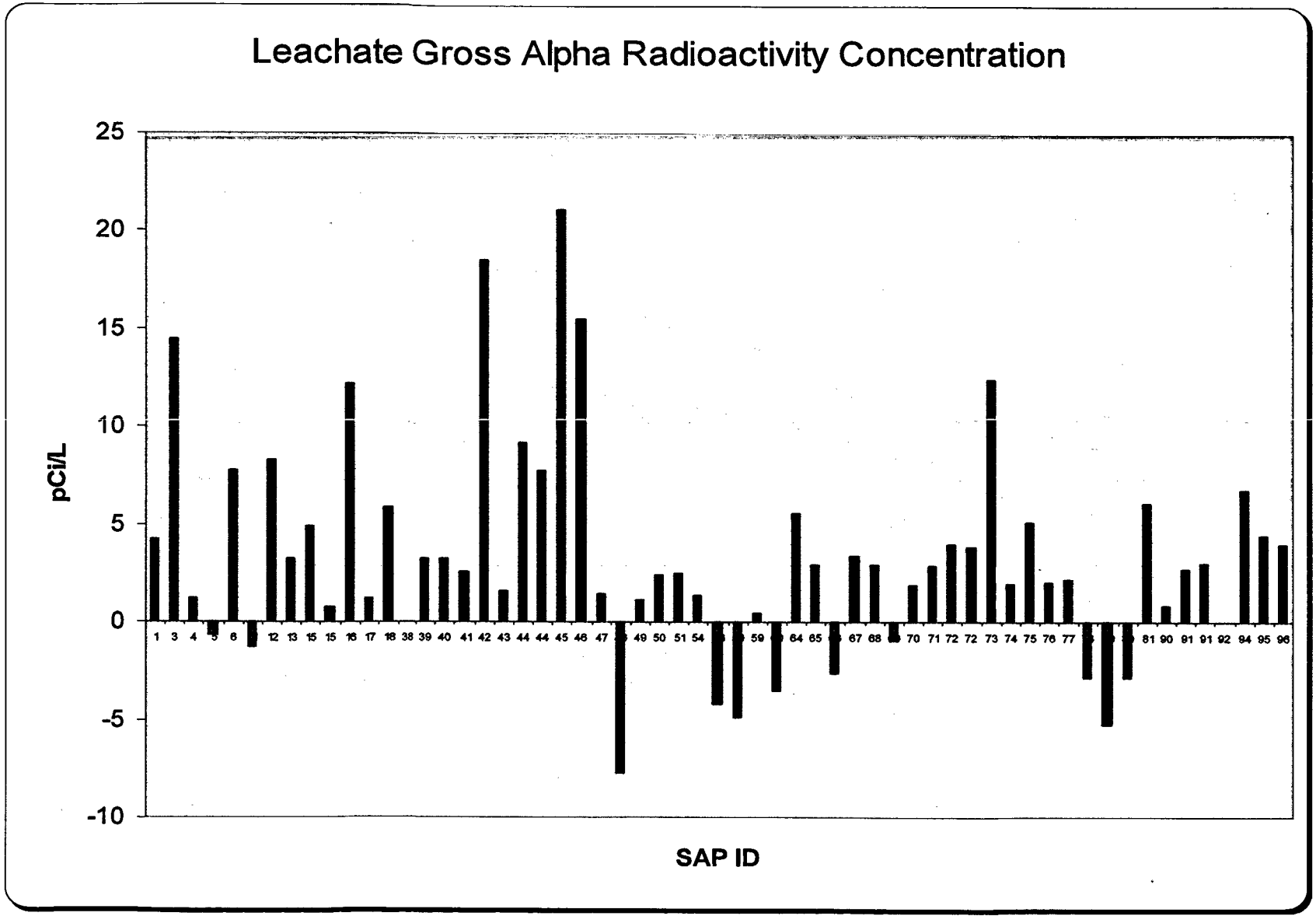
DEP BRP conducted interviews with landfill operators and DEP personnel to determine the approximate dilution that occurs at the initial point of leachate discharge from the landfill site. The discharge locations vary according to the EPA permit issued. The information gathered represents the average leachate effluent flow, compared to the average Publicly Owned Treatment Works influent or the low-flow $Q_{7,10}$ ("7-day, 10-year low flow"; the average minimum stream flow expected for seven consecutive days once every ten years.) data[12] for leachate released to a stream or river. These ratios are considered the dilution factor for leachate. Of the 29 landfills with leachate samples indicating >20,000 pCi/L tritium, 18 were queried with regard to dilution factors. The dilution factors ranged from 1.4 to 546, with resulting concentrations of tritium being less than 20,000 pCi/L. The results of the interviews conducted indicate that at the point of discharge, landfill leachate is adequately diluted to reduce tritium concentrations to below the Maximum Contaminant Levels required by the National Primary Drinking Water Regulations (see section 4.1.3.2 above).

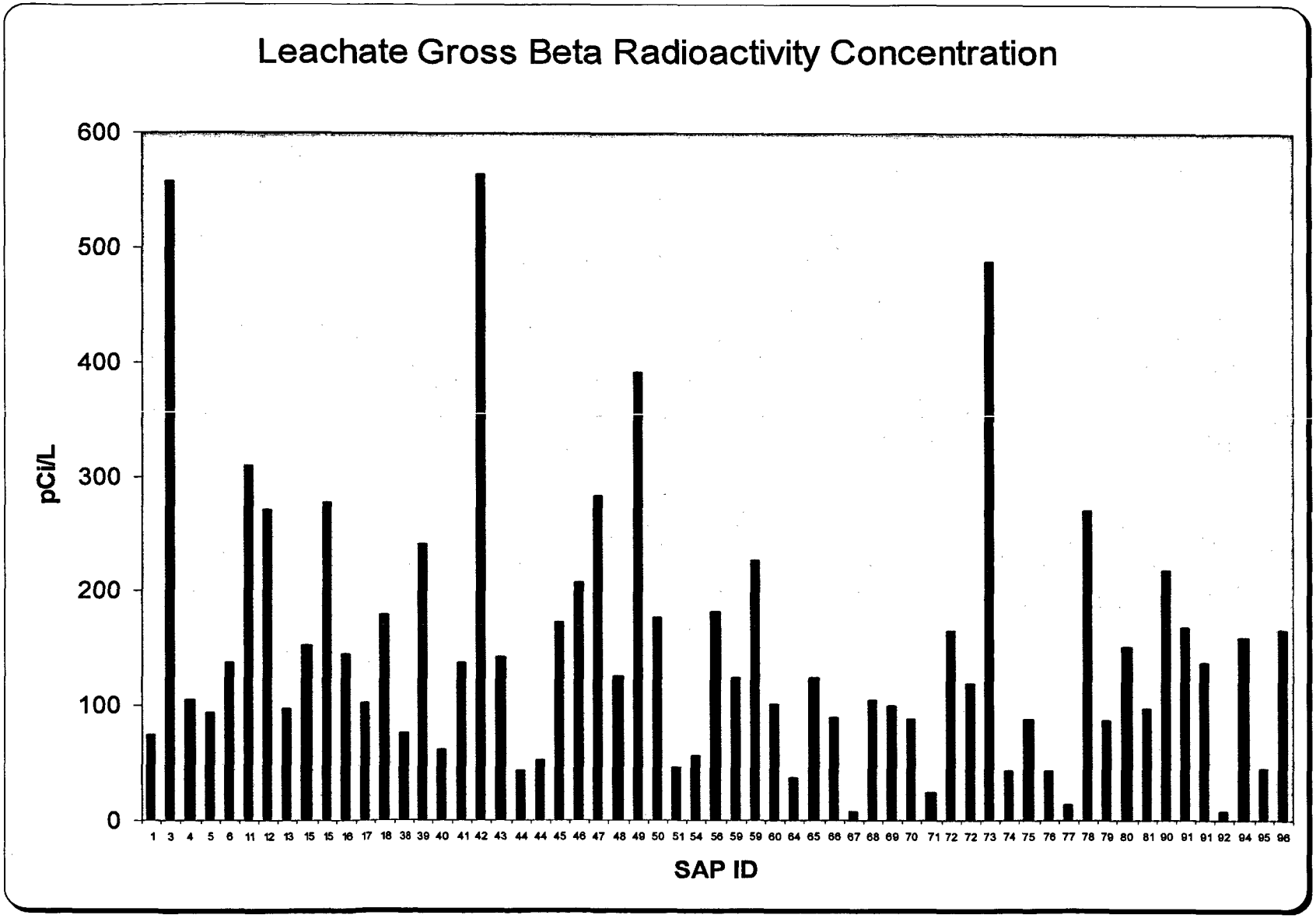
[12] Low-flow statistics for Pennsylvania streams developed by the U.S. Geological Survey, Water Resources Division, New Cumberland, Pa. [2002]. http://pa.water.usgs.gov/pc38/flowstats/

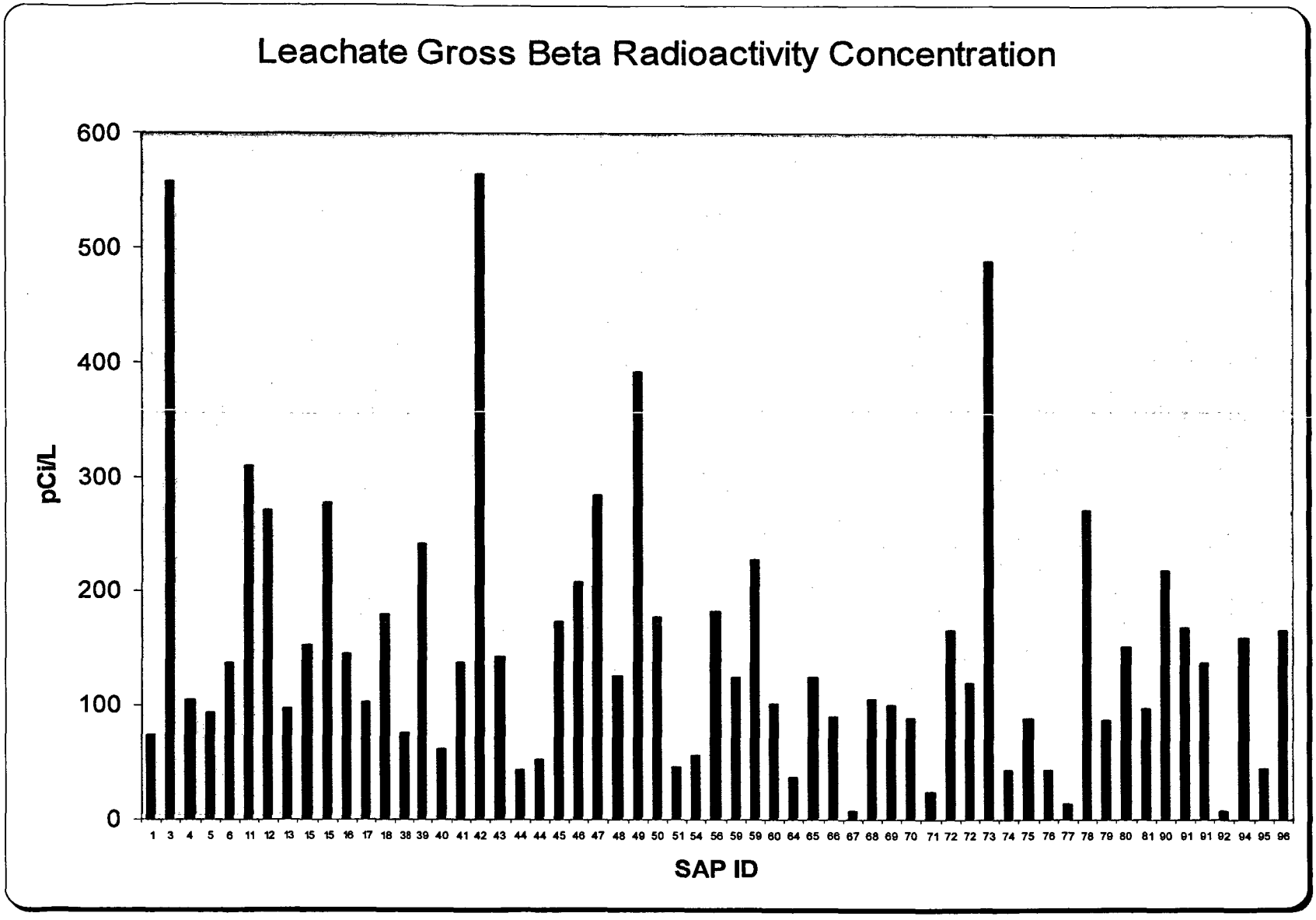
Attachment A

Radioactivity Concentration Data Displays


Leachate Tritium Concentration
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
pCi/L
1 3 4 5 6 11 12 13 15 15 16 17 18 38 39 40 41 42 43 44 44 45 46 47 48 49 50 51 54 56 59 59 60 64 65 66 67 68 69 70 71 72 72 73 74 75 76 77 78 79 80 81 90 91 91 92 94 95 96
SAP ID


Leachate Gross Alpha Radioactivity Concentration
25
20
15
10
5
0
-5
-10
pCi/L
SAP ID


Leachate Gross Beta Radioactivity Concentration
600
500
400
300
200
100
0
pCi/L
1 3 4 5 6 11 12 13 15 15 16 17 18 38 39 40 41 42 43 44 44 45 46 47 48 49 50 51 54 56 59 59 60 64 65 66 67 68 69 70 71 72 72 73 74 75 76 77 78 79 80 81 90 91 91 92 94 95 96
SAP ID


Leachate Gross Beta Radioactivity Concentration
600
500
400
300
200
100
0
pCi/L
1 3 4 5 6 11 12 13 15 15 16 17 18 38 39 40 41 42 43 44 44 45 46 47 48 49 50 51 54 56 59 59 60 64 65 66 67 68 69 70 71 72 72 73 74 75 76 77 78 79 80 81 90 91 91 92 94 95 96
SAP ID

Attachment B

Analytical Data Summary

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gross α			Gross β			Tritium		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	27-Oct-04	**4.22E+00**	2.59E+00	3.79E+00	**7.46E+01**	1.40E+01	2.09E+00	**2.82E+02**	1.98E+02	3.09E+02
3	2-Nov-04	1.45E+01	2.22E+01	3.75E+01	**5.57E+02**	1.05E+02	2.60E+01	**9.35E+04**	1.23E+04	5.12E+02
4	28-Oct-04	1.25E+00	2.90E+00	5.02E+00	**1.05E+02**	1.95E+01	2.68E+00	**1.12E+04**	1.56E+03	3.08E+02
5	16-Nov-04	-6.40E-01	1.35E+00	2.50E+00	**9.37E+01**	1.73E+01	1.27E+00	**3.92E+04**	5.17E+03	3.29E+02
6	2-Nov-04	**7.77E+00**	2.34E+00	2.22E+00	**1.37E+02**	2.53E+01	1.15E+00	**3.17E+04**	4.21E+03	3.80E+02
11	2-Nov-04	-1.24E+00	9.85E+00	1.78E+01	**3.09E+02**	5.77E+01	1.03E+01	**2.78E+04**	3.71E+03	4.17E+02
12	28-Oct-04	**8.28E+00**	6.78E+00	1.06E+01	**2.71E+02**	5.04E+01	6.32E+00	**4.44E+04**	5.84E+03	4.23E+02
13	8-Nov-04	**3.27E+00**	1.59E+00	2.33E+00	**9.73E+01**	1.80E+01	9.10E-01	**1.91E+04**	2.58E+03	3.30E+02
15	8-Nov-04	**4.94E+00**	3.99E+00	6.29E+00	**1.53E+02**	2.84E+01	3.27E+00	**9.44E+04**	1.23E+04	4.96E+02
15	8-Nov-04	7.28E-01	3.82E+00	6.71E+00	**2.77E+02**	5.10E+01	2.78E+00	**8.39E+04**	1.09E+04	4.50E+02
16	28-Oct-04	**1.22E+01**	5.57E+00	7.73E+00	**1.45E+02**	2.71E+01	3.27E+00	**5.67E+04**	7.43E+03	4.23E+02
17	2-Nov-04	**1.21E+00**	1.18E+00	2.03E+00	**1.03E+02**	1.90E+01	1.25E+00	**2.38E+04**	3.18E+03	2.77E+02
18	20-Oct-04	**5.85E+00**	4.55E+00	7.06E+00	**1.80E+02**	3.34E+01	3.74E+00	**5.43E+04**	7.11E+03	2.96E+02
38	18-Oct-04	0.00E+00	3.12E+00	6.05E+00	**7.53E+01**	1.43E+01	3.23E+00	**3.18E+04**	4.22E+03	3.06E+02
39	2-Nov-04	3.26E+00	8.11E+00	1.40E+01	**2.42E+02**	4.52E+01	7.76E+00	**5.60E+04**	7.33E+03	3.06E+02
40	19-Oct-04	**3.26E+00**	1.44E+00	1.88E+00	**6.11E+01**	1.13E+01	1.16E+00	**9.77E+03**	1.38E+03	2.78E+02
41	4-Nov-04	**2.59E+00**	1.41E+00	2.05E+00	**1.38E+02**	2.54E+01	1.14E+00	**2.30E+03**	4.75E+02	3.85E+02
42	1-Nov-04	**1.85E+01**	8.97E+00	1.25E+01	**5.64E+02**	1.04E+02	6.53E+00	**6.41E+03**	9.46E+02	2.80E+02
43	20-Oct-04	**1.56E+00**	1.26E+00	2.05E+00	**1.43E+02**	2.63E+01	1.05E+00	**3.09E+04**	4.09E+03	2.82E+02
44	3-Nov-04	**9.23E+00**	3.63E+00	4.52E+00	**4.34E+01**	8.50E+00	3.26E+00	**1.98E+02**	1.89E+02	3.07E+02
44	3-Nov-04	**7.76E+00**	3.53E+00	4.79E+00	**5.30E+01**	1.01E+01	2.76E+00	**2.25E+02**	1.90E+02	3.04E+02
45	1-Nov-04	**2.11E+01**	6.05E+00	5.51E+00	**1.74E+02**	3.23E+01	3.85E+00	**2.93E+04**	3.89E+03	3.08E+02
46	1-Nov-04	**1.55E+01**	7.58E+00	1.02E+01	**2.08E+02**	3.88E+01	6.57E+00	**2.59E+04**	3.46E+03	4.01E+02
47	1-Nov-04	1.46E+00	7.11E+00	1.25E+01	**2.84E+02**	5.26E+01	6.36E+00	**2.98E+04**	3.96E+03	3.80E+02
48	2-Nov-04	-7.72E+00	5.29E+00	1.02E+01	**1.26E+02**	2.36E+01	4.54E+00	**1.65E+04**	2.24E+03	3.02E+02
49	2-Nov-04	1.16E+00	7.60E+00	1.34E+01	**3.92E+02**	7.24E+01	5.56E+00	**2.36E+04**	3.16E+03	2.77E+02
50	3-Nov-04	**2.43E+00**	1.66E+00	2.68E+00	**1.77E+02**	3.27E+01	1.05E+00	**8.75E+04**	1.14E+04	3.80E+02
51	2-Nov-04	**2.50E+00**	1.75E+00	2.82E+00	**4.63E+01**	8.72E+00	1.50E+00	**6.07E+03**	9.01E+02	2.80E+02
54	15-Nov-04	**1.40E+00**	1.66E+00	3.01E+00	**5.71E+01**	1.07E+01	1.64E+00	**3.63E+04**	4.86E+03	3.28E+02
56	16-Nov-04	-4.22E+00	3.52E+00	6.71E+00	**1.83E+02**	3.39E+01	2.78E+00	**6.70E+03**	9.87E+02	3.27E+02
59	15-Nov-04	-4.85E+00	2.25E+00	4.40E+00	**1.24E+02**	2.29E+01	2.01E+00	**2.30E+04**	3.09E+03	3.35E+02
59	15-Nov-04	4.85E-01	2.37E+00	4.17E+00	**2.28E+02**	4.20E+01	1.85E+00	**2.46E+04**	3.28E+03	3.29E+02
60	16-Nov-04	-3.49E+00	3.20E+00	5.86E+00	**1.01E+02**	1.87E+01	2.08E+00	**2.62E+04**	3.49E+03	3.30E+02
64	8-Nov-04	**5.61E+00**	2.10E+00	2.44E+00	**3.77E+01**	7.08E+00	1.36E+00	**2.12E+04**	2.85E+03	3.28E+02
65	9-Nov-04	**2.97E+00**	1.55E+00	2.25E+00	**1.24E+02**	2.29E+01	1.22E+00	**6.37E+04**	8.32E+03	3.84E+02
66	10-Nov-04	-2.62E+00	2.40E+00	4.39E+00	**9.00E+01**	1.66E+01	1.56E+00	**1.09E+04**	1.53E+03	3.31E+02
67	10-Nov-04	**3.43E+00**	1.28E+00	1.48E+00	**7.25E+00**	1.50E+00	8.22E-01	**3.58E+03**	5.92E+02	3.30E+02
68	16-Nov-04	**2.91E+00**	2.04E+00	3.14E+00	**1.05E+02**	1.93E+01	1.64E+00	**5.85E+02**	2.39E+02	3.32E+02
69	22-Nov-04	-9.68E-01	2.25E+00	4.16E+00	**1.00E+02**	1.19E+02	1.84E+00	**1.97E+04**	2.65E+03	3.27E+02
70	1-Nov-04	**1.92E+00**	1.36E+00	2.20E+00	**8.85E+01**	1.64E+01	1.13E+00	**2.99E+03**	5.09E+02	2.78E+02
71	2-Nov-04	**2.88E+00**	2.17E+00	3.47E+00	**2.39E+01**	4.83E+00	2.36E+00	**3.41E+03**	5.66E+02	3.04E+02
72	2-Nov-04	**3.98E+00**	1.73E+00	2.30E+00	**1.66E+02**	3.03E+01	1.19E+00	**4.96E+04**	6.51E+03	3.82E+02
72	2-Nov-04	**3.88E+00**	1.63E+00	2.06E+00	**1.20E+02**	2.22E+01	1.16E+00	**4.93E+04**	6.47E+03	3.75E+02
73	8-Nov-04	**1.24E+01**	6.26E+00	8.63E+00	**4.88E+02**	8.99E+01	5.29E+00	4.54E+01	1.58E+02	2.79E+02
74	18-Oct-04	**1.96E+00**	2.58E+00	4.30E+00	**4.40E+01**	8.51E+00	2.75E+00	**1.29E+04**	1.78E+03	3.07E+02
75	10-Nov-04	**5.16E+00**	1.90E+00	2.23E+00	**8.85E+01**	1.64E+01	1.15E+00	**3.75E+04**	4.95E+03	2.75E+02
76	19-Nov-04	**2.04E+00**	2.51E+00	4.17E+00	**4.43E+01**	8.38E+00	2.12E+00	6.86E+00	1.86E+02	3.32E+02
77	15-Nov-04	**2.16E+00**	1.08E+00	1.52E+00	**1.45E+01**	2.80E+00	7.51E-01	**3.74E+03**	6.11E+02	3.26E+02
78	18-Oct-04	-2.86E+00	5.96E+00	1.13E+01	**2.71E+02**	5.05E+01	6.43E+00	**2.13E+04**	2.87E+03	4.08E+02
79	15-Nov-04	-5.24E+00	3.42E+00	6.60E+00	**8.70E+01**	1.63E+01	3.02E+00	**2.94E+03**	5.12E+02	3.29E+02
80	3-Nov-04	-2.84E+00	7.14E+00	1.31E+01	**1.51E+02**	2.86E+01	6.66E+00	**2.99E+04**	3.97E+03	3.09E+02
81	9-Nov-04	**6.08E+00**	2.07E+00	2.30E+00	**9.78E+01**	1.81E+01	1.19E+00	**7.53E+03**	1.09E+03	2.77E+02

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

SAP ID	Sample Date	Gross α			Gross β			Tritium		
		Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
90	16-Nov-04	**8.73E-01**	1.99E+00	3.45E+00	**2.18E+02**	4.02E+01	2.12E+00	**1.46E+04**	2.00E+03	3.30E+02
91	9-Nov-04	**2.73E+00**	1.78E+00	2.78E+00	**1.68E+02**	3.11E+01	1.39E+00	**5.36E+03**	8.30E+02	3.65E+02
91	9-Nov-04	**3.03E+00**	1.84E+00	2.80E+00	**1.38E+02**	2.54E+01	1.52E+00	**5.57E+03**	8.61E+02	3.77E+02
92	28-Oct-04	**0.00E+00**	6.54E-01	1.19E+00	**7.97E+00**	1.66E+00	9.56E-01	**4.18E+02**	2.11E+02	3.08E+02
94	28-Oct-04	**6.82E+00**	1.85E+01	3.23E+01	**1.59E+02**	3.34E+01	2.08E+01	**3.72E+04**	4.91E+03	3.06E+02
95	3-Nov-04	**4.42E+00**	2.38E+00	3.41E+00	**4.55E+01**	8.68E+00	2.16E+00	**4.11E+03**	6.56E+02	3.07E+02
96	9-Nov-04	**4.00E+00**	1.66E+00	2.07E+00	**1.66E+02**	3.05E+01	1.16E+00	**2.60E+04**	3.46E+03	2.76E+02
All samples (except 1, 4, 18, 38, 74, 78, 92, 94) were UNFILTERED.	**Results N**	59			59			59		
	Result +2σ Unc. ≥MDC	37	63%		59	100%		57	97%	
	Min	-7.72E+00	6.54E-01	1.19E+00	7.25E+00	1.50E+00	7.51E-01	6.86E+00	1.58E+02	2.75E+02
	Max	2.11E+01	2.22E+01	3.75E+01	5.64E+02	1.19E+02	2.60E+01	9.44E+04	1.23E+04	5.12E+02
	Mean	3.37E+00	3.91E+00	6.29E+00	1.52E+02	3.00E+01	3.48E+00	2.52E+04	3.38E+03	3.37E+02
	StdDev	5.46E+00	4.20E+01	6.64E+00	1.21E+02	3.00E+02	4.33E+00	2.43E+04	3.52E+04	5.40E+01
	Range	2.88E+01	2.15E+01	3.63E+01	5.57E+02	1.17E+02	2.52E+01	9.44E+04	1.21E+04	2.37E+02
	Median	2.73E+00	2.38E+00	4.17E+00	1.24E+02	2.36E+01	2.09E+00	2.13E+04	2.87E+03	3.28E+02
	Method Blank 0410-0693 (10/26/04)	*-1.90E-02*	*2.28E-01*	*4.11E-01*	*1.82E-01*	*2.61E-01*	*4.37E-01*	*5.21E+01*	*1.70E+02*	*2.97E+02*
	Method Blank 0411-0202 (11/05/04)	*4.10E-02*	*2.15E-01*	*3.81E-01*	*-2.69E-01*	*2.81E-01*	*4.93E-01*	*-6.78E+00*	*1.69E+02*	*3.05E+02*
	Method Blank 0411-0496 (11/16/04)	*3.52E-01*	*2.51E-01*	*3.81E-01*	*-1.38E-01*	*3.57E-01*	*6.16E-01*	*6.13E+01*	*1.60E+02*	*2.79E+02*
	Method Blank 0411-0956 (11/23/04)	*3.40E-01*	*2.50E-01*	*3.81E-01*	*-5.99E-01*	*3.60E-01*	*6.16E-01*	*-1.58E+01*	*1.82E+02*	*3.28E+02*
	Min	*-1.90E-02*	*2.15E-01*	*3.81E-01*	*-5.99E-01*	*2.61E-01*	*4.37E-01*	*-1.58E+01*	*1.60E+02*	*2.79E+02*
	Max	*3.52E-01*	*2.51E-01*	*4.11E-01*	*1.82E-01*	*3.60E-01*	*6.16E-01*	*6.13E+01*	*1.82E+02*	*3.28E+02*
	Mean	*1.79E-01*	*2.36E-01*	*3.89E-01*	*-2.06E-01*	*3.15E-01*	*5.41E-01*	*2.27E+01*	*1.70E+02*	*3.02E+02*
	StdDev	*1.95E-01*	*1.76E-02*	*1.50E-02*	*3.23E-01*	*5.12E-02*	*9.01E-02*	*3.96E+01*	*9.03E+00*	*2.03E+01*
	Range	*3.71E-01*	*3.60E-02*	*3.00E-02*	*7.81E-01*	*9.90E-02*	*1.79E-01*	*7.71E+01*	*2.20E+01*	*4.90E+01*
	Median	*1.91E-01*	*2.39E-01*	*3.81E-01*	*-2.04E-01*	*3.19E-01*	*5.55E-01*	*2.27E+01*	*1.70E+02*	*3.01E+02*

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gamma Spectrometry																		
		^{60}Co			^{137}Cs			^{241}Am			^{235}U			^{154}Eu			^{40}K		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	27-Oct-04	1.50E+00	4.48E+00	8.09E+00	-1.11E+00	4.06E+00	6.87E+00	2.74E+00	2.16E+01	3.81E+01	-3.07E+01	2.48E+01	3.97E+01	-9.55E+00	1.08E+01	1.73E+01	**9.20E+01**	6.09E+01	1.23E+02
3	2-Nov-04	3.61E-01	3.19E+00	5.78E+00	-3.18E+00	3.46E+00	5.41E+00	-1.27E+01	1.57E+01	2.66E+01	-3.05E+01	2.68E+01	4.25E+01	8.50E+00	1.08E+01	2.02E+01	**9.17E+02**	1.08E+02	5.35E+01
4	28-Oct-04	-3.90E-02	3.94E+00	7.31E+00	-3.53E-01	4.29E+00	7.70E+00	-8.74E+00	1.43E+01	2.41E+01	1.40E-02	2.92E+01	5.18E+01	-4.23E+00	1.34E+01	2.33E+01	**1.69E+02**	9.03E+01	7.02E+01
5	16-Nov-04	-1.61E+00	3.49E+00	5.41E+00	-1.02E+00	3.09E+00	5.37E+00	8.36E-01	1.58E+01	2.75E+01	-3.52E+01	2.63E+01	4.12E+01	-1.22E+00	9.16E+00	1.63E+01	**1.46E+02**	6.75E+01	5.35E+01
6	2-Nov-04	-2.15E+00	4.71E+00	7.45E+00	-4.63E-01	4.56E+00	7.38E+00	-4.44E+01	2.13E+01	3.72E+01	-4.27E+01	2.60E+01	3.97E+01	2.47E+00	1.16E+01	2.12E+01	**1.43E+02**	8.68E+01	7.72E+01
11	2-Nov-04	1.84E+00	4.57E+00	8.30E+00	-2.46E-01	4.03E+00	6.96E+00	-1.47E+01	2.08E+01	3.56E+01	-5.05E+01	2.56E+01	3.80E+01	-1.42E+01	1.25E+01	1.92E+01	**3.84E+02**	9.36E+01	7.05E+01
12	28-Oct-04	-2.72E+00	4.35E+00	7.25E+00	-3.10E+00	3.91E+00	6.54E+00	-7.87E+00	1.33E+01	2.23E+01	-1.63E+01	2.74E+01	4.69E+01	-4.51E+00	1.22E+01	2.11E+01	**4.09E+02**	1.01E+02	6.68E+01
13	8-Nov-04	3.69E-01	3.86E+00	7.15E+00	-7.91E+00	4.21E+00	7.42E+00	8.32E+00	1.36E+01	2.42E+01	-1.62E+01	2.67E+01	4.56E+01	3.12E-01	9.21E+00	1.73E+01	**1.71E+02**	8.85E+01	7.72E+01
15	8-Nov-04	-1.54E+00	3.76E+00	6.50E+00	1.85E+00	3.92E+00	7.31E+00	-1.89E+00	1.32E+01	2.27E+01	-1.37E+01	2.68E+01	4.60E+01	-8.42E+00	1.07E+01	1.76E+01	**7.90E+02**	1.27E+02	5.35E+01
15	8-Nov-04	-6.38E-01	3.45E+00	6.06E+00	1.06E+00	3.55E+00	6.43E+00	-9.91E+00	1.17E+01	1.94E+01	-7.90E+00	2.34E+01	4.03E+01	2.76E+00	9.49E+00	1.76E+01	**7.71E+02**	1.15E+02	5.25E+01
16	28-Oct-04	-4.24E+00	4.81E+00	7.76E+00	-4.45E-01	4.54E+00	7.90E+00	-7.29E+00	2.40E+01	4.18E+01	-4.69E+01	2.88E+01	4.43E+01	4.98E+00	1.21E+01	2.35E+01	**1.77E+02**	8.51E+01	8.98E+01
17	2-Nov-04	-1.58E+00	3.43E+00	5.83E+00	-1.35E+00	3.40E+00	5.87E+00	-1.54E+00	1.12E+01	1.91E+01	-1.33E+01	2.28E+01	3.88E+01	-1.31E+00	8.54E+00	1.52E+01	**3.01E+02**	8.21E+01	4.78E+01
18	20-Oct-04	-2.89E-01	1.64E+00	2.78E+00	2.85E-01	1.69E+00	2.93E+00	**3.32E+00**	6.52E+00	9.83E+00	-9.06E+00	1.22E+01	1.95E+01	3.30E+00	4.72E+00	8.40E+00	**3.21E+02**	5.17E+01	2.64E+01
38	18-Oct-04	1.32E+00	5.10E+00	9.12E+00	1.21E+00	3.80E+00	6.81E+00	-2.30E+01	2.25E+01	3.65E+01	-3.81E+01	2.55E+01	3.99E+01	3.58E+00	1.21E+01	2.23E+01	**9.83E+01**	7.87E+01	7.44E+01
39	2-Nov-04	-2.27E+00	3.86E+00	6.45E+00	7.86E-01	3.45E+00	6.30E+00	-4.14E-01	1.22E+01	2.11E+01	-1.19E+01	2.39E+01	4.11E+01	1.17E+00	9.38E+00	1.74E+01	**3.09E+02**	8.86E+02	6.10E+01
40	19-Oct-04	-5.55E-01	3.62E+00	6.36E+00	1.52E+00	3.28E+00	6.04E+00	-4.87E+00	1.28E+01	1.90E+01	-1.73E+01	2.36E+01	3.97E+01	-1.37E-01	9.16E+00	1.65E+01	**1.16E+02**	6.98E+01	4.88E+01
41	4-Nov-04	5.18E-01	3.39E+00	5.59E+00	-1.77E-01	3.21E+00	5.66E+00	**1.47E+01**	1.73E+01	2.76E+01	-1.97E+01	2.91E+01	4.09E+01	-4.89E+00	9.21E+00	1.58E+01	**1.99E+02**	6.36E+01	4.55E+01
42	1-Nov-04	-1.80E+00	5.41E+00	8.86E+00	1.75E-01	4.55E+00	7.45E+00	-1.30E+01	2.23E+01	3.82E+01	-4.13E+01	2.74E+01	4.24E+01	7.95E+00	1.25E+01	2.38E+01	**1.08E+03**	1.30E+02	6.40E+01
43	20-Oct-04	-2.09E+00	3.29E+00	5.46E+00	-1.18E+00	3.11E+00	5.39E+00	1.64E+00	1.14E+01	1.97E+01	-6.53E+00	2.28E+01	3.92E+01	4.68E+00	9.86E+00	1.86E+01	**2.05E+02**	7.86E+01	5.34E+01
44	3-Nov-04	2.78E+00	3.18E+00	6.15E+00	-4.41E+00	3.45E+00	5.25E+00	-2.25E+00	1.77E+01	2.68E+01	-6.15E+00	2.54E+01	4.23E+01	5.13E+00	9.18E+00	1.73E+01	**3.75E+01**	5.96E+01	1.20E+02
44	3-Nov-04	-2.99E+00	4.71E+00	7.76E+00	3.99E-01	4.33E+00	7.61E+00	-1.12E+01	2.33E+01	4.02E+01	-5.23E+01	2.78E+01	4.16E+01	-9.43E+00	1.09E+01	1.74E+01	**1.62E+02**	7.84E+01	6.49E+01
45	1-Nov-04	9.94E-01	3.41E+00	6.24E+00	3.16E+00	3.52E+00	6.19E+00	2.32E+00	1.64E+01	2.87E+01	-1.67E+01	2.61E+01	4.26E+01	-3.21E+00	8.24E+00	1.44E+01	**9.42E+01**	6.66E+01	5.56E+01
46	1-Nov-04	7.01E-01	2.81E+00	5.32E+00	3.73E-01	3.37E+00	6.04E+00	1.62E+00	1.16E+01	2.01E+01	1.25E+00	2.54E+01	3.92E+01	-3.77E+00	1.04E+01	1.79E+01	**2.87E+02**	8.37E+01	5.64E+01
47	1-Nov-04	1.54E-01	3.45E+00	5.64E+00	4.50E-01	3.33E+00	5.93E+00	**1.32E+01**	1.77E+01	2.79E+01	-2.45E+02	2.59E+01	4.16E+01	-2.52E+00	9.99E+00	1.75E+01	**3.79E+02**	8.23E+01	5.23E+01
48	2-Nov-04	5.90E-01	3.47E+00	6.33E+00	1.16E+00	3.26E+00	5.97E+00	7.80E+00	1.19E+01	2.11E+01	-2.37E+00	2.23E+01	3.89E+01	-4.58E+00	1.02E+01	1.74E+01	**1.63E+02**	7.17E+01	5.25E+01
49	2-Nov-04	9.02E-01	5.06E+00	8.66E+00	-1.02E+00	4.82E+00	7.75E+00	-2.54E+01	2.28E+01	3.82E+01	-1.47E+01	2.62E+01	4.35E+01	4.30E-02	1.22E+01	2.17E+01	**9.15E+02**	1.24E+02	7.25E+01
50	3-Nov-04	1.62E+00	3.50E+00	6.57E+00	-5.03E-01	3.14E+00	5.55E+00	5.87E+00	1.14E+01	2.01E+01	-1.37E+01	2.29E+01	3.89E+01	1.22E+00	8.56E+00	1.58E+01	**3.61E+02**	8.17E+01	4.57E+01
51	2-Nov-04	-1.49E+00	4.73E+00	7.62E+00	5.00E-02	4.25E+00	6.92E+00	1.46E+01	2.19E+01	3.93E+01	-3.28E+01	2.50E+01	3.93E+01	-4.22E+00	1.05E+01	1.81E+01	**4.98E+01**	6.16E+01	1.24E+02
54	15-Nov-04	1.06E+00	3.41E+00	5.73E+00	1.06E+00	3.25E+00	5.86E+00	-5.27E+00	1.58E+01	2.72E+01	-1.19E+01	2.62E+01	4.31E+01	-1.24E+00	9.64E+00	1.71E+01	**3.37E+02**	7.79E+01	5.52E+01
56	16-Nov-04	3.70E-02	3.86E+00	6.35E+00	5.21E-01	3.35E+00	5.97E+00	5.20E+00	1.80E+01	2.78E+01	-2.16E+01	2.70E+01	4.38E+01	2.36E-01	9.13E+00	1.65E+01	**1.60E+02**	6.79E+01	5.52E+01
59	15-Nov-04	-9.90E-01	3.19E+00	5.55E+00	9.92E-01	3.21E+00	5.86E+00	1.45E+00	1.14E+01	1.97E+01	-1.09E+01	2.34E+01	4.00E+01	6.85E-01	9.23E+00	1.68E+01	**3.73E+02**	8.89E+01	6.21E+01
59	15-Nov-04	-2.23E+00	5.38E+00	8.73E+00	2.16E+00	4.15E+00	7.05E+00	-7.20E+00	2.09E+01	3.62E+01	-2.33E+01	2.39E+01	3.85E+01	-3.11E+00	1.24E+01	2.14E+01	**4.64E+02**	9.21E+01	5.81E+01
60	16-Nov-04	8.42E-01	5.06E+00	8.65E+00	1.26E+00	4.38E+00	7.31E+00	-8.22E+00	2.31E+01	3.51E+01	-2.39E+01	2.41E+01	3.88E+01	-5.25E+00	1.14E+01	1.93E+01	**1.46E+02**	8.16E+01	7.10E+01
64	8-Nov-04	-2.35E+00	4.70E+00	7.39E+00	1.76E+00	4.12E+00	6.94E+00	5.10E+00	2.08E+01	3.70E+01	-6.65E+00	2.70E+01	3.99E+01	-5.65E+00	1.02E+01	1.71E+01	**1.60E+02**	7.50E+01	7.27E+01
65	9-Nov-04	-1.39E+00	4.96E+00	8.08E+00	1.59E+00	4.10E+00	6.89E+00	-2.03E+01	2.20E+01	3.71E+01	-3.35E+01	2.62E+01	4.12E+01	8.37E+00	1.08E+01	2.12E+01	**1.46E+02**	7.93E+01	7.44E+01
66	10-Nov-04	2.98E+00	3.82E+00	7.66E+00	-1.34E+00	3.95E+00	6.88E+00	4.14E-01	1.28E+01	2.23E+01	1.47E+01	2.74E+01	4.89E+01	5.65E+00	1.11E+01	2.15E+01	**2.16E+02**	8.31E+01	6.90E+01
67	10-Nov-04	-3.54E+00	3.59E+00	5.25E+00	-9.05E-01	3.03E+00	5.27E+00	4.71E+00	1.56E+01	2.76E+01	-8.33E+00	2.60E+01	4.31E+01	2.54E+00	9.53E+00	1.75E+01	**6.47E+01**	6.57E+01	5.29E+01
68	16-Nov-04	-1.35E+00	5.07E+00	8.29E+00	-2.96E+00	4.17E+00	6.30E+00	-9.76E+00	2.12E+01	3.66E+01	**2.79E+01**	1.47E+01	4.10E+01	-6.03E-01	1.14E+01	2.03E+01	**7.83E+01**	6.69E+01	6.54E+01
69	22-Nov-04	-1.95E+00	3.68E+00	5.72E+00	2.53E+00	3.35E+00	6.17E+00	-1.10E+01	1.59E+01	2.70E+01	**2.70E+01**	2.48E+01	4.26E+01	1.43E+00	9.40E+00	1.71E+01	**3.72E+02**	8.28E+01	5.84E+01
70	1-Nov-04	1.54E+00	2.26E+00	4.36E+00	-5.24E-01	2.08E+00	3.66E+00	8.69E+01	1.32E+02	2.33E+02	-2.40E+02	2.60E+02	4.30E+02	-3.86E+00	6.25E+00	9.93E+00	**9.58E+01**	5.07E+01	4.03E+01
71	2-Nov-04	-4.78E-01	3.09E+00	5.50E+00	-1.64E+00	3.23E+00	5.53E+00	-3.28E+00	1.17E+01	1.99E+01	6.05E+00	2.38E+01	4.19E+01	-3.48E+00	8.88E+00	1.53E+01	4.36E+01	5.78E+01	1.21E+02
72	2-Nov-04	5.70E-02	4.94E+00	8.29E+00	-3.94E-01	4.31E+00	6.95E+00	-6.36E+00	2.31E+01	3.87E+01	-2.42E+01	2.47E+01	3.99E+01	1.72E-01	1.15E+01	2.06E+01	**3.55E+02**	8.38E+01	5.93E+01
72	2-Nov-04	2.14E+00	5.23E+00	9.16E+00	9.85E-01	4.53E+00	7.52E+00	-3.85E+00	2.09E+01	3.65E+01	-4.07E+01	2.64E+01	4.06E+01	-5.73E+00	1.19E+01	2.00E+01	**4.46E+02**	9.86E+01	6.17E+01
73	8-Nov-04	-2.77E+00	3.80E+00	5.81E+00	**3.29E+00**	3.65E+00	6.72E+00	-4.90E+00	1.59E+01	2.74E+01	-7.96E+00	2.59E+01	4.29E+01	3.45E+00	9.02E+00	1.68E+01	**5.53E+02**	8.68E+01	4.31E+01
74	18-Oct-04	-1.29E+00	4.69E+00	7.95E+00	8.24E-01	3.76E+00	6.69E+00	-5.76E+00	2.09E+01	3.64E+01	-3.83E+01	2.53E+01	3.96E+01	-9.64E-01	1.13E+01	2.02E+01	1.65E+01	5.51E+01	1.05E+02
75	10-Nov-04	-2.98E+00	3.42E+00	5.49E+00	-2.81E+00	3.33E+00	5.53E+00	5.16E+00	1.16E+01	2.04E+01	-2.07E+01	2.32E+01	3.87E+01	-5.24E+00	1.00E+01	1.69E+01	**1.68E+02**	7.22E+01	5.59E+01
76	19-Nov-04	5.88E-01	3.33E+00	6.11E+00	**4.23E+00**	3.38E+00	6.52E+00	-2.74E+00	1.13E+01	1.92E+01	-1.01E+01	2.25E+01	3.86E+01	1.43E+00	8.28E+00	1.54E+01	**1.16E+02**	6.86E+01	5.42E+01
77	15-Nov-04	1.79E+00	3.52E+00	6.64E+00	-9.60E-02	3.40E+00	6.03E+00	-5.35E-01	1.12E+01	1.93E+01	-1.50E+01	2.37E+01	4.01E+01	-1.70E+00	9.09E+00	1.61E+01	**7.17E+01**	6.97E+01	5.68E+01
78	18-Oct-04	**3.81E+00**	3.35E+00	6.75E+00	1.71E+00	3.25E+00	6.02E+00	-7.96E+00	1.13E+01	1.88E+01	-1.84E+01	2.56E+01	3.78E+01	**1.52E+01**	9.32E+00	1.96E+01	**3.90E+02**	8.88E+01	4.06E+01
79	15-Nov-04	1.04E+00	3.33E+00	6.21E+00	**3.27E+00**	3.03E+00	5.86E+00	-4.62E+00	1.13E+01	1.91E+01	2.24E+00	2.25E+01	3.94E+01	**8.80E+00**	8.18E+00	1.68E+01	**1.63E+01**	6.12E+01	1.24E+02
80	3-Nov-04	-7.19E-01	4.48E+00	7.68E+00	2.72E+00	3.96E+00	7.27E+00	3.05E+00	2.11E+01	3.73E+01	-3.83E+01	2.62E+01	4.11E+01	1.36E+00	1.02E+01	1.89E+01	**2.65E+02**	8.69E+01	7.35E+01
81	9-Nov-04	-7.58E-01	3.72E+00	6.00E+00	-1.52E+00	3.10E+00	5.32E+00	-7.05E+00	1.79E+01	2.67E+01	-3.55E+01	2.59E+01	4.05E+01	-7.44E+00	8.96E+00	1.49E+01	**1.39E+02**	6.82E+01	5.66E+01

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

All samples (except 1, 4, 18, 38, 74, 78, 92, 94) were UNFILTERED.

		Gamma Spectrometry																	
		^{60}Co			^{137}Cs			^{241}Am			^{235}U			^{154}Eu			^{40}K		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
90	16-Nov-04	-8.92E-01	3.61E+00	6.28E+00	-2.85E+00	3.31E+00	5.48E+00	**1.09E+01**	1.09E+01	1.96E+01	-1.11E+01	2.31E+01	3.94E+01	7.16E-01	8.34E+00	1.54E+01	**2.32E+02**	7.87E+01	5.49E+01
91	9-Nov-04	-2.63E+00	3.61E+00	5.48E+00	3.88E-01	3.20E+00	5.71E+00	-8.62E+00	1.61E+01	2.76E+01	-1.50E+01	2.57E+01	4.20E+01	2.84E+00	8.25E+00	1.55E+01	**2.93E+02**	7.57E+01	5.52E+01
91	9-Nov-04	-1.22E+00	3.82E+00	6.10E+00	-1.20E+00	3.16E+00	5.47E+00	-3.22E+00	1.81E+01	2.73E+01	-2.88E+01	2.77E+01	4.41E+01	2.93E-01	9.60E+00	1.72E+01	**2.67E+02**	7.68E+01	5.56E+01
92	28-Oct-04	1.54E+00	3.12E+00	5.86E+00	-1.61E+00	3.30E+00	5.30E+00	5.32E+00	1.63E+01	2.73E+01	-3.38E+01	2.59E+01	4.08E+01	1.71E+00	8.92E+00	1.64E+01	2.52E+01	5.95E+01	1.19E+02
94	28-Oct-04	-2.09E-01	4.34E+00	7.53E+00	2.80E+00	3.74E+00	6.94E+00	7.52E+00	2.20E+01	3.91E+01	-2.95E+01	2.44E+01	3.92E+01	-1.67E+00	1.28E+01	2.24E+01	**2.94E+02**	8.78E+01	6.52E+01
95	3-Nov-04	1.14E+00	3.90E+00	7.39E+00	2.41E+00	3.53E+00	6.79E+00	3.68E+00	1.29E+01	2.28E+01	1.35E+01	2.71E+01	4.85E+01	-5.05E-01	8.04E+00	1.51E+01	**5.87E+01**	7.57E+01	7.81E+01
96	9-Nov-04	-5.80E-02	5.18E+00	8.72E+00	-1.87E+00	4.25E+00	6.62E+00	-8.11E-01	2.20E+01	3.86E+01	-3.13E+01	2.54E+01	4.02E+01	5.87E+00	1.20E+01	2.25E+01	**3.43E+02**	9.67E+01	7.81E+01
	Results N	59			59			59			59			59			59		
	Result +2σ Unc. ≥MDC	1	2%		4	7%		4	7%		2	3%		2	3%		53	90%	
	Min	-4.24E+00	1.64E+00	2.78E+00	-7.91E+00	1.69E+00	2.93E+00	-4.44E+01	6.52E+00	9.83E+00	-2.45E+02	1.22E+01	1.95E+01	-1.42E+01	4.72E+00	8.40E+00	1.63E+01	5.07E+01	2.64E+01
	Max	3.81E+00	5.41E+00	9.16E+00	4.23E+00	4.82E+00	7.90E+00	8.69E+01	1.32E+02	2.33E+02	2.79E+01	2.60E+02	4.30E+02	1.52E+01	1.34E+01	2.38E+01	1.08E+03	8.86E+02	1.24E+02
	Mean	-3.66E-01	3.93E+00	6.75E+00	1.24E-02	3.63E+00	6.29E+00	-1.60E+00	1.85E+01	3.16E+01	-2.57E+01	2.90E+01	4.77E+01	-2.68E-01	1.00E+01	1.80E+01	2.70E+02	9.38E+01	6.69E+01
	StdDev	1.74E+00	3.08E+01	1.30E+00	2.10E+00	2.82E+01	9.42E-01	1.54E+01	1.86E+02	2.78E+01	4.45E+01	3.23E+02	5.08E+01	5.14E+00	7.82E+01	2.96E+00	2.32E+02	1.08E+03	2.25E+01
	Range	8.05E+00	3.77E+00	6.38E+00	1.21E+01	3.13E+00	4.97E+00	1.31E+02	1.25E+02	2.23E+02	2.73E+02	2.48E+02	4.11E+02	2.94E+01	8.68E+00	1.54E+01	1.06E+03	8.36E+02	9.76E+01
	Median	-2.89E-01	3.76E+00	6.45E+00	1.75E-01	3.46E+00	6.30E+00	-2.25E+00	1.61E+01	2.73E+01	-1.67E+01	2.56E+01	4.08E+01	4.30E-02	9.86E+00	1.74E+01	1.99E+02	7.87E+01	5.93E+01
	Method Blank 0410-0693 (10/26/04)	*-2.70E-01*	*2.87E+00*	*3.72E+00*	*2.23E+00*	*1.05E+00*	*2.99E+00*	*-7.20E+00*	*9.78E+00*	*1.66E+01*	*-3.02E+01*	*1.24E+01*	*1.74E+01*	*-1.33E+00*	*5.18E+00*	*8.73E+00*	*1.89E+01*	*3.47E+01*	*5.09E+01*
	Method Blank 0411-0202 (11/05/04)	*-3.57E-01*	*3.48E+00*	*6.30E+00*	*-1.03E+00*	*3.71E+00*	*6.19E+00*	*-2.70E+00*	*1.56E+01*	*2.74E+01*	*-8.77E+00*	*2.67E+01*	*4.48E+01*	*-5.14E+00*	*9.82E+00*	*1.70E+01*	*1.22E+01*	*6.57E+01*	*1.35E+02*
	Method Blank 0411-0496 (11/16/04)	*8.30E-02*	*4.80E+00*	*8.04E+00*	*1.45E+00*	*4.29E+00*	*7.20E+00*	*-2.73E+00*	*2.04E+01*	*3.56E+01*	*-1.20E+01*	*2.14E+01*	*3.56E+00*	*-9.57E+00*	*1.13E+01*	*1.82E+01*	*1.89E+01*	*5.62E+01*	*1.12E+02*
	Method Blank 0411-0956 (11/23/04)	*-2.98E+00*	*3.41E+00*	*5.02E+00*	*5.00E-03*	*3.06E+00*	*5.43E+00*	*8.43E+00*	*1.33E+01*	*2.39E+01*	*-1.72E+01*	*2.29E+01*	*3.73E+01*	*-9.44E+00*	*8.18E+00*	*1.31E+01*	*-3.07E+00*	*5.66E+01*	*1.11E+02*
	Min	*-2.98E+00*	*2.87E+00*	*3.72E+00*	*-1.03E+00*	*1.05E+00*	*2.99E+00*	*-7.20E+00*	*9.78E+00*	*1.66E+01*	*-3.02E+01*	*1.24E+01*	*3.56E+00*	*-9.57E+00*	*5.18E+00*	*8.73E+00*	*-3.07E+00*	*3.47E+01*	*5.09E+01*
	Max	*8.30E-02*	*4.80E+00*	*8.04E+00*	*2.23E+00*	*4.29E+00*	*7.20E+00*	*8.43E+00*	*2.04E+01*	*3.56E+01*	*-8.77E+00*	*2.67E+01*	*4.48E+01*	*-1.33E+00*	*1.13E+01*	*1.82E+01*	*1.89E+01*	*6.57E+01*	*1.35E+02*
	Mean	*-8.61E-01*	*3.64E+00*	*5.77E+00*	*6.64E-01*	*3.03E+00*	*5.45E+00*	*-1.05E+00*	*1.48E+01*	*2.59E+01*	*-1.70E+01*	*2.09E+01*	*2.58E+01*	*-6.37E+00*	*8.62E+00*	*1.43E+01*	*1.17E+01*	*5.33E+01*	*1.02E+02*
	StdDev	*1.41E+00*	*8.20E-01*	*1.84E+00*	*1.46E+00*	*1.41E+00*	*1.79E+00*	*6.66E+00*	*4.45E+00*	*7.89E+00*	*9.43E+00*	*6.06E+00*	*1.88E+01*	*3.94E+00*	*2.62E+00*	*4.28E+00*	*1.04E+01*	*1.32E+01*	*3.60E+01*
	Range	*3.06E+00*	*1.93E+00*	*4.32E+00*	*3.26E+00*	*3.24E+00*	*4.21E+00*	*1.56E+01*	*1.06E+01*	*1.90E+01*	*2.14E+01*	*1.43E+01*	*4.12E+01*	*8.24E+00*	*6.12E+00*	*9.47E+00*	*2.20E+01*	*3.10E+01*	*8.41E+01*
	Median	*-3.14E-01*	*3.45E+00*	*5.66E+00*	*7.28E-01*	*3.39E+00*	*5.81E+00*	*-2.72E+00*	*1.45E+01*	*2.57E+01*	*-1.46E+01*	*2.22E+01*	*2.74E+01*	*-7.29E+00*	*9.00E+00*	*1.51E+01*	*1.56E+01*	*5.64E+01*	*1.12E+02*

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gamma Spectrometry											
		Thorium-232 Series Radionuclides											
		^{228}Ac			^{208}Tl			^{212}Bi			^{212}Pb		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	27-Oct-04	4.06E+00	1.41E+01	2.48E+01	-1.52E+00	4.04E+00	6.61E+00	2.75E+01	4.83E+01	9.20E+01	3.79E+00	7.36E+00	1.16E+01
3	2-Nov-04	1.96E+00	1.41E+01	2.25E+01	**4.51E+00**	4.17E+00	7.07E+00	-1.52E+01	4.99E+01	8.11E+01	3.10E+00	6.86E+00	1.17E+01
4	28-Oct-04	-2.90E-02	1.61E+01	2.84E+01	**4.49E+00**	6.91E+00	8.62E+00	**4.96E+01**	5.97E+01	1.08E+02	-3.82E+00	9.06E+00	1.50E+01
5	16-Nov-04	2.58E+00	1.38E+01	2.14E+01	2.49E-01	3.80E+00	6.11E+00	5.18E-01	4.20E+01	7.41E+01	3.07E+00	7.04E+00	1.12E+01
6	2-Nov-04	5.81E+00	1.48E+01	2.54E+01	-2.10E+00	4.56E+00	7.33E+00	-1.69E+00	5.30E+01	9.57E+01	3.65E+00	7.53E+00	1.26E+01
11	2-Nov-04	7.31E+00	1.57E+01	2.79E+01	-2.02E+00	3.95E+00	6.38E+00	1.34E+01	5.13E+01	9.49E+01	1.59E+00	7.83E+00	1.22E+01
12	28-Oct-04	**1.70E+01**	1.48E+01	2.76E+01	-2.64E+00	4.71E+00	7.96E+00	3.00E+01	5.65E+01	9.72E+01	-8.45E-01	8.39E+00	1.39E+01
13	8-Nov-04	**1.84E+01**	1.56E+01	2.88E+01	8.84E-01	4.96E+00	8.40E+00	2.09E+01	5.41E+01	9.61E+01	-1.01E+00	7.71E+00	1.38E+01
15	8-Nov-04	3.00E+00	1.54E+01	2.72E+01	6.90E-01	4.86E+00	8.20E+00	-2.60E+01	6.28E+01	1.04E+02	-7.40E-01	8.06E+00	1.43E+01
15	8-Nov-04	4.53E+00	1.38E+01	2.35E+01	**5.00E+00**	6.65E+00	7.32E+00	-4.32E+00	4.70E+01	7.67E+01	**8.86E+00**	9.53E+00	1.01E+01
16	28-Oct-04	5.32E+00	1.62E+01	2.97E+01	3.76E-01	4.31E+00	7.60E+00	4.00E+01	6.69E+01	1.27E+02	-4.97E-01	8.93E+00	1.43E+01
17	2-Nov-04	1.29E+00	1.33E+01	2.23E+01	1.18E+00	4.27E+00	6.92E+00	-1.39E+01	5.16E+01	8.38E+01	-3.53E-01	6.18E+00	1.11E+01
18	20-Oct-04	**6.29E+00**	7.73E+00	9.41E+00	**4.48E+00**	3.89E+00	3.47E+00	-1.40E+01	3.24E+01	3.82E+01	**3.71E+00**	5.00E+00	5.97E+00
38	18-Oct-04	-3.27E+00	1.50E+01	2.54E+01	1.69E+00	4.25E+00	7.38E+00	2.80E+00	5.07E+01	9.25E+01	-3.24E+00	8.01E+00	1.21E+01
39	2-Nov-04	1.13E+01	1.47E+01	2.62E+01	-3.19E+00	4.41E+00	7.21E+00	-9.42E+00	5.38E+01	8.50E+01	-2.61E+00	7.78E+00	1.25E+01
40	19-Oct-04	2.01E+00	1.34E+01	2.26E+01	5.47E-01	4.13E+00	6.57E+00	3.96E-01	5.02E+01	8.31E+01	-7.18E-01	6.58E+00	1.17E+01
41	4-Nov-04	8.92E-01	1.42E+01	2.24E+01	-5.53E-01	3.98E+00	6.36E+00	2.08E+01	4.31E+01	7.82E+01	**1.19E+01**	7.02E+00	1.16E+01
42	1-Nov-04	**4.76E+01**	1.68E+01	2.33E+01	0.00E+00	4.98E+00	8.30E+00	3.29E+01	5.71E+01	1.07E+02	**1.33E+01**	1.12E+01	1.16E+01
43	20-Oct-04	-1.06E+00	1.33E+01	2.20E+01	8.79E-01	4.23E+00	6.79E+00	-1.27E+01	5.03E+01	8.15E+01	**5.78E+00**	6.71E+00	1.23E+01
44	3-Nov-04	3.14E+00	1.31E+01	2.08E+01	-1.49E-01	3.84E+00	6.12E+00	1.00E+01	4.68E+01	7.84E+01	3.35E+00	6.55E+00	1.12E+01
44	3-Nov-04	-4.23E+00	1.51E+01	2.58E+01	**4.16E+00**	4.08E+00	7.59E+00	1.45E+01	5.39E+01	1.01E+02	**7.30E+00**	8.34E+00	1.37E+01
45	1-Nov-04	5.62E+00	1.38E+01	2.24E+01	2.03E+00	3.95E+00	6.50E+00	**7.17E+01**	4.81E+01	8.68E+01	3.40E+00	6.74E+00	1.15E+01
46	1-Nov-04	9.22E+00	1.46E+01	2.52E+01	-1.38E+00	4.13E+00	6.80E+00	2.69E+01	5.29E+01	8.72E+01	1.32E+00	7.58E+00	1.23E+01
47	1-Nov-04	2.54E+00	1.39E+01	2.20E+01	4.17E-01	4.10E+00	6.66E+00	**4.32E+01**	4.66E+01	8.60E+01	2.42E+00	7.22E+00	1.15E+01
48	2-Nov-04	1.15E+00	1.29E+01	2.16E+01	-2.39E+00	4.25E+00	6.90E+00	5.53E+00	5.11E+01	8.13E+01	3.59E+00	7.51E+00	1.23E+01
49	2-Nov-04	**2.33E+01**	2.11E+01	2.47E+01	4.30E-02	1.22E+01	2.17E+01	-4.03E-01	4.34E+00	7.18E+00	-1.40E+01	5.15E+01	9.14E+01
50	3-Nov-04	1.01E+00	1.40E+01	2.34E+01	-6.45E-01	4.16E+00	6.51E+00	7.26E+00	5.34E+01	8.96E+01	2.32E+00	6.38E+00	1.16E+01
51	2-Nov-04	8.61E+00	1.49E+01	2.59E+01	-3.61E+00	4.44E+00	6.91E+00	3.02E+01	5.06E+01	9.61E+01	**6.67E+00**	7.08E+00	1.20E+01
54	15-Nov-04	7.37E+00	1.39E+01	2.23E+01	-7.68E-01	4.06E+00	6.48E+00	1.45E+01	4.58E+01	8.19E+01	**6.97E+00**	7.55E+00	1.03E+01
56	16-Nov-04	**1.89E+01**	1.45E+01	2.37E+01	7.90E-02	4.02E+00	6.48E+00	2.42E+01	4.50E+01	8.16E+01	4.05E+00	6.95E+00	1.11E+01
59	15-Nov-04	-4.52E+00	1.26E+01	2.02E+01	1.41E+00	4.37E+00	7.11E+00	-2.44E+01	4.89E+01	7.73E+01	-6.23E+00	6.65E+00	1.14E+01
59	15-Nov-04	2.13E+00	1.34E+01	2.25E+01	-5.01E-01	4.77E+00	7.90E+00	1.92E+01	4.71E+01	8.91E+01	**1.09E+01**	1.07E+01	1.08E+01
60	16-Nov-04	8.91E+00	1.47E+01	2.56E+01	-1.99E+00	4.62E+00	7.46E+00	-1.74E+01	4.85E+01	8.57E+01	1.13E+00	7.59E+00	1.25E+01
64	8-Nov-04	8.42E+00	1.49E+01	2.59E+01	-4.18E+00	4.77E+00	7.42E+00	-1.06E+01	5.11E+01	9.13E+01	-2.01E+00	7.47E+00	1.20E+01
65	9-Nov-04	4.70E+00	1.39E+01	2.37E+01	-3.42E+00	4.13E+00	6.39E+00	-3.79E+00	5.14E+01	9.27E+01	-3.22E+00	7.39E+00	1.18E+01
66	10-Nov-04	**1.49E+01**	1.53E+01	2.83E+01	2.82E+00	5.09E+00	8.83E+00	**7.60E+01**	5.67E+01	1.08E+02	2.43E+00	8.03E+00	1.45E+01
67	10-Nov-04	5.66E+00	1.42E+01	2.27E+01	-1.44E+00	4.13E+00	6.54E+00	3.68E+01	3.43E+01	7.67E+01	3.77E+00	7.07E+00	1.13E+01
68	16-Nov-04	5.80E+00	1.37E+01	2.35E+01	1.79E+00	4.58E+00	7.84E+00	**5.42E+01**	5.37E+01	1.04E+02	7.30E-02	7.05E+00	1.15E+01
69	22-Nov-04	-2.88E+00	1.44E+01	2.22E+01	-3.17E+00	3.92E+00	5.98E+00	-4.57E+01	4.68E+01	7.67E+01	**8.93E+00**	8.30E+00	1.06E+01
70	1-Nov-04	1.21E+00	7.95E+00	1.34E+01	2.09E+00	3.34E+00	5.51E+00	-1.07E+01	3.12E+01	4.99E+01	7.21E+00	2.40E+01	4.34E+01
71	2-Nov-04	1.79E+00	1.35E+01	2.28E+01	-1.10E+00	4.09E+00	6.74E+00	2.27E+01	5.35E+01	8.77E+01	2.61E+00	7.51E+00	1.22E+01
72	2-Nov-04	-1.38E+00	1.51E+01	2.49E+01	-3.93E+00	4.42E+00	6.83E+00	2.80E+01	5.27E+01	9.92E+01	3.41E+00	6.94E+00	1.16E+01
72	2-Nov-04	5.74E+00	1.44E+01	2.46E+01	7.85E-01	4.36E+00	7.36E+00	7.36E+00	5.24E+01	9.59E+01	-1.57E+00	7.24E+00	1.17E+01
73	8-Nov-04	3.10E+00	1.40E+01	2.22E+01	-2.17E+00	4.15E+00	6.51E+00	**5.34E+01**	4.28E+01	8.12E+01	3.34E+00	6.88E+00	1.10E+01
74	18-Oct-04	2.63E+00	1.43E+01	2.50E+01	1.65E+00	4.06E+00	7.07E+00	1.59E+01	5.42E+01	1.00E+02	-6.65E-01	7.47E+00	1.14E+01
75	10-Nov-04	-5.31E+00	1.38E+01	2.22E+01	**5.04E+00**	4.42E+00	7.50E+00	-2.83E+01	5.02E+01	7.92E+01	-4.79E-01	6.85E+00	1.21E+01
76	19-Nov-04	3.63E+00	1.26E+01	2.14E+01	-4.34E-01	4.21E+00	6.63E+00	-3.37E+01	5.08E+01	7.94E+01	3.15E+00	6.50E+00	1.18E+01
77	15-Nov-04	-4.13E+00	1.31E+01	2.11E+01	**4.75E+00**	4.32E+00	7.30E+00	-3.03E+00	5.02E+01	8.27E+01	**1.33E+01**	9.84E+00	1.00E+01
78	18-Oct-04	-2.93E+00	1.38E+01	2.25E+01	-2.41E+00	4.41E+00	7.18E+00	1.84E+01	5.02E+01	8.13E+01	-2.95E+00	7.75E+00	1.23E+01
79	15-Nov-04	9.09E-01	1.30E+01	2.18E+01	1.54E+00	4.37E+00	7.12E+00	1.80E+01	4.95E+01	8.44E+01	**5.12E+00**	6.34E+00	1.01E+01
80	3-Nov-04	4.73E+00	1.42E+01	2.52E+01	-4.80E-02	4.25E+00	7.16E+00	-7.11E+00	5.29E+01	9.48E+01	**9.07E+00**	9.85E+00	1.02E+01
81	9-Nov-04	-2.15E+00	1.44E+01	2.24E+01	9.33E-01	3.94E+00	6.42E+00	1.12E+01	4.41E+01	7.88E+01	1.64E+00	6.87E+00	1.09E+01

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gamma Spectrometry											
		Thorium-232 Series Radionuclides											
		^{228}Ac			^{208}Tl			^{212}Bi			^{212}Pb		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
90	16-Nov-04	-1.51E+00	1.23E+01	2.02E+01	8.05E-01	4.20E+00	6.75E+00	6.62E+00	4.91E+01	8.21E+01	-2.34E+00	6.39E+00	1.13E+01
91	9-Nov-04	-3.43E+00	1.43E+01	2.20E+01	1.28E+00	3.96E+00	6.48E+00	1.64E+01	4.42E+01	7.95E+01	3.32E+00	7.01E+00	1.12E+01
91	9-Nov-04	-5.68E+00	1.47E+01	2.26E+01	-8.95E-01	4.04E+00	6.43E+00	2.39E+00	4.45E+01	7.84E+01	3.53E+00	6.92E+00	1.11E+01
92	28-Oct-04	8.42E+00	1.41E+01	2.30E+01	1.13E+00	3.87E+00	6.30E+00	**6.27E+01**	4.63E+01	8.30E+01	-1.64E+00	6.41E+00	1.07E+01
94	28-Oct-04	2.16E+00	1.35E+01	2.37E+01	3.20E-01	4.25E+00	7.21E+00	-4.65E+01	5.54E+01	9.34E+01	2.47E+00	7.48E+00	1.17E+01
95	3-Nov-04	9.38E+00	1.52E+01	2.75E+01	5.74E-01	4.67E+00	8.27E+00	-3.76E+01	6.41E+01	1.01E+02	-9.34E+00	8.31E+00	1.30E+01
96	9-Nov-04	**1.37E+01**	1.49E+01	2.35E+01	-3.19E-01	4.35E+00	7.21E+00	3.79E+01	5.14E+01	9.84E+01	-7.67E-01	7.28E+00	1.18E+01
All samples (except 1, 4, 18, 38, 74, 78, 92, 94) were UNFILTERED.	**Results N**	59			59			59			59		
	Result +2σ Unc. ≥MDC	8	14%		7	12%		7	12%		13	22%	
	Min	-5.68E+00	7.73E+00	9.41E+00	-4.18E+00	3.34E+00	3.47E+00	-4.65E+01	4.34E+00	7.18E+00	-1.40E+01	5.00E+00	5.97E+00
	Max	4.76E+01	2.11E+01	2.97E+01	5.04E+00	1.22E+01	2.17E+01	7.60E+01	6.69E+01	1.27E+02	1.33E+01	5.15E+01	9.14E+01
	Mean	4.84E+00	1.41E+01	2.35E+01	1.97E-01	4.48E+00	7.23E+00	1.03E+01	4.93E+01	8.62E+01	2.14E+00	8.55E+00	1.36E+01
	StdDev	8.40E+00	1.09E+02	3.23E+00	2.32E+00	3.55E+01	2.09E+00	2.73E+01	3.84E+02	1.68E+01	5.01E+00	8.08E+01	1.12E+01
	Range	5.33E+01	1.34E+01	2.03E+01	9.22E+00	8.86E+00	1.82E+01	1.23E+02	6.26E+01	1.20E+02	2.73E+01	4.65E+01	8.54E+01
	Median	3.10E+00	1.42E+01	2.33E+01	2.49E-01	4.25E+00	6.92E+00	1.00E+01	5.03E+01	8.57E+01	2.47E+00	7.39E+00	1.17E+01
	Method Blank 0410-0693 (10/26/04)	*-1.13E+00*	*8.77E+00*	*1.16E+01*	*-6.41E-01*	*2.47E+00*	*3.27E+00*	*1.97E+00*	*2.44E+01*	*4.28E+01*	*-1.24E+00*	*4.79E+00*	*5.41E+00*
	Method Blank 0411-0202 (11/05/04)	*4.70E+00*	*1.50E+01*	*2.53E+01*	*-2.35E+00*	*4.27E+00*	*6.81E+00*	*2.78E+01*	*5.23E+01*	*9.22E+01*	*2.63E+00*	*6.90E+00*	*1.20E+01*
	Method Blank 0411-0496 (11/16/04)	*5.03E+00*	*1.35E+01*	*2.30E+01*	*-3.38E+00*	*4.06E+00*	*6.27E+00*	*1.08E+00*	*5.10E+01*	*9.26E+01*	*-2.76E+00*	*6.93E+00*	*1.11E+01*
	Method Blank 0411-0956 (11/23/04)	*3.51E-01*	*1.35E+01*	*2.09E+01*	*1.01E+00*	*3.87E+00*	*6.32E+00*	*-2.37E+01*	*4.30E+01*	*7.28E+01*	*1.28E+00*	*6.31E+00*	*9.90E+00*
	Min	*-1.13E+00*	*8.77E+00*	*1.16E+01*	*-3.38E+00*	*2.47E+00*	*3.27E+00*	*-2.37E+01*	*2.44E+01*	*4.28E+01*	*-2.76E+00*	*4.79E+00*	*5.41E+00*
	Max	*5.03E+00*	*1.50E+01*	*2.53E+01*	*1.01E+00*	*4.27E+00*	*6.81E+00*	*2.78E+01*	*5.23E+01*	*9.26E+01*	*2.63E+00*	*6.93E+00*	*1.20E+01*
	Mean	*2.24E+00*	*1.27E+01*	*2.02E+01*	*-1.34E+00*	*3.67E+00*	*5.67E+00*	*1.79E+00*	*4.27E+01*	*7.51E+01*	*-2.25E-02*	*6.23E+00*	*9.60E+00*
	StdDev	*3.10E+00*	*2.71E+00*	*6.01E+00*	*1.93E+00*	*8.15E-01*	*1.62E+00*	*2.10E+01*	*1.29E+01*	*2.34E+01*	*2.43E+00*	*1.00E+00*	*2.92E+00*
	Range	*6.16E+00*	*6.23E+00*	*1.37E+01*	*4.39E+00*	*1.80E+00*	*3.54E+00*	*5.15E+01*	*2.79E+01*	*4.98E+01*	*5.39E+00*	*2.14E+00*	*6.59E+00*
	Median	*2.53E+00*	*1.35E+01*	*2.20E+01*	*-1.50E+00*	*3.97E+00*	*6.30E+00*	*1.53E+00*	*4.70E+01*	*8.25E+01*	*2.00E-02*	*6.61E+00*	*1.05E+01*

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gamma Spectrometry								
		Uranium-238 Series Radionuclides								
		^{214}Bi			^{214}Pb			^{234}Th		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	27-Oct-04	7.98E+00	3.05E+01	4.50E+01	**6.25E+00**	8.71E+00	1.40E+01	-2.52E+02	1.97E+02	3.13E+02
3	2-Nov-04	9.22E+00	9.80E+00	4.99E+01	4.03E+00	8.11E+00	1.33E+01	-2.04E+02	1.60E+02	2.71E+02
4	28-Oct-04	-6.08E+00	3.15E+01	5.66E+01	**1.22E+01**	1.37E+01	1.42E+01	-3.62E+00	1.28E+02	2.34E+02
5	16-Nov-04	**2.15E+01**	2.48E+01	4.45E+01	2.91E+00	8.04E+00	1.29E+01	-9.22E+01	1.59E+02	2.83E+02
6	2-Nov-04	-8.01E+00	2.83E+01	4.89E+01	**5.35E+00**	8.70E+00	1.40E+01	-2.01E+02	1.93E+02	3.15E+02
11	2-Nov-04	-6.24E+00	3.22E+01	5.08E+01	-1.47E+00	8.74E+00	1.33E+01	-1.50E+01	1.90E+02	3.18E+02
12	28-Oct-04	8.05E+00	9.69E+00	5.45E+01	4.26E+00	9.30E+00	1.61E+01	-7.40E+01	1.25E+02	2.18E+02
13	8-Nov-04	3.30E+00	3.24E+01	5.95E+01	3.71E+00	9.62E+00	1.59E+01	-1.10E+02	1.32E+02	2.09E+02
15	8-Nov-04	6.55E+00	3.06E+01	5.71E+01	2.29E+00	9.59E+00	1.58E+01	-1.63E+01	1.34E+02	2.25E+02
15	8-Nov-04	-1.08E+01	2.71E+01	4.68E+01	3.32E-01	8.94E+00	1.40E+01	3.10E+00	1.16E+02	1.90E+02
16	28-Oct-04	-2.06E+00	3.48E+01	5.77E+01	3.56E+00	1.04E+01	1.73E+01	-1.96E+02	2.08E+02	3.47E+02
17	2-Nov-04	-3.38E+00	2.55E+01	4.52E+01	-3.24E+00	8.38E+00	1.27E+01	-3.33E+01	1.13E+02	1.82E+02
18	20-Oct-04	5.21E+00	1.60E+01	2.30E+01	-2.25E+00	5.62E+00	6.70E+00	-2.97E+01	7.30E+01	9.23E+01
38	18-Oct-04	-3.29E-01	3.19E+01	5.12E+01	**7.23E+00**	9.06E+00	1.47E+01	-8.94E+01	1.88E+02	3.25E+02
39	2-Nov-04	7.66E+00	9.41E+00	4.72E+01	-1.53E+00	8.54E+00	1.41E+01	-5.12E+01	1.10E+02	1.95E+02
40	19-Oct-04	-1.34E-01	2.62E+01	4.68E+01	-3.25E+00	8.30E+00	1.25E+01	-1.54E+01	1.15E+02	1.88E+02
41	4-Nov-04	-1.05E+01	2.57E+01	4.20E+01	6.21E-01	8.00E+00	1.27E+01	6.58E+01	1.50E+02	2.78E+02
42	1-Nov-04	**3.51E+01**	3.24E+01	6.21E+01	**1.77E+01**	1.29E+01	1.28E+01	-8.65E+01	1.92E+02	3.31E+02
43	20-Oct-04	-7.07E+00	2.51E+01	4.40E+01	-3.75E-01	8.55E+00	1.33E+01	5.31E+00	1.16E+02	1.90E+02
44	3-Nov-04	-2.73E+01	2.52E+01	3.74E+01	**4.77E+00**	8.93E+00	1.31E+01	1.40E+00	1.48E+02	2.78E+02
44	3-Nov-04	4.22E+00	3.19E+01	5.27E+01	-9.56E-01	9.24E+00	1.44E+01	-1.75E+02	2.06E+02	3.46E+02
45	1-Nov-04	1.52E+01	1.07E+01	4.46E+01	**9.24E+00**	9.16E+00	1.09E+01	-6.47E+01	1.56E+02	2.84E+02
46	1-Nov-04	1.46E+01	1.17E+01	4.68E+01	**1.41E+01**	1.15E+01	1.12E+01	1.52E+01	1.09E+02	1.95E+02
47	1-Nov-04	-1.31E+01	2.45E+01	3.95E+01	**8.69E+00**	8.97E+00	1.18E+01	9.74E+01	1.49E+02	2.76E+02
48	2-Nov-04	1.05E+01	2.76E+01	4.60E+01	**1.79E+01**	1.07E+01	1.10E+01	-1.24E+02	1.14E+02	1.87E+02
49	2-Nov-04	-2.92E+00	7.85E+00	1.26E+01	9.49E+00	3.22E+01	5.83E+01	1.30E+00	2.00E+02	3.50E+02
50	3-Nov-04	-1.95E+01	2.68E+01	4.49E+01	1.60E+00	8.58E+00	1.35E+01	-9.93E+01	1.21E+02	1.88E+02
51	2-Nov-04	-2.65E+01	2.63E+01	4.19E+01	1.68E+00	9.04E+00	1.43E+01	-2.60E+02	1.97E+02	3.09E+02
54	15-Nov-04	-2.51E+00	2.62E+01	4.40E+01	**5.00E+00**	8.00E+00	1.30E+01	-7.09E+01	1.54E+02	2.76E+02
56	16-Nov-04	1.15E+01	2.53E+01	4.41E+01	**5.79E+00**	7.88E+00	1.28E+01	1.13E+02	1.53E+02	2.82E+02
59	15-Nov-04	-7.50E+00	2.62E+01	4.57E+01	**9.78E+00**	1.10E+01	1.14E+01	-6.77E+00	1.19E+02	1.94E+02
59	15-Nov-04	9.07E+00	9.82E+00	4.85E+01	-1.22E+00	9.05E+00	1.40E+01	-2.25E+02	1.89E+02	3.02E+02
60	16-Nov-04	1.22E+00	2.67E+01	4.80E+01	**6.37E+00**	8.89E+00	1.44E+01	9.60E+01	1.77E+02	3.15E+02
64	8-Nov-04	1.20E+01	2.65E+01	4.97E+01	-5.33E-01	9.09E+00	1.42E+01	-2.52E+02	1.92E+02	3.02E+02
65	9-Nov-04	-2.67E+00	2.75E+01	4.87E+01	1.48E+00	9.36E+00	1.49E+01	-1.26E+02	1.92E+02	3.25E+02
66	10-Nov-04	7.99E+00	3.10E+01	5.81E+01	**9.92E+00**	1.16E+01	1.42E+01	-7.19E+01	1.29E+02	2.10E+02
67	10-Nov-04	**2.83E+01**	2.56E+01	4.65E+01	**1.34E+01**	8.76E+00	1.11E+01	-8.72E+01	1.56E+02	2.78E+02
68	16-Nov-04	2.65E+01	2.36E+01	5.10E+01	**1.44E+01**	9.31E+00	1.58E+01	-5.37E+01	1.83E+02	3.19E+02
69	22-Nov-04	6.72E+00	2.68E+01	4.59E+01	**5.28E+00**	8.16E+00	1.33E+01	7.34E+00	1.54E+02	2.83E+02
70	1-Nov-04	-2.72E+00	1.61E+01	2.81E+01	**1.37E+01**	1.58E+01	1.81E+01	-1.42E+03	1.63E+03	2.50E+03
71	2-Nov-04	-1.29E+01	2.64E+01	4.34E+01	**1.13E+01**	1.07E+01	1.08E+01	-1.90E+02	1.17E+02	1.77E+02
72	2-Nov-04	-1.22E+00	2.67E+01	4.76E+01	2.63E-01	8.86E+00	1.38E+01	-1.22E+02	1.97E+02	3.34E+02
72	2-Nov-04	2.32E+00	2.40E+01	4.39E+01	-4.67E+00	9.11E+00	1.38E+01	-1.04E+02	1.84E+02	3.14E+02
73	8-Nov-04	-2.25E+01	2.77E+01	4.40E+01	-3.81E+00	7.84E+00	1.21E+01	-1.20E+02	1.56E+02	2.74E+02
74	18-Oct-04	-7.29E+00	2.84E+01	4.33E+01	**7.07E+00**	8.83E+00	1.43E+01	-1.67E+02	1.85E+02	3.08E+02
75	10-Nov-04	1.09E+00	2.46E+01	4.44E+01	-3.56E+00	8.79E+00	1.34E+01	8.30E+00	1.16E+02	1.90E+02
76	19-Nov-04	-1.49E+01	2.67E+01	4.56E+01	1.86E+00	8.59E+00	1.35E+01	1.96E+01	1.15E+02	1.90E+02
77	15-Nov-04	1.31E+01	2.65E+01	4.92E+01	4.06E+00	8.41E+00	1.33E+01	-6.75E-01	1.13E+02	1.85E+02
78	18-Oct-04	-2.04E+01	2.89E+01	4.68E+01	-4.75E+00	8.00E+00	1.27E+01	-3.64E+01	1.06E+02	1.88E+02
79	15-Nov-04	-1.41E+01	2.76E+01	4.72E+01	2.66E+00	8.86E+00	1.41E+01	-1.19E+02	1.18E+02	1.79E+02
80	3-Nov-04	**2.45E+01**	2.91E+01	5.05E+01	**9.87E+00**	8.93E+00	1.47E+01	-1.71E+02	1.91E+02	3.18E+02
81	9-Nov-04	1.18E+01	2.45E+01	4.28E+01	**8.69E+00**	8.15E+00	1.35E+01	9.46E+01	1.50E+02	2.77E+02

Leachate Aqueous Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

		Gamma Spectrometry								
		Uranium-238 Series Radionuclides								
		^{214}Bi			^{214}Pb			^{234}Th		
SAP ID	Sample Date	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
90	16-Nov-04	-1.06E+01	2.44E+01	4.22E+01	-1.30E+00	8.42E+00	1.29E+01	-4.63E+00	1.12E+02	1.83E+02
91	9-Nov-04	1.70E+01	2.69E+01	4.74E+01	**6.08E+00**	7.85E+00	1.28E+01	-1.31E+02	1.56E+02	2.72E+02
91	9-Nov-04	1.30E+01	2.63E+01	4.58E+01	9.91E-01	7.80E+00	1.24E+01	**1.41E+02**	1.54E+02	2.81E+02
92	28-Oct-04	7.97E+00	8.81E+00	4.37E+01	3.93E+00	7.88E+00	1.29E+01	3.18E+01	1.66E+02	2.81E+02
94	28-Oct-04	1.13E+01	3.19E+01	5.31E+01	**5.97E+00**	9.11E+00	1.47E+01	-1.39E+02	1.96E+02	3.33E+02
95	3-Nov-04	3.11E+00	3.11E+01	5.61E+01	**1.19E+01**	9.04E+00	1.39E+01	-9.60E+01	1.25E+02	2.15E+02
96	9-Nov-04	1.61E+01	2.88E+01	5.39E+01	4.73E+00	8.87E+00	1.43E+01	-8.56E+01	1.83E+02	3.15E+02
All samples (except 1, 4, 18, 38, 74, 78, 92, 94) were UNFILTERED.	**Results N**	59			59			59		
	Result +2σ Unc. ≥MDC	4	7%		26	44%		1	2%	
	Min	-2.73E+01	7.85E+00	1.26E+01	-4.75E+00	5.62E+00	6.70E+00	-1.42E+03	7.30E+01	9.23E+01
	Max	3.51E+01	3.48E+01	6.21E+01	1.79E+01	3.22E+01	5.83E+01	1.41E+02	1.63E+03	2.50E+03
	Mean	1.87E+00	2.49E+01	4.66E+01	4.57E+00	9.53E+00	1.42E+01	-8.97E+01	1.77E+02	2.97E+02
	StdDev	1.34E+01	1.98E+02	7.91E+00	5.66E+00	7.76E+01	6.08E+00	2.00E+02	2.02E+03	2.98E+02
	Range	6.24E+01	2.70E+01	4.95E+01	2.27E+01	2.66E+01	5.16E+01	1.56E+03	1.56E+03	2.41E+03
	Median	2.32E+00	2.65E+01	4.68E+01	4.06E+00	8.87E+00	1.35E+01	-7.19E+01	1.54E+02	2.78E+02
	Method Blank 0410-0693 (10/26/04)	*6.93E+00*	*1.99E+01*	*2.37E+01*	*8.44E+00*	*5.87E+00*	*7.07E+00*	*-1.32E+02*	*9.43E+01*	*1.43E+02*
	Method Blank 0411-0202 (11/05/04)	*7.86E+00*	*2.82E+01*	*4.95E+01*	*-3.81E-01*	*8.32E+00*	*1.36E+01*	*-1.96E+01*	*1.53E+02*	*2.93E+02*
	Method Blank 0411-0496 (11/16/04)	*1.03E+01*	*2.57E+01*	*4.80E+01*	*-3.83E+00*	*8.79E+00*	*1.33E+01*	*1.52E+00*	*1.71E+02*	*3.03E+02*
	Method Blank 0411-0956 (11/23/04)	*1.70E+00*	*2.46E+01*	*4.17E+01*	*-2.01E-01*	*7.46E+00*	*1.17E+01*	*-3.53E+01*	*1.32E+02*	*2.45E+02*
	Min	*1.70E+00*	*1.99E+01*	*2.37E+01*	*-3.83E+00*	*5.87E+00*	*7.07E+00*	*-1.32E+02*	*9.43E+01*	*1.43E+02*
	Max	*1.03E+01*	*2.82E+01*	*4.95E+01*	*8.44E+00*	*8.79E+00*	*1.36E+01*	*1.52E+00*	*1.71E+02*	*3.03E+02*
	Mean	*6.70E+00*	*2.46E+01*	*4.07E+01*	*1.01E+00*	*7.61E+00*	*1.14E+01*	*-4.63E+01*	*1.38E+02*	*2.46E+02*
	StdDev	*3.62E+00*	*3.48E+00*	*1.18E+01*	*5.23E+00*	*1.28E+00*	*3.02E+00*	*5.91E+01*	*3.30E+01*	*7.32E+01*
	Range	*8.60E+00*	*8.30E+00*	*2.58E+01*	*1.23E+01*	*2.92E+00*	*6.53E+00*	*1.34E+02*	*7.67E+01*	*1.60E+02*
	Median	*7.40E+00*	*2.52E+01*	*4.49E+01*	*-2.91E-01*	*7.89E+00*	*1.25E+01*	*-2.75E+01*	*1.43E+02*	*2.69E+02*

Leachate Follow-on Analytical Results (pCi/L)

Bold results exceed the corresponding MDC.

SAP ID	Sample Date	^{228}Ra			^{226}Ra			Total U - KPA (µg/L)			Total U - KPA (pCi/L)		
		Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	27-Oct-04	**1.62**	0.597	0.863	**1.45**	0.690	0.197	**0.286**	0.009	0.2	0.192	n.a.	n.a.
4	28-Oct-04	**1.59**	0.564	0.825	**0.606**	0.375	0.149	**2.18**	0.238	0.2	1.46	n.a.	n.a.
6	2-Nov-04	**5.56**	1.240	0.791	**4.2**	1.35	0.807	**0.479**	0.017	0.2	0.321	n.a.	n.a.
12	28-Oct-04	**6.66**	1.590	1.340	**3.58**	1.17	0.183	**0.572**	0.023	0.2	0.383	n.a.	n.a.
15	8-Nov-04	**2.22**	1.390	2.560	**8.79**	2.32	0.880	**0.613**	0.046	0.2	0.411	n.a.	n.a.
16	28-Oct-04	**3.27**	0.929	1.050	**2.24**	1.00	0.659	**0.897**	0.085	0.2	0.601	n.a.	n.a.
42	1-Nov-04	**41.95**	8.000	0.806	**24.2**	5.16	0.585	**2.5**	0.085	0.2	1.7	n.a.	n.a.
44	3-Nov-04	**1.76**	0.607	0.843	**2.5**	0.982	0.212	**1.12**	0.038	0.2	0.75	n.a.	n.a.
45	1-Nov-04	**6.45**	1.550	1.280	**2.38**	1.00	0.776	**0.265**	0.009	0.2	0.178	n.a.	n.a.
46	1-Nov-04	**4.72**	1.260	1.260	**1.18**	0.687	0.637	**0.273**	0.034	0.2	0.183	n.a.	n.a.
64	8-Nov-04	**1.75**	0.584	0.796	**2.07**	0.834	0.520	0.064	0.007	0.2	0.043	n.a.	n.a.
68	16-Nov-04	**4.16**	1.100	1.110	**2.22**	0.977	0.859	0.037	0.004	0.2	0.025	n.a.	n.a.
71	2-Nov-04	**0.711**	0.445	0.828	**1.04**	0.632	0.604	0.021	0.002	0.2	0.014	n.a.	n.a.
72	2-Nov-04	**2.96**	0.905	1.160	**0.724**	0.609	0.779	**0.545**	0.027	0.2	0.365	n.a.	n.a.
73	8-Nov-04	**1.13**	0.925	1.840	0.18	0.524	0.905	0.061	0.005	0.2	0.041	n.a.	n.a.
75	10-Nov-04	**3.91**	1.130	1.370	**1.32**	0.726	0.636	0.056	0.006	0.2	0.038	n.a.	n.a.
81	9-Nov-04	**1.06**	0.486	0.808	**3.71**	1.26	0.606	0.00	0.000	0.2	0	n.a.	n.a.
95	3-Nov-04	**2.63**	0.847	0.810	**0.602**	0.591	0.810	0.128	0.004	0.2	0.086	n.a.	n.a.
96	9-Nov-04	**8.53**	2.500	3.030	**2.79**	1.11	0.888	0.00	0.000	0.2	0	n.a.	n.a.
	Results N	19			19			19			19		
	Result +2σ Unc. ≥MDC	19	100%		18	95%		11	58%		n.a	n.a.	
	Min	0.711	0.445	0.791	0.18	0.375	0.149	0	0.000	0.2	0	n.a.	n.a.
	Max	41.95	8.000	3.030	24.2	5.16	0.905	2.5	0.238	0.2	1.7	n.a.	n.a.
	Mean	5.40	1.403	1.230	3.46	1.16	0.615	0.531	0.034	0.2	0.356	n.a.	n.a.
	StdDev	9.115	9.370	0.623	5.38	6.756	0.255	0.714	0.279	0	0.478	n.a.	n.a.
	Range	41.24	7.555	2.239	24.02	4.785	0.756	2.5	0.238	0	1.68	n.a.	n.a.
	Median	2.960	0.929	1.050	2.22	0.977	0.637	0.273	0.009	0.2	0.183	n.a.	n.a.

Leachate Filterable Residue Analytical Results (pCi/g)

Bold results exceed the corresponding MDC.

Gamma Spectrometry

SAP ID	Name	^{60}Co			^{137}Cs			^{241}Am			^{235}U			^{154}Eu			^{40}K		
		Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	ISG Plate (Bethlehem Steel)	8.55E-01	2.44E+00	5.10E+00	1.08E+00	2.28E+00	4.32E+00	2.47E+00	5.67E+00	1.06E+01	-1.20E+01	8.53E+00	1.33E+01	1.36E+00	6.80E+00	1.34E+01	1.75E+01	2.90E+01	6.57E+01
4	Pottstown MW	-3.29E-01	2.62E+00	5.07E+00	-2.99E-01	2.05E+00	3.68E+00	-1.78E+00	5.38E+00	9.54E+00	-1.87E+00	8.53E+00	1.51E+01	2.48E+00	7.29E+00	1.45E+01	-2.69E+01	3.14E+01	5.89E+01
18	Pine Grove MW	-1.47E-01	2.69E+00	4.64E+00	-3.14E+00	3.68E+00	4.98E+00	-2.68E+00	1.28E+01	2.19E+01	-1.95E+01	2.31E+01	3.61E+01	-4.31E+00	7.74E+00	1.31E+01	**1.05E+02**	6.64E+01	**3.75E+01**
38	Cumberland County MW	3.39E-01	5.24E+00	9.60E+00	-2.97E+00	6.44E+00	1.05E+01	-1.10E+01	2.80E+01	4.83E+01	-7.38E+01	4.74E+01	7.27E+01	8.94E+00	1.52E+01	2.91E+01	3.66E+01	9.78E+01	2.01E+02
74	Monroeville (Chambers) MW	-2.73E+00	4.12E+00	6.99E+00	-3.40E+00	5.33E+00	8.71E+00	-1.17E+01	2.35E+01	4.05E+01	-2.32E+01	3.64E+01	6.00E+01	-1.21E+01	1.36E+01	2.25E+01	3.88E+01	8.77E+01	1.80E+02
78	Shade MW	9.39E-01	5.22E+00	9.83E+00	4.54E+00	5.27E+00	1.01E+01	-2.85E+01	2.92E+01	4.91E+01	-6.09E+01	3.08E+01	4.49E+01	-5.45E+00	1.57E+01	2.72E+01	4.00E+01	6.48E+01	1.36E+02
92	Lake View MW	**2.87E+00**	2.36E+00	5.14E+00	-8.51E-01	2.10E+00	3.62E+00	-6.50E-01	5.49E+00	9.82E+00	-6.00E+00	1.15E+01	1.92E+01	2.02E+00	6.09E+00	1.22E+01	-5.57E+01	3.41E+01	7.04E+01
94	Northwest Sanitary MW	6.30E-01	1.97E+00	4.00E+00	**1.96E+00**	2.01E+00	3.94E+00	-2.35E+00	5.79E+00	1.01E+01	2.77E+00	1.15E+01	2.02E+01	-6.24E+00	6.69E+00	1.09E+01	-8.05E+00	3.82E+01	8.31E+01
	Result +2σ Unc. ≥MDC	8 1	 13%		8 1	 13%		8 0	 0%		8 0	 0%		8 0	 0%		8 1	 13%	
	Min	-2.73E+00	1.97E+00	4.00E+00	-3.40E+00	2.01E+00	3.62E+00	-2.85E+01	5.38E+00	9.54E+00	-7.38E+01	8.53E+00	1.33E+01	-1.21E+01	6.09E+00	1.09E+01	-5.57E+01	2.90E+01	3.75E+01
	Max	2.87E+00	5.24E+00	9.83E+00	4.54E+00	6.44E+00	1.05E+01	2.47E+00	2.92E+01	4.91E+01	2.77E+00	4.74E+01	7.27E+01	8.94E+00	1.57E+01	2.91E+01	1.05E+02	9.78E+01	2.01E+02
	Mean	3.03E-01	3.33E+00	6.30E+00	-3.85E-01	3.65E+00	6.23E+00	-7.02E+00	1.45E+01	2.50E+01	-2.43E+01	2.22E+01	3.52E+01	-1.66E+00	9.89E+00	1.79E+01	1.84E+01	5.62E+01	1.04E+02
	StdDev	1.57E+00	1.01E+01	2.27E+00	2.82E+00	1.14E+01	3.01E+00	9.98E+00	4.98E+01	1.80E+01	2.81E+01	7.39E+01	2.23E+01	6.58E+00	3.01E+01	7.26E+00	4.92E+01	1.74E+02	6.06E+01
	Range	5.60E+00	3.27E+00	5.83E+00	7.94E+00	4.43E+00	6.88E+00	3.10E+01	2.38E+01	3.96E+01	7.66E+01	3.89E+01	5.94E+01	2.10E+01	9.61E+00	1.82E+01	1.61E+02	6.88E+01	1.64E+02
	Median	4.85E-01	2.66E+00	5.12E+00	-5.75E-01	2.98E+00	4.65E+00	-2.52E+00	9.30E+00	1.63E+01	-1.58E+01	1.73E+01	2.82E+01	-1.48E+00	7.52E+00	1.40E+01	2.71E+01	5.15E+01	7.68E+01
	Method Blank 0410-0694 (10/26/04)	*3.38E+00*	*4.41E+00*	*8.36E+00*	*2.11E+00*	*3.15E+00*	*5.49E+00*	*4.26E+00*	*1.44E+01*	*2.51E+01*	*-3.78E+01*	*2.07E+01*	*3.08E+01*	*-1.15E+00*	*8.13E+00*	*1.39E+01*	*2.76E+01*	*5.13E+01*	*7.76E+01*
	Method Blank 0411-0203 (11/5/04)	*-1.88E-01*	*2.00E+00*	*3.82E+00*	*3.02E+00*	*1.74E+00*	*3.67E+00*	*-2.90E+00*	*4.80E+00*	*8.29E+00*	*-7.60E+00*	*7.14E+00*	*1.17E+01*	*4.73E-01*	*4.96E+00*	*9.65E+00*	*-1.83E+01*	*2.53E+01*	*4.83E+01*

Leachate Filterable Residue Analytical Results (pCi/g)

Bold results exceed the corresponding MDC.

SAP ID	Name	Gamma Spectrometry																		
		Thorium-232 Series Radionuclides												Uranium-238 Series Radionuclides						
		^{228}Ac			^{208}Tl			^{212}Bi			^{212}Pb			^{214}Bi			^{214}Pb			^{234}Th		
		Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC	Result	2σ Unc.	MDC
1	ISG Plate (Bethlehem Steel)	**1.00E+01**	7.40E+00	1.61E+01	-5.33E-01	1.92E+00	3.45E+00	3.88E+00	2.57E+01	5.02E+01	4.26E-01	2.90E+00	5.02E+00	1.68E+01	1.54E+01	3.29E+01	-4.00E-01	3.56E+00	6.12E+00	-5.11E+01	5.23E+01	8.72E+01
4	Pottstown MW	4.49E+00	8.32E+00	1.66E+01	-1.41E+00	1.98E+00	3.35E+00	8.53E+00	2.75E+01	5.42E+01	1.88E+00	3.07E+00	5.46E+00	7.65E+00	1.67E+01	3.25E+01	1.03E+00	3.30E+00	5.90E+00	-5.96E+01	5.05E+01	8.18E+01
18	Pine Grove MW	**1.28E+01**	1.67E+01	1.98E+01	**4.87E+00**	3.86E+00	4.85E+00	1.77E+01	4.99E+01	6.96E+01	-3.41E+00	6.40E+00	9.48E+00	-1.83E+01	2.93E+01	3.53E+01	**3.25E+00**	8.85E+00	1.13E+01	-1.83E+02	1.44E+02	2.35E+02
38	Cumberland County MW	4.02E+00	2.48E+01	4.07E+01	**6.30E+00**	7.27E+00	1.24E+01	2.50E+01	8.54E+01	1.46E+02	-3.14E+00	1.18E+01	1.98E+01	-1.64E+01	4.63E+01	7.53E+01	-3.74E+00	1.41E+01	2.25E+01	-2.19E+02	2.75E+02	4.96E+02
74	Monroeville (Chambers) MW	5.59E+00	1.96E+01	3.33E+01	1.99E+00	5.69E+00	9.68E+00	-1.70E+01	7.13E+01	1.19E+02	-1.26E+01	9.51E+00	1.52E+01	-1.18E+01	3.87E+01	6.49E+01	-2.73E+00	1.15E+01	1.88E+01	-2.10E+02	2.32E+02	4.19E+01
78	Shade MW	8.23E+00	1.92E+01	3.57E+01	2.86E+00	5.60E+00	1.02E+01	4.20E+01	7.39E+01	1.42E+02	-2.72E+00	9.39E+00	1.48E+01	1.60E+01	3.98E+01	7.01E+01	**7.98E+00**	1.05E+01	1.77E+01	4.54E+01	2.54E+02	4.61E+02
92	Lake View MW	-2.76E+00	7.75E+00	1.36E+01	**1.98E+00**	3.46E+00	3.69E+00	1.34E+01	2.80E+01	5.26E+01	-2.06E-01	3.28E+00	5.77E+00	9.91E+00	1.62E+01	3.24E+01	1.14E+00	4.22E+00	7.49E+00	-4.41E+01	5.76E+01	1.07E+02
94	Northwest Sanitary MW	-7.46E+00	8.29E+00	1.34E+01	-3.67E-01	2.16E+00	3.75E+00	8.30E+00	2.95E+01	5.41E+01	1.79E+00	3.21E+00	5.86E+00	-4.18E-01	1.48E+01	2.80E+01	**3.49E+00**	4.17E+00	7.65E+00	-3.50E+01	5.75E+01	1.08E+02
		8			8			8			8			8			8			8		
	Result +2σ Unc. ≥MDC	2	25%		3	38%		0	0%		0	0%		0	0%		3	38%		0	0%	
	Min	-7.46E+00	7.40E+00	1.34E+01	-1.41E+00	1.92E+00	3.35E+00	-1.70E+01	2.57E+01	5.02E+01	-1.26E+01	2.90E+00	5.02E+00	-1.83E+01	1.48E+01	2.80E+01	-3.74E+00	3.30E+00	5.90E+00	-2.19E+02	5.05E+01	4.19E+01
	Max	1.28E+01	2.48E+01	4.07E+01	6.30E+00	7.27E+00	1.24E+01	4.20E+01	8.54E+01	1.46E+02	1.88E+00	1.18E+01	1.98E+01	1.68E+01	4.63E+01	7.53E+01	7.98E+00	1.41E+01	2.25E+01	4.54E+01	2.75E+02	4.96E+02
	Mean	4.36E+00	1.40E+01	2.37E+01	1.96E+00	3.99E+00	6.42E+00	1.27E+01	4.89E+01	8.60E+01	-2.25E+00	6.20E+00	1.02E+01	4.30E-01	2.72E+01	4.64E+01	1.25E+00	7.53E+00	1.22E+01	-9.46E+01	1.40E+02	2.02E+02
	StdDev	6.66E+00	4.36E+01	1.11E+01	2.70E+00	1.25E+01	3.70E+00	1.70E+01	1.53E+02	4.23E+01	4.69E+00	1.99E+01	5.69E+00	1.43E+01	8.42E+01	1.99E+01	3.74E+00	2.40E+01	6.55E+00	9.67E+01	4.76E+02	1.80E+02
	Range	2.03E+01	1.74E+01	2.73E+01	7.71E+00	5.35E+00	9.05E+00	5.90E+01	5.97E+01	9.58E+01	1.45E+01	8.90E+00	1.48E+01	3.51E+01	3.15E+01	4.73E+01	1.17E+01	1.08E+01	1.66E+01	2.64E+02	2.25E+02	4.54E+02
	Median	5.04E+00	1.25E+01	1.82E+01	1.99E+00	3.66E+00	4.30E+00	1.10E+01	3.97E+01	6.19E+01	-1.46E+00	4.84E+00	7.67E+00	3.62E+00	2.30E+01	3.41E+01	1.09E+00	6.54E+00	9.48E+00	-5.54E+01	1.01E+02	1.08E+02
	Method Blank 0410-0694 (10/26/04)	*3.76E+00*	*1.41E+01*	*1.98E+01*	-1.90E+00	4.05E+00	5.43E+00	9.55E+00	4.02E+01	7.14E+01	-2.06E+00	7.61E+00	9.02E+00	1.02E+01	3.05E+01	3.76E+01	6.58E+00	9.34E+00	1.14E+01	-1.89E+02	1.42E+02	2.18E+02
	Method Blank 0411-0203 (11/5/04)	*-3.51E+00*	*6.63E+00*	*1.15E+01*	*7.00E-03*	*1.65E+00*	*3.00E+00*	*1.84E+01*	*1.88E+01*	*4.01E+01*	*-1.18E+00*	*2.44E+00*	*3.92E+00*	*-1.07E+00*	*1.37E+01*	*2.38E+01*	*1.12E+00*	*2.91E+00*	*5.04E+00*	*-3.34E+01*	*4.41E+01*	*7.56E+01*

Attachment C

Laboratory Analysis Reports

[Laboratory Reports on File]