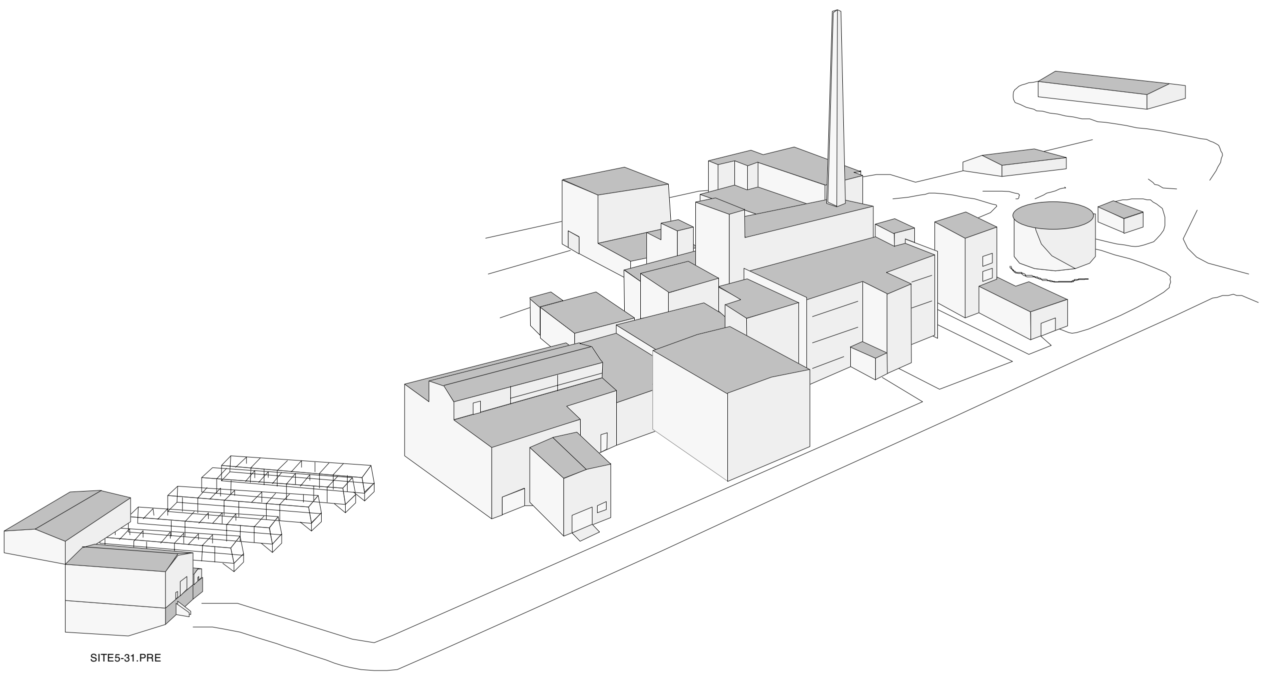
WEST VALLEY DEMONSTRATION PROJECT
SITE ENVIRONMENTAL REPORT
CALENDAR YEAR 1999



West Valley Nuclear Services Company
and
URS/Dames & Moore

Prepared for:
U.S. Department of Energy
Ohio Field Office
West Valley Demonstration Project
Under Contract DE-AC24-81NE44139

June 2000
10282 Rock Springs Road
West Valley, New York 14171-9799

Department of Energy
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To The Reader:

This report, prepared by the U.S. Department of Energy (DOE) West Valley Demonstration Project (OH/WVDP), summarizes the environmental protection program at the West Valley Demonstration Project (WVDP) for calendar year 1999. Consistent with prior years, this report is being made available to the public as soon as possible and well in advance of DOE's required release date of October 1, 2000.

Monitoring and surveillance of the WVDP facilities are conducted in order to protect public health and safety and the environment. The quality assurance protocols applied to the environmental monitoring program by the DOE ensure the validity and accuracy of the monitoring data. Also included in this report are groundwater and ambient air data from the New York State Energy Research and Development Authority's (NYSERDA) New York State-licensed Disposal Area (SDA).

Air, surface water, groundwater, soil, and biological samples are collected and analyzed for radiological and nonradiological constituents in order to evaluate the potential effects of activities at the WVDP. Calculated doses to the hypothetical maximally exposed off-site individual from air- and waterborne radiological releases in 1999 were less than one percent of the DOE limit. Radionuclide concentrations in biological samples were at levels near to or statistically identical to background concentrations.

Results of nonradiological (chemical) tests of surface water and soil samples showed no effects on the off-site environment. Nonradiological liquid effluent releases are controlled and permitted through the New York State Pollutant Discharge Elimination System (SPDES). Releases in 1999 were below regulatory limits with no exceptions.

In 1999 the Project continued the transition from high-level waste vitrification to preparation for facility cleanup. Monitoring of treated water effluents and facility ventilation system emissions verified that the dose received by off-site residents continues to be minimal.

If you have any questions or comments about the information in this report, please contact the West Valley Nuclear Services Company (WVNS) Manager of Communications, John D. Chamberlain, at (716) 942-4610, or complete and submit the enclosed survey.

Sincerely,

Barbara A. Mazurowski

B. A. Mazurowski, Director
West Valley Demonstration Project

West Valley Demonstration Project

Site Environmental Report

for

Calendar Year 1999

Prepared for the U.S. Department of Energy

Ohio Field Office

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June 2000

West Valley Nuclear Services Co.

10282 Rock Springs Road

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Preface

Environmental monitoring at the West Valley Demonstration Project (WVDP) is conducted by the West Valley Nuclear Services Company (WVNS), under contract to the U.S. Department of Energy (DOE). The data collected provide an historical record of radionuclide and radiation levels from natural and manmade sources in the survey area. The data also document the quality of the groundwater on and around the WVDP and the quality of the air and water discharged by the WVDP.

This report represents a single, comprehensive source of off-site and on-site environmental monitoring data collected during 1999 by environmental monitoring personnel. The environmental monitoring program and results are discussed in the body of this report. The monitoring data are presented in the appendices. Appendix A contain maps of on-site and off-site sampling locations. Appendix B is a summary of the site environmental monitoring schedule. Appendices C through J contain summaries of data obtained during 1999 and are intended for those readers interested in more detail than is provided in the main body of the report. Appendix K lists the environmental permits and regulations pertaining to the WVDP. Appendix L lists data from the New York State-licensed Disposal Area (SDA).

Requests for additional copies of the 1999 Site Environmental Report and questions regarding the report should be referred to the WVDP Communications Department, 10282 Rock Springs Road, West Valley, New York 14171 (telephone: 716-942-4610). Site environmental reports also are available electronically at http://www.wvdp.com under the Westinghouse/WVNS Site Contractor WVDP History page.

SUMMARY OF CHANGES TO THE 1999 WVDP SITE ENVIRONMENTAL REPORT FROM THE 1998 SITE ENVIRONMENTAL REPORT

This report, prepared by the U.S. Department of Energy (DOE) West Valley Demonstration Project office, summarizes the environmental protection program at the West Valley Demonstration Project (WVDP) for calendar year 1999. Monitoring and surveillance of the facilities used by the DOE for the WVDP are conducted in order to protect public health and safety and the environment. The quality assurance protocols applied to the environmental monitoring program by the DOE ensure the validity and accuracy of the monitoring data. Also included in this report are groundwater and ambient air data from the New York State Energy Research and Development Authority's (NYSERDA) New York State-licensed Disposal Area (SDA).

Changes in content for the 1999 WVDP annual Site Environmental Report are summarized below. The format and organization of the report are the same as the 1998 Site Environmental Report.

REVISIONS AND ADDITIONS

- The Compliance Summary has been updated to reflect the 1999 regulatory compliance status.

- Continued progress in vitrifying the residual high-level liquid radioactive waste and in preparing the Project facilities for decontamination and decommissioning is addressed in the Executive Summary, the Environmental Compliance Summary, and in Chapter 1.

- Data and text have been updated throughout the report to reflect the CY 1999 environmental monitoring program and compliance status. Tables, graphs, and maps of sampling locations, analytes, and frequencies have been updated. Some references also have been updated.

- Chapter 1 summarizes 1999 activities at the WVDP. Two new graphs were added to show long-term trends of decreasing exposure rates near two on-site waste storage areas: the chemical process cell waste storage area and the drum cell. Graphs of performance indicators were updated to include the 1999 performance results.

- Chapter 2 includes a discussion of 1999 radiological results of sampling of air emissions and water effluents as compared to DOE concentration guides. The 1999 results from near-site locations are also compared to results from background locations in order to evaluate the relative effects of site activities.

- Chapter 3 was updated to summarize and discuss results of the 1999 groundwater monitoring program, including continued monitoring, characterization, and mitigation of the strontium-90 plume on the north plateau. The pilot-scale permeable treatment wall that was installed in 1999 in the eastern lobe of the strontium-90 plume and the 1999 evaluation of screen corrosion in wells in the sand and gravel unit are described. One data table (formerly Table E-12), which summarized chromium and nickel data, was removed from Appendix E because the special monitoring for these parameters was completed before CY 1999.

- Chapter 4 provides an assessment of dose to the general public resulting from exposure to radiation and radionuclides released by the Project to the surrounding environment in 1999. As in previous years, the WVDP was found to be in compliance with all applicable effluent radiological guidelines and standards.

- Chapter 5 was updated to include 1999 changes to the WVDP quality assurance program and to summarize assessments of the environmental monitoring program. In 1999 the EPA's National Exposure Research Laboratory, Environmental Sciences Division radiological crosscheck program was privatized and samples were not distributed. The EPA's nonradiological crosscheck program also was privatized and no samples were available. The two tables that formerly summarized results from these crosschecks (J-3 and J-4 in the 1998 Site Environmental Report) were dropped from the 1999 Site Environmental Report.

- One new figure was added to Appendix A: Figure A-13 shows the projected 2000 census population by sector within 80 kilometers of the site.

- Changes to the environmental monitoring program in 1999 are summarized at the beginning of Appendix B.

SPECIAL ISSUES

- In 1999 the WVDP applied for DOE Voluntary Protection Program STAR designation. In early 2000, STAR status for the WVDP was announced.

- For the second successive year since the DOE began operations at the WVDP in 1982, no SPDES exceptions were noted.

- Negotiations with NYSDEC regarding additional SPDES permit monitoring requirements and limits for mercury were initiated in 1999. It is expected that a final SPDES permit that addresses mercury will be issued in 2000. A draft SPDES permit including storm water monitoring, submitted for public comment in June 1997, is still pending.

- No unplanned radiological releases to the off-site environment occurred in 1999.

- Corrective actions to bring environmental monitoring software and hardware into year-2000 compliance were completed in September 1999. No problems as a result of the millennium date change were noted in the WVDP environmental monitoring program.

- In 1999 the DOE approved the design and construction of a remote-handled waste facility.

- In 1999 the NRC commissioners approved the License Termination Rule as the decommissioning criteria for the WVDP. A draft policy statement describing the decision was issued on December 3, 1999.

ERRATA and CORRIGENDA
West Valley Demonstration Project
Site Environmental Report
Calendar Year 1998

Uranium calculations: A problem with uranium isotope calculations by a vendor laboratory was detected in 1998 through rigorous quality control analysis of the reported data. The values reported were higher than the true values and affected samples from 1995 through 1998. Most concentrations did not differ by more than 0.5%. Corrections to the calculations have been made and updated values have been entered in the WVDP environmental database. The tables in the 1998 Site Environmental Report that were affected by these changes are Tables C-1, D-7, and E-14.

Uncertainties in calculating operating times for the air sampler that ran intermittently at the contact size-reduction facility (ANCSFRK, Table D-6) resulted in total radionuclide release estimates that were approximately 6% lower than reported in 1998. Revised release estimates for this location would not have affected the reported dose estimate.

Other errata:

Location	Analyte/Item	1998 Report Read:	Should Read:
page 2-5	Units in Tables 2-1 and 2-2	Bq/m^3	Bq/L
page 2-5	Table 2-2, WNSWAMP, average	0.10±9.98E-01Bq/L	1.01±0.01E+02Bq/L
page C-3	WNSP001, U-238	1.40±0.06E-06 Ci	1.40±0.06E-04 Ci
page C-4	WNSP001, U-238	1.51±0.07E-06 Ci	1.40±0.06E-04 Ci
page E-26	Units in Figure E-1	µCi/mL	standard units
page E-26	Units in Figure E-2	µCi/mL	µmhos/cm@25^{0}C

Any questions about these corrigenda may be directed to the Manager of Communications, John D. Chamberlain, West Valley Nuclear Services Co., at (716) 942-4610.

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The West Valley Demonstration Project

EXECUTIVE SUMMARY

Project Description

The West Valley Demonstration Project (WVDP), the site of a U.S. Department of Energy (DOE) environmental cleanup activity operated by West Valley Nuclear Services Co. (WVNS), is in the process of stabilizing liquid high-level radioactive waste that remained at the site after commercial nuclear fuel reprocessing had been discontinued. The Project is located in Western New York State, about 30 miles south of Buffalo, within the New York State-owned Western New York Nuclear Service Center (WNYNSC). The WVDP is currently focusing on several goals that will lead to eventual site closure: removing and vitrifying the high-level residuals (heels) remaining in the high-level waste tanks, shipping low-level waste, preparing for the shipment of spent nuclear fuel, and cleaning up facilities not currently used.

Compliance

Management at the WVDP continued to provide strong support for environmental compliance in 1999. DOE Orders and applicable state and federal statutes and regulations are integrated into the Project's compliance program. Highlights of the 1999 compliance program were as follows:

- All State Pollutant Discharge Elimination System (SPDES) permit limits were met in 1999.

- No notices of violation or inspection findings from any environmental regulatory agencies were received by the WVDP in 1999.

- Inspections of hazardous waste activities by the New York State Department of Environmental Conservation (NYSDEC) verified Project compliance with the applicable state and federal regulations.

- The Project continued to monitor specific waste management areas at the site in order to comply with the Resource Conservation and Recovery Act (RCRA) §3008(h) Administrative Order on Consent.

- The Project also met the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA) by identifying information about hazardous materials used at the Project and making this information available to the local community.

A reader opinion survey has been inserted in this report. If it is missing, please contact the Communications Department at (716) 942-4610. Additional Project information is available on the Internet at http://www.wvdp.com.

- The SPDES permit currently identifies four permitted liquid outfalls at the Project. A draft SPDES permit to monitor eleven of thirty identified storm water outfalls was issued for public comment in June 1997, and a final permit is expected to be issued to the WVDP in 2000.

- Among other pollution-prevention accomplishments, waste minimization goals for 1999 were exceeded in all of the waste categories set in the one-year goals statement. The WVDP continues to exceed expectations for the five-year waste-minimization goals.

- In accordance with the Site Treatment Plan developed under the Federal Facility Compliance Act, all calendar year 1999 milestones for the characterization, treatment, and disposition of radioactive mixed waste at the WVDP were completed.

- There were no unplanned off-site releases of radiological material in 1999.

Environmental Monitoring Program

Throughout the first three years of vitrification, specific, sustained attention was given to environmental monitoring and assessment of effluents from changing site operations. In 1999 Project environmental scientists continued to sample and measure effluent air and water, groundwater, surface streams, soil, sediment, vegetation, meat, milk, and game animals, and to record environmental radiation measurements. More than 10,000 samples were collected in order to assess the effect of site activities on public health, safety, and the environment.

The Project's environmental monitoring network is continually being evaluated and updated to ensure that all the locations and sample types that would be sensitive to process-related changes are monitored. Samples are tested for radioactivity and/or nonradioactive substances using approved laboratory procedures. Both the laboratory test results and direct measurement data are reviewed at several stages for quality and for comparison with similar data.

Environmental data are entered in a controlled database and are automatically compared to upper and lower acceptance values. Data points falling outside these values are brought to the attention of WVDP scientists for further investigation. WVDP scientists assess all data points and evaluate trends at each location.

Surface Water Monitoring. The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility through the lagoon 3 release outfall. The treated effluent water flows into Erdman Brook, which joins Frank's Creek just before exiting the Project's fenced area. Four treated batches totaling approximately 7.7 million gallons were released over a combined twenty-five day period in 1999. In 1998, 11.5 million gallons were released.

The combined average concentration of all radionuclides in liquid releases from lagoon 3 in 1999 was approximately 32% of the DOE derived concentration guide (DCG), which is used to evaluate liquid process discharges. (See Chapter 1, p.1-5, for an explanation of DCGs.) The average radioactivity concentrations from 1995 to 1999 were 43%, 35%, 22%, 23%, and 32% of the DCG, respectively. The major dose contributors to the total combined liquid effluent in 1999 were cesium-137 and strontium-90. Higher concentrations of cesium-137 and strontium-90 in facility effluents may be a factor contributing to the increase, compared to 1998, in the percent of the DCG released in 1999.

Surface water is continually sampled on the Project premises by four automatic samplers: Timed composite samples are collected at

Frank's Creek where it exits the Project, at two other on-site points where water flows off-site, and at a surface drainage point near the former radioactive waste disposal areas. Samples also are collected periodically at nine other points of drainage from facility areas. The data from these samples are used to determine the type, amount, and probable origin of both radiological and nonradiological contaminants.

As in 1998, the most notable source of gross beta and strontium-90 radioactivity in surface water in 1999 was from groundwater migrating through the subsurface of the north plateau and emerging as seepage to join the surface water drainage from the north plateau into Frank's Creek and then off-site. (See Fig.A-2 in Appendix A [p.A-4].)

This drainage point has been carefully monitored since the contaminated seep was identified in 1993. A groundwater recovery and treatment system currently is being used to reduce the migration of strontium-90 to surface water on the north plateau. The strontium-90, which originates from pre-Project operations, was about 1.8 times the DCG for liquid discharges in 1999. The 1998 strontium-90 concentration at this point was about 1.4 times the DCG. The increase in the 1999 strontium-90 concentration at the northeast swamp drainage is not unexpected and is thought to be linked to a combination of groundwater moving beyond the influence of the currently operating recovery system and unusually low precipitation in 1999.

The WVDP is evaluating a pilot-scale permeable treatment wall for treating contaminated groundwater on the north plateau. A subsurface trench filled with ion-exchange media, installed in the eastern lobe of the plume, removes contaminants from the groundwater as it flows through the trench. (See Chapter 3, p.3-16 for additional discussion of this technology.)

Nonradiological contaminants, measured at three outfalls and calculated at one monitoring point, were below the New York SPDES permit limits.

Soil and Stream Sediments. Surface soil is collected annually near the ten air sampler locations in order to track long-term deposition. Sediments from off-site creeks are collected annually from three downstream and two upstream locations. Three on-site drainage areas are also sampled annually in order to track waterborne movement of contaminants.

Surface soil samples in 1999 showed little change from previous years. Except for one area that historically has shown average cesium-137 concentrations above background values, the concentrations of radionuclides normally present in soil from both worldwide fallout and from Project air emissions are no different at near-site locations than at background locations.

Because of pre-Project releases from nuclear fuel reprocessing activities, the concentrations of cesium-137 in downstream creek sediments have been historically above concentrations in the upstream sediments. However, in 1998 sediment samples at one downstream location showed a marked decrease in cesium-137, compared to historical values, after an unusually high June 1998 flood. The 1999 samples showed a continued level of cesium-137 that is lower than historical values. The fourteen-year graph (Fig. 2-4 [p.2-12]) indicates no upward trends at either upstream or downstream points.

Groundwater Monitoring. Groundwater samples were collected as scheduled from sixty-nine on-site locations in 1999. Computerized screening of 1999 data speeded identification and evaluation of changes. Monitoring activities in 1999 included gathering more detailed information about the north plateau strontium-90 contamination. The 1999 groundwater program confirmed that strontium-90 is still the major contributor to elevated gross beta contamination in the plume on the north plateau. The concentrations of other isotopes were below the DCG levels generally applied to surface water.

In addition to collecting samples from wells, groundwater was routinely collected from seeps on the bank above Frank's Creek along the northeastern edge of the north plateau. Results of radiological analyses indicate that gross beta activity from the north plateau plume has not migrated to these seepage areas. Site groundwater also is tested for a number of nonradiological contaminants: In 1999 there were no statistically remarkable changes in the levels measured.

As in previous years, near-site residential water-supply wells sampled during 1999 were within the historical range of values measured at the background well.

Air Monitoring. WVDP airborne radiological emissions in 1999 included emissions from six routinely operated permitted exhaust points and four exhausts excluded from permitting because of their low emission potential. As anticipated, radioactive releases from the Project in 1999 were far below the most restrictive limits that ensure public health and safety. Operating the vitrification process at a reduced capacity resulted in radiological air releases that were less than those noted in the last few months of 1998.

The dose from 1999 air emissions was about 0.11% of the EPA radionuclide emissions standard of 10 millirem (mrem) per year effective dose equivalent to the maximally exposed off-site individual. In 1998 the dose from these emissions was about 0.34%.

Although several fission products contribute to the radioactivity, the most significant continued to be airborne iodine-129, a long-lived radionuclide that exists in gaseous form at the high temperatures of the vitrification process and that is not fully removed during treatment of the air effluent. The 1999 levels of gaseous iodine-129 emissions were lower than 1998 levels. Approximately 99% of the 1999 calculated dose to the public is attributable to iodine-129 emissions from the vitrification process.

Six air samplers on the perimeter of the WNYNSC and four in more distant locations continuously collect samples of air at the average human breathing height. The samples are tested for radioactivity carried by airborne particles. At two of the ten locations samples also are collected for analysis for tritium and iodine-129.

Gross radioactivity (airborne particulate) in 1999 air samples from around the perimeter was within the historical range of radioactivity measured at remote background locations or nearby communities. Gross radioactivity at the nearest perimeter sampler remained the same in 1999 as in 1998. Concentrations in samples from three on-site ambient air samplers located near waste storage facilities operated during 1999 also were far below any applicable limits.

Nitrogen oxides, nonradiological byproducts of the vitrification process, are monitored as part of the emission-control process. No opacity or permit limits were exceeded in 1999. Although there are a number of permitted air-emissions sources at the Project, none release a sufficient quantity of nonradiological material to warrant continuous monitoring as a condition of a regulatory permit.

Vegetation, Meat, and Milk. Test results from near-site samples of beans, apples, corn, hay, beef, and milk were consistent with results noted in previous years. With the exception of strontium-90 that was detectable at slightly above background values in corn from a location near the WVDP, no site-related effects were noted.

Game Animals. Fifty fish specimens from Cattaraugus Creek were collected in 1999 for testing. Ten of these were from below the Springville dam, including species that migrate up from Lake Erie. Two semiannual sample sets of ten fish each were collected downstream of Buttermilk Creek, which receives Project liquid effluents, and two sets were collected upstream. These samples represent sportfishing species and bottom-feeding indicator species. Testing for gamma-emitting isotopes and strontium-90 showed no significant difference between average concentrations in upstream (background) fish and downstream fish.

Three samples of whitetail deer venison from a near-site (WNYNSC) herd were tested for gamma-emitting isotopes and strontium-90. Control deer samples from locations more than thirty miles away from the site also were collected in 1999. Low levels of radioactivity from cesium-137, strontium-90, and naturally occurring potassium-40 were detectable in both control and near-site deer samples. Although results vary from year to year, data from the last nine years show no statistical differences between radionuclide concentrations in near-site and control venison samples.

In 1999, the sixth year of public access to portions of the WNYNSC for deer hunting, seventy-two deer were taken by hunters during the hunting season.

Program Quality

The WVDP environmental monitoring program is designed to produce high quality, reliable results. To maintain this standard, each scientist must give continuous attention to the details of sample handling, following approved collection and analysis procedures and data review. Formal self-assessments were performed, and the environmental laboratory also continued the practice of analyzing radiological crosscheck samples sent from a national laboratory. Of 120 radiological analyses performed at both the on-site Project laboratory and off-site commercial service laboratories, 119 (99%) were within the control limits. The samples tested on-site at the Project environmental laboratory (twenty-five samples) were all within acceptable limits. Nonradiological check samples were not evaluated in 1999 because of a hiatus in the EPA crosscheck program.

Although no formal external audits of the environmental monitoring program were conducted in 1999, test results from the crosscheck program, self-assessments, and comparisons of co-located sample measurements taken by independent agencies such as the New York State Department of Health (NYSDOH) and NYSDEC indicate that high quality standards are being met. The WVNS Environmental Affairs and the Quality Assurance departments periodically conducted and documented reviews of program activities in 1999.

Notable 1999 Events

The WVDP's integrated safety management system was verified by the DOE in 1998, and in 1999 a self-assessment of the program confirmed its function as an important aspect of the WVDP's safety culture.

In 1999 the WVDP was recommended for STAR status, the highest safety award given within the DOE. This award, received in early 2000, has been granted to only five other DOE sites in recognition of superior health and safety performance by contractor management and employees.

Computer hardware and software were assessed for year-2000 compliance. No problems were noted at the millenium date change.

Dose Assessment

There were no events affecting public health and safety or the environment associated with Project operations in 1999. The small amounts of radioactive materials that were released were assessed and doses were calculated using approved computer modeling codes. These evaluations included calculations of doses received from the consumption of game animals and locally grown food. Airborne doses were calculated using CAP88-PC, an EPA-approved computer code. The result was a maximum dose to an off-site individual of 0.011 millirem (mrem). The limit is 10 mrem. Doses from the liquid pathway to the maximally exposed person were estimated to be 0.0283 mrem from Project effluents (excluding north plateau drainage). The north plateau drainage contribution to the total liquid dose was estimated to be an additional 0.0282 mrem. The predicted dose from all pathways was less than 0.07 mrem, or 0.07% of the 100-mrem DOE limit.

Conclusion

The West Valley Demonstration Project conducts extensive monitoring of on-site facilities and the surrounding environment. This program fulfills federal and state requirements to assess the effect of Project activities on public health and safety and the environment. In addition to demonstrating compliance with environmental regulations and directives, evaluation of data collected in 1999 continued to indicate that Project activities pose no threat to public health or safety or the environment.

INTRODUCTION

History of the West Valley Demonstration Project

In the early 1950s interest in promoting peaceful uses of atomic energy led to the passage of an amendment to the Atomic Energy Act that allowed the Atomic Energy Commission to encourage commercialization of nuclear fuel reprocessing as a way of developing a civilian nuclear industry. The Atomic Energy Commission made its technology available to private industry and invited proposals for the design, construction, and operation of reprocessing plants.

In 1961 the New York State Office of Atomic Development acquired 1,332 hectares (3,340 acres) near West Valley, New York and established the Western New York Nuclear Service Center (WNYNSC). Davison Chemical Co., together with the New York State Atomic Research and Development Authority, which later became the New York State Energy Research and Development Authority (NYSERDA), constructed and began operating a nuclear fuel reprocessing plant under a co-license issued by the Atomic Energy Commission. Nuclear Fuel Services, Inc. (NFS) was formed by Davison Chemical Co. to operate the plant as a commercial facility. NFS leased the property at the WNYNSC and in 1966 began operations to recycle fuel from both commercial and federally owned reactors.

In 1972, while the plant was closed for modifications and expansion, new and more rigorous federal and state safety regulations were imposed. Most of the changes concerned the disposal of high-level radioactive liquid waste and the prevention of earthquake damage to the facilities. NFS decided that compliance with the new regulations was not economically feasible and in 1976 notified NYSERDA that it would not continue in the fuel reprocessing business.

Following this decision, the reprocessing plant was shut down. Under the original agreement between NFS and New York State, the state was ultimately responsible for both the radioactive wastes and the facility. Numerous studies followed the closing, leading eventually in 1980 to the passage of Public Law 96-368, the West Valley Demonstration Project Act, which authorized the U.S. Department of Energy (DOE) to demonstrate a method for solidifying the 2.3 million liters (600,000 gal) of liquid high-level waste that remained at the West Valley site. Congress anticipated that the technologies developed at West Valley would be used at other facilities in the United States.

West Valley Nuclear Services Co. (WVNS), a subsidiary of Westinghouse Government Services Group, was chosen by the DOE to be the management and operating contractor for the West Valley Demonstration Project (WVDP).

The WVDP Act specifically states that the facilities and the high-level radioactive waste on-site shall be made available (by the state of New York) to the DOE without the transfer of title for as long as required to complete the Project.

The purpose of the WVDP is to solidify the high-level radioactive waste left at the site from the original nuclear fuel reprocessing activities, develop suitable containers for holding and transporting the solidified waste, arrange transportation of the solidified waste to a federal repository, dispose of any Project low-level and transuranic waste resulting from the solidification of high-level waste, and decontaminate and decommission the Project facilities.

The high-level waste was contained in underground storage tanks and had separated into two layers, a liquid supernatant and a settled sludge layer. Various subsystems were constructed that permitted the successful startup in May 1988 of the integrated radwaste treatment system (IRTS). The system removed most of the radioactivity from the liquid supernatant, allowing the major portion of the liquid to be treated as low-level waste. Treatment of the supernatant liquid from the high-level waste tanks through the IRTS was completed in 1990.

The next step in the process, washing the sludge with water to remove soluble constituents, began in late 1991 and was completed in 1994. (See Vitrification Overview [p.1-6] in Chapter 1 for a more detailed description.) In 1995, the contents of the high-level waste tanks were combined and the subsequent mixture washed a final time. Vitrification of the high-level waste residues began in July 1996. In June 1998 the WVDP successfully completed the first phase of the vitrification campaign, having processed more than 96% of the high-level waste inventory. Currently the WVDP is conducting the second phase of vitrification, which involves removing and solidifying the high-level residuals (heels) remaining in the tanks, and is planning for future decommissioning of vitrification and support facilities.

Purpose of this Report

This annual environmental monitoring report is published to inform WVDP stakeholders about environmental conditions at the WVDP. The report presents a summary of the environmental monitoring data gathered during the year in order to characterize the performance of the WVDP's environmental management, confirm compliance with standards and regulations, and highlight significant programs.

The geography, socioeconomics, climate, ecology, and geology of the region are principal factors in assessing possible effects of site activities on the surrounding population and environment and are an integral consideration in the design and structure of the environmental monitoring program.

Description of the West Valley Demonstration Project

The WVDP is located in northern Cattaraugus County about 50 kilometers (30 mi) south of Buffalo, New York (Fig.1 [*facing page*]). The WVDP facilities occupy a security-fenced area of about 80 hectares (200 acres) within the WNYNSC. This fenced area is referred to as either the Project premises or the restricted area.

The WVDP is situated on New York State's Allegheny plateau at an average elevation of 400 meters (1,300 ft). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 kilometers (5 mi) of the Project. Several roads and a railway pass through the WNYNSC, but the public does not have access to the WNYNSC. Generally, hunting, fishing, and human habita-

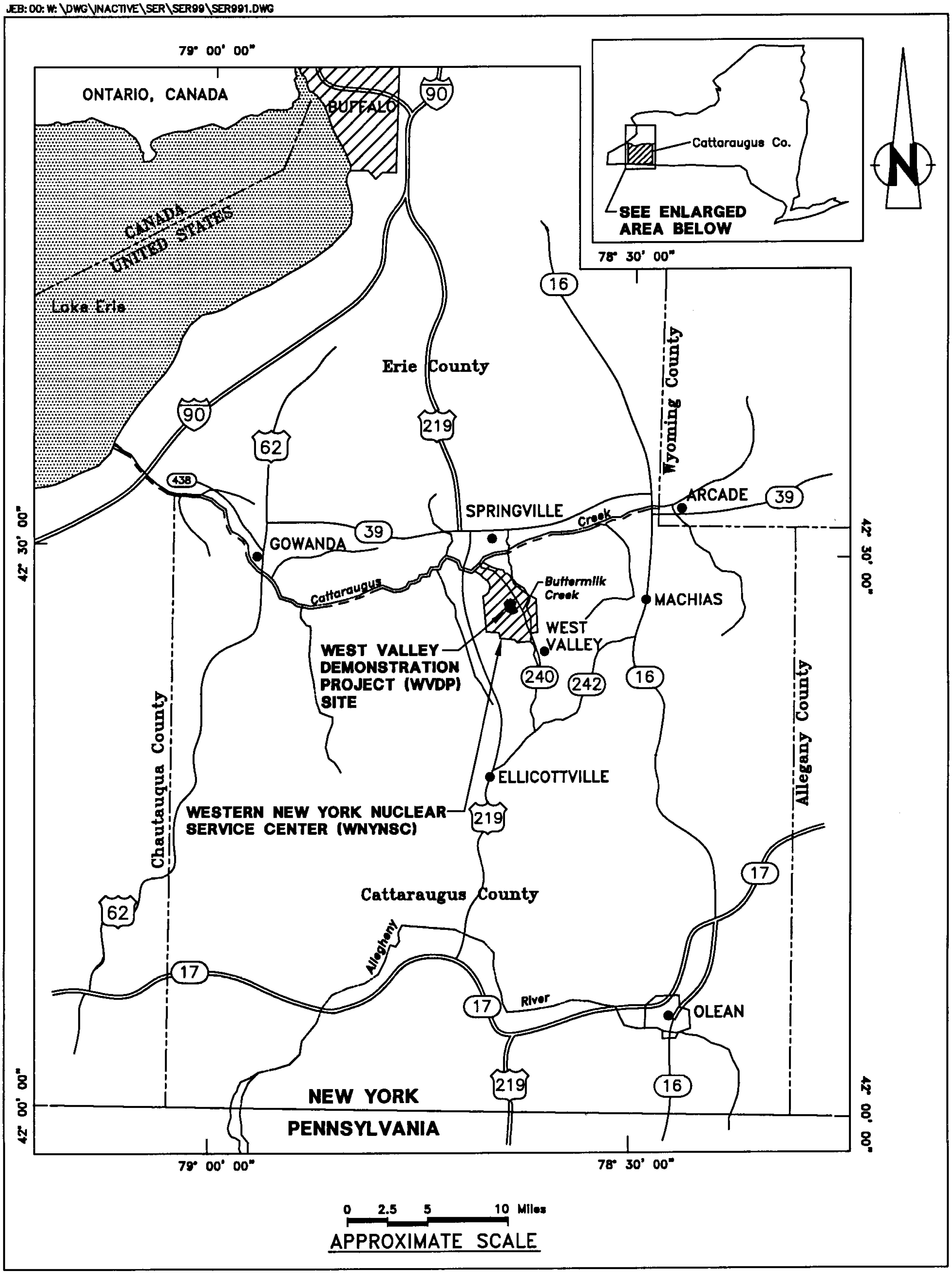


Figure 1. Location of the Western New York Nuclear Service Center.

tion on the WNYNSC are prohibited. A NYSERDA-sponsored pilot program to control the deer population, initiated in 1994, continued in 1999. Limited hunting access was given to local residents, and community response continued to be favorable.

Socioeconomics. The WNYNSC lies within the town of Ashford in Cattaraugus County. The nearby population, approximately 9,200 residents within 10 kilometers (6.2 mi) of the Project, relies primarily on an agricultural economy. No major industries are located within this area.

The land immediately adjacent to the WNYNSC is used principally for agriculture and arboriculture. Cattaraugus Creek is used locally for swimming, canoeing, and fishing. Although some water to irrigate nearby golf course greens and tree farms is taken from Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC before the creek flows into Lake Erie near Buffalo, New York. Water from Lake Erie is used as a public drinking-water supply.

Climate. Although there are recorded extremes of 37°C (98.6°F) and -42°C (-43.6°F) in Western New York, the climate is moderate, with an average annual temperature of 7.2°C (45.0°F). Rainfall is relatively high, averaging about 104 centimeters (41 in) per year. Precipitation in 1999 was below average, totaling about 79 centimeters (31 in). Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and, to a lesser extent, by Lake Ontario to the north. Regional winds are generally from the west and south at about 4 m/sec (9 mph).

Biology. The WNYNSC lies within the northern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land,

Indigenous Small Mammal (Marmota monax)

the site provides a habitat especially attractive to white-tailed deer and various indigenous birds, reptiles, and small mammals. No species on the federal endangered-species list are known to be present on the WNYNSC.

Geology and Groundwater Hydrology. The WVDP site is located on the west shoulder of a steep-sided glacially scoured bedrock valley that is filled with a sequence of glacial sediments. (See Figs. 3-1 and 3-2 [p.3-3] in Chapter 3, Groundwater Monitoring.) The WVDP site is bordered by two stream valleys (Frank's Creek and Quarry Creek) and divided by a third stream valley (Erdman Brook) into two portions, the north and south plateaus. (See Figs.A-6 through A-8 [pp.A-8 through A-10] in Appendix A.)

The uppermost layer of glacial sediments on the south plateau consists of a silty clay till, the Lavery till. The Lavery till does not transmit significant quantities of water except where it is exposed at ground surface, where weathering has fractured the near-surface sediments. Groundwater flow in the weathered till has both a vertically downward component and a horizontal component to the northeast. Groundwater flow in the unweathered portion of the till, beneath the exposed weathered till, is predominantly downward.

On the north plateau a permeable alluvial sand and gravel layer overlies the less permeable glacial sequence of sediments (i.e., the Lavery till, the Kent recessional sequence, and the Kent till). Groundwater flow in the sand and gravel unit of the north plateau is predominantly horizontal, towards the northeast, discharging to seeps and streams along the plateau's edge and via evapotranspiration.

Within the Lavery till on the north plateau is a silty, sandy unit of limited extent, the Lavery till-sand. Gradients indicate that groundwater flows east-southeast. Surface discharge points have not been observed.

The Kent recessional sequence that underlies the Lavery till beneath both north and south plateaus is composed of silt and silty sand with localized pockets of gravel. Groundwater flow in the Kent recessional sequence is also toward the northeast with discharge to Buttermilk Creek.

Information in this Report

Individual chapters in this report provide information on compliance with regulations, general information about the monitoring program and significant activities in 1999, summaries of the results of radiological and nonradiological monitoring, calculations of radiation doses to the population within 80 kilometers (50 mi) of the site, and information about practices that ensure the quality of environmental monitoring data. Graphs and tables illustrate important trends and concepts. The bulk of the supporting data is found in the appendices following the text. Page numbers referring the reader to the appendices or to figures and graphs are provided in the text wherever such information is noted.

Appendix A contains maps showing on-site and off-site sampling locations.

Appendix B summarizes the 1999 environmental monitoring program at the on-site (i.e., on the WNYNSC) and off-site locations. Samples are designated by a coded abbreviation indicating sample type and location. (A complete listing of the codes is found in the index to Appendix B [pp.B-v through B-vii].) Appendix B lists the kinds of samples taken, the frequency of collection, the parameters analyzed, the location of the sampling points, monitoring and reporting requirements, and a brief rationale for the monitoring activities conducted at each location.

Appendices C through I summarize radiometric and chemical analytical data from air, surface water, groundwater, fallout in precipitation, sediment, soils, biological samples (meat, milk, food crops, and fish), and direct radiation measurements and meteorological monitoring.

Appendix J provides data from the comparison of results of analyses of identically prepared samples (crosscheck samples) by both the WVDP and independent laboratories. Radiological concentrations in crosscheck samples of air, water, soil, and vegetation are reported here, as are chemical water quality parameters.

Appendix K provides a list of radiation protection standards set by the DOE that are most relevant to the operation of the WVDP. It also lists federal and state laws and regulations that affect the WVDP and the environmental permits held by the site in 1999.

Appendix L contains groundwater monitoring data for the New York State-licensed disposal area (SDA), provided by NYSERDA.

The Glossary, References, and Scientific Notation sections are intended to help the reader with the terminology used in this report.

Acronyms. Acronyms often are used in technical documents to speed up the reading process. Although using acronyms can be a practical way of referring to agencies or systems with unwieldy names, having to look up rarely used acronyms can defeat the purpose of using them. Accordingly, full names of agencies and systems have been used in this report where it will help the reader. However, acronyms that the reader is apt to recognize (e.g., DOE, EPA, NRC, NYSERDA) or that are used often in this report (e.g.,WVDP, WNYNSC) are spelled out only at the beginning of sections. A list of acronyms is provided in the back of this report.

Environmental Monitoring Program

The WVDP's environmental monitoring program began in February 1982. The primary program goal is to detect changes in the environment resulting from Project or pre-Project activities and to assess the effect of any such changes on the human population and the environment surrounding the site.

The monitoring network and sample collection schedule have been structured to accommodate specific biological and physical characteristics of the area. Among the several factors considered in designing the environmental monitoring program were the kinds of wastes and other byproducts resulting from the processing of high-level waste; possible routes that radiological and nonradiological contaminants could follow into the environment; geologic, hydrologic, and meteorologic site conditions; quality assurance standards for monitoring and sampling procedures and analyses; and the limits and standards set by federal and state governments and agencies. As new processes and systems become part of the Project, appropriate additional monitoring is provided. As processes are completed, unnecessary monitoring may be eliminated from the program.

Monitoring and Sampling. The environmental monitoring program consists of on-site effluent monitoring and on- and off-site environmental surveillance in which samples are measured for both radiological and nonradiological constituents. (See the Glossary [p.3] for more detailed definitions of *effluent monitoring* and *environmental surveillance*.) Monitoring and surveillance include both the continuous recording of data and the collecting of soil, sediment, water, air, and other samples at specific times.

Monitoring and sampling of environmental media provide two ways of assessing the effects of Project or pre-Project activities. Monitoring generally is a continuous process of measurement that allows rapid detection of any changes in the levels of constituents that could affect the environment. Sampling is the collection of media at scheduled times; sampling is slower than direct monitoring in indicating changes in constituent levels because the samples must be analyzed in a laboratory to obtain data. However, sample analysis allows much smaller quantities of radioactivity or chemical concentrations to be detected.

Permits and Regulations. Data gathering, analysis, and reporting to meet stringent federal and state requirements and standards are an integral part of the monitoring program. The current program meets the requirements of DOE Orders 5400.1 (General Environmental Protection Program), 5400.5 (Radiation Protection of the Public and Environment), and 231.1 (Environment, Safety, and Health Reporting), and

DOE Regulatory Guide DOE/EH-0173T (Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance).

The WVDP holds a State Pollutant Discharge Elimination System (SPDES) permit as required by the New York State Department of Environmental Conservation (NYSDEC), which regulates liquid effluent discharges containing nonradiological pollutants. The SPDES permit identifies the outfalls where liquid effluents are released to surface water drainage systems and specifies the sampling and analytical requirements for each outfall. It also specifies that concentrations of radionuclides at these outfalls must meet the requirements of DOE Orders 5400.1 and 5400.5. Radiological air emissions must comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations. Depending upon the potential to emit radionuclides, some radiological emission points must be permitted by the Environmental Protection Agency (EPA). In addition, the site operates under state-issued air discharge permits for nonradiological plant emissions.

For more information about air and SPDES permits see the Environmental Compliance Summary: Calendar Year 1999 (pp.ECS-7 and ECS-9). Environmental permits are listed in Appendix K (pp.K-5 and K-6).

Exposure Pathways Monitored at the West Valley Demonstration Project. The major near-term pathways for potential movement of contaminants away from the site are by surface water drainage and airborne transport. For this reason the environmental monitoring program emphasizes the collection of air and surface water samples.

Samples are collected on-site from locations such as plant ventilation stacks, various water effluent points, and surface water drainage locations. Analyses of samples of air, water, soils, and biota from the environment surrounding the site would detect any radioactivity that might reach the public from site releases. Extensive groundwater monitoring addresses the subsurface pathway.

Water and Sediment Pathways. Process waters are treated through filtration and ion-exchange in a liquid-treatment facility, the LLW2. The treated water is sent to a series of on-site holding lagoons for testing before being discharged through a single outfall. (The locations of the lagoons are noted on Fig.A-2 [p.A-4] in Appendix A.) Samples of this process water and the effluent at two other discharge points are collected in accordance with permit requirements. The samples are analyzed for radiological parameters, including gross alpha and gross beta, tritium, strontium-90, and gamma-emitting radionuclides, and for nonradiological parameters, including pH. Additional analyses of composite samples determine metals content, solids, biochemical oxygen demand, nitrates, nitrites, ammonia, sulfate, organic chemicals, and specific radionuclides.

In general, surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and gross beta radioactivity, tritium, and pH. Selected samples are analyzed for conductivity, chlorides, metals, volatile organic compounds, and other parameters. Potable water on the site is analyzed monthly for radioactivity and annually for chemical constituents. Residential drinking water wells located near the site are sampled annually and analyzed for gross alpha and gross beta radioactivity, tritium, gamma-emitting radionuclides, pH, and conductivity.

Off-site surface waters, primarily from Cattaraugus Creek and Buttermilk Creek, are sampled upstream of the Project for background radioactivity and downstream to measure possible Project contributions. Sediments deposited downstream of the facility and at upstream background locations are collected annually and analyzed for gross alpha, gross beta, and specific radionuclides. (See Appendix C [pp.C-3 through C-31] for water and sediment data summaries.)

Groundwater Pathways. Groundwater discharge at the WVDP site occurs as springs or seeps along stream channels, direct discharge to streams, evapotranspiration, vertical groundwater migration to underlying strata, and discharge to artificial draining systems and lagoons. All of these discharges vary with the seasons. Discharge from springs and seeps is highest during the spring. Evapotranspiration is at a maximum during the summer. Groundwater discharge is, in general, lowest during the winter because the ground surface is frozen, which minimizes recharge.

Routine monitoring of groundwater includes sampling for contamination and radiological indicator parameters (gross alpha and beta, tritium, pH, and conductivity) and for specific analytes of interest such as volatiles, semivolatiles, metals, and radionuclides at particular monitoring locations. (See Table E-1 [p.E-3] in Appendix E.)

Air Pathways. Permitted effluent air emissions are continuously monitored for alpha and beta activity. Alarms indicate any unusual rise in radioactivity. Air particulate sampling filters, which are retrieved and analyzed weekly for gross radioactivity, are also composited quarterly and analyzed for strontium-90 and specific gamma- and alpha-emitting radionuclides.

Iodine-129 and tritium also are measured in effluent ventilation air at some locations. At two locations silica gel-filled columns are used to collect water vapor that is then distilled from the desiccant and analyzed for tritium. The distillates are analyzed weekly. Six permanent samplers contain activated charcoal adsorbent that is analyzed for iodine-129; the charcoal is collected weekly and composited for quarterly analysis.

Off-site sampling locations include those considered most representative of background conditions and those most likely to be downwind of airborne releases. Among the criteria used to position off-site air samplers are prevailing wind direction, land usage, and the location of population centers.

Off-site air is continuously sampled at ten locations. Background samplers are located far from the site in Great Valley and Nashville, New York. Nearby-community samplers are in Springville and West Valley, New York. (See Fig.A-12 [p.A-14] in Appendix A for these four off-site air sampling locations.) Six samplers are located on the perimeter of the WNYNSC. (See Fig.A-5 [p.A-7] in Appendix A.) These samples are analyzed for parameters similar to the effluent air samples. (See Appendix D [pp.D-3 through D-29] for air monitoring data summaries.)

Atmospheric Fallout. An important contributor to environmental radioactivity is atmospheric fallout. Sources of fallout include earlier atmospheric testing of atomic explosives and residual radioactivity from accidents such as that which occurred at Chernobyl in the Ukraine.

Four site perimeter locations and one on-site location currently are sampled for fallout using pot-type samplers that are collected every month. Long-term fallout is assessed by analyzing soil collected annually at each of the six perimeter and four off-site air samplers. Three additional on-site soil samples are taken annually. (See Appendix D [pp.D-27 through D-29] for fallout data summaries and Appendix C [pp.C-29 and C-30] for soil data summaries.)

Food Pathways. A potentially significant pathway for radioactivity to reach humans is through consuming produce, meat, and milk from domesticated farm animals raised near the WVDP and game animals and fish that live in the vicinity of the WVDP.

Animal and fish samples from potentially affected areas are gathered and analyzed for radionuclide content in order to reveal any long-term trends. Fish are collected at several locations along Cattaraugus Creek at various distances downstream from the WVDP. Venison is sampled from deer ranging within the WNYNSC. Control samples of both fish and venison are collected from background areas outside WVDP influence. Beef, milk, hay, and produce samples also are collected at nearby farms and at selected locations well away from WVDP influence. (See Appendix F [pp.F-3 through F-8] for biological data summaries.)

Direct Radiation Measurement. Direct penetrating radiation is measured using thermoluminescent dosimeters (TLDs) located on- and off-site. Measurement points within the site are placed near selected waste management units and around the inner security fence. Other measurement locations are around the site perimeter and access road and at background locations remote from the WVDP. Forty-three measurement points were used in 1999. The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure. (See Appendix H [pp. H-3 through H-6] for a summary of the direct radiation data.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded at meteorological towers on-site and a nearby regional location. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are measured on-site. Wind speed and direction are measured at the regional tower. These data are valuable for evaluating long-term geohydrologic trends and for modeling airborne dispersion. In the event of an emergency, immediate access to the most recent meteorological data is indispensable for predicting the path and concentration of any materials that become airborne. (See Appendix I [pp. I-3 through I-8] for meteorological data summaries.)

Quality Assurance and Control

The work performed by and through the on-site Environmental Laboratory is regularly reviewed by several agencies for accuracy and compliance with applicable regulations. Assessments of the laboratory routinely focus on proper record keeping and reporting, timely calibration of equipment, training of personnel, adherence to accepted procedures, and general laboratory safety.

The Environmental Laboratory also participates in quality assurance crosscheck programs administered by federal agencies. (See Appendix J [pp. J-3 through J-6] for a summary of crosscheck performance.) The performance of outside laboratories contracted to analyze WVDP samples also is regularly assessed.

Environmental monitoring management continues to strengthen its formal self-assessment program, developing and implementing new strategies and procedures for ensuring high quality data. Experienced senior scientists and specialists in varying disciplines follow an annual schedule of self-assessments, produce formal reports with recommended corrective actions, and track the actions as they are completed.

A special assessment was conducted in 1998 to determine if environmental monitoring program hardware and software were capable of handling data correctly when the year 2000 arrived. Several systems were examined, including the meteorological system, water samplers, air samplers, radiological counting instruments, and data management and reporting systems. A schedule for completing corrective actions such as purchasing updated equipment and software was developed, and corrective actions were completed in September 1999. All environmental program-related systems were verified to be year-2000 compliant during the millenium date change.

Safety Management System

During 1998 WVNS developed a safety management system for the WVDP, which was validated by the DOE Ohio Field Office. The safety management system integrates all safety programs, including environmental protection, to ensure that Project work can be safely and efficiently performed. As a continuation of this effort, the WVDP applied for the DOE Voluntary Protection Program STAR designation, reserved for companies that have demonstrated sustained excellence in their safety and health program. STAR status for the WVDP, given to only five other DOE sites to date, was announced in early 2000.

ENVIRONMENTAL COMPLIANCE SUMMARY

CALENDAR YEAR 1999

Compliance Program

The West Valley Demonstration Project (WVDP) is currently focusing on several goals that will lead to eventual site closure. Processing of the high-level liquid waste into durable, solid glass is almost complete, and the WVDP is now working on removing and vitrifying the high-level radioactive residuals (heels) remaining in the high-level waste tanks. In addition, the WVDP is shipping low-level waste, developing a remote-handled waste facility, actively managing on-site groundwater contamination, preparing for the shipment of spent nuclear fuel, and cleaning up facilities not presently used in anticipation of eventual closure. Activities in progress at the WVDP are regulated by various federal and state laws that protect the public, workers, and the environment.

The U.S. Department of Energy (DOE), the federal agency that oversees the WVDP, established its policy concerning environmental protection in DOE Order 5400.1, General Environmental Protection Program. This Order lists the regulations, laws, and required reports that are applicable to DOE-operated facilities. DOE Orders 5400.1 and 231.1, Environment, Safety, and Health Reporting, require the preparation of this annual Site Environmental Report, which is intended to summarize environmental data gathered during the calendar year, describe significant programs, and document WVDP compliance with environmental regulations.

The major federal environmental laws and regulations that apply to the West Valley Demonstration Project are the Resource Conservation and Recovery Act, the Clean Air Act, the Emergency Planning and Community Right-to-Know Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and the National Environmental Policy Act. These laws are administered primarily by the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) through state programs and regulatory requirements such as permitting, reporting, inspecting, and self-auditing.

In addition, because the emission of radiological and nonradiological materials from an active facility cannot be completely prevented, the EPA, NYSDEC, and the DOE have established standards for such emissions that are intended to protect human health and the environment. The WVDP applies to NYSDEC and the EPA for permits that allow the site to release limited amounts of radiological and nonradiological constituents through controlled and monitored discharges into water and air in concentrations that have been determined to be safe for humans and the environment. In general, the permits describe the discharge points, specify management and reporting requirements, list the limits on those pollutants likely to be present, and define the sampling and analysis schedule.

Environmental inspections and audits are conducted routinely by the EPA, NYSDEC, the New York State Department of Health (NYSDOH), and the Cattaraugus County Health Department. On-site and off-site radiological monitoring in 1999 confirmed that site activities were conducted well within state and federal regulatory limits. On-site nonradiological effluent monitoring confirmed that site effluents remained within permitted limits.

Management at the WVDP continued to provide strong support for environmental compliance issues in 1999. Through an integrated environmental, safety, and health management system, DOE Orders and applicable state and federal environmental statutes and regulations are integrated into work activities, demonstrating a commitment to protecting WVDP employees, the public, and the environment while working toward the WVDP goals.

Summary of Permits

A summary of permits may be found in Appendix K, Table K-3 (pp.K-5 and K-6).

Compliance Status

The following environmental compliance summary describes the federal and state laws and regulations that are applicable to the WVDP and the relevant environmental compliance activities that occurred at the WVDP during 1999.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act was enacted to ensure that hazardous wastes are managed in a manner that protects human health and the environment. RCRA and its implementing regulations govern hazardous waste generation, treatment, storage, and disposal.

RCRA regulations mandate that generators take responsibility for ensuring the proper treatment, storage, and disposal of their wastes. The EPA is the federal agency responsible for issuing guidelines and regulations for the proper management of solid and hazardous waste (including mixed waste).

In New York, the EPA has delegated the authority to enforce these regulations, including the radioactive and hazardous mixed waste program, to NYSDEC. In addition, the U.S. Department of Transportation (DOT) is responsible for issuing guidelines and regulations for the labeling, packaging, and spill-reporting provisions for hazardous and mixed wastes while in transit.

A facility that treats or stores large quantities of hazardous waste for more than 90 days or disposes of hazardous waste at that facility must apply for a permit from the EPA (or authorized state). The permit defines the treatment processes to be used, the design capacities, the location of hazardous waste storage units, the design and operating criteria for disposal units, and the hazardous wastes to be handled.

In 1984 the DOE notified the EPA of hazardous waste activities at the WVDP and identified the WVDP as a generator of hazardous waste. In June 1990 the WVDP filed a RCRA Part A Hazardous Waste Permit Application with NYSDEC for storage and treatment of hazardous wastes and has been operating under interim status since then.

The WVDP continues to update the RCRA Part A Permit Application as changes to the site's interim-status waste-management operations occur. The last update occurred in October 1995. No updates to the Part A Permit Application were necessary in 1999. Proposed updates for calendar year 2000 are now being pursued for new waste management facilities such as the remote-handled waste facility.

Hazardous Waste Management Program. Hazardous wastes at the WVDP are managed in accordance with 6 NYCRR (New York Official Compilation of Codes, Rules, and Regulations) Parts 371-376. In order to dispose of hazardous wastes generated from on-site activities, the WVDP uses New York State-permitted transporters (pursuant to 6 NYCRR Part 364) to ship RCRA-regulated wastes to permitted or authorized treatment, storage, or disposal facilities (pursuant to 6 NYCRR Part 373-1). Using these services, the WVDP shipped approximately 6.9 metric tons (7.6 tons) of nonradioactive hazardous waste off-site in 1999, less than the amount generated and shipped in 1998. Approximately 876 kilograms (1,930 lbs) of the total were shipped out for recycling.

Off-site hazardous waste shipments and their receipt at designated treatment, storage, or disposal facilities (TSDFs) are documented by signed manifests that accompany the shipment. If the signed manifest is not returned to the WVDP within the regulatory limit of forty-five days from shipment, an exception report must be filed and receipt of the waste confirmed with the TSDF. No exception reports for WVDP waste shipments were required to be filed in 1999.

Hazardous waste activities must be reported to NYSDEC every year through the submittal of the facility's annual Hazardous Waste Report. This report summarizes the hazardous waste activities for the previous year, specifies the quantities of waste generated, treated, and/or disposed, and identifies the TSDFs used. The calendar year 1999 annual Hazardous Waste Report was submitted to NYSDEC by March 1, 2000. In addition, a hazardous waste reduction plan must be filed every two years and updated annually. These plans document efforts to minimize the generation of hazardous waste and were first submitted to NYSDEC in 1990. The most recent Annual Status Report for the Hazardous Waste Reduction Program was updated in June 1999. The next update is due in July 2000.

An annual inspection to assess compliance with hazardous waste regulations was conducted by NYSDEC on March 29, 1999. No deficiencies were noted during the inspection.

Nonhazardous, Regulated Waste Management Program. The WVDP shipped approximately 48 metric tons (53 tons) of nonradioactive, nonhazardous material off-site to solid waste management facilities in 1999. Of this amount, 8.9 metric tons (9.8 tons) were recycled or reclaimed. Some of the recycled materials were lead-acid batteries, nonhazardous oils such as motor oil, hydraulic oil, and compressor oil, and antifreeze, which were recycled at off-site authorized reclamation and recycling facilities. The WVDP also shipped approximately 716 metric tons (789 tons) of digested sludge and untreated wastewater from the site sanitary and industrial wastewater treatment facility to the Buffalo Sewer Authority for treatment.

Radioactive Mixed Waste Management Program. Radioactive mixed waste (RMW) contains both a radioactive component, regulated under the Atomic Energy Act, and a hazardous component, regulated under RCRA. Both the EPA and NYSDEC oversee radioactive mixed waste management at the WVDP. In March 1993 the DOE entered into a Federal and State Facility Compliance Agreement (FSFCA) with the EPA, NYSDEC, the New York State Energy Research and Development Authority (NYSERDA), and West Valley Nuclear Services Company (WVNS), the primary contractor for the DOE at the WVDP. The FSFCA addressed requirements for managing the hazardous component of the radioactive mixed waste, storage requirements for radioactive mixed waste, and characterization of historical wastes in storage at the WVDP.

In August 1997 a one-year extension of the FSFCA was requested to provide the additional time needed to characterize radioactive mixed waste stored in the chemical process cell waste storage area. In November 1997 NYSDEC granted a one-year extension exclusively for section 7.2, Waste Analysis, to complete the final characterization of containers. Characterization of historical wastes was completed and the FSFCA agreement terminated on March 22, 1999.

The Federal Facility Compliance Act (FFC Act) of 1992, an amendment to RCRA, was signed into law on October 6, 1992. The FFC Act requires DOE facilities to develop treatment plans for radioactive mixed waste inventories and to enter into agreements with the regulatory agencies that require the treatment of the inventories according to the approved plans.

DOE facilities were required to develop site treatment plans in three steps: conceptual, draft, and proposed. The WVDP's conceptual plan was submitted to NYSDEC in October 1993, the draft plan in August 1994, and the proposed site treatment plan in March 1995.

The proposed plan comprises two volumes: The Background Volume provides information on each radioactive mixed waste stream and information on the preferred treatment method for the waste. The Plan Volume contains proposed schedules for treating the radioactive mixed waste to meet the land disposal restriction (LDR) requirements of RCRA. Each submittal to NYSDEC underwent a public comment period during which input was solicited from WVDP stakeholders.

The DOE and NYSDEC entered into a consent order on September 3, 1996, that requires the completion of the milestones identified in the Plan Volume. The WVDP began implementing the site treatment plan immediately and updates it every year to bring waste stream, inventory, and treatment information current to the end of the fiscal year. An update of fiscal year 1999 activities was completed and submitted to NYSDEC in February 2000. All Plan Volume milestones for calendar year 1999 were met.

Shipments of radioactive mixed waste to off-site facilities for treatment and their receipt at the designated TSDF are documented via manifests. In 1999 the WVDP shipped approximately 166 kilograms (365 lbs) of radioactive mixed waste to an off-site facility.

RCRA §3008(h) Administrative Order on Consent. The DOE and NYSERDA entered into a RCRA §3008(h) Administrative Order on Consent with NYSDEC and the EPA in March 1992. The Consent Order required NYSERDA and the DOE's West Valley Demonstration Project Office (OH/WVDP) to conduct RCRA-facility investigations (RFIs) at solid waste management units (SWMUs) in order to determine if there has been a release or if there is a potential for release of RCRA-regulated hazardous constituents from SWMUs.

The final RFI reports were submitted in 1997, completing the investigative activities associated with the Consent Order. As a result of the RFIs, no immediate action, other than continued groundwater monitoring at several units, was required. The WVDP continued in 1999 to monitor and evaluate SWMUs and to comply with other requirements of the RCRA §3008(h) Administrative Order on Consent.

Waste Minimization and Pollution Prevention. The WVDP continued a long-term program to minimize the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial waste, and sanitary waste and to promote affirmative procurement as directed by Executive Order 12856 (Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements), Executive Order 12873 (Federal Acquisition, Recycling, and Waste Prevention), and Executive Order 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition), which promotes the Affirmative Procurement Program (APP).

The APP specifies responsibilities and direction for federal agencies in acquiring recycled and environmentally preferable products and services designated by the EPA in 40 CFR Part 247. WVNS reports its challenges and successes associated with the purchase and use of these materials and services to the DOE each year.

Waste streams on-site are separated into either waste from sources directly associated with the vitrification process or into other nonvitrification sources. The WVDP set the following cumulative waste-reduction goals for 1999: a 50% reduction in the generation of low-level radioactive waste, radioactive mixed waste, and hazardous waste; a 30% reduction in nonvitrification industrial waste; and a 50% reduction in sanitary waste.

The waste-reduction goals for wastes associated with vitrification operations were a 28% reduction in vitrification hazardous wastes and an 18% reduction in vitrification industrial waste, compared to an annualized 1996 total of waste generated.

These goals were met or exceeded during calendar year 1999. Low-level radioactive waste generation was reduced by 77%, radioactive mixed waste generation by 63%, and vitrification hazardous waste generation by 94%. Nonvitrification waste generation was reduced by 75% and sanitary waste generation by 54%. (See Chapter 1, p.1-16, for more detailed information concerning waste minimization.)

Underground Storage Tanks Program. RCRA regulations also cover the use and management of underground storage tanks and establish minimum design requirements in order to protect groundwater resources from releases. The regulations, specified in 40 CFR Part 280, require underground storage tanks to be equipped with overfill protection, spill prevention, corrosion protection, and leak detection systems. New tanks must comply with regulations at the time of installation.

New York State also regulates underground storage tanks through two programs, petroleum bulk storage (Title 6 NYCRR, Parts 612 - 614) and chemical bulk storage (6 NYCRR, Parts 595 - 599). The state registration and minimum design requirements are similar to those of the federal program except that petroleum tank fill ports must be color-coded using American Petroleum Institute standards to indicate the product being stored.

A 550-gallon double-walled steel underground storage tank, upgraded in 1998 to bring it into compliance with the most recent EPA requirements (40 CFR Part 280.21), is used to store standby diesel fuel for the supernatant treatment system ventilation blower system. This tank is equipped with aboveground piping, an upgraded interstitial leak detection system, and a high-level warning device. This is the only underground petroleum-storage tank currently in use at the WVDP.

A former underground petroleum-storage tank, closed in place before the New York State underground storage tank program closure requirements were implemented in 1985, was removed in 1997. Testing of soils from the tank excavation had shown evidence of earlier petroleum leakage, and on March 19, 1999 the DOE and NYSDEC executed a Stipulation Agreement Pursuant to Section 17-0303 of the Environmental Conservation Law and Section 176 of the Navigation Law for cleanup and removal of the petroleum contamination. A bioventing system, installed in August 1999 to remediate the petroleum-contaminated soils, stimulates natural in situ biodegradation of petroleum hydrocarbons in the soil by providing an abundant oxygen supply to existing soil microorganisms. The oxygen is provided by injecting air directly into the contaminated soil zone.

This system is scheduled to operate for two years. At the end of each year an assessment of the system's performance will be completed.

The WVDP does not use underground bulk chemical storage tanks.

New York State-regulated Aboveground Storage Tanks. The state of New York regulates aboveground petroleum bulk storage under 6 NYCRR Parts 612, 613, and 614, and aboveground hazardous bulk chemical storage under 6 NYCRR Part 595 et seq. These regulations require secondary containment, external gauges to measure the current reserves, monthly visual inspections of petroleum tanks, and documented daily, annual, and five-year inspections of chemical tanks. Documentation relating to these periodic inspections is maintained by the WVDP and is available for regulatory agencies to review. Petroleum tank fill ports also must be color-coded and chemical tanks must be labeled to indicate the product stored.

WVDP registration at the end of 1999 included nine aboveground petroleum tanks and eleven aboveground chemical storage tanks. Three of the petroleum tanks contain No. 2 fuel oil, one contains unleaded gasoline, and the remainder contain diesel fuel. The Quality Assurance department inspects the aboveground petroleum tanks every month.

Nine of the chemical storage tanks are used as needed to contain nitric acid or nitric acid mixtures. Sodium hydroxide and anhydrous ammonia are stored in the remaining two tanks. All of the tanks are equipped with gauges and secondary containment systems except the anhydrous ammonia tank, which does not require secondary containment. (Any release of the contents of the anhydrous ammonia tank would be in gaseous form; thus, secondary containment is unnecessary.)

In June and July of 1999 NYSDEC inspected the WVDP's chemical bulk storage tanks to assess compliance with the rules and regulations of the chemical bulk storage program. NYSDEC reported that the WVDP was in compliance with current regulations as well as with upgrading requirements that were to go into effect in December 1999.

Medical Waste Tracking. Medical waste poses a potential for humans to be exposed to infectious diseases and pathogens from contact with human bodily fluids. Medical evaluations, inoculations, and laboratory work at the on-site nurse's office regularly generate potentially infectious medical wastes that must be tracked in accordance with NYSDEC requirements (6 NYCRR Part 364.9). The WVDP has retained the services of a permitted waste hauler and disposal firm to manage these medical wastes. Medical wastes are sterilized with an autoclave by the disposal firm to remove the associated hazard and then disposed. Twenty-two kilograms (48 lbs) of medical waste consisting of dressings and protective clothing such as rubber gloves, and needles, syringes, and other sharps were generated and disposed in 1999.

Clean Air Act (CAA). The Clean Air Act, as amended in 1990, including Titles I through VI, establishes a framework for the EPA to regulate air emissions from both stationary and mobile sources. These amendments mandate that each state establish a program to permit the operation of sources of air pollution. In 1996 NYSDEC amended 6 NYCRR Parts 200, 201, 231, and 621 to implement the requirements of the new EPA Clean Air Act Title V permitting processes.

In New York State, either the EPA or NYSDEC issues permits for stationary sources that emit regulated pollutants, including hazardous air pollutants. Sources requiring permits are those that emit regulated pollutants from a particular source such as a stack, duct, vent, or other similar opening if the pollutants are in quantities above a predetermined threshold. WVDP radiological emissions are regulated by the EPA, and all other air pollutants are regulated by NYSDEC.

Air emissions of radionuclides from point sources at the WVDP are regulated by the EPA under the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations, 40 CFR Part 61, Subpart H, National Emission Standards for Emission of Radionuclides Other Than Radon From Department of Energy Facilities. The WVDP currently has permits for six radionuclide sources, including the slurry-fed ceramic melter and the vitrification heating, ventilation, and air conditioning (HVAC) system. Other less significant sources of radionuclide emissions, such as those from the on-site laundry, do not require permits. Non-point radiological sources of emissions such as lagoons also do not require permits. Emissions from all these sources are quantified for reporting to the EPA. The WVDP reports the radionuclide emissions from its non-permitted and permitted sources to the EPA annually in accordance with NESHAP regulations. Calculations to demonstrate compliance with NESHAP radioactive dose limits showed 1999 doses to be less than 0.2% of the 10 millirem standard.

Nonradiological point sources of air emissions are regulated by NYSDEC. Major-source facilities are required by 6 NYCRR Part 201 to file a Title V permit application, unless operating limits are established, to ensure that the facility does not emit pollutants above the threshold limits. WVDP emissions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) are each capped at 100 tons per year. Thus, the WVDP is not required to file a Title V permit.

The WVDP opted to file a State Facility Permit Application for the site. A State Facility Permit Application containing data on two new boilers was filed in October 1997 and approved in January 1998. A State Facility Permit modification to include all remaining WVDP air emission sources was submitted in December 1997, and the WVDP is awaiting approval of this permit. Existing certificate-to-operate permits (COs) are in effect until the State Facility Permit modification is approved by NYSDEC. The WVDP has a total of five COs for nonradiological point sources.

In July 1999 NYSDEC granted the WVDP a waiver of quarterly submissions of NO_x and SO_2 emission totals.The WVDP is required to submit only an annual certification, in September, that contains NO_x and SO_2 emission totals. The 1999 certification reported 7 tons of NO_x and 0.13 tons of SO_2, which were well below the 100-ton cap for each category. The WVDP also conducts cylinder gas audits every quarter but is no longer required to conduct relative accuracy test audits of the melter off-gas NO_x analyzers to establish compliance with the Capping Plan approved by NYSDEC on July 28, 1995.

EPCRA 302-303: Planning Notification	[√] Yes	[ ] No	[ ] Not Req.
EPCRA 304: EHS Release Notification	[ ] Yes	[ ] No	[√] Not Req.
EPCRA 311-312: MSDS/Chemical Inventory	[√] Yes	[ ] No	[ ] Not Req.
EPCRA 313: TRI Reporting	[√] Yes	[ ] No	[ ] Not Req.

There were no air permit or regulatory exceedances in 1999. The air permits that were in effect at the WVDP in 1999 are listed in Appendix K, Table K-3 (pp. K-5 and K-6).

Emergency Planning and Community Right-to-Know Act (EPCRA). The Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted as Title III of the Superfund Amendments and Reauthorization Act (SARA). EPCRA was designed to create a working partnership between industry, business, state and local governments, public health and emergency response representatives, and interested citizens. EPCRA is intended to address concerns about the effects of chemicals used, stored, and released in local communities.

Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, requires all federal agencies to comply with the following EPCRA provisions: planning notification (Sections 302 — 303), extremely hazardous substance (EHS) release notification (Section 304), material safety data sheet (MSDS)/chemical inventory (Sections 311 — 312), and toxic release inventory (TRI) reporting (Section 313). The WVDP continued to comply with these provisions in 1999, as indicated on the table above.

- WVDP representatives participated in semi-annual meetings of the Cattaraugus County Local Emergency Planning Committee (EPCRA Section 302-303). WVDP representatives also attended numerous meetings held by the Cattaraugus and Erie County Emergency Management Services concerning WVDP and other local emergency planning activities. Area hospitals and the West Valley Volunteer Hose Company continued to participate in on-site training drills and in information exchanges concerning hazardous-substance management at the WVDP.

- Compliance with all EPCRA reporting requirements was maintained and all required reports were submitted within the required time frame. There were no releases of extremely hazardous substances (EHS) at the WVDP that triggered the release notification requirements of Section 304 of EPCRA.

- Under EPCRA Section 311 requirements, the WVDP reviews information about reportable chemicals every quarter. If a hazardous chemical, which was not previously reported, is present on-site in an amount exceeding the threshold planning quantity, an MSDS and an updated hazardous chemical list are submitted to the state and local emergency response groups. This supplemental reporting ensures that the public and the emergency responders have current information about hazardous chemicals at the WVDP. No new chemicals were added to the hazardous chemicals list in 1999, and no additional EPCRA Section 311 notifications were required.

- Under EPCRA Section 312 regulations, the WVDP submits annual reports to state and local emergency response organizations and fire departments that specify the quantity, location, and hazards associated with chemicals stored on-site. The number of reportable chemicals did not change between 1998 and 1999: sixteen reportable chemicals above threshold planning quantities were stored at the WVDP in 1999.

- Under EPCRA Section 313 requirements, the WVDP filed a toxic release inventory (TRI) report with the EPA in 1999 for nitric acid and for anhydrous ammonia for the preceding year, calendar year 1998.

Clean Water Act (CWA). Section 402 of the Clean Water Act of 1972 generally regulates disposal of liquids and, as amended, authorizes the EPA to regulate discharges of pollutants to surface water through a National Pollutant Discharge Elimination System (NPDES) permit program. The EPA has delegated this authority to the state of New York, which issues State Pollutant Discharge Elimination System (SPDES) permits for discharges to surface water.

Section 404 of the CWA regulates the development of areas in and adjacent to the waters of the United States. Supreme Court interpretations of Section 404 have resulted in the inclusion of wetlands in the regulatory definition of waters of the United States. Section 404 regulates the disposal of solids, in the form of dredged or fill material, into these areas by granting the U.S. Army Corps of Engineers the authority to designate disposal areas and issue permits for these activities. Executive Order 11990, Protection of Wetlands, directs federal agencies to "avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternate." (Article 24 of the New York State Environmental Conservation Law also contains requirements for the protection of freshwater wetlands.)

In addition, Section 401 of the CWA requires applicants for a federal license or permit pursuant to Section 404 to obtain certification from the state that the proposed discharge complies with effluent and water quality-related limitations, guidelines, and national standards of performance identified under sections 301, 302, 303, 306, 307, and 511(c) of the CWA. The EPA has delegated administration of this program to New York State.

SPDES-permitted Outfalls. Point-source liquid effluent discharges to surface waters of New York State are permitted through the New York SPDES program. The WVDP has four SPDES-permitted compliance points for discharges to Erdman Brook and Frank's Creek.

- Outfall 001 (WNSP001) discharges treated wastewater from the low-level waste treatment facility (LLWTF) and the north plateau groundwater recovery system. (See North Plateau Groundwater Recovery System [p.ECS-11] and Chapter 3, Groundwater Monitoring, Special Groundwater Monitoring [p. 3-15].) The treated wastewater is held in lagoon 3, sampled and analyzed, and periodically released after notifying NYSDEC. In 1999 the treated wastewater from the low-level waste treatment facility (LLWTF) was discharged at WNSP001 in four batches totaling 29.1 million liters (7.67 million gal) for the year. The annual average concentration of radioactivity at the point of release was approximately 32% of the DOE derived concentration guides (DCGs). None of the individual releases exceeded the DCGs. (See *derived concentration guide* in the Glossary and Chapter 1 [p.1-5].)

• Outfall 007 (WNSP007) discharges the effluent from the site sanitary and industrial wastewater treatment facility, which treats sewage and various nonradioactive wastewaters from physical plant systems (e.g., water plant production residuals and boiler blowdown). The average daily flow at WNSP007 in 1999 was 43,100 liters (11,400 gal).

• Outfall 008 (WNSP008) discharges groundwater and surface water runoff directed from the northeast side of the site's LLWTF lagoon system through a french drain. The average daily flow at WNSP008 in 1999 was 6,910 liters (1,830 gal).

• Monitoring point 116, located in Frank's Creek, represents the confluence of discharge from outfalls 001, 007, and 008; base stream flow; wet weather flows (e.g., surface water runoff); groundwater seepage; and augmentation water (untreated water from the site reservoirs). This is not a physical outfall but a location chosen for monitoring in order to demonstrate compliance with SPDES permit limits during discharge of lagoon 3. Before discharge of lagoon 3, sample data for total dissolved solids (TDS) and flow measurements from upstream sources are used to calculate the amount of augmentation water and flow needed to maintain compliance with SPDES-permitted TDS limits.

There were no SPDES permit limit exceptions during calendar year 1999.

In March 1999 NYSDEC conducted its annual facility inspection. At the request of the inspector, the SPDES outfalls, the sanitary and industrial wastewater treatment facility, and the LLWTF were observed. No violations were noted during the inspection.

In March 1996 a permit application had been submitted to NYSDEC to increase the average flow of effluent from the north plateau groundwater recovery system from approximately 9.8 million liters (2.6 million gal) a year to approximately 39.7 million liters (10.5 million gal) a year. (See North Plateau Groundwater Recovery System [p.ECS-11].) NYSDEC issued the draft SPDES permit in June 1997 for public comment. The final permit is expected to be issued to the WVDP in 2000.

In April 1996 the WVDP obtained storm water characterization data through sampling and analysis and submitted an application for a modification of the SPDES permit to address storm water discharges.

Increasing concentrations of total mercury were observed in 1999 in process water collected in the low-level waste treatment facility. The source of the mercury was determined to be process water from the liquid waste treatment system evaporator. (The evaporator is used to separate liquids from solid residuals generated during processing of high-level radioactive waste.) Negotiations with NYSDEC regarding additional SPDES permit monitoring requirements and limits were initiated in 1999. It is expected that a final SPDES permit that addresses mercury will be issued in 2000.

Wetlands. Jurisdictional wetlands are defined in Clean Water Act Section 404 as those satisfying specific technical criteria related to vegetation, soils, and hydrologic conditions. The WVDP notifies the U.S. Army Corps of Engineers and NYSDEC of proposed actions that could affect wetland units not specifically exempted from regulation or notification.

A wetlands assessment in the summer of 1998 identified and delineated jurisdictional wetlands regulated under the Clean Water Act, Section 404, and/or those wetlands that may be regulated by the state of New York under Article 24 of the Environmental Conservation Law. The 375-acre assessment area covered a portion of the Western New York Nuclear Service Center (WNYNSC), including the entire 220-acre WVDP and adjacent parcels north, south, and east of the WVDP premises. The assessment also supported the requirements of Executive Order 11990, Protection of Wetlands, and updated a 1993 investigation.

Fifty-nine jurisdictional wetlands ranging in size from 0.01 acres to 8.6 acres were identified, a total of approximately 39 acres of wetland. The wetland delineation was conducted in August 1999 and subsequently submitted to the U.S. Army Corps of Engineers for verification of wetland boundaries. Verification was obtained in November 1999.

In August 1999 a 150-ft corridor along both sides of the railroad spur from the southern fenced boundary of the Project premises to the intersection with Fox Valley Road was assessed to identify and delineate jurisdictional wetlands. Twenty-three separate wetland units were identified.

In December 1999 a Joint Application for Permit was submitted to NYSDEC and the U.S. Army Corps of Engineers for activities in or near wetlands associated with the railroad spur. These activities will include improvements to portions of the storm water drainage system and to the culvert that carries the railroad spur over Buttermilk Creek. It is expected that permits and water quality certifications will be issued for these proposed activities by May 2000.

North Plateau Groundwater Recovery System. In November 1995 the WVDP installed a groundwater recovery system to mitigate the movement of strontium-90 contamination in the groundwater northeast of the process building. Three recovery wells, installed near the leading edge of the groundwater plume, collect contaminated groundwater from the underlying sand and gravel unit. The groundwater is then treated in the new low-level waste treatment facility (LLW2) using ion-exchange to remove strontium-90. After the groundwater is processed, it is discharged to lagoon 4 or 5, near the LLW2. Approximately 67 million liters (17.8 million gal) of groundwater have been processed through the system since its inception, including about 13 million liters (3.4 million gal) in 1999.

In 1998 the Project began evaluating in-place permeable treatment wall (PTW) technology for treating contaminated groundwater. PTW technology is a passive treatment method, i.e., neither pumps nor a separate water treatment system are used. Rather, contaminants are removed from the groundwater as it flows through a subsurface trench filled with treatment media. Laboratory benchscale tests were initiated in December 1998 to examine this technology for removal of strontium-90 in WVDP groundwater, and a pilot-scale treatment wall was installed in 1999.

Petroleum- and Chemical-Product Spill Reporting. The WVDP has a Spill Notification and Reporting Policy to ensure that all spills (see Glossary) are properly managed, documented, and remediated in accordance with applicable regulations. This policy identifies the departmental responsibilities for spill management and the proper spill-control procedures.

The policy stresses the responsibility of each employee to notify the main plant operations shift supervisor upon discovery of a spill. This first-line reporting requirement helps to ensure that spills are properly evaluated and managed.

Under a 1996 agreement with NYSDEC regarding petroleum spill-reporting protocol, the WVDP is not required to report spills of petroleum products of 5 gallons or less onto an impervious surface that are cleaned up within two hours of discovery. Petroleum-product spills of 5 gallons or less onto the ground are entered in a monthly petroleum spill log, which is submitted to NYSDEC on or by the fifteenth day of the following month.

Spills of any amount that travel to waters of the state must be reported within two hours to the NYSDEC spill hotline and also are entered in the monthly log. Spills of petroleum products that enter navigable waters of New York State are reported to the National Response Center within two hours of discovery. There were no spills to navigable waters at the WVDP in 1999.

The WVDP also reports spills or releases of hazardous substances in accordance with the reporting requirements of RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) if a reportable quantity has been exceeded, the CAA, EPCRA, the CWA, and the Toxic Substances Control Act (TSCA). No chemical spills or releases exceeded reportable quantities and, thus, no reporting was required. All spills that occurred in 1999 were cleaned up in a timely manner in accordance with the WVDP Spill Notification and Reporting Policy, thereby minimizing any effects on the environment. Debris generated during cleanup was characterized and dispositioned appropriately.

Safe Drinking Water Act (SDWA). The Safe Drinking Water Act (SDWA), as amended, requires that each federal agency having jurisdiction over a federally owned or maintained public water system must comply with all federal, state, and local requirements regarding safe drinking water. Compliance with regulations promulgated under the SDWA in the state of New York is overseen by the New York State Department of Health (NYSDOH) through county health departments.

The WVDP obtains its drinking water from surface water reservoirs on the WNYNSC and is considered a non-transient, noncommunity public water supplier. The WVDP's drinking water treatment facility purifies the water by clarification, filtration, and chlorination before it is distributed on-site.

As an operator of a drinking water supply system, the WVDP routinely collects and analyzes drinking water samples to monitor water quality. The results of these analyses are reported to the Cattaraugus County Health Department, which also independently analyzes a sample of WVDP drinking water every month to determine bacterial and residual chlorine content. Analysis of the microbiological samples collected in 1999 produced satisfactory results and the free chlorine residual measurements taken throughout the distribution system were positive on all occasions, indicating proper disinfection.

The WVDP regularly tests the site's drinking water for lead and copper in accordance with EPA and NYSDOH regulations. NYSDOH regulations allow a facility to reduce sampling from once a year to once every three years if three consecutive sampling campaigns produce results below the action level. Because sampling for lead and copper in 1997, 1998, and 1999 indicated that all results were below the action levels for these metals, the next scheduled sampling for lead and copper will be in 2002.

The Cattaraugus County Health Department conducted its annual inspection of the WVDP water supply system on November 2, 1999. No findings or notices of violation were issued.

Toxic Substances Control Act (TSCA). The Toxic Substances Control Act (TSCA) of 1976 regulates the manufacture, processing, distribution, and use of chemicals, including asbestos-containing materials (ACM) and polychlorinated biphenyls (PCBs). Because PCBs are regulated as a hazardous waste in New York State, the WVDP continued in 1999 to manage radioactively contaminated PCB wastes as radioactive mixed wastes and nonradioactive PCB waste as hazardous waste. Details concerning PCB-contaminated radioactive waste management, including a description of the waste and proposed treatment technologies and schedules, can be found in section 3.1.5 of the Site Treatment Plan, Fiscal Year 1998 Update (West Valley Nuclear Services Co., Inc. February 1999).

To comply with TSCA, all operations associated with PCBs comply with the PCB and PCB-Contaminated Material Management Plan (West Valley Nuclear Services Co., Inc. December 28, 1998). The WVDP also maintains an annual document log that details PCB use and appropriate PCB waste storage on-site and any changes in storage-for-disposal status. The WVDP complies with the regulations for the disposal of PCBs, which conditionally allow radioactive and nonradioactive PCB wastes to be stored for more than one year (40 CFR Parts 750 and 761).

The WVDP Asbestos Management Plan update (West Valley Nuclear Services Co. October 26, 1999) includes results of a review of the asbestos-management program completed by the WVDP Waste Operations department in January 1999.

In 1999 the WVDP also continued to maintain compliance with all TSCA requirements pertaining to asbestos by managing asbestos-containing material (ACM) at the site in accordance with the Asbestos Management Plan. The plan was prepared to ensure compliance with TSCA requirements and includes requirements for limiting worker exposure to ACM and for asbestos-abatement projects, maintenance activities, and periodic surveillance inspections (at least once every three years). The plan also identifies the inventory and status of on-site ACM.

Activities in 1999 included the repair or abatement of damaged/friable ACM, removal of roofing materials containing asbestos, removal of all friable asbestos from the LLWTF, and the maintenance of signs and labels to warn workers of asbestos-containing material. All activities associated with ACM are completed by personnel who are certified by the New York State Department of Labor (NYSDOL). WVNS maintains an asbestos-handling license issued by NYSDOL.

National Environmental Policy Act (NEPA). The National Environmental Policy Act (NEPA) of 1969, as amended, establishes a national policy to ensure that protection of the environment is included in federal planning and decision making (Title I). Its goals are to prevent or eliminate potential damage to the environment that could arise from federal legislative actions or proposed federal projects. The President's Council on Environmental Quality (CEQ), established under subsection II of NEPA, sets the policy for fulfilling these goals. The CEQ regulations for implementing NEPA are promulgated in 40 CFR Parts 1500 - 1508.

NEPA requires that all federal agencies proposing actions having the potential to significantly affect the quality of human health and the environment prepare detailed environmental statements. The DOE implements NEPA by requiring an environmental review of all proposed actions. The DOE's NEPA procedures are a hierarchical system of assessments for reviewing and documenting proposed actions that is commensurate with the action's potential for affecting the environment.

The levels of review and documentation are: no impact and a categorical exclusion (CX); potential impact and an environmental assessment (EA); and significant impact and an environmental impact statement (EIS). (See the Glossary for definitions of *categorical exclusion*, *environmental assessment*, and *environmental impact statement*.) Several actions at the WVDP were reviewed and approved in 1999 under the DOE's NEPA-implementing regulations:

- In July 1999, under the 1998 Supplement Analysis to the 1982 Final EIS for the WVDP (DOE/EIS-0081), the DOE approved the design and construction of a facility for remotely handling waste. (For a description of this Supplement Analysis see the NEPA section in the Environmental Compliance Summary of the West Valley Demonstration Project Site Environmental Report: Calendar Year 1998.)

- Routine maintenance activities, installation of a hydrogen peroxide addition system for controlling algae growth in the lagoons, and bioventilation of petroleum-contaminated soil were categorically excluded.

Completion of the WVDP and Closure of the WNYNSC. Activities continued in 1999 in support of the Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Service Center (DOE/EIS-0226-D). The DOE and NYSERDA continued work associated with developing a preferred alternative.

On February 23, 1999, the Nuclear Regulatory Commission (NRC), as a cooperating agency in the EIS process and as part of its responsibilities under the WVDP Act, issued SECY-99-057 as a supplement to SECY-98-251, Decommissioning Criteria for West Valley. Based on these documents, the NRC Commissioners approved the License Termination Rule (LTR) as the decommissioning criteria for the WVDP in a June 3, 1999 memorandum. On September 2, 1999 SECY-99-232 was issued, informing the Commission of the NRC staff's intent to provide a draft policy statement on the decommissioning criteria for the WVDP and the West Valley site.

The LTR specifies a range of criteria for two decommissioning options: release of the site with no restrictions on its use and release of the site with legally enforceable controls to limit future access and use. Alternate criteria also are available if the licensee provides assurance that the public's health and safety would continue to be protected, employs restrictions on site use and access, reduces doses to as-low-as-reasonably-achievable (ALARA) levels, documents that community advice has been sought and addressed, and submits the decommissioning plan or License Termination Plan to the Commission. The use of this alternate criteria requires Commission approval after consideration of EPA and public comments and NRC staff recommendations. A draft policy statement describing the decision was issued on December 3, 1999.

Nationwide Management of Waste. In May 1997 DOE Headquarters issued the Final Waste Management Programmatic Environmental Impact Statement to evaluate nationwide management and siting alternatives for the treatment, storage, and disposal of five types of radioactive and hazardous waste. The alternatives address waste generated, stored, or buried over the next twenty years at fifty-four sites in the DOE complex.

The Final Waste Management Programmatic EIS was issued with the intent of developing and issuing separate records of decision for each type of waste analyzed. In 1998 the DOE issued records of decisions for transuranic and non-wastewater hazardous waste. On August 26, 1999 the DOE issued the record of decision for high-level radioactive waste. This decision specifies that the WVDP high-level vitrified waste will remain in storage on-site until it is accepted for disposal at a geologic repository.

On December 10, 1999 the DOE issued its preferred alternative for the management of low-level radioactive waste and mixed low-level waste. Hanford and the Nevada Test Site were identified as the preferred regional disposal sites for these waste types (64 Federal Register 69241). The Federal Register notes that the term "regional" does not impose geographical restrictions on which DOE sites could ship low-level and mixed low-level waste to these disposal sites.

Migratory Bird Treaty Act. The WVDP monitors Project activities to ensure continued compliance with the requirements of both the Migratory Bird Treaty Act and the Endangered Species Act. A New York State Fish and Wildlife License allows the WVDP to remove nests of migratory birds as needed to avoid the potential spread of radioactive contamination or to otherwise protect the health and safety of Project employees and visitors. The WVDP's license (DWP00-001) was received from NYSDEC and is effective from January 1, 2000 through December 31, 2000.

Every two years the WVDP updates its information about the potential for federally listed or proposed endangered or threatened species to be in the vicinity of Project activities. This was most recently done by letter to the U.S. Fish and Wildlife Service on June 7, 1999. Their reply on June 21, 1999, reconfirmed that "except for occasional transient individuals" no plant or animal species protected under the Endangered Species Act were known to exist at the WVDP.

Current Achievements and Program Highlights

The WVDP's successful high-level waste vitrification program is only one of two such programs operating in the nation.

Phase II Vitrification. Phase II of vitrification, processing the high-level waste residuals (heels) in storage tank 8D-2, continued in 1999. Thirty-five glass canisters were filled during this phase of operation, bringing the total number processed since operations began in 1996 to 245 canisters.

A high-pressure water spray lance was designed, tested, and installed in high-level waste tank 8D-1 to mobilize the material that has settled into the grid structure at the bottom of the tank. The mechanical arm that deploys the spray lance is equipped with a camera and light system to allow visual observation of the inside of the tank. A similar spray lance and camera system is being fabricated for use in high-level waste tank 8D-2 to remove settled material in that tank. Additional waste-retrieval equipment that will increase the tools available for further cleanout of the tanks has been designed and is being fabricated and tested.

Integrated Safety Management System (ISMS). In August 1999 a self-assessment was conducted to verify that the WVDP's integrated environmental, safety, and health management system continued to function in accordance with the 1998 plan.

• The WVDP's ISMS had been verified by the DOE Ohio Field Office in November 1998. The Criteria Review and Approach Documents that resulted from the DOE verification review were re-evaluated during the 1999 self-assessment to identify areas for improvement and/or additional consideration. Based on this re-evaluation, the system configuration was revised to include policies and procedures for the site-wide work review group, the environmental management system (EMS), and other WVDP programs related to work planning and worker safety.

• Similarly, based on the Criteria Review and Approach Documents, the EMS was revised to describe its relationship to the ISMS, to clarify EMS deliverables, and to add the EMS to the set of binding documents describing activities at the WVDP that allow safe operation of the facility.

The WVDP has demonstrated its commitment to an all-inclusive approach to safety through its safety programs and implementation, in which employees are encouraged and empowered to take ownership of safety in their jobs.

The DOE Voluntary Protection Program (VPP) STAR Status Program was developed by the department of Occupational Safety and Health (OSHA) and adopted by the DOE to recognize superior health and safety performance by contractor management and employees.

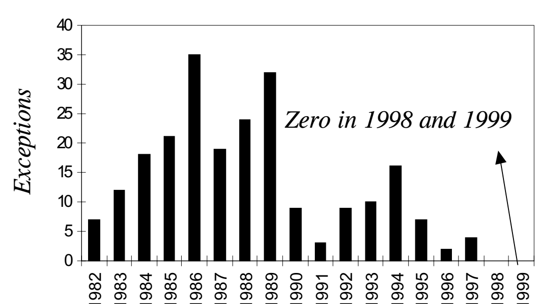
In 1999 the WVDP was recommended for STAR Status, the highest safety award given within OSHA or the DOE. This prestigious award has been granted to only five other DOE sites.

Environmental Management System (EMS). WVNS's environmental management system comprises procedures that provide the basic policy and direction for accomplishing work through proactive management, environmental stewardship, and the integration of appropriate technologies across all Project functions. Environmental management is integrated with other safety management and work planning processes at the WVDP through the integrated environmental, health, and safety management program (ISMS).

The WVNS EMS satisfies the requirements of both the Code of Environmental Management Principles (CEMP) for federal agencies and ISO (International Organization for Standardization) 14001, Environmental Management Systems: Specifications for Guidance and Use, which are the two major frameworks for environmental management systems. The CEMP was developed by the EPA in response to Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. It embodies the principles and underlying performance objectives that are the basis for responsible environmental management. ISO 14001 is a comparable environmental management system that is being implemented throughout the world.

Clean Water Act. As shown in the chart below, the annual number of exceptions to the discharge concentration limits specified in the site's SPDES permit have been substantially re-

WVDP SPDES Permit Limit Exceptions 1982-1999



duced, especially when compared to the peak of thirty-five exceptions noted in 1986. In 1999, for the second consecutive year, no exceptions were reported.

Storm Water Discharge Permit. Surface water runoff from precipitation can become contaminated with pollutants from industrial process facilities, material storage and handling areas, access roads, or vehicle parking areas. To protect the environment, aquatic resources, and public health, Section 402(p) of the CWA requires that a storm water discharge permit application containing facility-specific information be submitted to the permitting authority. NYSDEC, the permitting authority in New York State, uses this information to ascertain the potential for pollution from storm water collection and discharge systems and to determine appropriate permitting requirements. The WVDP is expecting a SPDES permit modification in 2000 that addresses the site's storm water runoff.

Flood Protection: Water-Supply Dam Repairs. In 1998 an inspection by NYSDEC of the site's two water-supply reservoir dams and the emergency spillway showed that an area around dam #1 had slumped and that repairs were needed. NYSDEC concurred with the WVDP's repair plans and confirmed that these actions constituted routine maintenance. All repairs — relocation of a section of the roadway, removal of associated piers and rock baskets, diversion of the road underdrain, installation of silt fencing, and reseeding — are scheduled for completion by September 2000.

Closed Landfill Maintenance. Closure of the on-site nonradioactive construction and demolition debris landfill (CDDL) was completed in August 1986. The landfill area was closed in accordance with NYSDEC requirements for this type of landfill, following a closure plan (Standish 1985) approved by NYSDEC. To meet routine post-closure requirements, the CDDL cover was inspected twice in 1999 and found to be in generally good condition. The grass cover on the clay and soil cap is routinely maintained and cut, and drainage is maintained to ensure that no obvious ponding or soil erosion occurs.

Release of Materials Containing Residual Radioactivity. The release of property containing residual radioactivity from DOE facilities is carefully controlled by DOE guidelines and procedures. Any transfer that places property (real property, structures, or equipment) containing radioactivity into public use is classified as a type of environmental release.

In keeping with DOE initiatives to expand environmental information provided to the public, certain details of transfers of property containing residual radioactivity are to be included in annual site environmental reports. The information provided should include the type of material and the amount of residual radioactivity, the basis for releasing the property for public use (including release limits and when the property was released), the end use and cost savings associated with release of the property, and doses to individuals and the collective dose to the public associated with each release. The WVDP did not release any property classified per DOE Order 5400.5 as material containing residual radioactive material in 1999.

Project Assessment Activities in 1999

As the primary contractor for the DOE at the WVDP, WVNS maintains a comprehensive review program for proposed and ongoing operations. Assessments are conducted through formal surveillances and informal programs. Formal surveillances ensure compliance with regulations, directives, and DOE Orders.

The informal program is used to identify issues or potential problems that can be corrected on the spot.

The local DOE Project office also independently reviews various aspects of the environmental and waste management programs, and in 1999 overall results of the reviews reflected continuing, well-managed environmental programs at the WVDP.

Significant external environmental overview activities in 1999 included inspections by NYSDEC for compliance with RCRA, SPDES, and chemical bulk storage tanks requirements and an annual compliance inspection of the WVDP potable water supply system by the Cattaraugus County Health Department. These inspections did not identify any environmental program findings and further demonstrated the WVDP's commitment to protection of the environment.

Hardware and software used in the environmental monitoring program were assessed for year-2000 compliance. Included in the assessment were the meteorological system, water samplers, air samplers, radiological counting instruments, emergency response equipment, laboratory and field equipment and instruments, and data management and reporting systems. All corrective actions identified in the assessment were completed by September 1999. No problems in the WVDP environmental program as a result of the millennium date change were noted.

ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the Western New York Nuclear Service Center (WNYNSC) on the West Valley Demonstration Project (WVDP) premises is the byproduct of spent nuclear fuel reprocessed during the late 1960s and early 1970s by Nuclear Fuel Services, Inc.(NFS).

Inasmuch as the WNYNSC is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity and chemicals associated with the residual effects of NFS operations and the Project's high-level waste treatment and low-level waste management operations. The following information about the operations at the WVDP and about radiation and radioactivity will be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radiation and Radioactivity. Radioactivity is a process in which unstable atomic nuclei spontaneously disintegrate or "decay" into atomic nuclei of another isotope or element. (See *isotope*, p.5, in the Glossary.) The nuclei decay until only a stable, nonradioactive isotope remains. Depending on the isotope, this process can take anywhere from less than a second to hundreds of thousands of years.

As atomic nuclei decay, radiation is released in three main forms: alpha particles, beta particles, and gamma rays. By emitting energy or particles, the nucleus moves toward a less energetic, more stable state.

Alpha Particles. An alpha particle, released by decay, is a fragment of a much larger nucleus. It consists of two protons and two neutrons (similar to a helium atom nucleus) and is positively charged. Compared to beta particles, alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation, therefore, is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because all of their energy is absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is the uranium isotope with an atomic weight of 232 (uranium-232). Uranium-232 is in the high-level waste mixture at the WVDP as a result of a thorium-based nuclear fuel reprocessing campaign conducted by NFS and has been previously detected on occasion in liquid waste streams.

Beta Particles. A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum less than an inch thick. If beta particles are released inside the body they do much less damage than an equal number of alpha particles. Because they are smaller and faster and have less of a charge, beta particles deposit energy in fewer tissue cells and over a larger volume than alpha particles. Strontium-90, a fission product (see Glossary, p.4), is an example of a beta-emitting radionuclide. Strontium-90 is found in the stabilized supernatant.

Gamma Rays. Gamma rays are high-energy "packets" of electromagnetic radiation, called photons, that are emitted from the nucleus. They are similar to x-rays but generally have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can be effectively reduced only by shielding consisting of several inches of a heavy element, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m, a short-lived daughter product of cesium-137. Both barium-137m and cesium-137 are major constituents of the WVDP high-level radioactive waste.

Measurement of Radioactivity. The rate at which radiation is emitted from a disintegrating nucleus can be described by the number of decay events or nuclear transformations that occur in a radioactive material over a fixed period of time. This process of emitting energy, or radioactivity, is measured in curies (Ci) or becquerels (Bq).

The curie is based on the decay rate of the radionuclide radium-226 (Ra-226). One gram of radium-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7E+10 d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second. (See the Scientific Notation section at the back of this report for information on exponentiation, i.e., the use of "E" to mean the power of 10.)

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-trillionth (1E-12) of a curie, equal to 3.7E-02 disintegrations per second, or 2.22 disintegrations per minute.

Measurement of Dose. The amount of energy absorbed by the receiving material is measured in rads (radiation absorbed dose). A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the approximate amount of energy necessary to lift a mosquito one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation.

Alpha, beta, and gamma radiation affect the body to different degrees. Each type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause twenty times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of 1.

The unit of dose measurement to humans is the rem (roentgen-equivalent-man). Rems are

Ionizing Radiation

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock electrons loose from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes an electrically neutral atom, in which the positively charged protons and the negatively charged electrons balance each other, into a charged atom called an ion. An ion can be either positively or negatively charged. Various kinds of ionizing radiation produce different degrees of damage.

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person who has been exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with other chromosomes. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in the offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed within a given exposure time. The only observable effect of an instantaneous whole-body dose of 50 rem (0.5 Sv) might be a temporary reduction in white blood cell count. An instantaneous dose of 100-200 rem (1-2 Sv) might cause additional temporary effects such as vomiting but usually would have no long-lasting side effects.

Assessing biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation appears to be an increased risk of cancer. However, scientists have not been able to demonstrate with certainty that exposure to low-level radiation causes an increase in injurious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Background Radiation

Background radiation is always present, and everyone is constantly exposed to low levels of such radiation from both naturally occurring and manmade sources. In the United States the average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem) or 3.6 millisieverts (mSv). Most of this radiation, approximately 295 mrem (2.95 mSv), comes from natural sources. The rest comes from medical procedures, consumer products, and other manmade sources. *(See p.4-3 in Chapter 4, Radiological Dose Assessment.)*

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

equal to the number of rads multiplied by the quality factor for each type of radiation. Dose can also be expressed in sieverts. One sievert equals 100 rem.

Environmental Monitoring Program Overview

Human beings may be exposed to radioactivity primarily through air, water, and food. At the WVDP all three pathways are monitored, but air and surface water pathways are the two primary means by which radioactive material can move off-site.

The geology of the site (types of soil and bedrock), the hydrology (location and flow of surface water and groundwater), and meteorological characteristics of the site (wind speed, patterns, and direction) are all considered in evaluating potential exposure through the major pathways.

The on-site and off-site monitoring program at the WVDP includes measuring the concentration of alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity from key locations, which can be done within a matter of hours, produces a comprehensive picture of on-site and off-site levels of radioactivity from all sources. In a facility such as the WVDP, frequent updating and tracking of the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they have been previously detected in WVDP waste materials. Radiation from other important radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected by gross measurement techniques, so these must be analyzed separately using methods with greater sensitivity. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WVDP environs.

The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in air and water effluents. Because manmade sources of radiation at the Project have been decaying for more than twenty years, the monitoring program does not routinely include short-lived radionuclides, i.e., isotopes with a half-life of less than two years, which would have only 1/1,000 of the original radioactivity remaining. (See Appendix B [pp. B-1 through B-44] for the schedule of samples and radionuclides measured and Appendix K, Table K-1 [p.K-3] for related Department of Energy [DOE] protection standards, i.e., derived concentration guides [DCGs] and half-lives of radionuclides measured in WVDP samples.)

Data Reporting. Because the decay of radioactive atoms is a random process, there is an inherent uncertainty associated with all environmental radioactivity measurements. This can be demonstrated by repeatedly measuring the number of atoms that decay in a radioactive sample over some fixed period of time. The result of such an experiment would be a range of values for which the average value would provide the best indication of how many radioactive atoms were present in the sample.

However, in actual practice a sample of the environment usually is measured for radioactivity just once, not many times. The inherent uncertainty of the measurement, then, stems from the fact that it cannot be known whether the result that was obtained from one measurement is higher or lower than the "true" value, i.e., the average value that would be obtained if many measurements had been taken.

The term confidence interval is used to describe the range of measurement values above and below the test result within which the "true"

Derived Concentration Guides

A derived concentration guide (DCG) is defined by the DOE as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to a "reference man." These concentrations — DCGs — are considered screening levels that enable site personnel to review effluent and environmental data and to decide if further investigation is needed. (See Table K-1, Appendix K, p.K-3 for a list of DCGs.)

DOE Orders require that the hypothetical dose to the public from facility effluents be estimated using specific computer codes. (See Dose Assessment Methodology [p.4-5] in Chapter 4, Radiological Dose Assessment.) Doses estimated for WVDP activities are calculated using actual site data and are not related directly to DCG values.

Dose estimates are based on a sum of isotope quantities released and the dose equivalent effects for that isotope. For liquid effluent screening purposes, percentages of the DCGs for all radionuclides present are added. If the total percentage of the DCGs is less than 100, then the effluent released complies with the DOE guideline.

Although the DOE provides DCGs for airborne radionuclides, the more stringent U.S. Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants (NESHAP) apply to Project airborne effluents. As a convenient reference point, both air and water sampling results are compared with DCGs throughout this report.

value is expected to lie. This interval is derived mathematically. The width of the interval is based primarily on a predetermined confidence level, i.e., the probability that the confidence interval actually encompasses the "true" value. The WVDP environmental monitoring program uses a 95% confidence level for all radioactivity measurements and calculates confidence intervals accordingly.

The confidence interval around a measured value is indicated by the plus-or-minus (±) value following the result, e.g., 5.30 ± 3.6E-09 μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be 0.00000000530 ± 0.0000000036 μCi/mL. A sample measurement expressed this way is correctly interpreted to mean "there is a 95% probability that the concentration of radioactivity in this sample is between 1.7E-09μCi/mL and 8.9E-09μCi/mL."

If the confidence interval for the measured value includes zero (e.g., 5.30 ± 6.5E-09μCi/mL), the value is considered to be below the detection limit. The values listed in tables of radioactivity measurements in the appendices include the confidence interval regardless of the detection limit value.

In general, the detection limit is the minimum amount of constituent or material of interest detected by an instrument or method that can be distinguished from background and instrument noise. Thus, the detection limit is the lowest value at which a sample result shows a statistically positive difference from a sample in which no constituent is present.

Nonradiological data conventionally are presented without an associated uncertainty and are expressed by the detection limit prefaced by a "less-than" symbol (<) if that analyte was not measurable. (See also Data Assessment and Reporting [p.5-7] in Chapter 5, Quality Assurance.)

Changes in the 1999 Environmental Monitoring Program. Changes in the 1999 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

- Stack monitoring equipment upgrades for the supernatant treatment system/permanent ventilation system (STS/PVS) were completed in September 1999. The point of sample withdrawal (ANSTSTK) remained the same in the PVS stack, and equipment for real-time, continuous monitoring of stack effluents was relocated from the PVS building to a dedicated shelter nearby.

- To accommodate replacement of the lag storage area (LSA)-4 waste storage structure and construction of the new shipping depot, the on-site ambient air monitoring location for diffuse source emissions from the lag storage areas was co-located with stack monitoring equipment for the container sorting and packaging facility (ANCSPFK).

Appendix B summarizes the program changes (p.B-iv) and lists the sample points and parameters measured in 1999 (pp.B-1 through B-44).

Vitrification Overview. High-level radioactive waste from NFS operations was originally stored in two of four underground tanks (tanks 8D-2 and 8D-4). The waste in 8D-2, the larger of the active tanks, had settled into two layers: a liquid — the supernatant — and a precipitate layer on the tank bottom — the sludge. To solidify the high-level waste, WVDP engineers designed and developed a process of pretreatment and vitrification.

Pretreatment Accomplishments. The supernatant (in tank 8D-2) was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total radioactivity in the supernatant. During pretreatment, sodium salts and sulfates were separated from the radioactive constituents in both the liquid portion of the high-level waste and the sludge layer in the bottom of the tank.

Pretreatment of the supernatant began in 1988. The integrated radwaste treatment system (IRTS) reduced the volume of the high-level waste needing vitrification by producing low-level waste stabilized in cement: The supernatant was passed through zeolite-filled ion exchange columns in the supernatant treatment system (STS) to remove more than 99.9% of the radioactive cesium. The resulting liquid was then concentrated by evaporation in the liquid waste treatment system (LWTS). This low-level radioactive concentrate was blended with cement in the cement solidification system (CSS) and placed in 269-liter (71-gal) steel drums. The cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

In the last step the steel drums were stored in an on-site aboveground vault, the drum cell. Processing of the supernatant was completed in 1990, with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge. Pretreatment of the sludge layer in high-level waste tank 8D-2 began in 1991. Five specially designed 50-foot-long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing of the wash water through the integrated radwaste treatment system began. Processing removed radioactive constituents for later solidification into glass, and the wash water containing salt was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 765,000 gallons of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced.

In January 1995, high-level waste liquid stored in tank 8D-4 was transferred to tank 8D-2. (Tank 8D-4 contained THOREX high-level radioactive waste, which had been produced by a single reprocessing campaign of a special fuel containing thorium that had been conducted from November 1968 to January 1969 by the previous facility operators.) The resulting mixture was washed and the wash water was processed. The IRTS processing of the combined wash waters was completed in May 1995.

In all, through the supernatant treatment process and the sludge wash process, more than 1.7 million gallons of liquid had been processed by the end of 1995, producing a total of 19,877 drums of cemented low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the integrated radwaste treatment system to remove radioactivity was blended with the washed sludge before being transferred to the vitrification facility for blending with the glass-formers. In 1995 and early 1996 final waste transfers to high-level waste tank 8D-2 were completed in preparation for vitrification.

Preparation for Vitrification. Nonradioactive testing of a full-scale vitrification system was conducted from 1984 to 1989. In 1990 all vitrification test equipment was removed to allow installation of shield walls for fully remote radioactive operations. The walls and shielded tunnel connecting the vitrification facility to the former reprocessing plant were completed in 1991.

The slurry-fed ceramic melter was fully assembled, bricked, and installed in 1993, and the cold chemical building was completed, as was the sludge mobilization system that transfers high-level waste to the melter. This system was fully tested in 1994. Several additional major systems components also were installed in 1994: the canister turntable, which positions the stainless steel canisters as they are filled with molten glass; the submerged bed scrubber, which cleans gases produced by the vitrification process; and the transfer cart, which moves filled canisters to the storage area.

Nonradiological testing ("cold" operations) of the vitrification facility began in 1995, and the first canister of nonradiological glass was produced. The WVDP declared its readiness to proceed with the necessary equipment tie-ins of the ventilation and utility systems to the vitrification facility building and tie-ins of the transfer lines to and from the high-level waste tank farm and the vitrification facility. In this closed-loop system, the transfer lines connect to multiple common lines so that material can be moved among all the points in the system. High-level waste vitrification began in 1996 and continued throughout 1999.

1999 Activities at the WVDP

The WVDP's environmental management system is an important factor in the environmental monitoring program and the accomplishment of its mission. Significant components, initiatives, and pertinent information about the work accomplished at the WVDP in 1999 are summarized below.

Vitrification. Solidification of the high-level waste in glass continued in 1999. The high-level waste mixture of washed sludge and spent zeolite from the ion-exchange process is combined in batches with glass-forming chemicals and then fed to a ceramic melter. The waste mixture is heated to approximately 2,000°F and poured into stainless steel canisters. Approximately 270 stainless steel canisters eventually will be needed to hold all of the vitrified waste.

Each canister, 10 feet long by 2 feet in diameter, is filled with a uniform, high-level waste glass that will be suitable for eventual shipment to a federal repository. During Phase I (June 1996 to June 1998) 210 canisters were filled.

In 1999 more than 0.6 million curies of radioactivity were transferred to the vitrification facility and fifteen high-level waste canisters were produced. Since the beginning of vitrification in 1996 through calendar year 1999, 245 high-level waste canisters have been filled and more than 11 million cesium/strontium curies have been transferred to the vitrification facility and vitrified.

Environmental Management of Aqueous Radioactive Waste. Water containing radioactive material from site process operations is collected and treated in the low-level waste treatment facility LLW2. (Water from the sanitary system, which does not contain added radioactive material, is managed in a separate system.)

The treated process water is held, sampled, and analyzed before it is released through a State Pollutant Discharge Elimination System (SPDES)-permitted outfall. In 1999, 29.1 million liters (7.67 million gal) of water were treated in the LLWTF system (i.e., the LLW2 and associated lagoons) and discharged through outfall 001, the lagoon 3 weir. The discharge waters contained an estimated 12.3 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous fourteen years averaged about 39 millicuries per year. The 1999 release was about 32% of this average. (See Radiological Monitoring: Surface Water, Low-level Waste Treatment Facility Sampling Location [p.2-2] in Chapter 2.)

Approximately 0.11 curies of tritium were released in WVDP liquid effluents in 1999 — 7% of the fourteen-year average of 1.47 curies.

Environmental Management of Airborne Radioactive Emissions. Ventilated air from the various points in the IRTS process (high-level waste sludge treatment, main plant and liquid waste treatment system, and the cement solidification system) and from other waste management activities is sampled continuously during operation for both particulate matter and for gaseous radioactivity. In addition to monitors that alarm if particulate matter radioactivity increases above pre-set levels, the sample media are analyzed in the laboratory for the specific radionuclides that are present in the radioactive materials being handled.

Air used to ventilate the facilities where radioactive material cleanup processes are operated is passed through filtration devices before being emitted to the atmosphere. These filtration devices are generally more effective for particulate matter than for gaseous radioactivity. For this reason, facility air emissions tend to contain a greater amount of gaseous radioactivity (e.g., tritium and iodine-129) than radioactivity associated with particulate matter (e.g., strontium-90 and cesium-137). However, gaseous radionuclide emissions still remain so far below the most restrictive regulatory limit for public safety that additional treatment technologies beyond that already provided by, for example, the vitrification off-gas treatment system, are not necessary.

Gaseous radioactivity emissions from the main plant in 1999 included approximately 6.77 millicuries of tritium (as hydrogen tritium oxide [HTO]) and 1.90 millicuries of iodine-129. (See Chapter 2, p.2-24, for a discussion of iodine-129 emissions from the main plant stack.) As expected, these 1999 values are quite low when compared to 1997, a year in which the vitrification system was in operation for the entire year at a relatively high rate of production and tritium and iodine-129 emissions were 140 millicuries and 7.43 millicuries respectively.

Particulate matter radioactivity emissions from the main plant in 1999 included approximately 0.2 millicuries of beta-emitting radioactivity and 0.001 millicuries of alpha-emitting radioactivity. In 1997, beta-emitting and alpha-emitting radioactivity emissions were 0.4 millicuries and 0.001 millicuries respectively.

Environmental Management of Radiological Exposure. Radiological exposures measured at on-site monitoring locations DNTLD24, located near the chemical process cell waste storage area (CPC-WSA), and DNTLD36, located near the drum cell, have shown steady decreases for several years. (See Fig.A-10 [p.A-12] for the locations of these two monitoring points.) Exposure data for these two monitoring locations are shown in Figures 1-1 (*below*) and 1-2 (*p.1-10*).

The beginning of the long-term steady decrease in exposure at DNTLD24 correlates well with the cessation of placement of waste containers in the CPC-WSA in 1987 and with the decay of the mix of isotopes in the stored waste. The decreases noted at DNTLD36 can be attributed to the cessation of the placement of waste drums in the drum cell as well as the decay of the mix of isotopes in the stored waste over time and to the revised stacking plan initiated in 1990, which changed the arrangement of waste and shield drums in the drum cell.

Unplanned Radiological Releases. There were no unplanned air or liquid radiological releases on-site or to the off-site environment from the Project in 1999.

NRC-licensed Disposal Area (NDA) Interceptor Trench and Pretreatment System. Radioactively contaminated n-dodecane in combination with tributyl phosphate (TBP) was discovered at the northern boundary of the NDA in 1983, shortly after the DOE assumed control of the WVDP site. Extensive sampling and monitoring through 1989 revealed the possibility that the n-dodecane/TBP could migrate. To contain this subsurface organic contaminant migration, an interceptor trench and liquid pretreatment system (LPS) were built.

The trench was designed to intercept and collect subsurface water, which could be carrying n-dodecane/TBP, in order to prevent the material from entering the surface water drainage ditch leading into Erdman Brook. The LPS was installed to decant the n-dodecane/TBP from the water and to remove iodine-129 from the collected water before its transfer to the low-level waste treatment facility. The separated n-

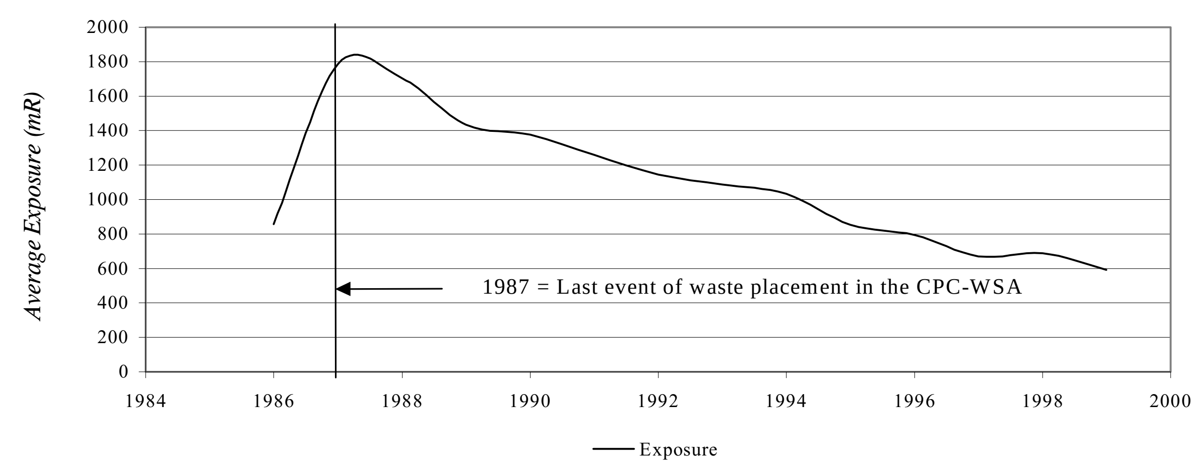


Figure 1-1. Average Annual Exposure at DNTLD24

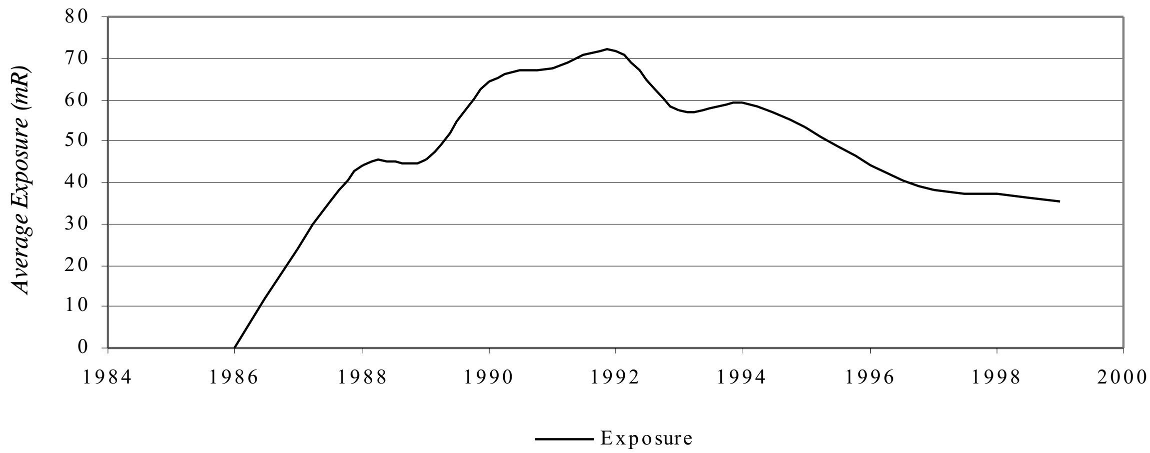


Figure 1-2. Average Annual Exposure at DNTLD36

dodecane/TBP would be stored for subsequent treatment and disposal.

As in previous years, no water containing n-dodecane/TBP was encountered in the trench and no water or n-dodecane/TBP was treated by the LPS in 1999. Approximately 650,000 liters (172,000 gals) of water were collected from the interceptor trench and transferred to lagoon 2 during the year. Results of surface and groundwater monitoring in the vicinity of the trench are discussed in Chapter 2 under SDA and NDA Sampling Locations, p.2-6, and in Chapter 3 under Results of Monitoring at the NDA, p.3-13.

Waste Minimization Program. The WVDP formalized a waste minimization program in 1991 to reduce the generation of low-level waste, mixed waste, and hazardous waste. This program is a comprehensive and continual effort to prevent or minimize pollution, with the overall goal of reducing health and safety risks, protecting the environment, and complying with all federal and state regulations. (For more details see the Environmental Compliance Summary: Calendar Year 1999 Waste Minimization and Pollution Prevention [p.ECS-5].)

Pollution Prevention Awareness Program. The WVDP's pollution prevention (P2) awareness program is a significant part of the Project's waste minimization program. The goal of the program is to make all employees aware of the importance of pollution prevention both at work and at home.

A crucial component of the P2 awareness program at the WVDP is the Pollution Prevention Coordinators group. This group communicates, shares, and publicizes prevention, reduction, reuse, and recycling information to all departments at the WVDP. The P2 coordinators identify and facilitate the implementation of effective source reduction, reuse, recycling, and procurement of recycled products. Six self-directed teams evaluate specific concerns and issues and make recommendations for resolution.

Waste Management. In 1998 the Waste Management department implemented the Waste Management Reengineering Action Plan, a program to improve methods of addressing waste management at the WVDP.

To define the path forward for disposal of all WVDP radioactive wastes, a waste management strategic policy, Planning for Waste Disposal, was developed and issued in November 1999. The policy provides an overall methodology for ensuring that wastes are fully recognized and evaluated and that methods for effectively managing waste for dispositioning are included in work plans.

Radman®, a characterization and shipping software system, was used to profile the miscellaneous debris waste stream. The Project's low-level waste miscellaneous debris profile was approved by Envirocare, and the WVDP initiated shipments in February 1999 under the DOE Ohio Field Office (DOE-OH) consolidated contract.

To ensure up-front characterization of all radiological wastes, waste management personnel were assigned to assist on-site groups with large projects that would generate waste (e.g., removal of laboratory wastes from the process mechanical cell and removal of wastes from the scrap removal room tank).

WVNS improved cost effectiveness and enhanced operational efficiency while maintaining sound conduct-of-operations principles by following through on the goals set in the Waste Management Reengineering Action Plan and the Planning for Waste Disposal policy. Specific accomplishments include:

• shipping 35,400 cubic feet of low-level waste during fiscal year 1999, which was more than 40% above the 1999 goal and an increase of more than 600% compared to the amount of low-level waste shipped in any previous year

• reclaiming almost 40,000 cubic feet of indoor storage space through space-saving activities

• removing fabric and structural steel from lag storage area (LSA)- 4 under budget and on time

• dewatering and repacking more than 300 containers of ion-exchange resin from tanks in the 02 building

• completing ahead of schedule a major remediation of areas containing asbestos

• reducing the inventory of clean lead by approximately 39,000 pounds

• demonstrating intermodal container use, including container preparation for loading and transport to Pennsylvania for rail shipment of waste to Envirocare

• improving the low-level waste storage capacity report

• completing Site Treatment Plan milestones on or ahead of schedule.

An Environmental Affairs assessment team, including three specialists from the Westinghouse Savannah River site and Safe Sites of Colorado, visited the site to assess waste management programs and confirmed compliance with RCRA requirements.

DOE-OH/WVDP also audited the environmental management and waste management systems in August 1999 and found that both systems were effective and that personnel have thorough technical expertise and regulatory knowledge.

National Environmental Policy Act Activities. Under the National Environmental Policy Act (NEPA), the Department of Energy is required to consider the overall environmental effects of its proposed actions or federal projects. The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental effect. The levels of documentation include categorical exclusions (CXs), environmental assessments (EAs), and environmental impact statements (EISs).

Categorical exclusions evaluate and document actions that will not have a significant effect on the environment. Environmental assessments evaluate the extent to which the proposed action will affect the environment. If a proposed action has the potential for significant effects, an environmental impact statement is prepared that describes proposed alternatives to an action and explains the effects.

Facility maintenance and minor projects that support high-level waste vitrification are documented and submitted for approval as categorical exclusions, although environmental assessments occasionally are necessary for larger-scale activities.

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the WVDP and closure of the facilities at the WNYNSC. The environmental impact statement describes the potential environmental effects associated with Project completion and various site closure alternatives.

The draft environmental impact statement was completed in 1996 and released for a six-month public review and comment period. Having met throughout 1997 and 1998 to review alternatives presented in the environmental impact statement, the Citizen Task Force issued the West Valley Citizen Task Force Final Report (July 29, 1998). This report provided recommendations and advice on the development of a preferred alternative. The Citizen Task Force continues to meet and discuss issues related to Project completion and site closure decision-making.

Because the Nuclear Regulatory Commission (NRC) is authorized by the West Valley Demonstration Project Act to prescribe decommissioning criteria for the WVDP, the NRC staff proposed such criteria for the Project to the NRC Commissioners in 1998 (Decommissioning Criteria for West Valley, October 30, 1998 [SECY 98-251]). The DOE, NYSERDA, the New York State Department of Environmental Conservation (NYSDEC), and the Citizen Task Force were invited to a public meeting on January 12, 1999 to provide input to the NRC on their issues and concerns.

As a result of this meeting, the NRC issued a Staff Requirements Memorandum (SRM) on January 26, 1999, requesting additional information on the proposed decommissioning criteria. In response, the NRC staff provided SECY 99-057, Supplement to SECY 98-251. The NRC subsequently issued an SRM on June 3, 1999 based on the contents of both SECY 98-251 and SECY 99-057 and the written and oral com-

In addition to the public comment process required by the National Environmental Policy Act, NYSERDA, with participation from the DOE, formed a Citizen Task Force in January 1997. The mission of the Task Force is to assist in the development of a preferred alternative for the completion of the West Valley Demonstration Project and the cleanup, closure, or long-term management of the facilities at the Western New York Nuclear Service Center. The Task Force process has helped illuminate the various interests and concerns of the community, increased the two-way flow of information between the site managers and the community, and provided an effective way for the Task Force members to establish a mutually agreed upon set of recommendations for the site managers to consider in their decision-making process.

ments from interested parties. This SRM approved the NRC's License Termination Rule (LTR) as the decommissioning criteria to be applied to the WVDP and the West Valley site.

On December 3, 1999, the NRC published in the Federal Register (Vol.64, No.232, pp. 67952-67954) its draft policy statement and issued a notice of a public meeting to be held on January 5, 2000 at the Ashford Office Complex to solicit public comment on the draft policy statement. The NRC's draft policy statement is available electronically at http://www.nrc.gov/NRC/ADAMS/index.html.

In addition, copies of SECY 98-251, SECY 99-057, a transcript of the January 12, 2000 public meeting, the January 26, 1999 SRM and the June 3, 1999 SRM, and the NRC's vote sheets on SECY 98-251 and SECY 99-057 can be obtained electronically at http://www.nrc.gov/NRC/COMMISSION/activities.html.

Self-assessments. Self-assessments continued to be conducted in 1999 to review the management and effectiveness of the WVDP environmental protection and monitoring programs. Results of these self-assessments are evaluated and corrective actions are tracked through completion. Overall results of these self-assessments found that the WVDP continued to implement and in some cases improve the quality of the environmental protection and monitoring program. (See the Environmental Compliance Summary: Calendar Year 1999 [p.ECS-17] and Chapter 5, Quality Assurance [p.5-6].)

Occupational Safety and Environmental Training. The occupational safety of personnel who are involved in industrial operations under DOE cognizance is protected by standards mandated by DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards, which directs compliance with specific Occupational Safety and Health Act (OSHA) requirements. This act governs diverse occupational hazards ranging from electrical safety and protection from fire to the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy working environment for employees.

Hazardous Waste Operations and Emergency Response regulations require that employees at treatment, storage, and disposal facilities, who may be exposed to health and safety hazards during hazardous waste operations, receive training appropriate to their job function and responsibilities. The WVDP Environmental, Health, and Safety training matrix identifies the specific training requirements for such employees.

The WVDP provides the standard twenty-four-hour hazardous waste operations and emergency response training. (Emergency response training includes spill response measures and controlling contamination of groundwater.) Training programs also contain information on waste minimization, pollution prevention, and the WVDP environmental management program. Besides this standard training, employees working in radiological areas receive additional training on subjects such as understanding radiation and radiation warning signs, dosimetry, and respiratory protection. In addition, qualification standards for specific job functions at the site are required and maintained. These programs have evolved into a comprehensive curriculum of knowledge and skills necessary to maintain the health and safety of employees and ensure the continued compliance of the WVDP.

The WVDP maintains a hazardous materials response team that is trained to respond to spills of hazardous materials. This team maintains its proficiency through classroom instruction and scheduled training drills.

Medical emergencies on-site are handled by the WVDP Emergency Medical Response Team. This team consists of on-site professional medical staff, volunteer New York State-certified emergency medical technicians, and main plant operators who are certified as New York State First Responders.

Any person working at the WVDP who has a picture badge receives general employee training covering health and safety, emergency response, and environmental compliance issues. All visitors to the WVDP receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Voluntary Protection Program STAR Status. The WVDP was recommended for the Voluntary Protection Program (VPP) STAR Status in 1999 in recognition of outstanding safety achievements. For additional information on the VPP see the Environmental Compliance Summary: Calendar Year 1999, p. ECS-16.

ISMS Implementation. A plan to integrate environmental, safety, and health (ES&H) management programs at the WVDP was developed and initiated at the WVDP during 1998. During development of the ISMS, the enhanced work planning program (EWP) was identified as an integral part of the ISMS and a site-wide work review group was established to review work plans, identify ES&H concerns, and specify practices that ensure that work is performed safely.

Implementation of an ISMS at the WVDP, including the EWP, was verified by the DOE Ohio Field Office in November 1998. In September 1999 a self-assessment verified that the ISMS continues to be carried out according to the system description. As a result of the self-assessment, the environmental management system (EMS) was revised to describe its relationship to the ISMS. No additional actions were required by the self-assessment.

EMS Implementation. The WVNS environmental management system provides the basic policy and direction of work at the WVDP through procedures that support proactive management, environmental stewardship, and the integration of appropriate technologies throughout all aspects of the work at the WVDP.

The Project's environmental management system satisfies the requirements of the Code of Environmental Management Principles (CEMP) for federal agencies and ISO 14001, Environmental Management Systems: Specification for Guidance and Use, which is being implemented worldwide. The CEMP was developed by the EPA in response to Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, in order to serve as the basis for responsible environmental management. Following the principles and performance objectives of the CEMP helps to ensure that a federal facility's environmental performance is proactive, flexible, cost-effective, and sustainable.

Performance Measures

Performance measures can be used to evaluate effectiveness, efficiency, quality, timeliness, productivity, safety, or other areas that reflect achievements related to organization or process goals and can be used as a tool to identify the need to institute changes.

The performance measures applicable to operations conducted at the WVDP, discussed here, reflect process performance related to wastewater treatment in the low-level waste treatment facility, the identification of spills and releases, the reduction in the generation of wastes, the potential radiological dose received by the maximally exposed off-site individual, and the transfer of high-level waste to the vitrification system.

Radiation Doses to the Maximally Exposed Off-Site Individual. One of the most important pieces of information derived from environmental monitoring program data is the potential radiological dose to an off-site individual from on-site activities. As an overall assessment of Project activities and the effectiveness of the as-low-as-reasonably achievable (ALARA) concept, the effective radiological dose to the maximally exposed off-site individual is an indicator of well-managed radiological operations. The effective dose equivalents for air effluent emissions, liquid effluent discharges, and other liquid releases (such as swamp drainage) from 1993 through 1999 are graphed in Figure 1-3 (*below*). Note that the sum of these values is well below the DOE standard of 100 mrem. These consistently low results indicate that radiological activities at the site are well-controlled. (See also Table 4-2 [p.4-7] in Chapter 4, Radiological Dose Assessment.)

SPDES Permit Limit Exceptions. Effective operation of the site wastewater treatment facilities is indicated by compliance with the applicable discharge permit limitations. Approximately sixty parameters are monitored regularly as part of the SPDES permit requirements. The analytical results are reported to NYSDEC via Discharge Monitoring Reports required under the SPDES program.

Although the goal of the low-level waste treatment facility (LLWTF) and wastewater treatment facility (WWTF) operations is to maintain effluent water quality consistently within the permit requirements, occasionally SPDES permit limit exceptions do occur. All SPDES permit limit exceptions are evaluated to determine their cause and to identify corrective measures. A Water Task Team composed of WVDP personnel with expertise in wastewater engineering, treatment plant operations and process monitoring, and NPDES/SPDES permitting and compliance was formed in 1995 to address the causes of these exceptions.

Since 1995 virtually all of the recorded exceptions had been for parameters such as nitrite, pH, and five-day biochemical oxygen demand (BOD_5), which regulate or are greatly influenced by natural (microbiological) treatment processes occurring at the site's industrial and sanitary WWTF and the LLWTF. The Water Task Team's efforts produced significant results: for the second consecutive year there were no permit limit exceptions. (See Fig.1-4 [p.1-16].)

Although exceptions are not always related to operating deficiencies, corrective actions may

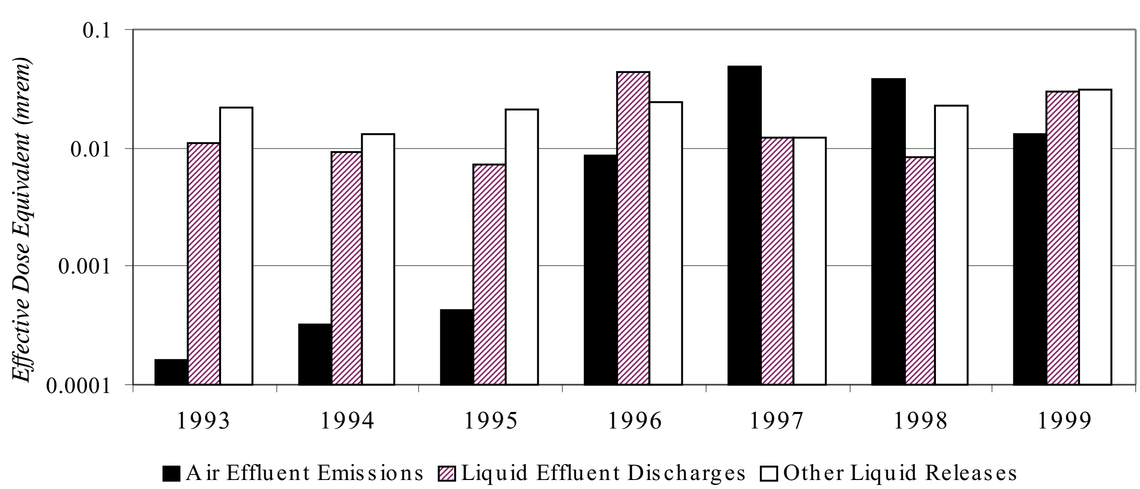


Figure 1-3. Annual Effective Dose Equivalent to the Maximally Exposed Off-site Individual

include improved operation or treatment techniques. In 1997 the WVDP notified NYSDEC of the presence of mercury in the influent wastewater to the LLWTF and of its likely presence at outfall 001 at concentrations below the detectable level of 0.2 μg/L. In 1998 and 1999 an increase in the mercury concentration was observed in process wastewater from the liquid waste treatment system (LWTS) evaporator, water that is eventually treated at the LLWTF. The LWTS evaporator processes radioactive wastewater from the high-level radioactive waste vitrification and supernatant treatment operations.

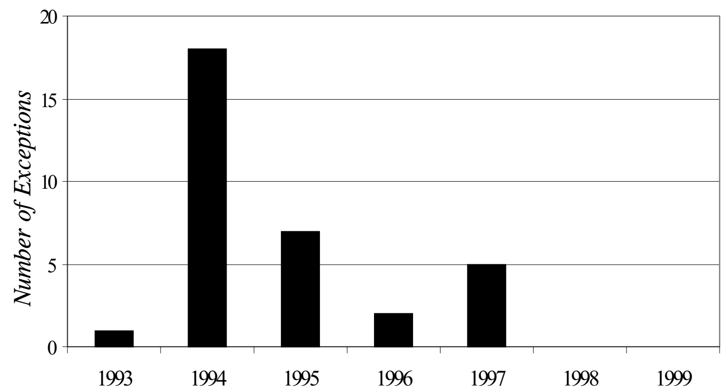


Figure 1-4. Yearly SPDES Permit Exceptions

Tests were performed on the radioactive wastewater from the evaporator to determine the performance of various treatment media in removing the mercury. A professional engineer's report on construction and operation of a treatment system to remove mercury from the evaporator wastewater was prepared and submitted to NYSDEC in December 1999 for approval.

During 1999 a system was implemented that will evaluate the potential effects on LLWTF effluents from the dispositioning of waste streams with variable contaminant concentrations. Initial evaluation of several small-volume hazardous, mixed, and industrial waste streams suggested that these wastes were suitable for disposal at the interceptors, the head-works of the LLWTF, without affecting compliance with discharge limits.

Disposition of these waste streams requires review and evaluation of SPDES-regulated constituent loadings to determine whether the proposed discharge is within the SPDES permit limits and to provide assurances that the resulting discharge will not constitute release of RCRA-regulated mixed wastes to the lagoon system. The WVDP developed a computerized spreadsheet that automatically calculates and estimates concentrations of RCRA- and SPDES-regulated constituents in the mixture of all wastewater streams entering the interceptors. The calculations are based on conservative (worst case) assumptions and on the known regulated constituent concentrations and volumes in routinely generated wastewater streams and in the nonroutine waste streams proposed for discharge.

After several weeks of trial use the automated calculation procedure was implemented through WVDP standard operating procedures. Since its initial development, the computerized spreadsheet calculations have been used to evaluate more than thirty separate nonroutine wastewater streams for disposition to the LLWTF during 1999.

Waste Minimization and Pollution Prevention. The WVDP has initiated a program to reduce the quantities of waste generated from site activities. Reductions in the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial wastes, and sanitary wastes such as paper, glass, plastic, wood, and scrap metal were targeted. To demonstrate the effectiveness of the waste minimization program, a graph of the percentage of waste reduction achieved above the annual goal for each category is presented in Figure 1-5 (*below*) for calendar years 1993 through 1999.

Not all waste streams have been tracked over this period. Note that the low-level radioactive waste figures from 1993 through 1995 include the volume of drummed waste produced in the cement solidification system. The hazardous waste quantity for 1994 also includes about 1,900 kilograms (4,200 lbs) of waste produced in preparing for vitrification. Hazardous waste and industrial waste volumes have been tracked separately for vitrification-related and nonvitrification-related waste streams since vitrification began in 1996. To maintain historical comparability, the percentages in Figure 1-5 include only the nonvitrification portions of these two waste streams.

Specific waste minimization achievements include the following:

- 200 tons of excess clean lead in storage were sold to a recycling vendor
- 141 tons of scrap carbon and stainless steel were recycled
- 93 tons of structural steel and tent fabric (from the demolition of lag storage area #4) were sold to a recycling vendor
- permeable treatment wall (PTW) sheet piles used for a pilot project were saved and stored for reuse in the future rather than being disposed
- soft water was piped to the laundry to reduce the calcium concentration in the water and extend the useful life of ion-exchange resin, which captures calcium and cesium ions, resulting in a 50% reduction in the need for laundry detergent and an associated reduction in the volume of ion-exchange resin
- one-time use anti-contamination articles were replaced with washable items to significantly reduce the use of plastic bags and tape in radioactive work areas.

Spills and Releases. Chemical spills greater than the applicable reportable quantity must be reported immediately to NYSDEC and the National Response Center and other agencies as required. There were no reportable chemical spills during 1999.

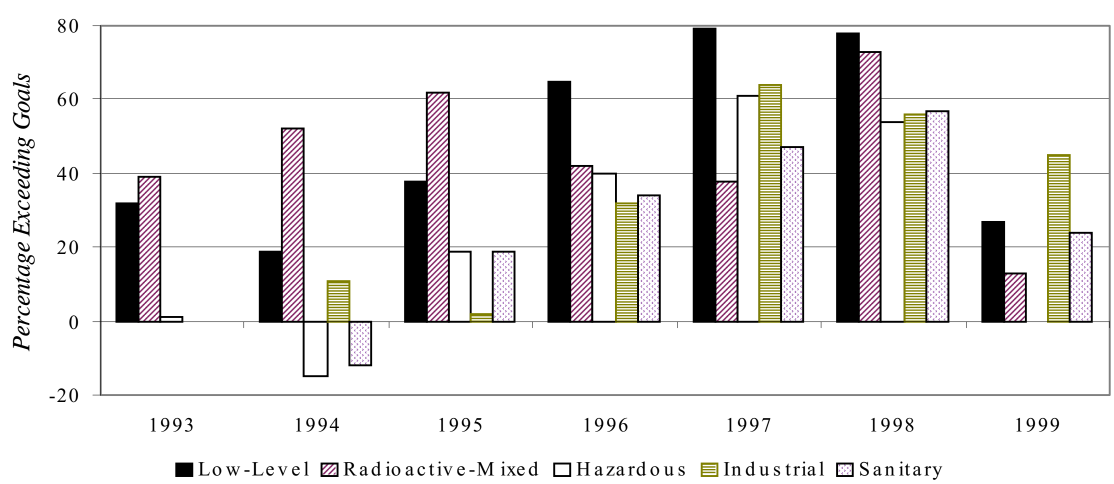


Figure 1-5. Percentage of Waste Reduction Exceeding Annual Goals

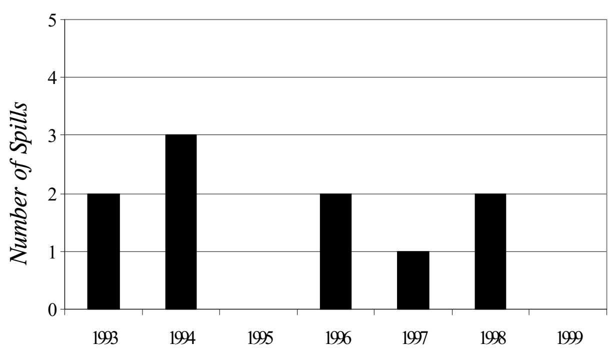


Figure 1-6. Number of Immediately Reportable Spills or Releases

Petroleum spills greater than 5 gallons or of any amount that travel to waters of the state must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. There were no reportable petroleum spills in 1999. Figure 1-6 (*above*) is a bar graph of immediately reportable spills from 1993 to 1999.

Prevention is the best means of protection against oil, chemical, and hazardous substance spills or releases. WVDP employees are trained in applicable standard operating procedures for equipment that they use, and best management practices have been developed that identify potential spill sources and measures that will reduce the potential for releases to occur. Spill training, notification, and reporting policies have also been developed to emphasize the responsibility of each employee to report spills immediately upon discovery. This first-line reporting helps to ensure that spills will be properly documented and mitigated in accordance with applicable regulations.

Vitrification. To safely solidify the high-level radioactive waste at the site in borosilicate glass, the high-level waste sludge is transferred in batches from the tank where it currently is stored to the vitrification facility. After transfer, the waste is solidified into a durable glass for safe storage and future transport to a federal repository. It is estimated that 11 million to 12 million curies of strontium and cesium radioactivity in the high-level waste eventually will be vitrified. (Radioactive cesium and strontium isotopes account for 98% of the long-lived radioactivity.) To quantify the progress made toward completing the vitrification goal, Figure 1-7 (*below*) shows the number of curies transferred to the vitrification facility in 1999.

On June 10, 1998, the WVDP marked completion of the Project's production phase (Phase I) of high-level waste processing. This milestone included safely vitrifying 85% of the high-level waste inventory in 210 canisters of solidified waste glass and immobilizing more than 9.3 million curies of radioactivity. More than 11.0 million curies were immobilized through vitrification and 245 canisters were filled by the end of 1999, bringing the Project total of immobilized liquid high-level waste to more than 20.7 million curies, including pretreatment and vitrification.

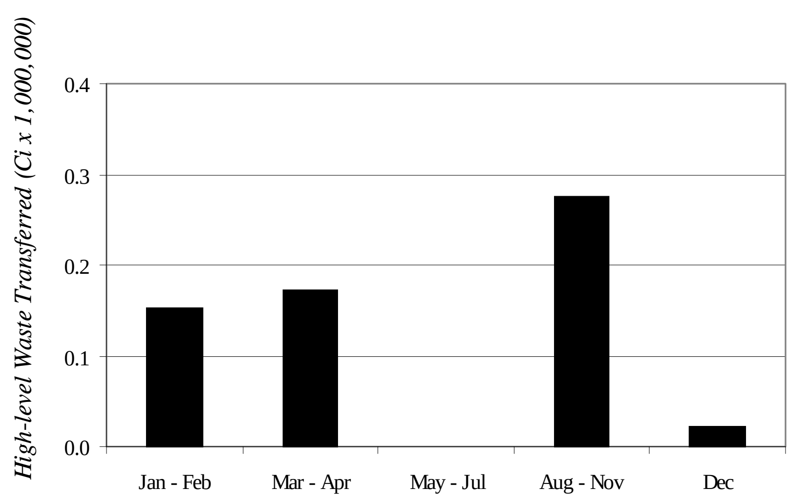


Figure 1-7. Number of Curies Transferred to the Vitrification Facility in 1999

ENVIRONMENTAL MONITORING

Routine Monitoring Program

Routine activities at the West Valley Demonstration Project (WVDP) can result in the release of radioactive or hazardous substances that could affect the environment. Possible pathways for the movement of radionuclides or hazardous substances from the WVDP to the public include milk and food consumed by humans; forage consumed by animals; sediments, soils, groundwater, and surface water; and effluent air and liquids released by the WVDP.

The food pathway is monitored by collecting samples of beef, hay, milk, and produce at near-site and remote locations, samples of fish upstream and downstream of the site, and venison samples from near-site deer and from background locations. Stream sediments are sampled upstream and downstream of the WVDP, and both on-site groundwater and off-site drinking water are routinely sampled. Direct radiation is monitored on-site, at the perimeter of the site, in communities near the site, and at background locations.

The primary focus of the monitoring program, however, is on surface water and air pathways, as these are the primary means of transport of radionuclides from the WVDP.

Liquid and air effluents are monitored on-site by collecting samples at locations where radioactivity or other regulated substances are released or might be released. Release points include water effluent outfalls and plant ventilation stacks.

Surface water samples are collected within the Project site from ponds, swamps, seeps, and drainage channels that flow through the Western New York Nuclear Service Center (WNYNSC) and thence off-site into Cattaraugus Creek.

Both surface water and air samples are collected at site perimeter locations where the highest off-site concentrations of transported radionuclides might be expected. Samples are also collected at remote locations to provide background concentration data for comparison with data from on-site and near-site samples.

Sampling Program Overview

The complete environmental monitoring schedule is located in Appendix B. This schedule provides information on monitoring and reporting requirements and the types and extent of sampling and monitoring at each location. An explanation of the codes that identify the sample medium and the specific sampling or monitoring location is also found in Appendix B (p.B-iii). For example, a sample location code such as AFGRVAL indicates an air sample (A), off-site (F), at the Great Valley (GRVAL) sampling station. These codes are used throughout this report for ease of reference and to be consistent with the data reported in the appendices.

Water Sampling Locations. Automatic samplers collect surface water at points along drainage channels within the WNYNSC that are most likely to show any radioactivity released from the site. These automatic samplers collect a 50-milliliter (mL) aliquot (about one-quarter of a cup of water) every half-hour. The aliquots are pumped into a large container from which samples are collected. The samplers operate on-site at four locations: WNSP006, the point in Frank's Creek where Project drainage leaves the security-fenced area; WNNDADR, the drainage point downstream of the Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA); WNSWAMP, the northeast swamp drainage; and WNSW74A, the north swamp drainage.

Off-site, automatic samplers collect surface waters from Buttermilk Creek at a background station upstream of the site (WFBCBKG), from Buttermilk Creek downstream of the site at Thomas Corners Road bridge (WFBCTCB), and from Cattaraugus Creek at Felton Bridge (WFFELBR).

Grab samples are collected at several other surface water locations both on-site and off-site, including a background location on Cattaraugus Creek at Bigelow Bridge (WFBIGBR).

Figure A-2 (p.A-4 in Appendix A) shows the locations of the on-site surface water monitoring points. Figure A-3 (p.A-5) shows the locations of the off-site surface water monitoring points.

Air Sampling Locations. Air samplers are located on-site, at the perimeter of the site, and at points remote from the WVDP. Figure A-4 (p.A-6) shows the locations of the on-site air effluent monitors and samplers and the on-site ambient air samplers; Figure A-5 (p.A-7) and Figure A-12 (p.A-14 in Appendix A) show the locations of the perimeter and remote air samplers.

Radiological Monitoring: Surface Water

The WVDP site is drained by several small streams. (See Figs.A-2 [p.A-4] and A-3 [p.A-5].) Frank's Creek flows along — and receives drainage from — the south plateau. As Frank's Creek flows northward, it is joined by a tributary, Erdman Brook, which receives run-off from the low-level waste treatment facility. On the north plateau, beyond the Project fence line, the north and northeast swamp areas and Quarry Creek drain into Frank's Creek.

Frank's Creek continues past the WVDP perimeter and flows across the WNYNSC, where it enters Buttermilk Creek. Radionuclide concentrations in Buttermilk Creek are monitored upstream and downstream of the WVDP. Further downstream, Buttermilk Creek leaves the WNYNSC and enters Cattaraugus Creek, which is also monitored for radionuclide concentrations both upstream and downstream of the point where the creek receives effluents from the WVDP.

Two liquid effluents, from the low-level waste treatment facility and from the northeast and north swamp drainage, contribute to site dose estimates. (See Chapter 4, Radiological Dose Assessment, Table 4-2 [p.4-7] for an estimate of the dose attributable to these waterborne effluents.)

Low-level Waste Treatment Facility Sampling Location. The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility through the lagoon 3 weir

(WNSP001 on Fig.A-2 [p.A-4]) into Erdman Brook, a tributary of Frank's Creek. There were four batch releases totaling about 29.1 million liters (7.67 million gal) in 1999. Composite samples were collected near the beginning and end of each discharge and one effluent grab sample was collected during each day of discharge. Samples were analyzed for gross alpha and gross beta radioactivity, for gamma-emitting radionuclides, and for specific radionuclides as noted in Appendix B, p.B-7.

The total amounts of radioactivity from specific radionuclides in the lagoon 3 effluent are listed in Appendix C, Table C-1 (p.C-3). The annual average concentration of each radionuclide is divided by its corresponding Department of Energy (DOE) derived concentration guide (DCG) in order to determine what percentage of the DCG was released. (DOE standards and DCGs for radionuclides of interest at the WVDP are found in Appendix K [Table K-1, p.K-3].) As a DOE policy, the sum of the percentages calculated for all radionuclides released should not exceed 100%.

The combined annual average of radionuclide concentrations from the lagoon 3 effluent discharge weir in 1999 was approximately 31.5% of the DCGs. (See Table C-2 [p.C-4]). This is comparable to the average concentration over the last five years of approximately 33%.

In 1998 the low-level waste treatment facility water-processing equipment (LLWTF) was replaced by a new facility and equipment (LLW2). Both the LLWTF and the LLW2 were designed to efficiently remove strontium-90 and cesium-137, the more prevalent of the long-lived fission products in WVDP wastewaters.

Other radionuclides are also removed to a lesser extent by the low-level waste treatment facility. For example, one other major contributor to the total combined DCG in lagoon 3 effluent is uranium-232, which averaged about 10% of its DCG in 1999. Uranium-232 and other uranium isotopes are found in WVDP liquid waste because they were present in the nuclear fuel that was once reprocessed at the site. Variations in liquid effluent radionuclide ratios continue to reflect the dynamic nature of the waste streams being processed through the low-level waste treatment facility.

(Outfall WNSP001 also is monitored for nonradiological parameters under the New York State Pollutant Discharge Elimination System [SPDES] program. See Nonradiological Monitoring: Surface Water [p.2-25].)

Northeast Swamp and North Swamp Sampling Locations. The northeast and north swamp drainages on the site's north plateau conduct surface water and emergent groundwater off-site.

The northeast swamp sampling point (WNSWAMP) monitors surface water drainage from the site's north plateau. The north swamp sampling point (WNSW74A) monitors drainage to Quarry Creek from the northern end of the Project premises. (See Fig.A-2 [p.A-4].) Waters from the northeast swamp drainage run into Frank's Creek downstream of location WNSP006. (See Other Surface Water Sampling Locations [p.2-4].)

Samples from WNSWAMP and WNSW74A are collected weekly and analyzed for radiological parameters. Other than gross beta and strontium-90, concentrations of all radiological parameters detected at WNSWAMP and WNSW74A were less than 1% of the applicable DCGs. The maximum and minimum gross alpha and gross beta results from WNSWAMP and WNSW74A are noted on Tables 2-1 and 2-2 (p.2-5). Complete data from these two locations are found in Tables C-7 and C-8 (pp.C-9 and C-10 in Appendix C).

An upward trend in gross beta concentrations at WNSWAMP, first noted in 1993, continued into 1999, when it leveled off. Gross beta activity at this location is largely attributable to strontium-90. (See Special Groundwater Monitoring, p.3-15.)

Strontium-90 concentrations at WNSWAMP in 1999 ranged from a low of 6.07E-07 μCi/mL to a high of 3.22E-06 μCi/mL (22.4 Bq/L to 119 Bq/L), with an annual average of 1.83E-06 μCi/mL (67.8 Bq/L). This average is 183% of the DCG for strontium-90, 1E-06 μCi/mL (37 Bq/L). (See Chapter 3, Fig.3-4, p.3-16, for a graph of the annualized average strontium-90 concentration at WNSWAMP in 1999.) Even though waters exceeding the strontium-90 DCG drain from WNSWAMP into Frank's Creek, waters collected from Cattaraugus Creek downstream at the first point of public access (WFFELBR) averaged less than 1% of the DCG. (See Off-site Surface Water Sampling, p.2-9.)

Other Surface Water Sampling Locations. Samples from the sanitary and industrial wastewater treatment facility discharge (WNSP007), from subsurface drainage from the perimeter of the low-level waste treatment facility storage lagoons (WNSP008), and from a point in Frank's Creek (WNSP006, where discharges from WNSP001, WNSP007, and WNSP008 leave the site) are routinely monitored for radiological parameters. (See Fig.A-2 [p.A-4].) Radiological results of analyses from WNSP006, WNSP007, and WNSP008 are summarized in Tables C-4, C-5, and C-6 (pp.C-6 through C-8). Samples from these points also are monitored for nonradiological parameters as part of the site's SPDES program. (See Nonradiological Monitoring: Surface Water [p.2-25].)

WNSP006 is located more than 4.0 kilometers (2.5 mi) upstream from Thomas Corners Road, the last monitoring point before Buttermilk Creek leaves the WNYNSC. Samples from WNSP006 are retrieved weekly and composited both monthly and quarterly and are analyzed for the same radionuclides as the effluent samples from WNSP001. The highest monthly concentration of a beta-emitting radionuclide at WNSP006 was strontium-90 at 3.31E-08 μCi/mL (1.22 Bq/L), which corresponds to 3.3% of the DCG for strontium-90. Average concentrations of gross alpha (as americium-241), gross beta (as strontium-90), strontium-90, cesium-137, and tritium were each less than 5% of the comparable DCG, as were 1999 averages for the radiological parameters monitored at WNSP007 and WNSP008.

The average gross alpha and gross beta data from location WNSP006 and the maximum and minimum results are noted in Tables 2-1 and 2-2 (*facing page*) for comparison with results from other on- and off-site surface water locations.

The thirteen-year trends of gross alpha, gross beta, and tritium concentrations at location WNSP006 are shown on Figure 2-1 (p.2-6). The long-term trend plot for WNSP006 shows fluctuations that reflect variable concentrations in treated WVDP liquid effluent being released from the site. Concentrations observed farther downstream at the Felton Bridge sampling location, the first point of public access to surface waters leaving the WVDP site, continue to be close to or indistinguishable from background.

Sampling point WNSP005, which monitors drainage from land on the east side of the main plant, and WNCOOLW, which monitors facility coolant water, are sampled monthly for gross alpha, gross beta, and tritium concentrations. WNCOOLW also is sampled quarterly for gamma isotopes. Radiological data for WNSP005 and WNCOOLW are found in Tables C-3 and C-11 (pp.C-5 and C-13).

Average gross alpha and tritium concentrations for both locations were below detection levels in 1999. Average gross beta concentrations at WNSP005 and WNCOOLW were considerably

Table 2-1
1999 Gross Alpha Concentrations at Surface Water Sampling Locations

Location	No. of Samples	Range		Annual Average	
Off-site		*(µCi/mL)*	*(Bq/L)*	*(µCi/mL)*	*(Bq/L)*
WFBCBKG	12	<3.84E-10 — 3.58E-09	<1.42E-02 — 1.32E-01	7.77±8.23E-10	2.88±3.05E-02
WFBCTCB	12	<5.21E-10 — 1.90E-09	<1.93E-02 — 7.03E-02	8.62±8.36E-10	3.19±3.09E-02
WFBIGBR	12	<4.22E-10 — 1.59E-09	<1.56E-02 — 5.89E-02	3.18±8.57E-10	1.17±3.17E-02
WFFELBR	12	7.85E-10 — 6.01E-09	2.90E-02 — 2.22E-01	2.29±1.52E-09	8.49±5.61E-02
On-site					
WNNDADR	12	<9.51E-10 — 2.65E-09	<3.52E-02 — 9.81E-02	0.72±1.35E-09	2.68±4.98E-02
WNSP006	53	<5.72E-10 — 4.74E-09	<2.12E-02 — 1.75E-01	0.62±1.55E-09	2.30±5.73E-02
WNSW74A	53	<7.64E-10 — 3.60E-09	<2.83E-02 — 1.33E-01	-0.12±1.99E-09	-0.43±7.37E-02
WNSWAMP	53	<5.74E-10 — 2.85E-09	<2.12E-02 — 1.06E-01	-0.11±1.69E-09	-0.43±6.27E-02

Table 2-2
1999 Gross Beta Concentrations at Surface Water Sampling Locations

Location	No. of Samples	Range		Annual Average	
Off-site		*(µCi/mL)*	*(Bq/L)*	*(µCi/mL)*	*(Bq/L)*
WFBCBKG	12	1.72E-09 — 8.27E-09	6.38E-02 — 3.06E-01	3.67±1.34E-09	1.36±0.50E-01
WFBCTCB	12	5.24E-09 — 1.52E-08	1.94E-01 — 5.64E-01	8.70±1.59E-09	3.22±0.59E-01
WFBIGBR	12	1.46E-09 — 4.00E-09	5.38E-02 — 1.48E-01	2.70±1.24E-09	9.99±4.60E-02
WFFELBR	12	1.80E-09 — 1.47E-08	6.65E-02 — 5.45E-01	5.86±1.94E-09	2.17±0.72E-01
On-site					
WNNDADR	12	1.21E-07 — 1.88E-07	4.47E+00 — 6.95E+00	1.47±0.05E-07	5.44±0.20E+00
WNSP006	53	1.21E-08 — 1.73E-07	4.47E-01 — 6.39E+00	4.65±0.43E-08	1.72±0.16E+00
WNSW74A	53	3.93E-09 — 4.24E-08	1.45E-01 — 1.57E+00	1.09±0.38E-08	4.02±1.40E-01
WNSWAMP	53	5.49E-07 — 6.64E-06	2.03E+01 — 2.46E+02	3.71±0.03E-06	1.37±0.01E+02

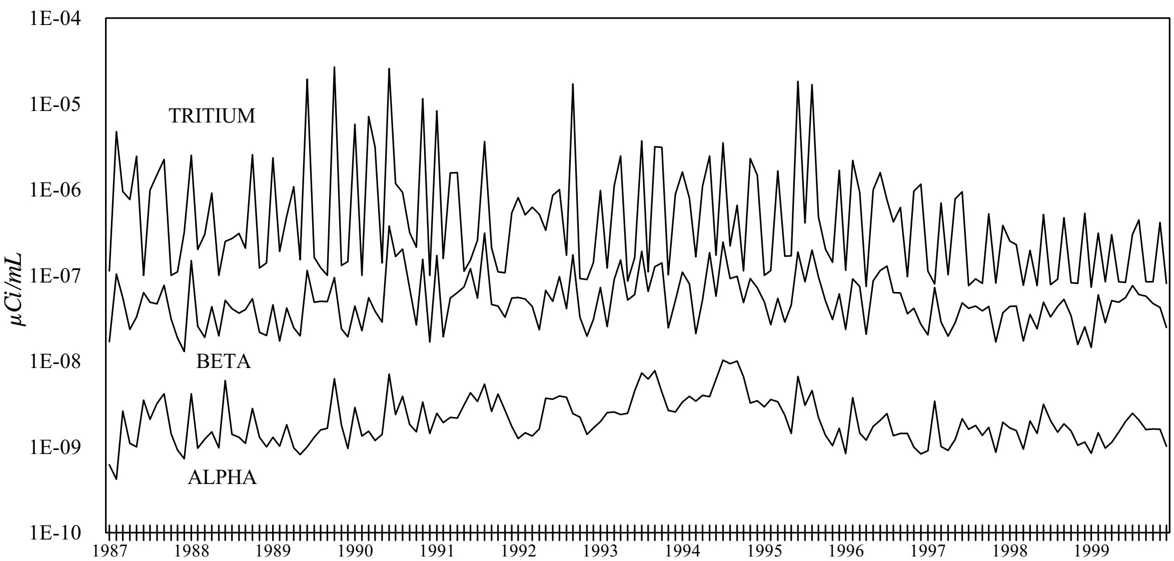


Figure 2-1. Thirteen-year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNSP006

lower than the strontium-90 DCG (<14% and <1% respectively). Average cesium concentrations at WNCOOLW were below detection levels in 1999.

Another sampling point, WN8D1DR, is at a storm sewer manhole access that originally collected surface and shallow groundwater flow from the high-level waste tank farm area. (Notable increases in gross beta and tritium activity at this location, attributable to historical site contamination, were described in previous annual site environmental reports.) In July 1993 the access was valved off from the original high-level waste tank farm drainage area to prevent collected waters from rising freely to the surface. Although samples from this location are not thought to be representative of either local groundwater or surface water, weekly sampling for gross alpha, gross beta, and tritium continues at this point. A monthly composite is analyzed for gamma radionuclides and strontium-90.

Average gross alpha, cesium-137, and tritium concentrations from WN8D1DR were all below detection levels in 1999. Gross beta concentrations, attributable largely to strontium-90, were less than 2% of the applicable DCG. Radiological data for WN8D1DR are found in Table C-13 (p.C-15).

SDA and NDA Sampling Locations. Two inactive underground disposal areas, the Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA) and the state-licensed disposal area (SDA), lie on the south plateau of the site. (The SDA is managed by the New York State Energy and Research Development Authority [NYSERDA].) The drum cell, an aboveground structure used to store approximately 19,000 drums of processed low-level radioactive waste, is located nearby. Surface waters, which flow from the south to the north, are routinely monitored at several points around these sites. (See Fig.A-2 [p.A-4].)

New York State-licensed Disposal Area (SDA). Immediately south of the SDA, sampling point WNDCELD monitors surface drainage from the area of the drum cell. Point WNSDADR monitors drainage from trench covers on the southwestern area of the SDA. To the northeast, sampling point WNFRC67, in Frank's Creek, is used to monitor drainage downstream of the drum cell and the eastern and southern borders of the SDA. Results from WNDCELD are in Table C-14 (p.C-16), from WNSDADR in Table C-12 (p.C-14), and from WNFRC67 in Table C-9 (p.C-11).

Averages for most radiological parameters at these points were below analytical detection levels in 1999. Although monthly gross alpha, gross beta, and tritium concentrations increased in late summer and early fall, comparison of the 1999 data sets with the 1999 background data sets (WFBCBKG) showed no statistically significant differences. The highest beta concentration, 2E-08 μCi/mL at WNSDADR, was 2% of the most restrictive beta DCG.

NRC-licensed Disposal Area (NDA). Sampling point WNNDATR is a sump at the bottom of a steep-sided trench immediately downgradient of the NDA that intercepts groundwater from the NDA. If radiological or nonradiological contamination were to migrate through the NDA, it would most likely be first detected in samples from WNNDATR. Monthly samples from WNNDATR are taken under the auspices of the environmental monitoring program, and quarterly samples under the auspices of the groundwater monitoring program.

Surface water drainage downstream of the NDA is monitored at WNNDADR; sampling point WNERB53 in Erdman Brook monitors surface waters further downstream from the NDA before they join with drainage from the main plant and lagoon areas. Results from WNNDATR are in Table C-20 (p.C-22), from WNNDADR in Table C-19 (p.C-21), and from WNERB53 in Table C-10 (p.C-12). Gross alpha and gross beta results from WNNDADR are included in Tables 2-1 and 2-2 (p.2-5) for comparison with results from other surface water locations.

In addition to the routine samples collected by the WVDP, samples are collected and analyzed by the New York State Department of Health (NYSDOH) at the two stream sampling points that receive drainage from the south plateau, WNFRC67 and WNERB53.

Gross alpha results at WNNDATR, WNNDADR, and WNERB53 were indistinguishable from background (WFBCBKG). Although gross beta results at these three locations were elevated with respect to background, average concentrations were well below applicable DCGs in 1999:

- Gross beta concentrations at WNNDATR averaged 1.22E-07μCi/mL (4.5 Bq/L), which is just under 13% of the DCG for strontium-90 in water (1E-06 μCi/mL).

- Gross beta concentrations at WNNDADR averaged 1.47E-07μCi/mL (5.4 Bq/L). Assuming that the gross beta concentration originates entirely from strontium-90, this average is close to 15% of the DCG for strontium-90. (The actual average strontium-90 concentration — 6.98E-08 μCi/mL [2.6 Bq/L] — was about 7% of the DCG.) Gross beta concentrations were higher downstream of the NDA at WNNDADR than in waters from the interceptor trench, WNNDATR. However, gross beta concentrations at WNNDADR appear to be steady or declining. (See Fig. 2-2, p.2-8.) Residual contamination from past waste burial activities in soils outside the NDA is the likely source of gross beta activity in samples from WNNDADR.

- Gross beta concentrations at WNERB53 averaged 1.95E-08 μCi/mL (0.72 Bq/L). This is less than 2% of the DCG for strontium-90.

- Although average tritium concentrations at both WNNDATR and WNNDADR were elevated with respect to background concentra-

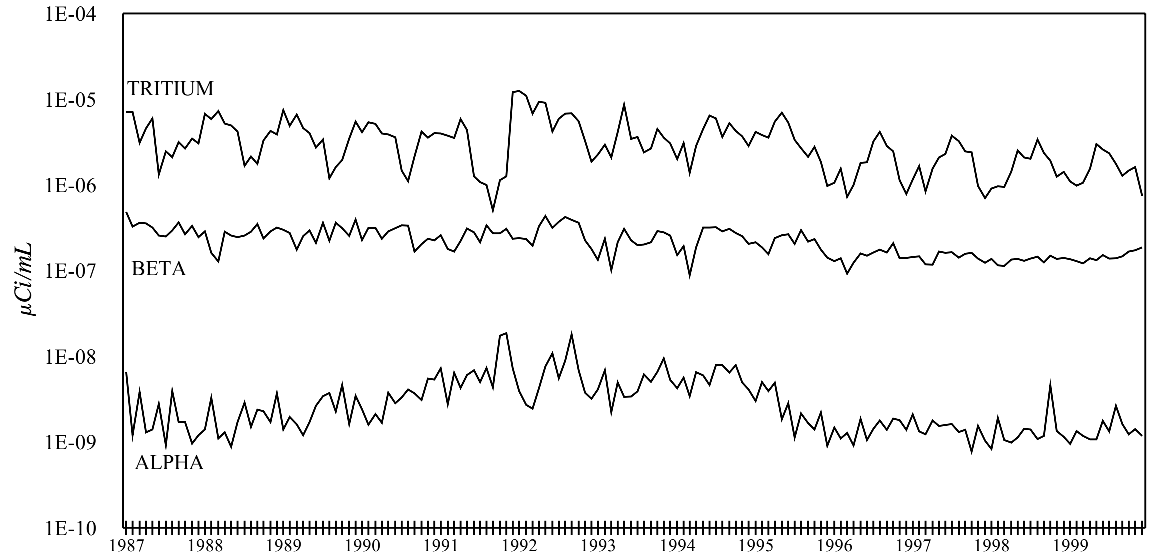


Figure 2-2. Thirteen-year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNNDADR

tions (WFBCBKG), these were less than 1% of the DCG for tritium in water (2E-03 µCi/mL). The average tritium concentration at WNNDATR was 7.12E-06 µCi/mL (263 Bq/L), and at WNNDADR it was 1.61E-06 µCi/mL (60 Bq/L). Allowing for seasonal variations, the overall trends of tritium concentrations at WNNDADR and WNNDATR have shown a slight decrease over time. (See Fig.2-2 above.) Since the half-life of tritium is slightly longer than twelve years, decreasing tritium concentrations may be partially attributed to radioactive decay. Tritium concentrations at WNERB53 were indistinguishable from background.

• A key indicator of possible migration of non-radiological organic contaminants from the NDA would be iodine-129, which is known to travel with the organic contaminants present in the NDA and is soluble in water. Although iodine-129 has been detected upon occasion at WNNDADR and WNNDATR in previous years, in 1999 all iodine-129 concentrations at these locations were below the analytical detection limit of 2E-09 µCi/mL.

• Average cesium-137 results as measured at WNNDADR and WNNDATR were below detection levels in 1999.

• Average total organic halides (TOX) concentrations from both WNNDATR and WNNDADR were lower in 1999 than in 1998. TOX measurements are used to detect the presence of certain organic compounds.

Standing Pond Water Sampling Locations. In addition to samples from moving water (streams or seeps), samples from ponds within the retained premises (WNYNSC) are also collected and tested annually for various radiological and water quality parameters in order to confirm that no major changes are occurring in standing water within the Project environs.

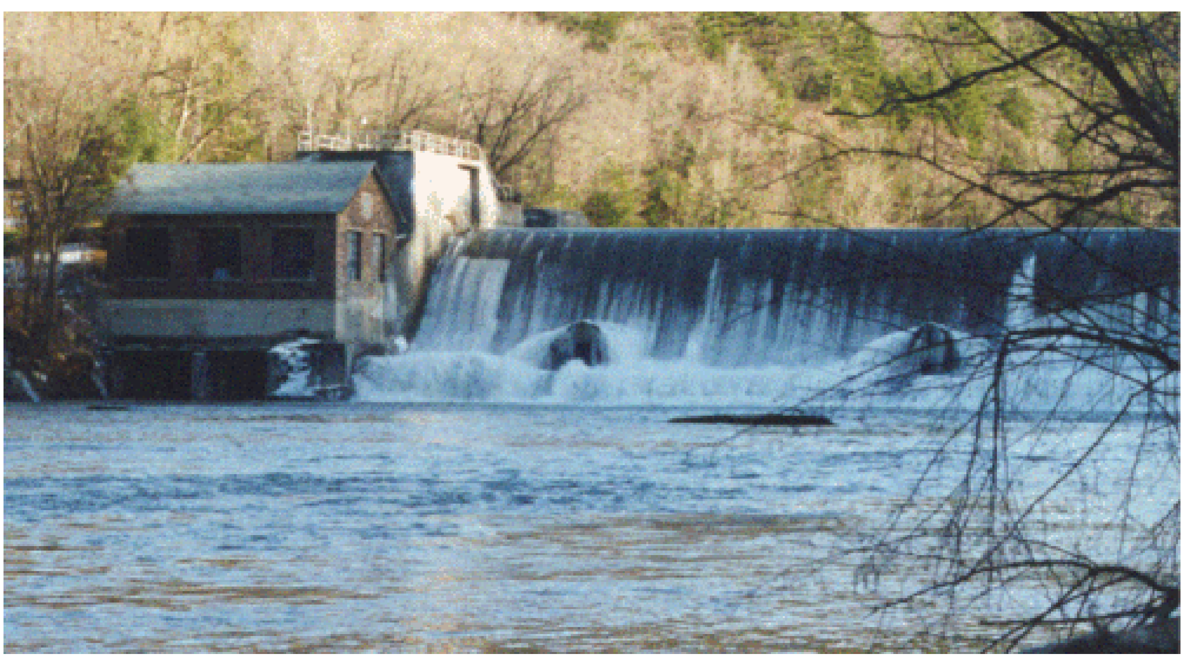
Four ponds near the site were tested in 1999. For comparison, a background pond 14.1 kilometers (8.8 mi) north of the Project was also tested. (See Figs.A-2 and A-3 [pp.A-4 and A-5] for the locations of the five ponds and Table C-21 [p.C-23] for a summary of sampling results.) Gross beta concentrations at all but one pond on the north plateau, WNSTAW6, were statistically indistinguishable from background concentrations, and the gross beta concentration at WNSTAW6, although elevated, was less than 1% of the DCG for strontium-90 in water. Gross alpha and tritium concentrations in samples from all on-site ponds were statistically the same as concentrations at the background pond.

Off-site Surface Water Sampling Locations. Samples of surface water are collected at four off-site locations, two on Buttermilk Creek and two on Cattaraugus Creek. Off-site surface water and sediment sampling locations are shown on Fig.A-3 (p.A-5). Tables 2-1 and 2-2 (p.2-5) list the ranges and annual averages for gross alpha and gross beta activity at off-site surface water locations, which may be compared to data from on-site locations.

Fox Valley Road and Thomas Corners Bridge Sampling Locations. Buttermilk Creek is the major surface drainage from the WNYNSC. Two surface water monitoring stations are located on Buttermilk Creek, one upstream of the WVDP at Fox Valley Road (WFBCBKG) and one downstream of the WVDP at Thomas Corners bridge (WFBCTCB) that is also upstream of Buttermilk Creek's confluence with Cattaraugus Creek. The Thomas Corners bridge sampling location represents an important link in the pathway to humans because dairy cattle have access to the water here.

Samples collected every week are composited monthly and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite is analyzed for gamma-emitting radionuclides and strontium-90. Quarterly samples from WFBCBKG, the background location, also are analyzed for specific radionuclides as noted in Appendix B, p.B-29, and the results are used as a base for comparison with results of samples from site effluents.

Table C-22 (p.C-24) lists radionuclide concentrations at the Fox Valley Road background location; Table C-23 (p.C-25) lists radionuclide



Springville Dam on Cattaraugus Creek

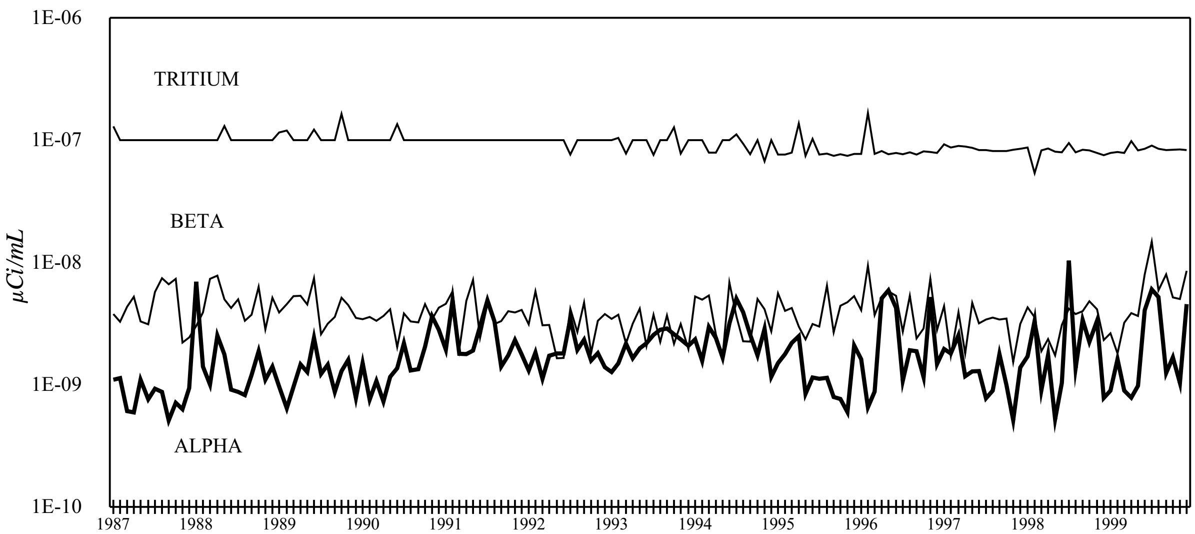


Figure 2-3. Thirteen-year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WFFELBR

concentrations downstream of the site at Thomas Corners bridge. Gross alpha, tritium, and cesium-137 concentrations at Thomas Corners bridge were statistically the same as background concentrations in 1999. The 1999 average gross beta concentration at Thomas Corners bridge was slightly higher than the concentration upstream of the site. This may be attributed to small amounts of radioactivity from the site entering Buttermilk Creek via Frank's Creek. However, even if the largest gross beta concentration (1.52E-08 μCi/mL [0.56 Bq/L]) were attributable entirely to strontium-90, it would represent less than 2% of the DCG.

Cattaraugus Creek at Felton Bridge and Bigelow Bridge Sampling Locations. Buttermilk Creek flows through the WNYNSC and then off-site, where it flows into Cattaraugus Creek. An automated sampler is located on Cattaraugus Creek at Felton Bridge (WFFELBR), just downstream of the point where Buttermilk Creek enters. Samples are collected weekly and analyzed for gross alpha, gross beta, and tritium concentrations. A chart recorder registers the stream depth during the sampling period so that a flow-weighted weekly sample can be proportioned into a monthly composite, which is analyzed for gross alpha, gross beta, tritium, strontium-90, and gamma-emitting radionuclides. (See Table C-24 [p.C-26].)

Background samples are collected monthly from Cattaraugus Creek at Bigelow Bridge (WFBIGBR), which is upstream of the point where Buttermilk Creek enters. These samples are analyzed for concentrations of gross alpha, gross beta, tritium, strontium-90, and gamma-emitting radionuclides. (See Table C-25 [p.C-26].)

No differences were noted between upstream and downstream concentrations of gross alpha, tritium, or cesium-137 in 1999. Although strontium-90 concentrations were not statistically higher at the Felton Bridge location than at the Bigelow Bridge background location, gross beta concentrations were higher at Felton Bridge.

The average weekly gross alpha concentration at Felton Bridge in 1999 was 1.26E-09 μCi/mL (0.05 Bq/L), which is less than 5% of the most conservative alpha DCG; the average weekly gross beta concentration was 4.23E-09 μCi/mL

(0.16 Bq/L), which is less than 1% of the most conservative beta DCG.

Figure 2-3 (*facing page*) shows gross alpha, gross beta, and tritium results over the past thirteen years in Cattaraugus Creek samples taken at Felton Bridge. For the most part, tritium concentrations represent method detection limits and not detected radioactivity. (Method detection limit values are levels below which the analytical measurement could not detect any radioactivity above background. [See Data Reporting in Chapter 1, p.1-4].) Taking into account seasonal fluctuations, gross beta activity appears to have remained constant at this location since 1987.

Drinking Water Sampling Locations. Nine off-site private, residential wells between 1.5 kilometers (0.9 mi) and 7 kilometers (4.3 mi) from the facility were sampled for radiological parameters in 1999. The wells represent the nearest unrestricted use of groundwater near the Project; none draw drinking water from groundwater units underlying the site. A tenth private well, 29 kilometers (18 mi) south of the site, provides a background sample. Sampling locations are shown in Figures A-9 and A-12 (pp.A-11 and A-14) in Appendix A. Results from the sampling are presented in Table C-26 (p.C-27). Radiological results from near-site wells are within the historical range of values measured at the background well.

On-site drinking water sources were also monitored for radionuclides at four locations: the Environmental Laboratory (WNDNKEL); the maintenance shop (WNDNKMS); the main plant (WNDNKMP); and the utility room (WNDNKUR). Monthly samples were analyzed for gross alpha, gross beta, and tritium concentrations. Results were consistent with those from the off-site background drinking water well. (See Appendix C, Tables C-15 through C-18 [pp.C-17 through C-20].)

Radiological Monitoring: Sediments

Particulate matter in streams can adsorb radiological constituents in liquid effluents, settle on the bottom of the stream as sediment, and subsequently be eroded or resuspended, especially during periods of high stream flow. These resuspended sediments may provide a pathway for radiological constituents to reach humans either directly via exposure or indirectly through the food pathway.

Sediments are collected on-site at the three points where liquid effluents leaving the site are most likely to be radiologically contaminated: Frank's Creek where it leaves the security fence (SNSP006); the north swamp (SNSW74A); and the northeast swamp (SNSWAMP). Figure A-2 (p.A-4) shows the on-site sediment sampling locations. (Note that swamp sediment samples may be partially composed of soils.) Background samples are also collected at off-site locations upstream of the site. Results from radiological analyses of these samples are listed in Table C-28 (p.C-29). As expected, gross beta, cesium-137, and strontium-90 results were higher at the on-site sediment sampling points than at the off-site background sampling points; gross alpha concentrations were similar to background values.

Sediments are collected off-site at three locations downstream of the WVDP: Buttermilk Creek at Thomas Corners Road (SFTCSED), Cattaraugus Creek at Felton Bridge (SFCCSED), and Cattaraugus Creek at the Springville dam (SFSDSED). The first two sampling points are located at automatic water samplers. The other is in front of the Springville dam, where water would be expected to transport and deposit sediments that had adsorbed radionuclides from the site. Locations upstream of the WVDP are Buttermilk Creek at Fox Valley Road (SFBCSED) and Cattaraugus Creek at Bigelow Bridge

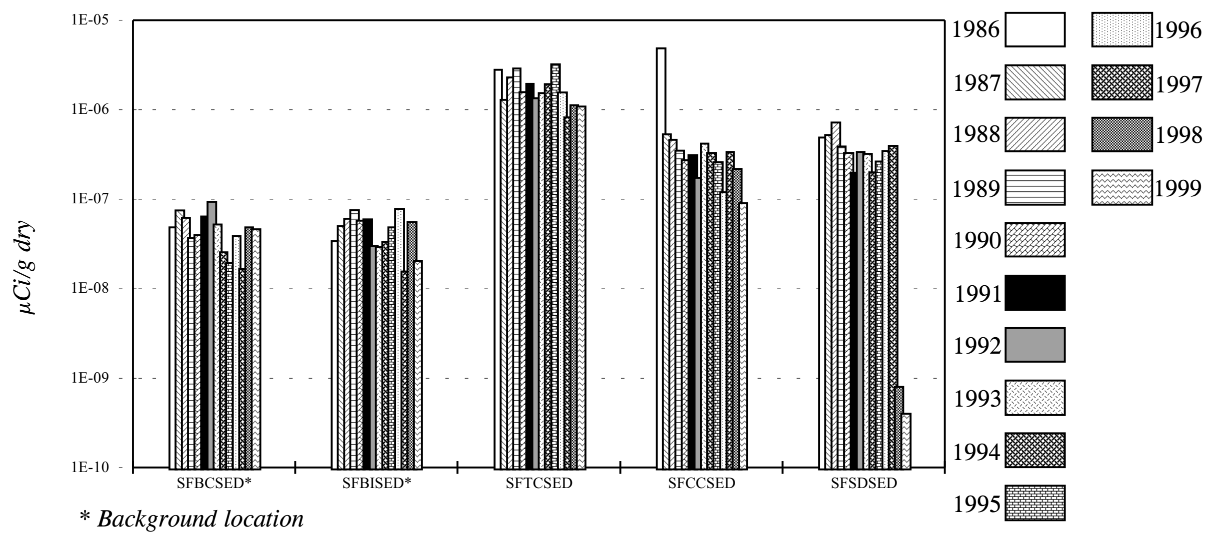


Figure 2-4. Fourteen-year Trends of Cesium-137 in Stream Sediments at Two Locations Upstream and Three Locations Downstream of the WVDP

(SFBISED). The two upstream locations provide background data for comparison with downstream points. Figure A-3 (p.A-5) shows the off-site sediment sampling locations.

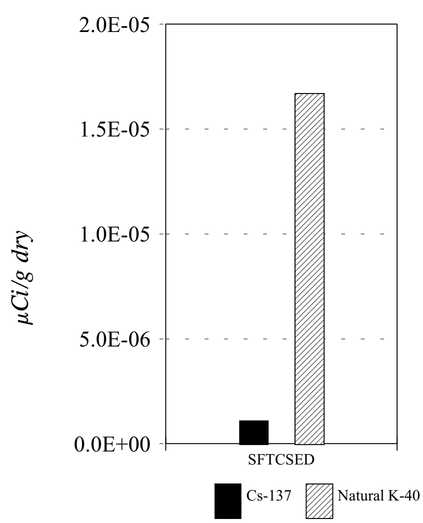


Figure 2-5. Comparison of Cesium-137 with Naturally Occurring Potassium-40 Concentrations in 1999 at Downstream Sampling Location SFTCSED

Although gross alpha, gross beta, and strontium-90 concentrations in sediments downstream of the WVDP are not statistically different from background concentrations, cesium-137 concentrations in downstream sediments historically have been higher. A comparison of annual averaged cesium-137 concentrations from 1986 through 1999 for the five off-site sampling locations is illustrated in Figure 2-4 (*above*). As the figure indicates, cesium-137 concentrations are relatively stable at the two background locations (SFBCSED and SFBISED) and are either stable or declining at the three locations downstream of the WVDP (SFTCSED, SFCCSED, and SFSDSED). As noted in the 1998 Site Environmental Report, the level of cesium-137 observed behind the Springville dam (SFSDSED) was noticeably lower in 1998 than in the past, which may have been associated with the scouring of sediments during a flood on June 26, 1998. In 1999 the concentration of cesium-137 in samples from this same location again were lower than historical values. The cesium-137 concentrations at the two other downstream locations (SFTCSED and SFCCSED) remained near historical levels.

Although cesium-137 activity historically is elevated in downstream Cattaraugus Creek sediments, relative to upstream sediments (see Appendix C, Table C-30 [p.C-31]), the levels are far lower than those of naturally occurring gamma emitters such as potassium-40. (Fig. 2-5 [*facing page*] is a graphic comparison of cesium-137 to potassium-40 at the downstream location nearest the WVDP, i.e., Buttermilk Creek at Thomas Corners Road - SFTCSED.) In addition, these downstream-sediment cesium-137 concentrations are still within the historical range of cesium-137 concentrations in background surface soil (Great Valley [SFGRVAL] and Nashville [SFNASHV]). (See Appendix C, Table C-29 [p.C-30].)

Radiological Monitoring: Air

Permits obtained from the U.S. Environmental Protection Agency (EPA) allow air containing small amounts of radioactivity to be released from plant ventilation stacks during normal operations. The air released must meet criteria specified in the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations to ensure that the environment and the public's health and safety are protected. Dose-based comparisons of WVDP emissions against NESHAP criteria are presented in Chapter 4, Radiological Dose Assessment.

Unlike NESHAP dose criteria, the DOE DCGs are expressed in units of μCi/mL and therefore can be directly compared to concentrations of radionuclides in WVDP air emisssions. DOE standards and DCGs for radionuclides of interest at the WVDP are found in Appendix K, Table K-1 (p.K-3).

Radiological parameters measured in air emissions include concentrations of gross alpha and gross beta, tritium, strontium-90, cesium-137, and other radionuclides. When comparing concentrations with dose limits for screening purposes, gross alpha and beta radioactivities are assumed to come from americium-241 and strontium-90, respectively, because the dose effects for these radionuclides are the most limiting for major particulate emissions at the WVDP.

On-site Ventilation Systems. The exhaust from each EPA-permitted fixed ventilation system on-site is continuously filtered, monitored, and sampled as it is released to the atmosphere. Because concentrations of radionuclides in air emissions are quite low, a large volume of air must be sampled at each point in order to measure the quantity of specific radionuclides released from the facility.

Specially designed sampling nozzles continuously remove a representative portion of the exhaust air, which is then drawn through very fine glass fiber or membrane filters to trap particulates. Sensitive detectors continuously monitor these filters and provide readouts of alpha and beta radioactivity levels.

Separate sampling units on the ventilation stacks of the permitted systems contain another glass fiber filter that is removed every week and tested in the laboratory. These filters are analyzed routinely for the parameters defined in Appendix B of this report.

Special samples also are collected in order to monitor gaseous (non-particulate) emissions of radioactivity. For example, six of the sampling systems contain an activated carbon cartridge that collects gaseous iodine-129, and at two locations water vapor is collected by trapping moisture in silica gel desiccant columns. The trapped water is distilled from the silica gel desiccant and analyzed for tritium. Figure A-4 (p.A-6) shows the locations of on-site air monitoring and sampling points.

The Main Plant Ventilation Stack. The main ventilation stack (ANSTACK) is the primary source of airborne releases at the WVDP. This stack, which vents to the atmosphere at a height of more than 60 meters (more than 200 ft), releases filtered ventilation from several facilities, including the liquid waste treatment system, the analytical laboratories, and off-gas from the vitrification system.

Samples from the main plant stack are collected weekly and analyzed for gross alpha, gross beta, and tritium concentrations. Weekly filters are composited quarterly and analyzed for strontium-90, gamma-emitting radionuclides, total uranium, uranium isotopes, plutonium isotopes, and americium-241. Charcoal cartridges collected weekly are composited quarterly and analyzed for iodine-129. In addition, filters from the main plant ventilation stack are routinely analyzed for strontium-89 and cesium-137 as part of operational-safety monitoring.

Monthly and quarterly total curies released from the main stack in 1999 are summarized in Table D-1 (p.D-3). Total curies released, annual averages, and a comparison of total curies released with the applicable DCGs are summarized in Table D-2 (p.D-4). As in previous years, 1999 results show that average radioactivity levels at the point of discharge from the stack were already below concentration guidelines for airborne radioactivity in an unrestricted environment. Airborne concentrations from the stack to the site boundary are further reduced via dispersion by a factor of about 200,000. Results from air samples taken just outside the site boundary confirm that WVDP operations had no discernible effect on off-site air quality. (See Perimeter and Remote Air Sampling, p.2-16.)

Figure 2-6 (*below*) shows the gross alpha and gross beta curies released per month from the main stack during the past thirteen years. The figure indicates a steady five-year downward trend in both gross alpha and gross beta activity from 1987 to mid-1992 and a stabilization through mid-1995. Pre-vitrification transfers of cesium-loaded zeolite from waste tank 8D-1 to 8D-2 began in late 1995, and releases increased. Since radioactive vitrification operations began in mid-1996 both gross alpha and gross beta

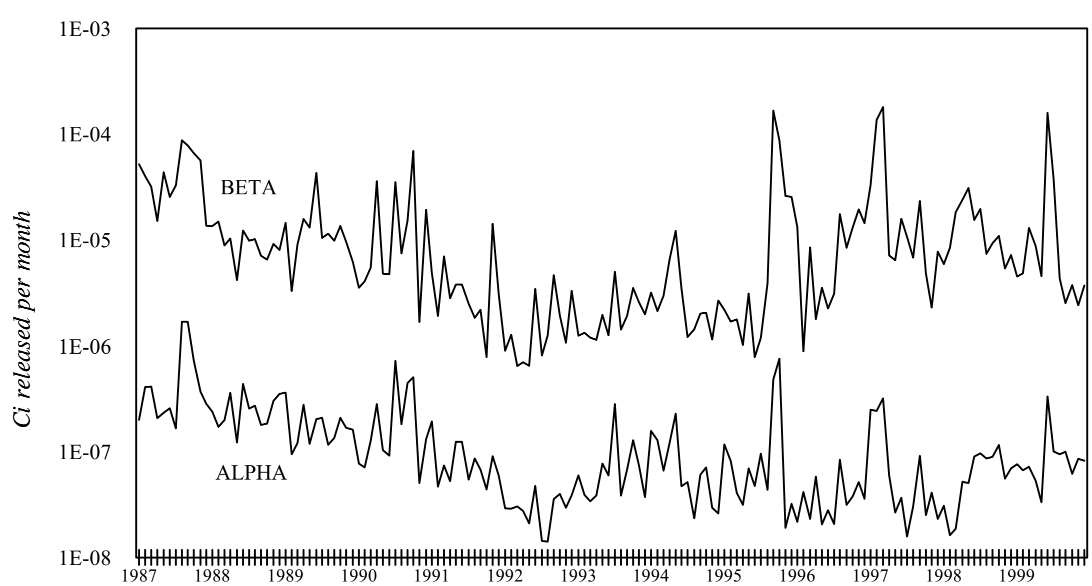


Figure 2-6. Thirteen-year Trends of Gross Alpha and Gross Beta Activity at the Main Stack Sampling Location (ANSTACK)

releases have fluctuated while generally remaining higher than previtrification levels.

In June 1998 the WVDP completed the first phase of high-level waste vitrification, processing the bulk of the waste in tank 8D-2. In the latter part of 1998 the focus of the vitrification program shifted to the second phase, vitrifying waste from the high-level waste residuals in the tank. Phase II vitrification continued throughout 1999. Thirty-five glass canisters were filled during this phase of vitrification.

Concentrations of iodine-129 and tritium released from the main ventilation stack have decreased compared to those observed during the first phase of vitrification. Concentrations of gross alpha, gross beta, cesium-137, and strontium-90 have remained at relatively steady levels since vitrification began.

Vitrification Facility Sampling System. Sampling point ANVITSK and the seismically protected backup sample point ANSEISK monitor emissions from the vitrification heating, ventilation, and air conditioning (HVAC) system. (Off-gas ventilation from the vitrification system itself is released through the main plant stack.)

Radioactivity concentrations were monitored at ANVITSK and ANSEISK before actual radioactive vitrification began in July 1996. The previtrification levels provide a baseline for comparison with concentrations of radionuclides in emissions during vitrification. Results from 1999 are found in Tables D-3 and D-4 (pp.D-5 and D-6).

With the exception of iodine-129, concentrations of radionuclides measured during 1999 were indistinguishable from baseline values. Concentrations of iodine-129 increased marginally during the fourth quarter of 1999, but on an annualized basis these values are indistinguishable from the 1998 data.

Other On-site Air Sampling Systems. Sampling systems similar to those of the main stack monitor airborne effluents from the 01-14 building ventilation stack (ANCSSTK); the contact size-reduction facility ventilation stack (ANCSRFK); the supernatant treatment system ventilation stack (ANSTSTK); and the container sorting and packaging facility ventilation stack (ANCSPFK). (See Fig.A-4 [p.A-6].)

Tables D-5 through D-8 (pp.D-7 through D-10) show monthly totals of gross alpha and beta radioactivity and quarterly total radioactivity released for specific radionuclides at each of these sampling locations. The 1999 samples from ANCSSTK, ANCSRFK, ANSTSTK, and ANCSPFK showed detectable concentrations of gross radioactivity in some cases as well as specific beta- and alpha-emitting radionuclides, but none approached any DOE effluent limitations.

Three other operations are routinely monitored for airborne radioactive releases: the new low-level waste treatment facility ventilation system (ANLLW2V), which came on-line in 1998; the old low-level waste treatment facility ventilation (ANLLWTVH); and the contaminated clothing laundry ventilation system (ANLAUNV).

The old and new low-level waste treatment facility ventilation points and the laundry ventilation system are sampled for gross alpha and gross beta radioactivity. These emission points are not required to be permitted because the potential magnitude of the emissions is so low. Although only semiannual grab sampling is required to verify the low level of emissions, all three points are sampled continuously while discharging to the environment. Data for these three facilities are presented in Tables D-9 through D-11 (pp. D-11 and D-12). Results from 1999 samples were well below DOE effluent limitations.

Permitted portable outdoor ventilation enclosures (OVEs) are used occasionally to provide the ventilation necessary for the safety of personnel working with radioactive materials in areas outside permanently ventilated facilities. Air samples from OVEs are collected continuously while those emission points are discharging, and data from these units are included in annual airborne emission evaluations. (See Table D-15 [p.D-16].) In 1999 average discharges from OVEs were well below DOE guidelines for alpha and beta radioactivity in an unrestricted environment.

Three on-site air samplers collect samples of ambient air in the vicinity of three site waste storage areas—the lag storage area (ANLAGAM), the NDA (ANNDAAM), and the SDA (ANSDAT9). (See Fig.A-4 [p.A-6].) These samplers were put in place to monitor potential diffuse releases of radioactivity. Monitoring data from these locations are presented in Appendix D, Tables D-12 through D-14 (pp. D-13 through D-15). Comparison of radiological data sets for these locations with those at the background air monitoring location AFGRVAL show results that are statistically the same, with the exception of elevated weekly tritium results at ANSDAT9. However, even the highest positive weekly tritium result from ANSDAT9 (5.13E-12μCi/mL [1.90E-04 Bq/L]) was less than 0.005% of the DOE DCG for tritium in air (1E-07μCi/mL).

Perimeter and Remote Air Sampling. Samples for radionuclides in air are collected continuously at six locations around the perimeter of the site and at four remote locations. Maps of perimeter and remote air sampling locations are found on Figure A-5 (p.A-7) and Figure A-12 (p.A-14).

The perimeter locations on Fox Valley Road (AFFXVRD), Rock Springs Road (AFRSPRD), Route 240 (AFRT240), Thomas Corners Road (AFTCORD), Dutch Hill Road (AFBOEHN), and at the site's bulk storage warehouse (AFBLKST) were chosen because they provide historical continuity (as former NFS sampling locations) or because they represent the most likely locations for detecting off-site airborne concentrations of radioactivity.

The remote locations provide data from nearby communities — West Valley (AFWEVAL) and Springville (AFSPRVL) — and from more distant background areas. Concentrations mea-

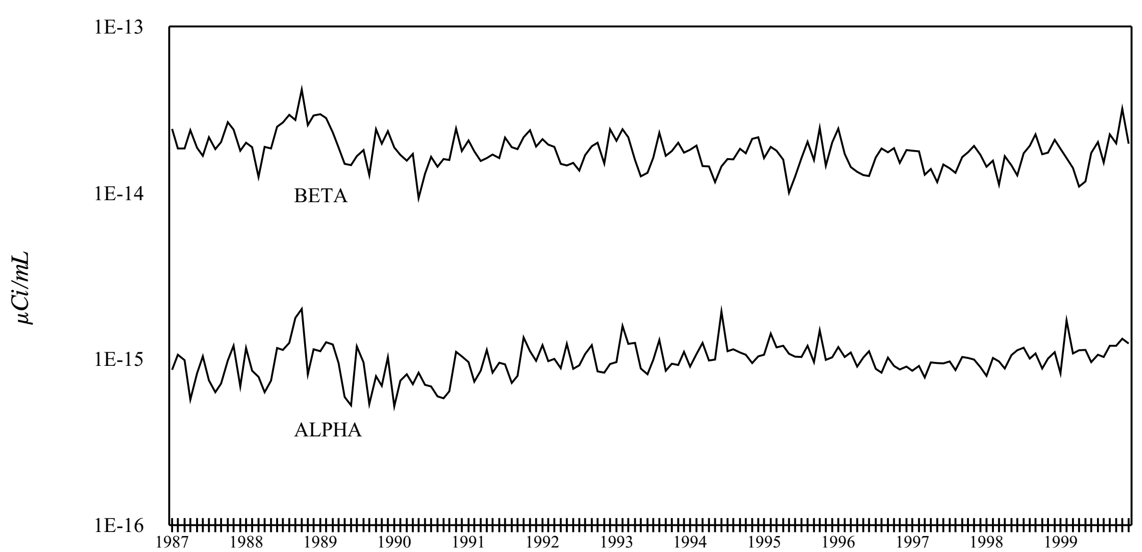


Figure 2-7. Thirteen-year Trends of Gross Alpha and Gross Beta Concentrations at the Rock Springs Road Sampling Location (AFRSPRD)

sured at Great Valley (AFGRVAL, 30.9 km south of the site) and Nashville (AFNASHV, 39.8 km west of the site in the town of Hanover) are considered representative of regional background air.

At all locations airborne particulates are collected on filters for radiological analysis. Samplers maintain an average flow of approximately 40 L/min (1.4 ft^3/min) through a 47-millimeter glass fiber filter. The sampler heads are set above the ground at the height of the average human breathing zone. Filters are collected weekly and analyzed after a seven-day "decay" period to remove interference from short-lived naturally occurring radionuclides. After weekly sample filters are measured for gross alpha and gross beta concentrations, they are combined in a quarterly composite consisting of thirteen weekly filters. The composite is analyzed for specific alpha-emitting, beta-emitting, and gamma-emitting radionuclides.

At two locations, the nearest perimeter location in the predominant downwind direction (Rock Springs Road) and the farthest background location (Great Valley), desiccant columns are used to collect airborne moisture for tritium analysis and charcoal cartridges are used to collect samples for iodine-129 analysis.

Trends of gross alpha and gross beta concentrations at the Rock Springs Road location are shown in Figure 2-7 (p. 2-16). Within a range of seasonal and weekly fluctuations, the concentrations have been relatively constant over the past thirteen years.

The gross alpha and gross beta ranges and annual averages for each of the off-site sampling points are noted on Tables 2-3 and 2-4 (p.2-18). All gross alpha averages were below detection levels. Gross beta results from samples taken at two near-site communities and from the site perimeter were similar to those from the background samplers, suggesting that there is no adverse site influence on the air quality at these near-site locations. Gross beta concentrations at all off-site and perimeter locations averaged about 1.99E-14 μCi/mL, which is about 0.2% of the DCG for strontium-90 in air (9E-12 μCi/mL). The highest average gross beta concentration (2.25E-14 μCi/mL) was at Thomas Corners Road. This represents less than 0.3% of the DCG. Additional radionuclide data from these samplers are provided in Tables D-16 through D-25 (pp. D-17 to D-26).

Although low levels of tritium, strontium-90, iodine-129, and cesium-137 were detected in emissions from the main stack on-site, average results for these radionuclides at near-site locations were indistinguishable from background values, confirming that site releases have a negligible effect on near-site air quality.

Fallout Pot Sampling. Short-term global fallout is sampled for radionuclide concentrations each month at four of the perimeter air sampler locations and at one on-site location near the rain gauge outside the Environmental Laboratory. (See Figs.A-4 and A-5 [pp.A-6 and A-7].) Monthly gross alpha, gross beta, potassium-40, and cesium-137 results are reported in nCi/m^2 and tritium results are reported in μCi/mL. The 1999 results from on-site and perimeter locations are similar to each other and are within the ranges noted in previous years. The small levels of tritium and cesium-137 detected in main stack emissions did not measurably affect on-site or perimeter fallout pot samples in 1999. The 1999 data from these analyses and the pH in precipitation are summarized in Tables D-26 through D-30 (pp.D-27 through D-29).

Off-Site Surface Soil Sampling. In order to assess long-term fallout deposition, surface soil near the off-site air samplers is collected annually and analyzed for radioactivity. Samples were collected in 1999 from ten locations: six near-site points on the perimeter of the

Table 2-3
1999 Gross Alpha Concentrations at Off-site, Perimeter, and On-site Ambient Air Sampling Locations

Location	No. of Samples	Range		Annual Average	
		(µCi/mL)	*(Bq/m³)*	*(µCi/mL)*	*(Bq/m³)*
AFBLKST	53	<6.07E-16 — 2.01E-15	<2.25E-05 — 7.44E-05	0.77±1.16E-15	2.85±4.28E-05
AFBOEHN	53	<7.46E-16 — 3.17E-15	<2.76E-05 — 1.17E-04	0.86±1.20E-15	3.19±4.43E-05
AFFXVRD	53	<7.52E-16 — 2.05E-15	<2.78E-05 — 7.58E-05	0.79±1.12E-15	2.92±4.14E-05
AFGRVAL	53	<7.62E-16 — 2.10E-15	<2.82E-05 — 7.78E-05	0.73±1.12E-15	2.68±4.13E-05
AFNASHV	53	<8.20E-16 — 2.22E-15	<3.03E-05 — 8.22E-05	0.80±1.14E-15	2.95±4.23E-05
AFRSPRD	53	<5.49E-16 — 2.86E-15	<2.03E-05 — 1.06E-04	0.67±1.11E-15	2.48±4.12E-05
AFRT240	53	<7.84E-16 — 2.37E-15	<2.90E-05 — 8.75E-05	0.81±1.18E-15	2.99±4.35E-05
AFSPRVL	53	<7.90E-16 — 2.20E-15	<2.92E-05 — 8.15E-05	0.79±1.14E-15	2.93±4.23E-05
AFTCORD	53	<6.84E-16 — 2.29E-15	<2.53E-05 — 8.47E-05	0.90±1.20E-15	3.32±4.43E-05
AFWEVAL	53	<8.02E-16 — 2.45E-15	<2.97E-05 — 9.07E-05	0.88±1.19E-15	3.25±4.41E-05
ANLAGAM	51	<5.64E-16 — 4.85E-15	<2.09E-05 — 1.80E-04	0.91±1.12E-15	3.37±4.15E-05
ANNDAAM	53	<5.77E-16 — 2.76E-15	<2.13E-05 — 1.02E-04	8.46±9.12E-16	3.13±3.38E-05

Table 2-4
1999 Gross Beta Concentrations at Off-site, Perimeter, and On-site Ambient Air Sampling Locations

Location	No. of Samples	Range		Annual Average	
		(µCi/mL)	*(Bq/m³)*	*(µCi/mL)*	*(Bq/m³)*
AFBLKST	53	8.64E-15 — 4.67E-14	3.20E-04 — 1.73E-03	1.96±0.35E-14	7.27±1.28E-04
AFBOEHN	53	1.05E-14 — 5.08E-14	3.88E-04 — 1.88E-03	2.12±0.36E-14	7.85±1.32E-04
AFFXVRD	53	8.56E-15 — 4.48E-14	3.17E-04 — 1.66E-03	2.04±0.34E-14	7.54±1.26E-04
AFGRVAL	53	8.94E-15 — 3.73E-14	3.31E-04 — 1.38E-03	1.86±0.33E-14	6.90±1.23E-04
AFNASHV	53	9.65E-15 — 5.34E-14	3.57E-04 — 1.98E-03	2.00±0.34E-14	7.40±1.27E-04
AFRSPRD	53	9.06E-15 — 4.80E-14	3.35E-04 — 1.78E-03	1.81±0.33E-14	6.70±1.22E-04
AFRT240	53	1.12E-14 — 4.94E-14	4.14E-04 — 1.83E-03	2.01±0.35E-14	7.43±1.29E-04
AFSPRVL	53	7.88E-15 — 4.40E-14	2.92E-04 — 1.63E-03	1.92±0.34E-14	7.10±1.25E-04
AFTCORD	53	9.58E-15 — 6.26E-14	3.55E-04 — 2.32E-03	2.25±0.37E-14	8.32±1.35E-04
AFWEVAL	53	1.05E-14 — 4.81E-14	3.90E-04 — 1.78E-03	1.96±0.35E-14	7.26±1.28E-04
ANLAGAM	51	9.12E-15 — 4.09E-14	3.37E-04 — 1.51E-03	1.92±0.32E-14	7.11±1.17E-04
ANNDAAM	53	5.95E-15 — 4.30E-14	2.20E-04 — 1.59E-03	1.82±0.27E-14	6.75±1.01E-04

WNYNSC, two in nearby communities, and two in locations 30 to 40 kilometers distant from the Project. Maps of the off-site surface soil sampling locations are on Figures A-3 and A-12 (pp.A-5 and A-14).

Concentrations of gross alpha and beta radioactivity, strontium-90, cesium-137, plutonium-239/240, and americium-241 were determined at all ten locations; concentrations of uranium radionuclides and total uranium were determined at two perimeter locations and one background location.

The measured concentrations of site-related radionuclides in soils from the perimeter and community locations (Table C-29 [p.C-30]) were statistically indistinguishable from normal regional background concentrations. However, cesium-137 concentrations from the Rock Springs Road location — northwest of the site — remained marginally higher than background concentrations. Soils collected near the Rock Springs Road air sampler have consistently shown higher than background cesium-137 concentrations.

Radiological Monitoring: Food Chain

Each year food and forage samples are collected from locations near the site (Fig. A-9 [p.A-11]) and from remote locations (Fig.A-12 [p.A-14] in Appendix A). Fish and deer are collected during periods when they would normally be taken by sportsmen for consumption. Most milk samples are collected monthly; beef is collected semiannually. Hay, corn, apples, and beans are collected at the time of harvest.

Fish. Fish are obtained under a collector's permit by electrofishing, a method that temporarily stuns the fish, allowing them to be netted for collection. Electrofishing allows a more species-selective control than sport fishing, with unwanted fish being returned to the creek essentially unharmed.

Fish are collected from three locations in Cattaraugus Creek: Two locations are downstream of WNYNSC drainage — one above the Springville dam (BFFCATC) and one below the Springville dam (BFFCATD) — and one location is upstream of the site (BFFCTRL). (See Fig.A-12, p.A-14.)

Twenty fish samples were collected in 1999 (ten the first half of the year and ten the second half of the year) immediately downstream (above the Springville dam at BFFCATC), and another twenty were collected from the control location upstream of the site (BFFCTRL). Ten fish samples were collected from Cattaraugus Creek below the dam (BFFCATD), including species that migrate more than 60 kilometers (nearly 40 mi) upstream from Lake Erie. These specimens are representative of sport fishing catches in the creek downstream of the Springville dam.

The edible portion of each fish was analyzed for strontium-90 content and the gamma-emitting radionuclide cesium-137. (See Table F-4 [pp. F-6 through F-8] in Appendix F for a summary of the results.) No statistically significant differences were found in strontium-90 or cesium-137 concentrations between fish collected upstream of the site and fish collected downstream of the site.

Venison. Venison from vehicle-deer accidents around the WNYNSC was analyzed for tritium, potassium-40, strontium-90, and cesium-137 concentrations, as was venison from deer collected far from the site in the towns of Bolivar, Arkwright, and Portville, New York. (See Figs.A-9 and A-12 [pp.A-11 and A-14].) Results from these samples are shown in Table F-2 (p.F-4) in Appendix F.

Electrofishing in Cattaraugus Creek

Low levels of radioactivity from cesium-137, strontium-90, and naturally occurring potassium-40 were detected in both near-site and control samples. Although results vary from year to year, data from the last nine years show no statistical differences between radionuclide concentrations in near-site and control samples.

For the sixth year, during the large-game hunting season, hunters were allowed access to the WNYNSC, excluding the WVDP premises, in a controlled hunting program established by NYSERDA. Historically, concentrations of radioactivity in deer flesh have been very low and Project activities have been shown to have little or no effect on the local herd.

Beef. Beef samples are taken semiannually from both near-site and remote locations (Figs.A-9 and A-12 [pp.A-11 and A-14] in Appendix A). As with venison samples, beef samples are analyzed for tritium, potassium-40, strontium-90, and cesium-137. Results are presented in Table F-2 (p.F-4) in Appendix F. No significant differences were found between results from near-site and background samples.

Milk. Monthly milk samples were taken in 1999 from dairy farms near the site to the north and west — downwind in the prevailing wind direction from the WVDP — and from control farms more than 25 kilometers from the site. Annual milk samples were collected at two near-site farms to the south and east of the site. For locations of near-site and remote sampling points, see Figure A-9 (p.A-11) and Figure A-12 (p.A-14) in Appendix A.

Monthly samples from each location were composited into single quarterly samples for analysis. Quarterly composites and annual samples were analyzed for tritium, potassium-40, strontium-90, iodine-129, and cesium-137. Results are presented in Table F-1 (p.F-3) in Appendix F. Near-site sample results were indistinguishable from background control sample results.

Vegetables, Fruit, and Forage. Sweet corn, beans, apples, and hay were collected at near-site and background locations at harvest time. Sampling locations are shown on Figures A-9 (p.A-11) and A-12 (p.A-14) in Appendix A. Samples were analyzed for tritium, potassium-

40, cobalt-60, strontium-90, and cesium-137. Results are presented in Table F-3 (p.F-5) in Appendix F.

No tritium, cobalt-60, or cesium-137 were found in any of the near-site samples; positive strontium-90 results were noted in all but one sample, a background corn sample. Strontium-90 was higher in near-site corn and hay than in background corn and hay. However, strontium-90 concentrations were higher in background beans than in near-site beans. All results were within the ranges noted in previous years.

Direct Environmental Radiation Monitoring

This was the sixteenth full year in which direct penetrating radiation was monitored at the WVDP. Thermoluminescent dosimeters (TLDs) are placed at each monitoring location for one calendar quarter (three months) and are then processed to obtain the integrated gamma radiation exposure at that location.

Monitoring points are located on-site at the waste management units, at the site security fence, around the WNYNSC perimeter and the access road, and at background locations remote from the WVDP (Figs.A-10, A-11, and A-12 [pp.A-12, A-13, and A-14]). The identification numbers associated with each location were assigned in chronological order of original installation. (See TLD Locations and Identification Numbers below.)

Quarterly and annual averages of TLD measurements at off-site and on-site locations are noted in Appendix H, Tables H-1 and H-2 (pp.H-3 and H-4). The results from 1999 mea-

TLD Locations and Identification Numbers

Perimeter of the WNYNSC	1-16, 20
Perimeter of the WVDP security fence	24, 26-34
On-site sources or waste management units *(Note: some TLDs monitor more than one waste management unit)*	18, 32-36, 43 (drum cell) 18, 19, 33, 42, 43 (SDA) 24 (component storage, near WVDP security fence) 25 (maximum measured exposure rate at the closest point of public access) 38 (main plant and, in previous years, the cement solidification system) 39 (parking lot security fence closest to the vitrification facility) 40 (high-level waste tank farm)
Near-site communities	21 (Springville) 22 (West Valley)
Background	17 (Five Points Landfill in Mansfield) 23 (Great Valley) 37 (Nashville) 41 (Sardinia)

surements show typical seasonal variations and are similar to results from previous years.

On-Site Radiation Monitoring. Table H-2 (p.H-4) shows the average quarterly exposure rate at each on-site TLD. The on-site monitoring point with the highest dose readings was location #24. Sealed containers of radioactive components and debris from the plant decontamination work are stored nearby. The storage area is well within the WNYNSC boundary, just inside the WVDP fenced area, and is not accessible by the public.

The average exposure rate at location #24 was about 591 milliroentgens (mR) per quarter (0.27 mR/hr) during 1999, which is almost identical to the exposure rate noted at this location in 1998 (0.32 mR/hr). Exposure rates at this location are gradually decreasing because the radioactivity in the materials stored nearby is decaying. (See Fig. 1-1 [p.1-9] in Chapter 1.)

The average 1999 dose rate at locations around the integrated radwaste treatment storage building — the drum cell — including TLDs #18, #32, #34, #35, #36, and #43 was 0.02 mR/hr, about the same as in 1998. Exposure rates around the drum cell are above background levels because the building contains drums filled with decontaminated supernatant mixed with cement. (See also Fig. 1-2 [p.1-10] in Chapter 1.) The drum cell and the surrounding TLD locations are well within the WNYNSC boundary and are not accessible by the public.

Results from TLD #42, near a waste tank that stores SDA leachate, are also above background. However, results from on-site TLDs farther away from radioactive waste storage areas approach background levels. For example, results from location #27 (near Frank's Creek northeast of the NDA, SDA, and drum cell), and #28 and #31 (near Rock Springs Road west of the drum cell at the security fence) are statistically indistinguishable from background exposure rates.

Perimeter and Off-Site Radiation Monitoring. Table H-1 (p.H-3) lists the average quarterly exposure rate at each off-site TLD location. The perimeter TLDs (TLDs #1-16 and #20) are

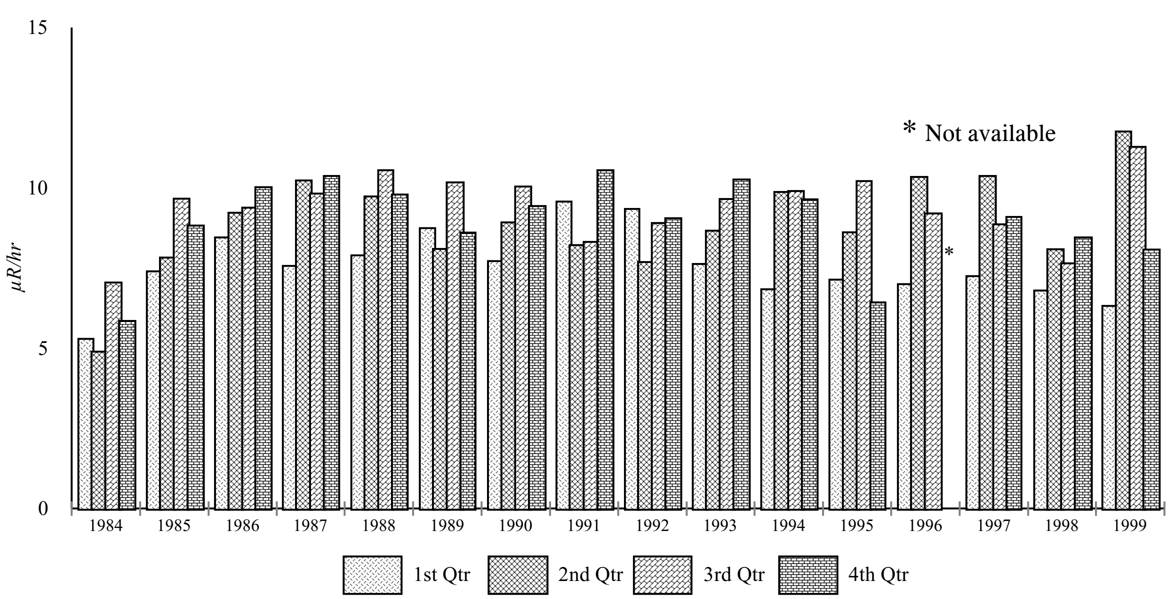


Figure 2-8. Sixteen-year Trend of Environmental Radiation Levels at Perimeter TLDs

located in the sixteen compass sectors around the facility near the WNYNSC boundary. Results from the background and community TLDs were essentially the same as results from the perimeter TLDs. The perimeter TLD quarterly averages since 1985 (expressed in microroentgen per hour [μR/hr]), shown on Figure 2-8 (*facing page*) indicate seasonal fluctuations but no long-term trends. The quarterly average of the seventeen WNYNSC-perimeter TLDs was 20.9 mR per quarter (9.5 μR/hr) in 1999, slightly higher than in 1998.

Confirmation of Results. The performance of the environmental TLDs is confirmed periodically using a portable high-pressure ion chamber (HPIC) detection system. In the third quarter of 1999 the HPIC was taken to each of the forty-three environmental TLD locations and instantaneous dose readings (in μR/hr) were obtained. These readings are listed with the comparable third-quarter environmental TLD results in Table H-3 (p.H-5). The TLD results include the entire third quarter of 1999; the HPIC results were collected over a period of less than 30 minutes. Since the measurements are made with different systems and over differing periods of time, they are not directly comparable. Even so, the relative percent difference between the two sets of measurements was less than 12%, indicating good agreement between these two different measurement methods. (Guidance in ANSI N545-1975, the standard for environmental dosimetry, uses less than 30% total uncertainty as a performance specification for TLD measurements.)

Meteorological Monitoring

Meteorological monitoring at the WVDP provides representative and verifiable data that characterize the local and regional climatology of the site. These data are used primarily to assess potential effects of routine and nonroutine releases of airborne radioactive materials and to develop dispersion models used to calculate the effective dose equivalent to off-site residents.

Since dispersive capabilities of the atmosphere are dependent upon wind speed, wind direction, and atmospheric stability (which is a function of the difference in temperature between two elevations), these parameters are closely monitored and are available to the emergency response organization at the WVDP.

The on-site 60-meter meteorological tower (Fig. A-1 [p.A-3]) continuously monitors wind speed and wind direction. Temperatures are measured at both 60-meter and 10-meter elevations. In addition, an independent, remote 10-meter meteorological station located approximately 8 kilometers south of the site on a hillcrest on Dutch Hill Road continuously monitors wind speed and wind direction. (See Fig.A-12 [p.A-14].) Dewpoint, precipitation, and barometric pressure are also monitored on-site.

The two meteorological locations supply data to the primary digital and analog data acquisition systems located within the Environmental Laboratory. On-site systems are provided with either uninterruptible or standby power backup in case of site power failures. In 1999 the on-site system data recovery rate (time valid data were logged versus total elapsed time) was approximately 95.7%. Regional data at the 10-meter elevation are shown on Figure I-1 (p.I-3). Figures I-2 and I-3 (pp. I-4 and I-5) illustrate 1999 mean wind speed and wind direction at the 10-meter and 60-meter elevations on the on-site tower.

Weekly and cumulative total precipitation data are illustrated in Figures I-4 and I-5 (p.I-6) in Appendix I. Precipitation in 1999 was approximately 78.7 centimeters (31 in), about 24% below the annual average of 104 centimeters (41 in).

Documentation such as meteorological system calibration records, site log books, and analog strip charts are stored in protected archives. Electronic files containing meteorological data are copied (downloaded) weekly and stored off-site. Meteorological towers and instruments are examined three times per week for proper function and are calibrated semiannually and/ or whenever instrument maintenance might affect calibration.

The meteorological system was evaluated in 1998 and equipment and software upgraded in 1999 to ensure year-2000 compliance.

Checking Data from the Meteorological Tower

Special Monitoring

Special monitoring comprises sampling and analyses not covered by the routine environmental monitoring program but that address items of environmental interest. Special monitoring programs are used to verify and/or track these items.

Iodine Emissions from the Main Stack. When radioactive vitrification operations began in 1996, emission rates of radioactive isotopes of iodine increased at the main stack. The increase occurred because gaseous iodine is not as efficiently removed by the vitrification process off-gas treatment system as are most other radionuclides.

Iodine-129 is a long-lived radionuclide that has always been present in main stack emissions, and in 1996 iodine-131 also was detected. Iodine-131, an isotope with a half-life of eight days, originates from the decay of curium-244, which is present in the high-level waste. Iodine-131 gas was not detectable until vitrification began because the previtrification storage and management of high-level waste had prevented detectable levels of iodine-131 from reaching the air effluent. In the process of preparing the high-level waste for vitrification, the quantities of iodine-129 increased compared to previtrification levels and a very small — yet detectable — quantity of iodine-131 was released.

Iodine-129 was monitored closely during 1999 and the results compared to the operation of the vitrification facility. Weekly iodine-129 concentrations were within the range of values observed since vitrification began. In 1999 the total quantity of iodine-129 decreased slightly from the 1998 total. (See Table D-1 [p.D-3].)

(For more information on the off-site effective dose from airborne emissions see Predicted Dose from Airborne Emissions [p.4-8] in Chapter 4.)

Mercury at the Low-level Waste Treatment Facility. Increasing concentrations of total mercury were observed in 1999 in process water collected in the low-level waste treatment facility. The source of the mercury was determined to be process water from the liquid waste treatment system evaporator. (The evaporator is used to separate liquids from solid residuals generated during processing of high-level radioactive waste.) Negotiations with NYSDEC regarding additional SPDES permit monitoring requirements and limits were initiated in 1999. In addition, special sampling and analysis methods for very low levels of mercury are being evaluated. It is expected that a final SPDES permit that addresses mercury will be issued in 2000.

Nonradiological Monitoring: Surface Water

Liquid discharges are regulated under the State Pollutant Discharge Elimination System (SPDES). The WVDP holds a SPDES permit that identifies the outfalls where liquid effluents are released to Erdman Brook (Fig.A-2 [p.A-4]) and specifies the sampling and analytical requirements for each outfall. The current SPDES permit (effective June 1995) was administratively renewed without changes by NYSDEC and was issued to the WVDP in September 1998 with an effective date of February 1, 1999 and an expiration date of February 1, 2004. The conditions and requirements of the SPDES permit are summarized in Table G-1 (pp.G-3 and G-4) in Appendix G.

The permit identifies four outfalls:

- outfall WNSP001, discharge from the low-level waste treatment facility

- outfall WNSP007, discharge from the sanitary and industrial wastewater treatment facility

- outfall WNSP008, groundwater effluent from the perimeter of the low-level waste treatment facility storage lagoons

- outfall 116, a sampling location in Frank's Creek that represents the confluence of outfalls WNSP001, WNSP007, and WNSP008 as well as storm water runoff, groundwater surface seepage, and augmentation water. Samples from upstream sources (WNSP001, WNSP007, and WNSP008) are used to calculate total dissolved solids at this location and to demonstrate compliance with the SPDES permit limit for this parameter. (Outfall 116 is referred to as a "pseudo-monitoring" point on the SPDES permit. [See the Glossary, p.7.])

Some of the more significant features of the SPDES permit are the requirements to report five-day biochemical oxygen demand (BOD_5), total dissolved solids, iron, and ammonia data as flow-weighted concentrations and to apply a net discharge limit for iron. The net limit allows the Project to account for the iron that is naturally present in the site's incoming water. The flow-weighted limits apply to the flow-proportioned sum of the Project effluents.

The SPDES monitoring data for 1999 are displayed in Tables G-3A through G-8 (pp.G-5 through G-15). The WVDP reported no permit exceedances in 1999. (See also the Environmental Compliance Summary: Calendar Year 1999, SPDES-permitted Outfalls [pp. ECS-9 through ECS-10]).

Semiannual grab samples at locations WNSP006 (Frank's Creek at the security fence), WNSWAMP (northeast swamp drainage), WNSW74A (north swamp drainage), and WFBCBKG (Buttermilk Creek at Fox Valley) were taken in 1999. These samples are screened for organic constituents and selected anions, cations, and metals. Results of these measurements for all of these locations are found in Table C-27 (p.C-28).

Nonradiological Monitoring: Drinking Water

Site drinking water is monitored to verify compliance with EPA and NYSDOH regulations. (See Safe Drinking Water Act [p.ECS-12] in the Environmental Compliance Summary: Calendar Year 1999.) Samples are collected annually and analyzed for nitrate, fluoride, and metals concentrations. Sampling and analysis for copper and lead are conducted according to Cattaraugus County Health Department guidance. The 1999 monitoring results indicated that the Project's drinking water met NYSDOH, EPA, and Cattaraugus County Health Department drinking water quality standards.

Nonradiological Monitoring: Air

Nonradiological air emissions and plant effluents are permitted under NYSDEC and EPA regulations. (The regulations that apply to the WVDP are listed in Table K-2 [p.K-4] in Appendix K. The individual air permits [certificates to operate] held by the WVDP are identified and described in Table K-3 [pp.K-5 and K-6].) The nonradiological air permits are for emissions of regulated pollutants that include particulates, ammonia, and nitric acid mist. Emissions of oxides of nitrogen and sulfur are each limited to 100 tons per year and are reported to NYSDEC every quarter. Nitrogen oxides emissions for 1999 were approximately 7 tons; sulfur dioxide emissions were approximately 0.13 tons.

Although monitoring of these parameters currently is not required, the WVDP has developed an opacity observation program: If nitrogen oxides (NO_x) are emitted at sufficient concentrations, the air discharged from the main stack will take on a yellow-brown color. The intensity of this color (opacity) is in proportion to NO_x concentration. In order to be capable of assessing and documenting such potential emissions, selected staff environmental scientists and engineers completed a New York State-certified opacity observation training course.

GROUNDWATER MONITORING

Groundwater Monitoring Program Overview

Groundwater at the West Valley Demonstration Project (WVDP) is monitored according to a comprehensive program developed to comply with all applicable state and federal regulations. The monitoring program also meets requirements of Department of Energy (DOE) Order 5400.1 to obtain data for determining baseline conditions of groundwater quality and quantity, to provide data that will allow the early detection of groundwater contamination, to identify existing and potential groundwater contamination sources and maintain surveillance of these sources, and to provide data upon which decisions can be made concerning the integrity of existing disposal areas and the management and protection of groundwater resources.

Current groundwater monitoring activities at the WVDP are summarized in two primary documents, the Groundwater Monitoring Plan (West Valley Nuclear Services Co., Inc. December 1998) and the Groundwater Protection Plan (West Valley Nuclear Services Co., Inc. April 1997). The Groundwater Monitoring Plan outlines the WVDP's plans for groundwater characterization, current groundwater monitoring, and support of long-term monitoring requirements identified in the Resource Conservation and Recovery Act (RCRA) facilities investigation (RFI) and DOE programs. The Groundwater Protection Plan provides additional information regarding protection of groundwater from on-site activities.

Geologic History of the West Valley Site

The Western New York Nuclear Service Center (WNYNSC) is located on the Allegheny Plateau near the northern border of Cattaraugus County in Western New York. Underneath the WNYNSC site is a sequence of Holocene (recent age) and Pleistocene (ice age) sediments in a steep-sided valley incised in bedrock. The bedrock is composed of shales and interbedded siltstones of the upper Devonian Canadaway and Conneaut Groups and dips southward at about 5 m/km (Rickard 1975).

The Pleistocene sediments overlying the bedrock typically consist of a sequence of three glacial tills of Lavery, Kent, and possibly Olean age. The tills are separated by stratified fluviolacustrine deposits. In the northern part of the site the Lavery till is capped by alluvial-fluvial coarse-grained deposits.

Glaciation of the ancestral valley occurred between 24,000 and 15,000 years ago (Albanese et al. 1984), ending with the deposition of up to 40 meters (130 ft) of Lavery till. Post-Lavery outwash and alluvial fans, including the sand and gravel unit that covers the northern portion of the WVDP site, were deposited on the Lavery till between 15,000 and 14,200 years ago (La Fleur 1979).

Surface Water Hydrology of the West Valley Site

The WNYNSC lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 43 kilometers (27 mi) southwest of Buffalo. Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP site.

The 80-hectare (200-acre) WVDP site, located on the WNYNSC, is contained within the smaller Frank's Creek watershed. Frank's Creek, a tributary of Buttermilk Creek, forms the eastern and southern boundary of the WVDP, and Quarry Creek, a tributary of Frank's Creek, forms the northern boundary. (See Fig.A-6 [p.A-8].)

Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau. The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA), and the New York State-licensed disposal area (SDA) are located on the south plateau.

Hydrogeology of the West Valley Site

Glacial Deposits. As noted above, the WVDP site area is underlain by a sequence of glacial tills comprised primarily of clays and silts separated by coarser-grained interstadial layers. The bottommost layer, the Kent till, is less permeable than the other geological units and does not provide a pathway for contaminant movement from the WVDP and so it is not discussed here. The sediments above the Kent till — the Kent recessional sequence, the Lavery till and the intra-Lavery till-sand, and the surficial sand and gravel — are generally regarded as containing all of the potential routes for the migration of contaminants (via groundwater) from the WVDP site. (See Figs. 3-1 and 3-2 [*facing page*], which show the relative locations of these sediments on the north and south plateaus.) The Kent recessional sequence and the Lavery till are common to both the north and south plateaus.

Kent Recessional Sequence. The Kent recessional sequence consists of a fine-grained lacustrine unit of interbedded clay and silty clay layers locally overlain by coarse-grained glacial sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern margin of the site where the walls of the bedrock valley intersect the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, toward Buttermilk Creek. The mean hydraulic conductivity generally ranges from 1E-06 cm/sec (1E-03 ft/day) to 1E-05 cm/sec (1E-02 ft/day). Recharge comes from the overlying Lavery till and the bedrock in the southwest, and discharge is to Buttermilk Creek.

Lavery Till. The Lavery till is predominantly an olive-gray, silty clay glacial till with scattered lenses of silt and sand. It underlies both the north and south plateaus and ranges up to 40 meters (130 ft) in thickness beneath the active areas of the site, generally increasing northeastward towards Buttermilk Creek and the center of the bedrock valley. On the south plateau the upper zone of the Lavery till is weathered and fractured. (See the description of the south plateau below.)

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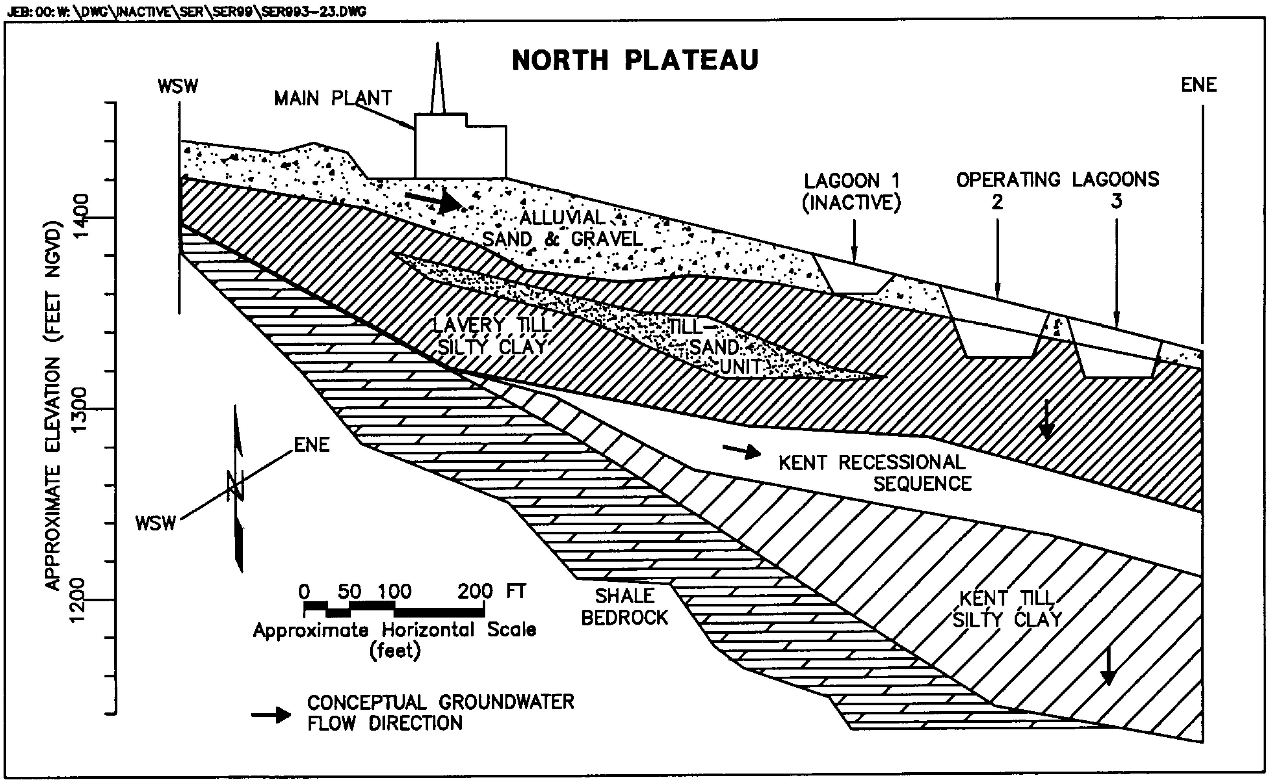

Figure 3-1. Geologic Cross Section through the North Plateau

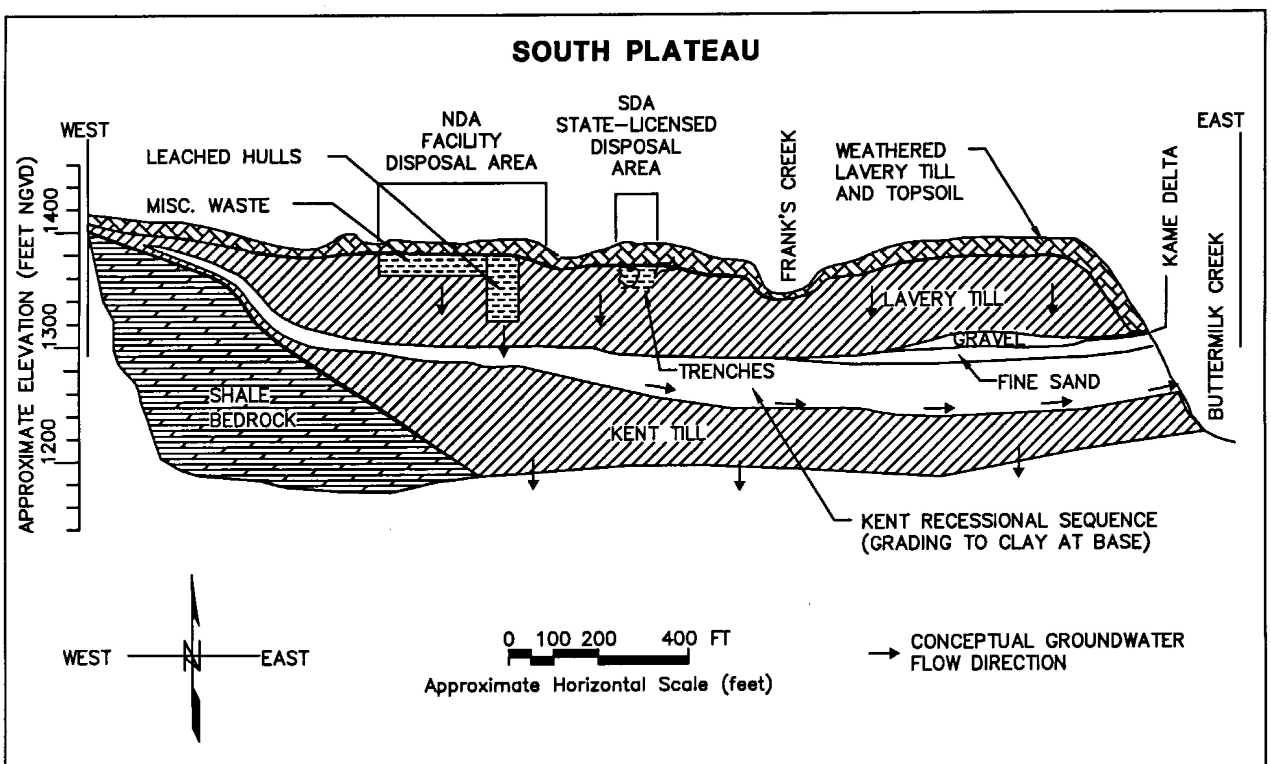

Figure 3-2. Geologic Cross Section through the South Plateau

Hydraulic head distributions in the *unweathered* Lavery till indicate that groundwater flow is predominantly vertically downward at a relatively slow rate, towards the underlying Kent recessional sequence. The mean hydraulic conductivity of this unweathered till generally ranges from 1E-08 cm/sec (1E-05 ft/day) to 1E-07 cm/sec (1E-04 ft/day).

South Plateau. On the south plateau the upper portion of the Lavery till is exposed at the ground surface and is weathered and fractured to a depth of 0.9 meters to 4.9 meters (3 ft to 16 ft). This layer is referred to as the *weathered Lavery till* and is unique to the south plateau. The weathered Lavery till has been oxidized to a brown color and contains numerous fractures and root tubes.

Groundwater flow in the weathered till has both horizontal and vertical components. This enables the groundwater to move laterally across the south plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. The hydraulic conductivity of the weathered till generally ranges from 1E-07 cm/sec (1E-04 ft/day) to 1E-05 cm/sec (1E-02 ft/day). The highest conductivities are associated with the dense fracture zones found within the upper 2 meters (7 ft) of the unit.

North Plateau. On the north plateau, where the main plant, waste tanks, and lagoons are located, the weathered till layer is much thinner or nonexistent and the unweathered Lavery till is immediately overlain by the sand and gravel unit.

The *sand and gravel unit* and the Lavery *till-sand* are unique to the north plateau. The sand and gravel unit is a silty sand and gravel layer composed of younger Holocene alluvial deposits that overlie older Pleistocene-age glaciofluvial deposits. Together these two layers range up to 12.5 meters (41 ft) in thickness near the center of the plateau and pinch out along the northern, eastern, and southern edges of the plateau, where they have been truncated by the downward erosion of stream channels. Depth to groundwater within the sand and gravel unit varies from 0 meters to 5 meters (0 ft to 16 ft), being deepest generally beneath the central north plateau (beneath the main plant facilities) and intersecting the ground surface farther north towards the security fence. Groundwater in this unit generally flows northeastward across the north plateau towards Frank's Creek. Groundwater near the northwestern and southeastern margins of the sand and gravel layer also flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till. The mean hydraulic conductivity generally is from 1E-06 cm/sec (1E-03 ft/day) to 1E-03 cm/sec (1E+00 ft/day).

Within the unweathered Lavery till on the north plateau is another unit, the *Lavery till-sand*. On-site investigations from 1989 through 1990 identified this lenticular sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the southeastern portion of the north plateau. Groundwater flow through this unit is in an east-southeast direction. Surface discharge locations have not been observed. Results of the most recent hydraulic testing in 1996 and 1998 of eight wells monitoring this unit indicate a mean hydraulic conductivity of 1E-03 cm/sec (1E+00 ft/day).

Routine Groundwater Monitoring Program

The purpose of groundwater monitoring at the WVDP is to detect changes in groundwater quality within the five different hydrogeologic units described above: the sand and gravel, the weathered Lavery till, the unweathered Lavery till, the Lavery till-sand, and the Kent recessional sequence.

Monitoring Well Network. Table E-1 (Appendix E [p.E-3]) lists the eleven super solid waste management units (SSWMUs) monitored by the well network, the hydraulic position of each well relative to the waste management unit, the geologic unit monitored, and the analytes measured in 1999. Note that monitoring of certain wells, marked by an asterisk, is required by the RCRA §3008(h) Administrative Order on Consent for the WVDP.

Figures A-7 and A-8 (pp.A-9 and A-10) show the boundaries of ten of the SSWMUs at the WVDP. (Twenty-one additional wells in an eleventh SSWMU monitor the SDA and are the responsibility of the New York State Energy Research and Development Authority [NYSERDA]. Locations of NYSERDA wells are shown on Fig.A-8 [p.A-10] in Appendix A. The SDA, a closed radioactive waste landfill, is contiguous with the Project premises, but the WVDP is not responsible for the facilities or activities relating to it. Under a joint agreement with the DOE, NYSERDA contracts with the Project to obtain specifically requested technical support in SDA-related matters. The 1999 groundwater monitoring results from the SDA are reported in this document in Appendix L [pp.L-3 through L-14] but are not discussed here.)

Table E-1 (pp.E-3 through E-6) identifies the positions of monitoring locations relative to the SSWMUs. The wells monitoring a given hydrogeologic unit (e.g., sand and gravel, weathered Lavery till) also are arranged in a generalized upgradient to downgradient order based upon their location within the entire hydrogeologic unit. The hydraulic position of a well relative to a SSWMU, i.e., upgradient or downgradient, does not necessarily match that same well's position within a hydrogeologic unit. For example, a well that is upgradient in relation to a SSWMU may be located at any position within a hydrogeologic unit within the boundaries of the WVDP, depending on the geographic position of the SSWMU relative to the hydrogeologic unit. In general, the following text and graphics refer to the hydraulic position of monitoring wells within their respective hydrogeologic units, thus providing a site-wide perspective rather than a perspective centered on SSWMUs.

Potentiometric (water level) measurements also are collected from the wells listed in Table E-1 in conjunction with the quarterly analytical sampling schedule. (See Table 3-1, p. 3-6.) Groundwater elevation data are used to produce groundwater contour maps (which delineate flow directions and gradients) and long-term trend graphs (which illustrate seasonal fluctuations and identify changes in the groundwater system).

Eleven surface water elevation stakes were installed in August 1998 in relatively flat areas of the north plateau where the water table in the sand and gravel unit intersects the ground surface, forming pools or puddles of standing water. Surface water elevation measurements taken at these locations were found to correlate with groundwater elevation measurements taken at monitoring wells and are used routinely to help define groundwater flow-direction and gradients in the sand and gravel unit in areas where monitoring well coverage is sparse or nonexistent.

Two groundwater monitoring wells (active well 602 and inactive well 8601) were decommissioned in the spring of 1999 because their locations interfered with construction planned for lag storage area (LSA) #4, particularly the construction of a shipping depot outside the storage area entrance. In order to continue groundwater monitoring coverage in the area, a replacement monitoring well (well 602A) was installed near former well 602 but away from the construction.

Groundwater Monitoring Program Highlights 1982 to 1999. The groundwater monitoring program is designed to support DOE

Table 3-1
1999 Groundwater Sampling and Analysis Agenda

Analyte Group	*Description of Parameters* [1]	*Location of Sampling Results in Appendix E*
Contamination Indicator Parameters (I)	pH, specific conductance (field measurement)	Tables E-2 through E-8 (pp. E-7 through E-16)
Radiological Indicator Parameters (RI)	Gross alpha, gross beta, tritium	Tables E-2 through E-8 (pp. E-7 through E-16)
Volatile Organic Compounds (V)	Appendix 33 VOCs (Volatile Organic Compounds) (See Table E-14 [p. E-22].)	Table E-9 (p. E-16)
Semivolatile Organic Compounds (SV)	Appendix 33 SVOCs (Semi-volatile Organic Compounds) (See Table E-14 [p. E-22].)	Table E-10 (p. E-17)
Appendix 33 Metals (M33)	Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, tin, vanadium, zinc	Table E-11 (pp. E-17 through E-18)
Special Monitoring Parameters for Early Warning Wells (SM)	Aluminum, iron, manganese	Table E-12 (p. E-19)
Radioisotopic Analyses: alpha- , beta- , and gamma-emitters (R)	C-14, Cs-137, I-129, Ra-226, Ra-228, Sr-90, Tc-99, U-232, U-233/234, U-235/236, U-238, total uranium	Table E-13 (pp. E-19 through E-21)
Strontium-90 (S)	Sr-90	Table E-13 (pp. E-19 through E-21)

1999 Quarterly Sampling Schedule:
1st Qtr - December 1, 1998 to February 28, 1999
2nd Qtr - March 1, 1999 to May 31, 1999
3rd Qtr - June 1, 1999 to August 31, 1999
4th Qtr - September 1, 1999 to November 30, 1999

[1]*Analysis performed at selected active monitoring locations only. See Table E-1 (pp. E-3 through E-6) for the analytes sampled at each monitoring location.*

Groundwater Sampling Methodology

Groundwater samples are collected from monitoring wells using either dedicated Teflon® well bailers or bladder pumps. (Dedicated bailers are equipped with Teflon®-coated stainless steel leaders.)

The method of collection depends on well construction, water depth, and the water-yielding characteristics of the well. Bailers are used in low-yield wells; bladder pumps are used in wells with good water-yielding characteristics.

To ensure that only representative groundwater is sampled, three well volumes are removed (purged) from the well before the actual samples are collected. If three well volumes cannot be removed because of limited recharge, purging the well to dryness provides sufficient purging. Conductivity and pH are measured before sampling and after sampling, if sufficient water is still available, to confirm the geochemical stability of the groundwater during sampling.

The bailer, a tube with a check valve at the bottom, is lowered into the well until it reaches the desired point in the water column. The bailer is lowered slowly to minimize agitation of the water column and is then withdrawn from the well with a sample and emptied into a sample container. The bailer, bailer line, and bottom-emptying device used to drain the bailer are dedicated to the well, i.e., are not used for any other well.

Bladder pumps use compressed air to gently squeeze a Teflon® bladder that is encased in a stainless steel tube located near the bottom of the well. When the pressure is released, new groundwater flows into the bladder. A series of check valves ensures that the water flows only in one direction. The operating air is always separated from the sample and is expelled to the surface by a separate line.

Bladder pumps reduce mixing and agitation of the water in the well. Each bladder pump system is dedicated to an individual well to reduce the likelihood of sample contamination from external materials or cross contamination. The air compressor and pump control box can be used from well to well because they do not contact the sample.

Immediately after the samples are collected they are put into a cooler and returned to the Project's Environmental Laboratory. The samples are preserved with chemicals, if necessary, and stored under controlled conditions to minimize chemical and/or biological changes after sample collection. The samples are then either packaged for expedited delivery to an off-site contract laboratory or kept in controlled storage to await on-site testing. A strict chain-of-custody protocol is followed for all samples collected by the WVDP.

Order 5400.1 requirements and the RCRA §3008(h) Administrative Order on Consent for the WVDP. In general, the content of the program is dictated by these requirements in conjunction with current operating practices and historical knowledge of previous site activities.

• WVDP groundwater monitoring began in 1982 with the monitoring of tritium in the sand and gravel unit in the area of the lagoon system.

• By 1984 twenty wells in the vicinity of the main plant and the NDA provided monitoring coverage.

• In 1986 fourteen new wells, a groundwater seep location, and the french drain outfall were added to monitor additional site facilities.

• Ninety-six new wells were installed in 1990 to support data collection for the environmental impact statement and RCRA facility investigations.

• A RCRA facility investigation expanded-characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, yielded valuable information regarding the presence or absence of groundwater contamination near each SSWMU and was also used to guide later monitoring program modifications.

• In 1993 monitoring results indicated elevated gross beta activity in groundwater in the sand and gravel unit on the north plateau. Subsequent investigation of this area delineated a plume of contamination with a southwest to northeast orientation. (See Special Groundwater Monitoring, p. 3-15, for more detail.)

• Long-term monitoring needs were the focus of a 1995 groundwater monitoring program evaluation. After a comprehensive assessment, the number of sampling locations was reduced from ninety-one to sixty-five and analytical parameters were tailored for each sampling location, for a more focused, efficient, and cost-effective program.

• In 1996 several groundwater seep monitoring locations on the northeast edge of the north plateau were added to the monitoring program.

• From 1996 through 1999, in response to current sampling results and to DOE and RCRA monitoring requirements, wells, analytes, and sampling frequencies were modified.

Annual Analytical Trigger Limit Review. A computerized data evaluation program using “trigger limits” for chemical and radiological analytes was instituted in 1995. These pre-set limits — conservative values for chemical or radiological concentrations — were developed to expedite a prompt focus on any monitoring anomalies. These values are based on regulatory limits, detection limits, or statistically derived levels. Trigger limits are reviewed and updated every year, if necessary, using all pre-existing data as well as data collected during the year. The trigger limits were updated in early 1999.

Upper and lower trigger limits for groundwater elevation measurements were introduced in 1999. These limits are used to identify field measurement anomalies, allowing prompt investigation and remeasurement, if necessary.

Results of Routine Groundwater Monitoring

Groundwater monitoring program components are completed in accordance with regulatory protocols. These components include placing and installing wells properly, collecting groundwater samples appropriately, incorporating quality assurance methods, and evaluating data appropriately.

The tables in Appendix E (pp.E-7 through E-21) group the results of groundwater monitoring according to the five hydrogeologic units monitored: the sand and gravel unit, the Lavery till-sand unit, the weathered Lavery till unit, the unweathered Lavery till unit, and the Kent recessional sequence. These tables contain the results of 1999 sampling for the radiological and nonradiological analyte groups noted on Table 3-1 (p.3-6). Table E-14 (pp.E-22 through E-24) lists the practical quantitation limits (PQLs) for individual NYCRR [New York Official Compilation of Codes, Rules, and Regulations] Title 6, Appendix 33 analytes. (The PQL is the lowest level of an analyte that can be measured within specified limits of precision during routine laboratory operations [New York State Department of Environmental Conservation 1991].)

Appendix E tables also display each well's hydraulic position relative to other wells within the same hydrogeologic unit. Wells identified as UP refer to either background or upgradient wells that are upgradient of all other wells in the same hydrogeologic unit. Downgradient locations are designated B, C, or D to indicate their positions along the groundwater flow path relative to each other. Wells denoted as DOWN - B are closest to the UP wells. Wells denoted as DOWN - C are downgradient of DOWN - B wells but are upgradient of DOWN - D wells. DOWN - D wells are downgradient of all other wells in that hydrogeologic unit. Grouping the wells by hydraulic position provides a logical basis for presenting the groundwater monitoring data in the tables and figures in this report.

Sample collection periods also are noted. The 1999 sampling year covers the period from December 1998 (the first quarter of 1999) through September 1999 (the fourth quarter of 1999).

Graphs showing the range of values for contamination and radiological indicator parameters (pH, conductivity, gross alpha, gross beta, and tritium) have been prepared for all active monitoring locations in each geologic unit. (See Appendix E [pp.E-25 through E-34].) These high-low graphs allow results for all wells within a given hydrogeologic unit to be compared to each other. All the high-low graphs present the upgradient wells on the left side of the figure. Downgradient locations are plotted to the right according to their relative position along the groundwater flow path.

On the high-low graphs depicting nonradiological results (pH and conductivity), the upper and lower tick marks on the vertical bar indicate the highest and lowest measurements recorded during 1999. The middle tick represents the arithmetic mean of all 1999 results. The vertical bar indicates the total range of the data set for each monitoring location during the year.

On the high-low graphs depicting radiological results (gross alpha, gross beta, and tritium), the middle tick is again used to represent the arithmetic mean of all 1999 results. However, the upper and lower tick marks on the vertical bar indicate the upper and lower ranges of the pooled error terms for all 1999 results. This format illustrates the relative amount of uncertainty associated with the radiological measurements. By displaying the uncertainty together with the mean, a more realistic perspective is obtained. (See also Data Reporting [p.1-4] in Chapter 1, Environmental Monitoring Program Information.) On magnified-scale graphs, markers for some locations can not be shown because the magnitude of the concentrations is larger than the upper range of the graph.

The sample counting results for gross alpha, gross beta, and tritium, even if below the minimum detectable concentrations, were used to generate the high-low graphs. Thus, negative values were included. This is most common for the gross alpha analyses, where sample radiological counting results may be lower than the associated instrument background.

The wells used to provide background values are noted on each graph. All the geologic units except the sand and gravel unit use a single well for background. In previous years well NB1S was used as the single background reference well for the sand and gravel unit. However, in 1997 the collective monitoring results from three upgradient wells (301, 401, and 706) were substituted for comparison with other sand and gravel wells as a way of better representing the natural spatial variability within this geologic unit. Both the DOE and NYSDEC have accepted the use of this collective background reference instead of well NB1S.

Trend-line graphs have been used to show concentrations of a particular parameter over time at monitoring locations that have historically shown radiological concentrations above background values or volatile organic compound (VOC) concentrations above practical quantitation limits. Graphs are included for gross beta and tritium at selected groundwater monitoring locations (104, 105, 111, 408, 501, 502, 801, 8603, 8604, 8605, and GSEEP) and for the VOCs 1,1-dichloroethane (1,1-DCA) at wells 8609 and 8612; dichlorodifluoromethane (DCDFMeth) at wells 803 and 8612; 1,2-dichloroethylene (1,2-DCE) and 1,1,1-trichloroethane (1,1,1-TCA) at well 8612. (See Volatile and Semivolatile Organic Compounds Sampling [p.3-14].)

Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations. Figures 3-5 through 3-9 (pp.3-18 through 3-20) show the trends of gross beta activity and tritium at selected monitoring locations in the sand and gravel unit. These specific groundwater monitoring locations were selected for trending because they have shown elevated or rising levels of gross beta activity, with some also showing elevated levels of tritium activity. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations and can be compared

Measuring Water Levels in a Groundwater Monitoring Well

to the average background concentrations plotted on each graph.

Gross Beta. The groundwater plume of gross beta activity in the sand and gravel unit on the north plateau (Fig.3-3 [*facing page*]) continues to be monitored closely. The source of the plume's activity can be traced to the subsurface beneath the southwest corner of the former process building. In 1998 nine wells (104, 111, 408, 501, 502, 801, 8603, 8604, and 8605) showed elevated levels of gross beta activity, i.e., activity that exceeded the DOE DCG for strontium-90, 1.0E-06 μCi/mL. During 1999 gross beta concentrations at well 105, which is located within the eastern branch of the plume's leading edge, increased to a level above the DOE DCG for strontium-90.

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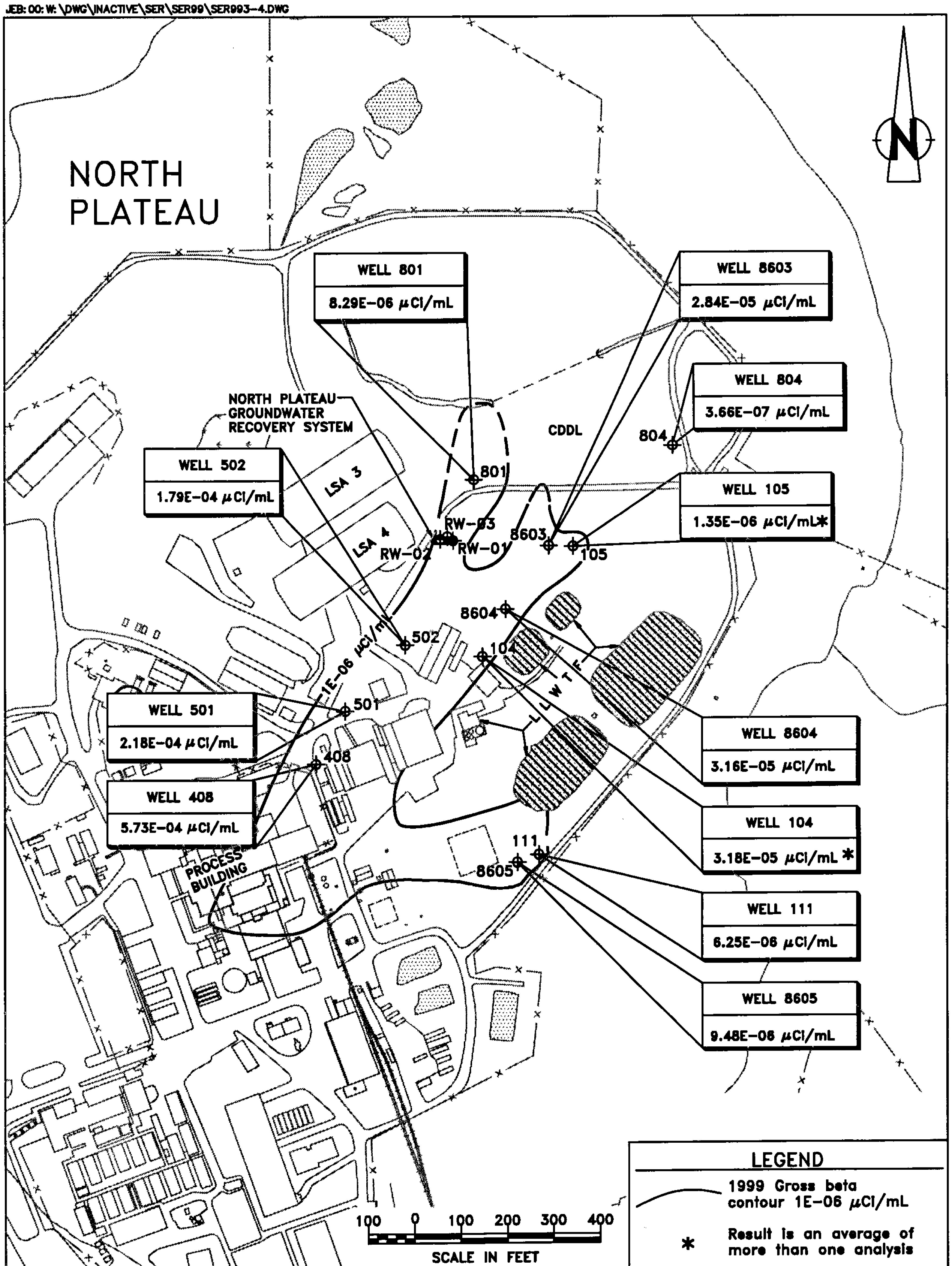


Figure 3-3. North Plateau Gross Beta Plume Area: Fourth-Quarter 1999 Results.

• Figure 3-5 (p.3-18) shows gross beta concentrations in wells 104, 111, 408, 501, 502, and 801 over the last nine years. As in previous years, samples from well 408 continued to show the highest gross beta concentrations of all the wells within the north plateau gross beta plume area. The yearly average gross beta concentration at well 408 decreased slightly in 1999 after showing a small increase in 1998. In comparison with 1998 values, the gross beta concentrations in the other wells within the plume all showed very slight to moderate increases during 1999.

• Figure 3-6 (p. 3-18) shows gross beta concentrations in well 105. The recent steep increase in gross beta activity is readily apparent.

• Figure 3-7 (p.3-19) is a graph of gross beta activity at sand and gravel unit monitoring locations 8603, 8604, 8605, and GSEEP. After several years of increases in gross beta concentrations in well 8604, the trend leveled off in 1997 and in 1998 and 1999 showed slight decreases. Results from well 8603 have continued to show a steady upward trend, apparently due to migration of strontium-90 within the eastern lobe of the north plateau plume.

Lagoon 1, formerly part of the low-level waste treatment facility, has been identified as a source of the gross beta activity at wells 8605 and 111. The gross beta concentrations at well 8605 have been slowly but steadily decreasing over the past several years.

Tritium. Tritium in sand and gravel wells also is monitored under the routine monitoring program.

• Figure 3-8 (p.3-19) shows the tritium concentrations in wells 104, 111, 408, 501, 502, and 801 over the nine-year period that the WVDP's current groundwater monitoring program has been in place. The figure shows that tritium concentrations in well 111 apparently have decreased over recent years. Other monitoring points show slight decreases or relatively steady concentration trends.

• Figure 3-9 (p.3-20) shows fourteen-year trends of tritium concentrations at monitoring locations 8603, 8604, 8605, and GSEEP. Wells 8603 and 8604 indicate gradually declining trends in tritium; 8605 shows a significant decrease over time.

• Figure 3-6 (p. 3-18) shows the tritium activity in well 105. Tritium concentrations also appear to be decreasing slightly over time in this well.

North Plateau Seeps. Analytical results of sampling for radiological parameters from the sand and gravel unit seepage monitoring locations were compared to the results from GSEEP, a seep monitored since 1991 that has not been affected by the gross beta plume. (See Fig.A-7 [p.A-9].) Radiological monitoring results continue to indicate that the gross beta plume has not migrated to these seepage areas. Gross alpha concentrations at all of the seep sampling locations were very low — generally below the associated uncertainty or less than the detection limit. Gross beta concentrations from all seep monitoring locations, with the exception of SP11, were less than or similar to GSEEP concentrations during 1999. The gross beta concentrations at SP11 were slightly greater than those at GSEEP but still were well below the gross beta DCG. (See Table E-7 [p.E-15].)

Tritium concentrations at the seeps remained similar in magnitude or were less than concentrations at GSEEP. Minor seasonal fluctuations over time also are apparent. Tritium concentrations in the north plateau seeps, including GSEEP, are slightly above the levels reported in background wells of the sand and gravel unit. The concentrations are similar to those seen in sand and gravel unit wells monitoring the lagoon areas of the north plateau but are still far below the DOE DCG for tritium.

Historical sampling results at the seep monitoring locations were evaluated to determine the most efficient and effective monitoring program with respect to locations, analytical parameters, and frequency. Six of the eight active seeps showed either gross beta concentrations similar to or less than GSEEP or were consistently dry. It was recommended that monitoring at four of the seeps (SP02, SP05, SP18, and SP23) be discontinued and that monitoring at all other active seeps be continued according to the current protocol (West Valley Nuclear Services Co. and Dames & Moore March 1999). These recommendations have been reviewed and approved by the DOE and NYSDEC and were instituted with the first-quarter 2000 sampling round.

The north plateau seep monitoring locations are inspected periodically and repaired as necessary to maintain optimum seepage flow. This ensures the quality, quantity, and representativeness of the groundwater samples. Minor repairs were required at seep monitoring locations SP04 and SP11, including some repositioning of the sampling pipes and clearing of root growth within the pipes. The conditions of both seep monitoring locations were checked again before the first-quarter 2000 sampling round.

North Plateau Well Points. Seven well points were installed in 1990 downgradient of the process building and were sampled annually between 1993 and 1996 for radiological indicator parameters. Data from these well points were used to supplement data collected from groundwater monitoring wells. Four wellpoints were removed from the sampling program in 1997 because sufficient coverage was provided by active monitoring wells.

However, well points A, C, and H (Fig. A-6 [p.A-8]) have yielded samples with concentrations of tritium that, while elevated with respect to historical monitoring of wells in the area, are well below the DOE derived concentration guide of 2.0E-03 μCi/mL. (See Table E-8 [p.E-16].) Data from downgradient monitoring wells have not indicated similarly elevated levels of tritium.

This area east of the process building and west of inactive lagoon 1 may be an area of localized contamination, and it will continue to be monitored annually for contamination indicator and radiological indicator parameters. Sampling will continue at well points A, C, and H to further monitor tritium concentrations in this localized area.

Results of Radioisotopic Sampling. Groundwater samples for radioisotopic analyses are collected regularly from selected monitoring points in the sand and gravel unit and the weathered Lavery till. (See Table E-13 [pp.E-19 through E-21].) Results from 1999 generally confirmed historical findings. Strontium-90 remained the major contributor to elevated gross beta activity in the plume on the north plateau.

Technetium-99, iodine-129, and carbon-14, which have been noted at several monitoring locations at concentrations above background levels (in specific wells within the gross beta plume and downgradient of inactive lagoon 1 and the NDA), contribute very small percentages to total gross beta concentrations. None of these concentrations have been above DCGs, and gross beta analyses continue to provide surveillance on a quarterly basis.

Results of Monitoring at the NDA. Gross beta and tritium concentrations in samples from well 909 and location NDATR (Fig.A-6 [p.A-8]) continued to be elevated with respect to other locations monitoring the NDA but remained well below the DCGs. Radiological indicator results have historically fluctuated at these locations but, in general, upward trends in both gross beta and tritium are discernible at well 909. Gross beta concentrations from well 909 are considerably higher than at NDATR. Residual soil contamination near well 909 is the suspected source of elevated gross beta concentrations at well 909. Although gross beta at NDATR also is elevated, a general downward trend in tritium concentrations also is discernible at NDATR.

A trench was constructed around two sides of the NDA to collect groundwater that may contain a mixture of n-dodecane and tributyl phosphate (TBP). (See also Chapter 1, Environmental Monitoring Program Information, NRC-licensed Disposal Area [NDA] Interceptor Trench and Pretreatment System [p.1-9].) There were no monitoring results in 1999 that indicated the presence of TBP or n-dodecane. Groundwater levels are monitored quarterly in and around the trench to ensure that an inward gradient is maintained.

Volatile and Semivolatile Organic Compounds Sampling

Volatile and semivolatile organic compounds were sampled at specific locations (wells 8612, 8609, 803, and seep sampling location SP12 [Fig.A-6, p.A-8]) that have shown historical results above their respective practical quantitation limits (PQLs). (See Table E-14 [pp.E-22 through E-24] for a list of PQLs.) Other monitoring locations are sampled for volatile and/or semivolatile organic compounds because they are downgradient of locations that have shown positive results or to comply with the RCRA §3008(h) Administrative Order on Consent.

1,1-dichloroethane. Trends in concentrations of the compound 1,1-dichloroethane (1,1-DCA) from 1991 through 1999 are illustrated in Figure 3-10 (p.3-20). Concentrations of 1,1-DCA at well 8612 have decreased somewhat over the past three years. The compound was not detected at wells 8609, 803, or groundwater seep SP12 during 1999. (See Table E-9 [p. E-16].)

Dichlorodifluoromethane. Trends of dichlorodifluoromethane (DCDFMeth) concentrations are shown in Figure 3-11 (p.3-21). The concentrations of DCDFMeth at well 8612 remained at low levels in 1999 — near the detection limit. DCDFMeth was not identified at wells 803 or 8609 or seep SP12 during 1999.

1,2-dichloroethylene. Another positive VOC detection, first noted in 1995, was 1,2-dichloroethylene (1,2-DCE) at well 8612 (Fig.3-12 [p.3-21]), which showed a fluctuating concentration during 1999. The concentrations reported in 1999 generally are lower than those reported in 1998.

1,1,1-trichloroethane. The compound 1,1,1-trichloroethane (1,1,1-TCA) also was detected at well 8612 below the PQL, but it was not detected in wells 803 or 8609 or at seep SP12.

The VOCs 1,1-DCA, DCDFMeth, and 1,1,1-TCA are often found in combination with each other and with 1,2-DCE. In well 8612 each of these three compounds first exhibited an increasing trend that, over the past few years, was then followed by a decreasing trend. It is expected that 1,2-DCE will exhibit similar behavior, and continued routine monitoring will evaluate future trends.

Tributyl phosphate. Aqueous concentrations of tributyl phosphate (TBP) were detected at well 8605, near former lagoon 1, at concentrations similar to or less than those in 1998. During 1999 TBP also was detected in well 111, which is next to and downgradient of well 8605, but at levels much lower than those at well 8605. (See Table E-10 [p.E-17].)

The ongoing detection of TBP in this localized area may be related to previously detected low, positive concentrations of iodine-129 and uranium-232 in wells 111 and 8605, as noted in previous annual Site Environmental Reports. The presence of all three contaminants reflects residual contamination from waste disposal activities in the former lagoon 1 area during earlier fuel reprocessing. Future trends of TBP will be evaluated as part of the routine groundwater monitoring program.

Special Groundwater Monitoring

Gross Beta Plume on the North Plateau. Elevated gross beta activity has been detected in groundwater from the surficial sand and gravel unit in localized areas north and east of the building where NFS reprocessed nuclear fuel (Fig. 3-3 [p.3-11]). In December 1993 elevated gross beta concentrations were detected in surface water at former sampling location WNDMPNE, located at the edge of the plateau. This detection initiated a subsurface investigation in 1994. Groundwater and soil were sampled using the Geoprobe®, a mobile sampling system. The investigation was used to define the extent of the gross beta plume beneath and downgradient of the process building. The gross beta plume delineated was approximately 300 feet wide and 800 feet long.

The highest gross beta concentrations in groundwater and soil were near the southeast corner of the process building. The maximum activity in groundwater was 3.6E-03 μCi/mL, and the maximum activity in soil reached 2.4E-02 μCi/g. Strontium-90 and its daughter product, yttrium-90, were determined to be the isotopes responsible for most of this elevated gross beta activity (West Valley Nuclear Services Co., Inc. 1995).

In 1995 the north plateau groundwater recovery system (NPGRS) was installed to minimize the spread of the gross beta plume. The NPGRS is located near the leading edge of the main lobe of the plume where groundwater flows preferentially towards the edge of the plateau. The NPGRS consists of three extraction wells (RW-01, RW-02, and RW-03) that recover the contaminated groundwater and then treat it by ion exchange to remove strontium-90. Treated water is transferred to lagoon 4 or 5 and then to lagoon 3 and ultimately is discharged to Erdman Brook.

The north plateau groundwater recovery system operated successfully throughout 1999, processing about 13 million liters (3.4 million gal). The system has recovered and processed approximately 67 million liters (17.8 million gal) since November 1995.

Northeast Swamp Drainage Monitoring. Routine surface water sampling during 1999 continued to monitor radiological discharges through the northeast swamp drainage at location WNSWAMP. (See Appendix C, Table C-7 [p.C-9].) Gross beta and strontium-90 concentrations continued to fluctuate due to seasonal effects. The annualized average strontium-90 concentrations trended upward and then leveled off to some extent during 1999. (See Fig. 3-4 [p.3-16].) The increase was expected and is attributable to groundwater downgradient of the influence of the NPGRS.

Although the annualized averaged concentration of strontium-90 in surface water exceeded the DOE DCG at sampling location WNSWAMP (on the WVDP premises), monitoring downstream at the first point of public access (WFFELBR) continued to show strontium-90 concentrations to be nearly indistinguishable from background (WFBIGBR) concentrations. (See also Off-site Surface Water Sampling Locations, p.2-8, in Chapter 2, Environmental Monitoring.)

1998 Geoprobe® Investigation in the Core Area of the North Plateau Plume. As a result of recommendations from a 1997 external review of WVDP response actions on the north plateau, more attention was given in 1998 to the core area of the plume. (The core area is the portion of the gross beta plume beneath or immediately downgradient of the former pro-

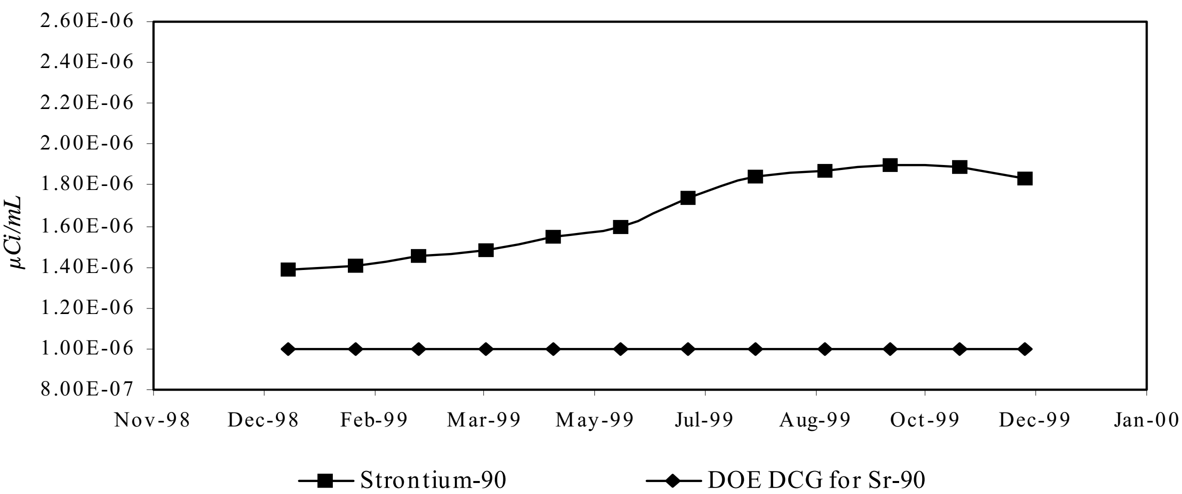


Figure 3-4. Annualized Average Strontium-90 Concentrations at WNSWAMP

cess building suspected to be the source of the plume.) A summary report, 1998 Geoprobe® Investigation in the Core Area of the North Plateau Groundwater Plume (West Valley Nuclear Services Co., Inc. June 1999) discusses groundwater and soil sampling data in the core area and compares radiological sampling results with a 1994 sampling. The 1998 study verified that strontium-90 continues to be the predominant contaminant in groundwater and saturated soil within the north plateau groundwater plume. The data also are consistent with the present interpretation that the observed contamination is the result of a radioactive liquid release that occurred about thirty years ago.

The report also noted that while the overall distribution of strontium-90 in groundwater within the plume was similar to 1994, activity levels detected in 1998 Geoprobe® samples were generally lower than in the 1994 Geoprobe® samples due to radioactive decay and continuing migration and dispersion of the plume.

Permeable Treatment Wall. A pilot-scale permeable treatment wall (PTW) was completed in the fall of 1999 in the eastern lobe of the north plateau strontium-90 groundwater plume in order to test this passive, in situ remediation technology. The PTW is a trench constructed in the subsurface and backfilled with clinoptilolite, a medium selected for its ability to adsorb strontium-90 ions from groundwater. The PTW extends vertically downward through the sand and gravel unit to the top of the underlying Lavery till and is approximately 30 feet long and 10 feet wide.

It is expected that strontium-90 ions will be removed from groundwater in the subsurface via adsorption to the clinoptilolite as groundwater passes through, thereby significantly reducing the gross beta activity in groundwater exiting the PTW. This type of passive treatment eliminates the need to bring contaminated groundwater to the surface for treatment, thus minimizing personnel exposure and waste generation. If the pilot PTW performs as expected, a full-scale treatment wall is planned for the main trunk of the north plateau plume.

North Plateau Groundwater Quality Early Warning Sampling. An early warning evaluation of selected monitoring well data was devised to identify possible changes in the quality of the groundwater recovered by the NPGRS that might affect compliance with site effluent limitations on pollutants specified in the SPDES permit for outfall 001. This monitoring is important because water recovered by the NPGRS ultimately is discharged through outfall 001.

The early warning system compares quarterly monitoring results from three wells (116, 602, and 502) in the vicinity of the NPGRS to early warning levels (multiples of the SPDES permit levels) in order to identify concentrations that may affect compliance with SPDES effluent limits. Two of the wells, 116 and 602, are used to monitor groundwater in the area affected by NPGRS drawdown. The third well, 502, is directly upgradient of the NPGRS and is sampled for additional metals not routinely analyzed under the current groundwater monitoring program. Analytical results from the early warning sampling can be found in Tables E-11 and E-12 (pp.E-17 through E-19 in Appendix E).

Evaluation of Groundwater Monitoring Well Corrosion. The 1998 investigation of elevated chromium and nickel concentrations in groundwater from sand and gravel monitoring wells indicated that these metals apparently were released by corrosion of stainless steel well materials (West Valley Nuclear Services, Inc. and Dames & Moore June 1998b). To ensure continued monitoring well integrity and the collection of high-quality samples representative of actual groundwater conditions, the WVDP evaluated current corrosion and corrosion-removal methods by inspecting the inside of the wells with a downhole video camera, documenting the observed conditions, and attempting to remove corrosion, where present, with a wire brush. A second video inspection was made after cleaning to evaluate the effectiveness of the work. Three of the seven wells selected for evaluation were found to have measurable corrosion near the bottom of the well screens, and one well contained a minor amount of spotty corrosion. The other three wells were found to be virtually free of corrosion. Simple brushing and well-purging proved to be successful in removing the corrosion from all four wells. No degradation of the well casings or screens was evident after corrosion was removed. Recommendations for managing corrosion are being considered and will be made final in a long-term plan.

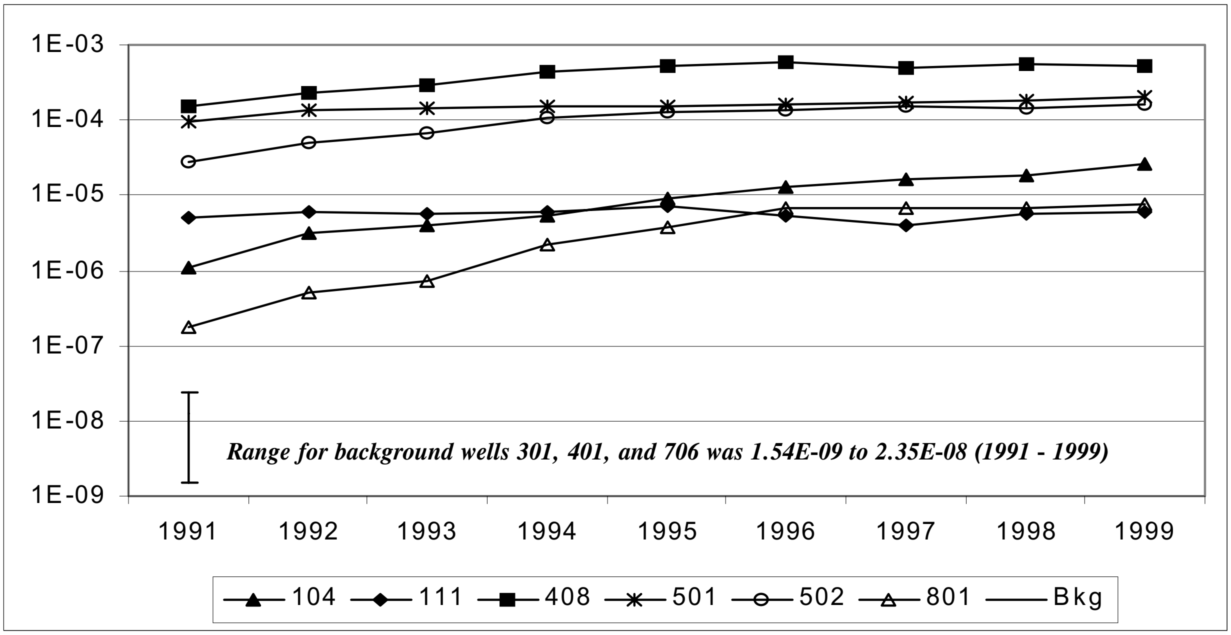


Figure 3-5. Nine-year Trends of Averaged Gross Beta Activity (μCi/mL) at Selected Locations in the Sand and Gravel Unit

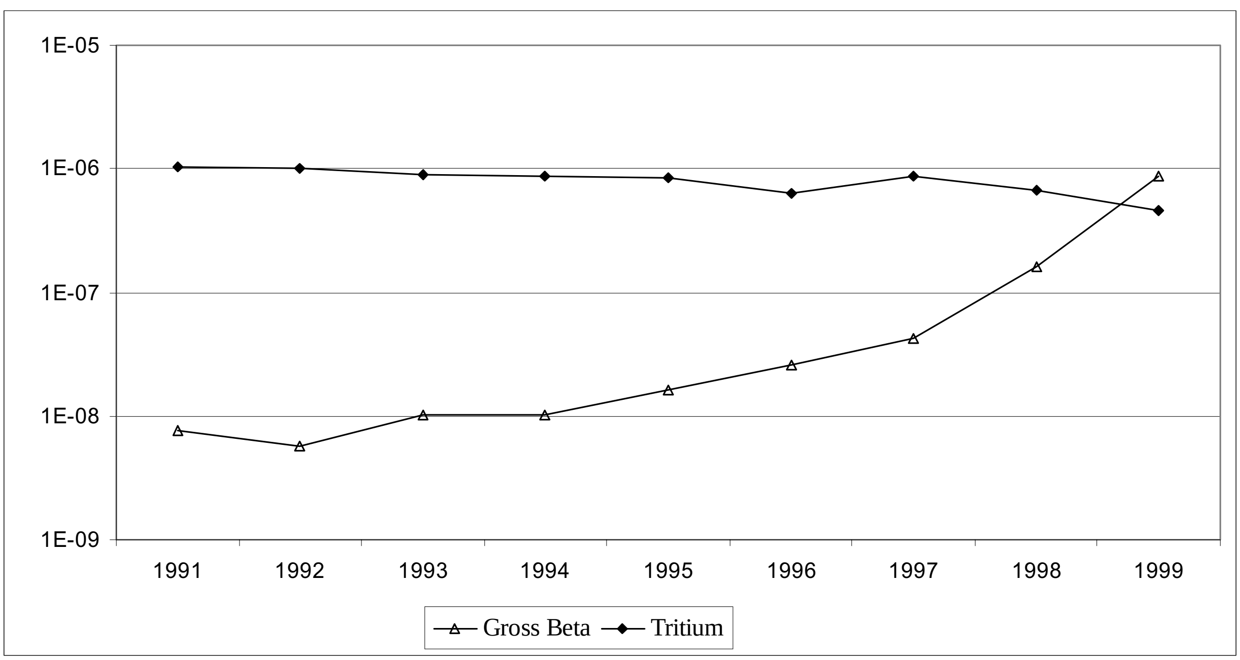


Figure 3-6. Nine-year Trends of Gross Beta and Tritium (μCi/mL) at Well 105

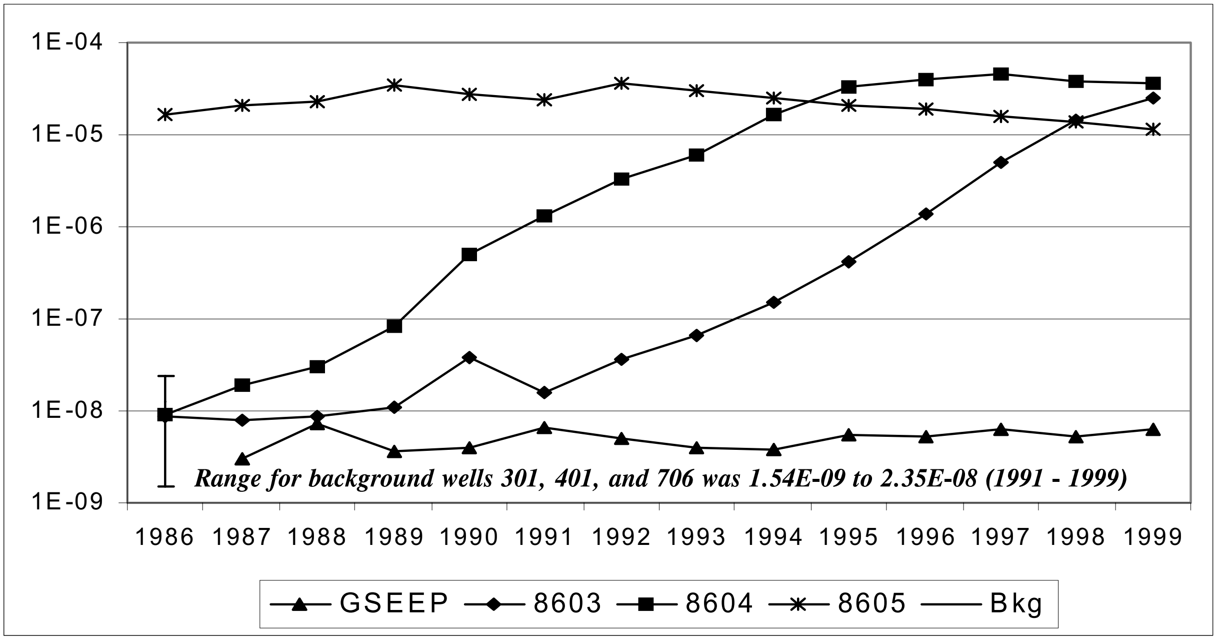


Figure 3-7. Fourteen-year Trends of Averaged Gross Beta Activity (µCi/mL) at Selected Locations in the Sand and Gravel Unit

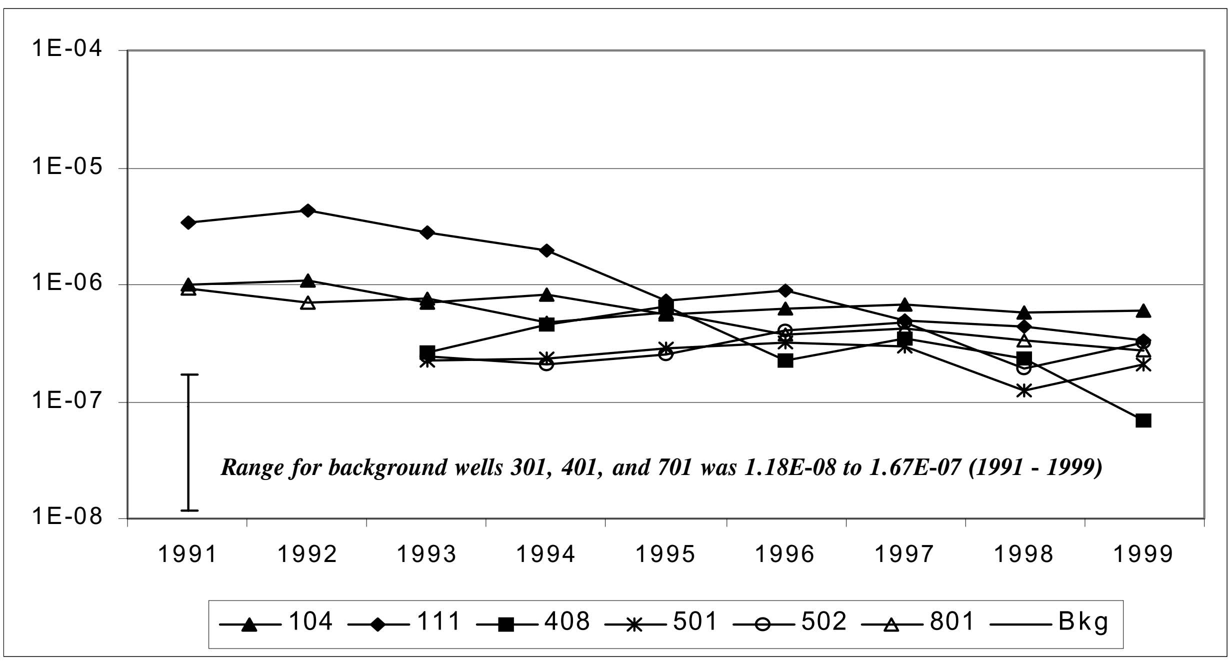


Figure 3-8. Nine-year Trends of Averaged Tritium Activity (µCi/mL) at Selected Locations in the Sand and Gravel Unit

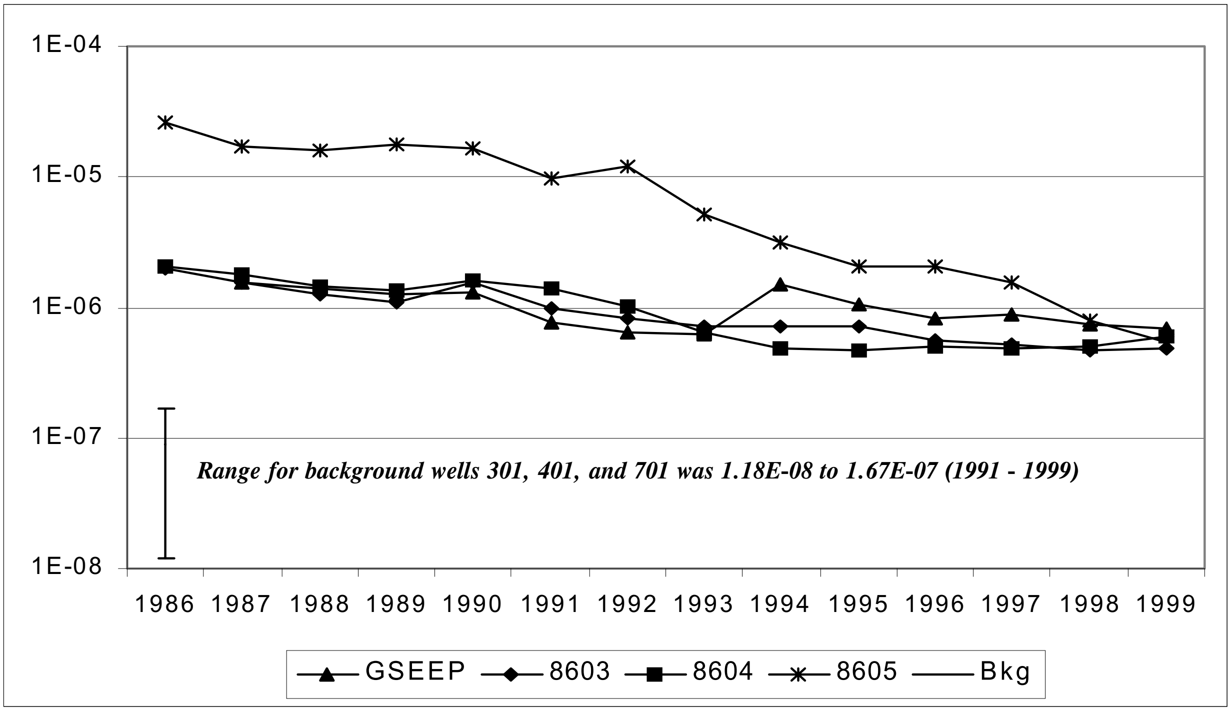


Figure 3-9. Fourteen-year Trends of Averaged Tritium Activity (µCi/mL) at Selected Locations in the Sand and Gravel Unit

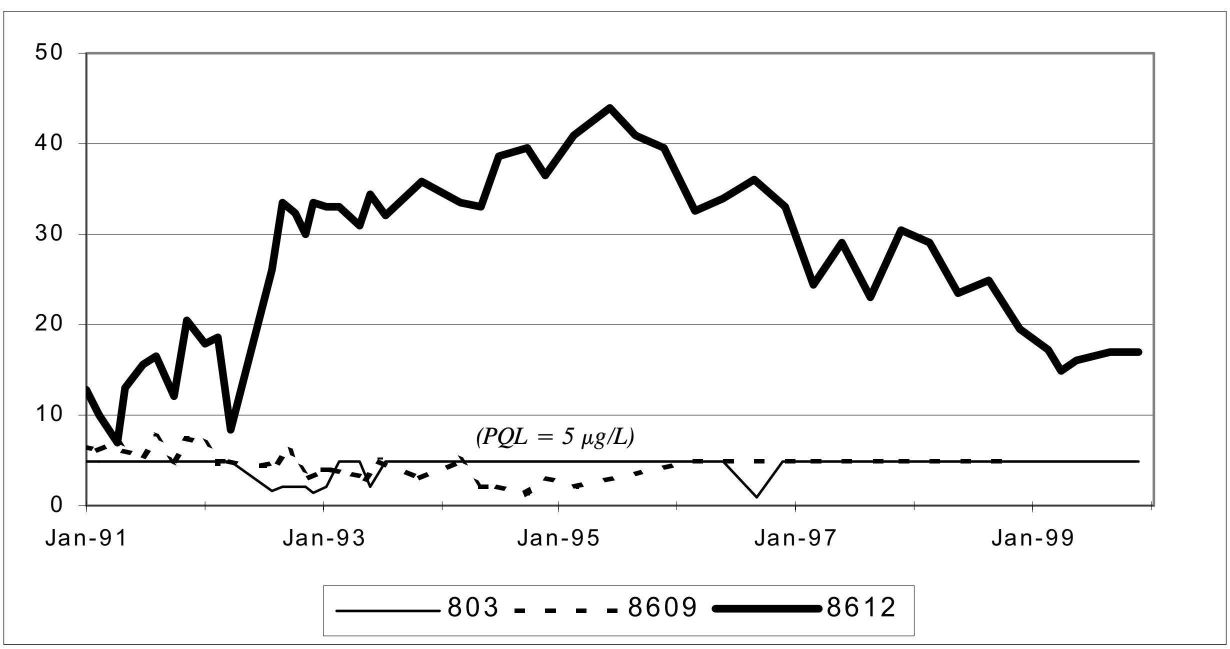


Figure 3-10. Nine-year Trends of 1,1-DCA (µg/L) at Selected Monitoring Locations

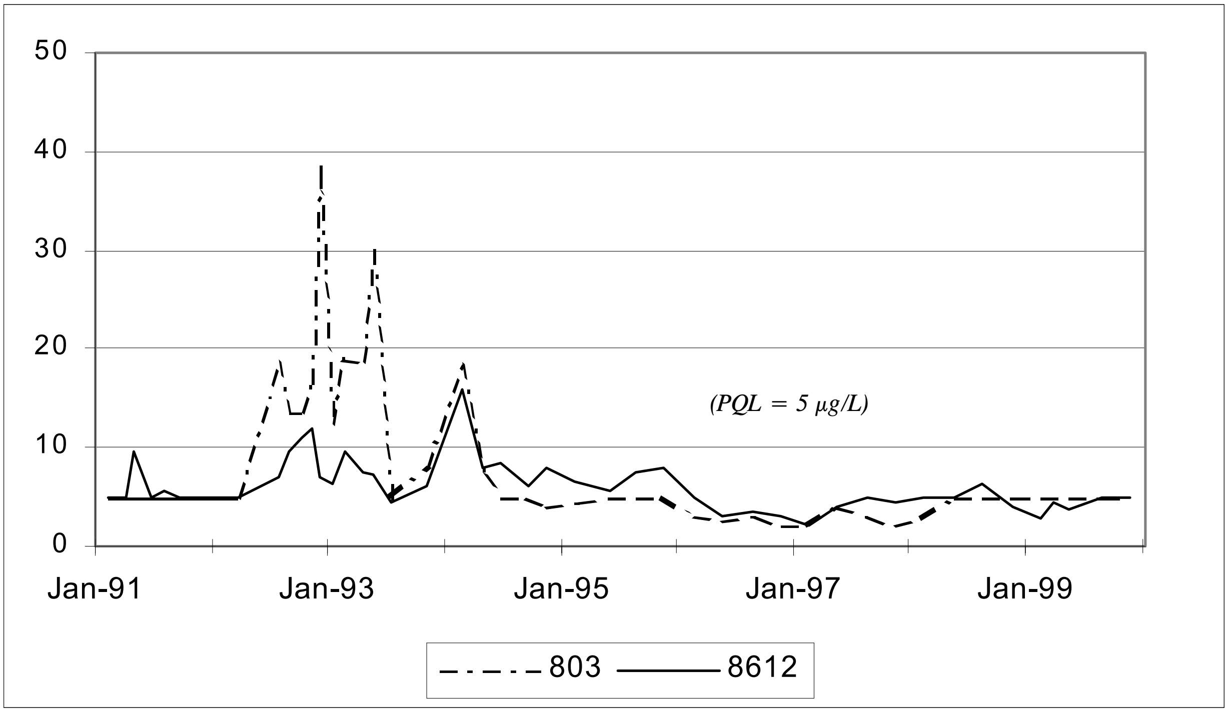


Figure 3-11. Nine-year Trends of Dichlorodifluoromethane (DCDFMeth) (µg/L) at Selected Monitoring Locations

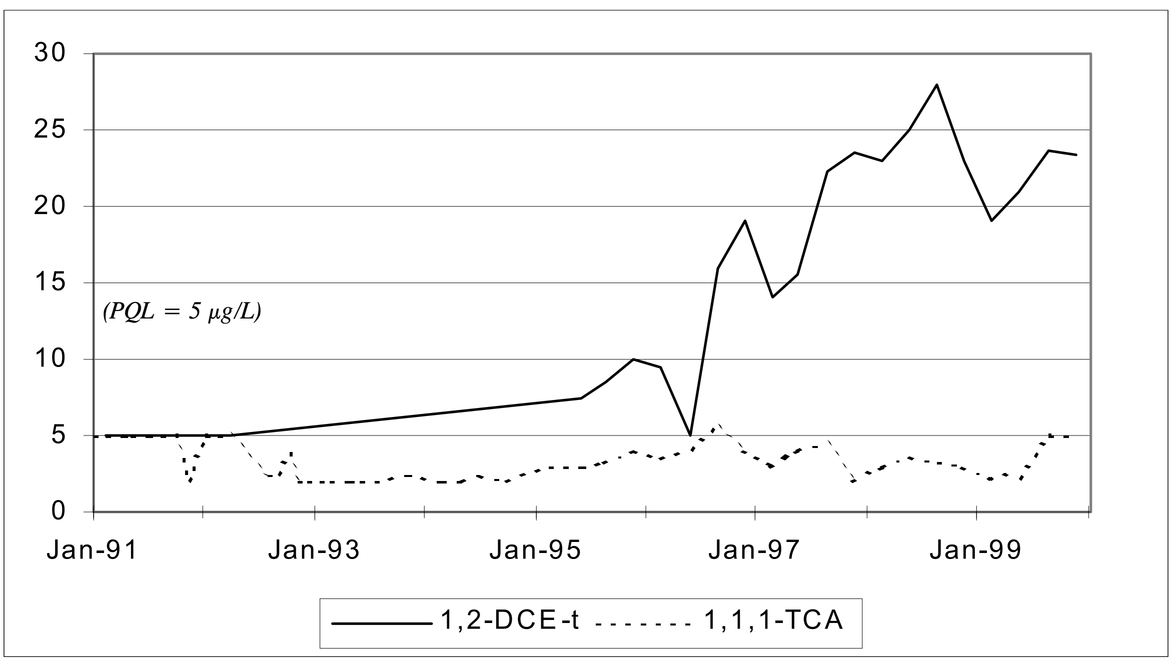


Figure 3-12. Nine-year Trends of 1,2-DCE and 1,1,1-TCA (µg/L) at Well 8612

RADIOLOGICAL DOSE ASSESSMENT

Introduction

Each year the potential radiological dose to the public that is attributable to operations and effluents from the West Valley Demonstration Project (WVDP) is assessed to verify that no individual could possibly have received a dose exceeding the limits established by the regulatory agencies. The results of these conservative dose calculations demonstrate that the potential maximum dose to an off-site resident was well below permissible standards and was consistent with the as-low-as-reasonably achievable (ALARA) philosophy of radiation protection.

This chapter describes the methods used to estimate the dose to the general public resulting from exposure to radiation and radionuclides released by the Project to the surrounding environment during 1999. Estimated doses are compared directly to current radiation standards established by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) for protection of the public. The values are also compared to the annual dose the average resident of the U.S. receives from natural background radiation and to doses reported in previous years for the Project.

Radioactivity. Atoms that emit radiation are called radionuclides. Radionuclides are unstable isotopes that have the same number of protons as any other isotope of the element but different numbers of neutrons, resulting in different atomic masses. For example, the element hydrogen has two stable isotopes, H-1 and H-2 (deuterium), and one radioactive isotope, H-3 (tritium). The numbers following the element's symbol identify the atomic mass, which is the number of protons plus neutrons in the nucleus. Thus, H-1 has one proton and no neutrons, H-2 has one proton and one neutron, and H-3 has one proton and two neutrons.

When radioactive atoms decay by emitting radiation, the daughter products that result may be either radioactive or stable. Generally, radionuclides with high atomic numbers, such as uranium-238 and plutonium-239, have many generations of radioactive progeny. For example, the radioactive decay of plutonium-239 creates uranium-235, thorium-231, protactinium-231, and so on through eleven progeny until only the stable isotope lead-207 remains.

Radionuclides with lower atomic numbers often have no more than one daughter. For example, strontium-90 has one radioactive daughter, yttrium-90, which finally decays into stable zirconium; cobalt-60 decays directly to stable nickel with no intermediate nuclide.

The time required for half of the radioactivity of a radionuclide to decay is referred to as the radionuclide's half-life. Each radionuclide has a unique half-life; both strontium-90 and cesium-137 have half-lives of approximately 30 years while plutonium-239 has a half-life of 24,400 years. Knowledge of radionuclide half-lives is often used to estimate past and future inventories of radioactive material. For example, a 1.0-millicurie source of cesium-137 in 1999 would have measured 2.0 millicuries in 1969 and will be 0.5 millicuries in 2029.

Radiation emitted by radionuclides may consist of electromagnetic rays such as x-rays and gamma rays or charged particles such as alpha and beta particles. A radionuclide may emit one or more of these radiations at characteristic energies that can be used to identify them.

Radiation Dose. The energy released from a radionuclide is eventually deposited in matter encountered along the path of the radiation. The radiation energy absorbed by a unit mass of material is referred to as the absorbed dose. The absorbing material can be either inanimate matter or living tissue.

Alpha particles leave a dense track of ionization as they travel through tissue and thus deliver the most dose per unit-path length. However, alpha particles are not penetrating and must be taken into the body by inhalation or ingestion to cause harm. Beta and gamma radiation can penetrate the protective dead skin layer of the body from the outside, resulting in exposure of the internal organs to radiation.

Because beta and gamma radiations deposit much less energy in tissue per unit-path length relative to alpha radiation, they produce fewer biological effects for the same absorbed dose. To allow for the different biological effects of different kinds of radiation, the absorbed dose is multiplied by a quality factor to yield a unit called the dose equivalent. A radiation dose expressed as a dose equivalent, rather than as an absorbed dose, permits the risks from different types of radiation exposure to be compared to each other (e.g., exposure to alpha radiation compared to exposure to gamma radiation). For this reason, regulatory agencies limit the dose to individuals in terms of total dose equivalent.

Units of Measurement. The unit for dose equivalent in common use in the U.S. is the rem, which stands for roentgen-equivalent-man. The international unit of dose equivalent is the sievert (Sv), which is equal to 100 rem. The millirem (mrem) and millisievert (mSv), used more frequently to report the low dose equivalents encountered in environmental exposures, are equal to one-thousandth of a rem or sievert.

The effective dose equivalent (EDE), also expressed in units of rem or sievert, provides a means of combining unequal organ and tissue doses into a single "effective" whole body dose that represents a comparable probability of inducing a fatal cancer. The probability that a given dose will result in the induction of a fatal cancer is referred to as the risk associated with that dose. The EDE is calculated by multiplying the organ dose equivalent by the organ-weighting factors developed by the International Commission on Radiological Protection (ICRP) in Publications 26 (1977) and 30 (1979). The weighting factor is a ratio of the risk from a specific organ or tissue dose to the total risk resulting from an equal whole body dose. All organ-weighted dose equivalents are then summed to obtain the EDE.

The dose from internally deposited radionuclides calculated for a fifty-year period following intake is called the fifty-year committed effective dose equivalent (CEDE). The CEDE sums the dose to an individual over fifty years to account for the biological retention of radionuclides in the body. The total EDE for one year of exposure to radioactivity is calculated by adding the CEDE to the dose equivalent from external, penetrating radiation received during the year. Unless otherwise specified, all doses discussed here are EDE values, which include the CEDE for internal emitters.

A collective population dose is expressed in units of person-rem or person-sievert because the individual doses are summed over the entire potentially exposed population. The average individual dose can therefore be obtained by dividing the collective dose by the number in the population.

Sources of Radiation. Members of the public are routinely exposed to different sources of ionizing radiation from both natural and manmade sources. Figure 4-1 (*below*) shows the relative contribution to the annual dose in millirem from these sources in comparison to the estimated 1999 maximum individual dose from the WVDP. The National Council on Radiation Protection and Measurements (NCRP) Report 93 (1987) estimates that the average annual effective dose equivalent received by an individual living in the U.S. is about 360 mrem (3.6 mSv) from both natural and manmade sources of radiation.

While most of the radiation dose received by the general public is natural background radiation, manmade sources of radiation also contribute to the average dose. Such sources include diagnostic and therapeutic x-rays, nuclear medicine, fallout from atmospheric nuclear weapons tests, effluents from nuclear fuel cycle facilities, and consumer products such as smoke detectors and cigarettes.

As can be seen in Figure 4-1 (*below*), natural sources of radiation contribute 295 mrem (2.95 mSv) and manmade sources contribute 65 mrem (0.65 mSv) of the total annual U.S. average dose of 360 mrem (3.60 mSv). The WVDP contributed a very small amount (0.068 mrem [0.00068 mSv]) to the total annual manmade radiation dose to the maximally exposed individual residing near the WVDP. This is much less than the average dose received from using consumer products and is insignificant compared to the federal standard of 100 mrem from manmade sources or the 295 mrem received annually from natural sources.

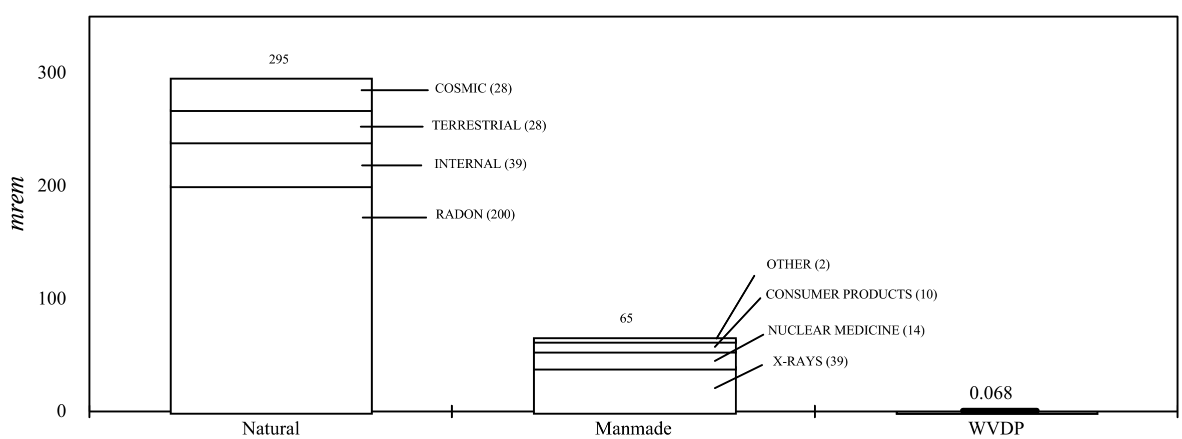


Figure 4-1. Comparison of Annual Background Radiation Dose to the Dose from 1999 WVDP Effluents

Health Effects of Low-level Radiation. Radionuclides entering the body through air, water, or food are distributed in different organs of the body. For example, isotopes of iodine concentrate in the thyroid. Strontium, plutonium, and americium isotopes concentrate in the skeleton. When inhaled, uranium and plutonium isotopes remain in the lungs for a long period of time. Some radionuclides such as tritium, carbon-14, or cesium-137 are distributed uniformly throughout the body. Therefore, depending on the radionuclide, some organs may receive quite different doses. Moreover, at the same dose levels, certain organs (such as the breast) are more prone to developing a fatal cancer than other organs (such as the thyroid).

Because of the uncertainty and difficulty in measuring the incidence of increased cancer resulting from exposure to ionizing radiation, to be conservative, a linear model is used to predict health risk from low levels of radiation. This model assumes that there is a risk associated with all dose levels even though the body may effectively repair damage incurred from low levels of alpha, beta, and gamma radiations.

Exposure Pathways

The radionuclides present at the WVDP site are residues from the reprocessing of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site during the year through ventilation systems and liquid discharges and makes a negligible contribution to the radiation dose to the surrounding population through a variety of exposure pathways.

An exposure pathway consists of a source of contamination or radiation that is transported by environmental media to a receptor where exposure to contaminants may occur. For example, a member of the public could be exposed to low levels of radioactive particulates carried by prevailing winds.

The potential pathways of exposure from Project emissions are inhalation of gases and particulates, ingestion of locally grown food products, ingestion of fish, beef, and deer tissues, and exposure to external penetrating radiations emanating from contaminated materials. The drinking water pathway was excluded from calculations of potential maximum dose to individuals because surveys revealed that local residents do not use water from Cattaraugus Creek as drinking water. Table 4-1 (*facing page*) summarizes the potential exposure pathways for the local off-site population.

Land Use Survey

Periodic surveys of local residents provide information about local family sizes, sources of food, and gardening practices. Information from the most recent survey, conducted in 1996, was used to confirm the locations of the nearest residences and other population parameters. These parameters are required for computer models that are used for the annual dose assessments. (See the discussion of Dose Assessment Methodology [p.4-5] for more information on the computer model used.)

Radioactive Vitrification Operations

The start of radioactive vitrification operations in June/July 1996 resulted in an increase of radioactive emissions from the main plant stack. Specifically, the release rate of iodine-129 increased from a 1993 —1995 average of 25 microcuries (μCi) per year to 1,200 μCi in 1996 and 7,430 μCi in 1997 as a result of the processing of the high-level waste.

In 1998 the yearly release of iodine-129 fell to 4,970 μCi/yr due to the completion of Phase I of vitrification. In 1999 the total iodine-129 release was 1,900 μCi, a reduction from 1998 levels that is consistent with the reduction in vitrification activities. (See Chapter 2, Special

Table 4-1
Potential Local Off-Site Exposure Pathways Under Existing WVDP Conditions

Exposure Pathway and Transporting Medium	Reason for Inclusion/Exclusion
Inhalation: gases and particulates in air (included)	Off-site transport of contaminants from WVDP stacks or resuspended particulates from soils
Ingestion: cultivated crops (included)	Local agricultural products irrigated with contaminated ground- or surface water; foliar deposition and uptake of airborne contaminants
Ingestion: surface and groundwater (excluded)	No documented use of local surface water or downgradient groundwater wells as drinking water by local residents
Ingestion: fish, beef, venison, and milk (included)	Fish exposed to contaminants in water or sediments may be consumed; beef, venison, and milk consumption following deposition of transported airborne and surface water contaminants
External exposure: radiation emanating from particulates and gases from air or surface water (included)	Transport of air particulates and gases to off-site receptors; transport of contaminants in surface water and direct exposure during stream use and swimming

Monitoring, [p.2-24] for further discussion of iodine-129 emissions from the main plant stack.)

Dose Assessment Methodology

The potential radiation dose to the general public from activities at the WVDP is evaluated by using a two-part methodology and following the requirements in DOE Order 5400.5. The first part uses the measurements of radionuclide concentrations in liquid and air discharges from the Project. (See Appendix C and Appendix D.) These data, together with meteorological and demographic information, are input to computer models that calculate the potential or estimated doses, rather than actual radiation doses, from all credible pathways to individuals and the population.

Because of the difficulty of distinguishing the small amount of radioactivity emitted from the site from that which occurs naturally in the environment, computer codes are used to model the environmental dispersion of radionuclides emitted from on-site monitored ventilation stacks and liquid discharge points. The EDE to the maximally exposed off-site individual and the collective EDE to the population within a 50-mile radius is calculated using models that have been approved by the DOE and the EPA to demonstrate compliance with radiation standards.

Radiological dose is evaluated for all major exposure pathways, including external irradiation, inhalation, and ingestion of local food products. The dose contributions from each radionuclide and pathway combination are then summed to obtain the total dose estimates reported in Table 4-2 (*facing page*).

The second phase of the dose assessments is based on measurement of radioactivity in foodstuffs sampled in the vicinity of the WVDP and the comparison of these values with measurements of samples collected from locations well beyond the potential influence of site effluents. These measurements of environmental media show that the concentrations of radioactivity are small and usually are near the analytical detection limits, thereby providing additional assurance that operations at the WVDP are not adversely affecting the public.

If any of the near-site food samples contain radionuclide concentrations that are statistically higher than the concentrations in control samples, separate dose calculations are performed. However, these calculated doses are not added to the estimates that are based on predictive computer modeling (Table 4-2 [*facing page*]) because the models already include contributions from all environmental pathways.

Comparison of Near-site and Background Environmental Media Concentrations. Near-site and control (background) samples of fish, milk, beef, venison, and local produce were collected and analyzed for various radionuclides, including tritium, cobalt-60, strontium-90, iodine-129, and cesium-137. The measured radionuclide concentrations reported in Appendix F, Tables F-1 through F-4 (pp.F-3 through F-8) are the basis for comparing near-site and background concentrations.

If differences are found between near-site and background sample concentrations, the amount by which the near-site sample concentration exceeded background is used to calculate a potential maximum individual dose for comparison with dose limits and the dose from background alone. If no differences in concentrations are found, then no further assessment is conducted.

The maximum potential dose to nearby residents from the consumption of foods with radionuclide concentrations above background is calculated by multiplying the excess concentrations by the maximum adult annual consumption rate for each type of food and the unit dose conversion factor for ingestion of the measured radionuclide. The consumption rates are based on site-specific data and recommendations in NRC Regulatory Guide 1.109 for terrestrial food chain dose assessments (U.S. Nuclear Regulatory Commission October 1977). The internal dose conversion factors were obtained from Internal Dose Conversion Factors for Calculation of Dose to the Public (U.S. Department of Energy July 1988).

Note that foodstuffs are weighed when received at the laboratory and the percent moisture is determined from the difference between the mass of the dried sample weighed after preparation for radiological measurement and the original "wet" as-measured mass. Doses are calculated based on the reconstituted "wet" mass of the original sample.

Fish. Samples of fish were collected from Cattaraugus Creek from May 1999 through November 1999. Twenty fish were collected both at background locations upstream of the site and at locations downstream of the site above the Springville dam. Ten fish were collected at points downstream of the site below the dam.

Edible portions of all fish samples were analyzed for strontium-90 and cesium-137, and the values were compared to background values. (See Table F-4 [pp.F-6 through F-8].) Average values for strontium-90 were either below de-

Table 4-2

Summary of Annual Effective Dose Equivalents to an Individual and Population from WVDP Releases in 1999

Exposure Pathways	Annual Effective Dose Equivalent	
	Maximally Exposed Off-Site Individual[1] *mrem (mSv)*	*Collective Effective Dose Equivalent*[2] *person-rem (person-Sv)*
Airborne Releases[3]	1.1E-02 (1.1E-04)	1.1E-01 (1.1E-03)
% EPA standard (10 mrem)	0.11%	*NA*
Waterborne Releases[4]		
Effluents only	2.83E-02 (2.83E-04)	2.4E-02 (2.4E-04)
Effluents plus north plateau drainage	5.6E-02 (5.6E-04)	1.3E-01 (1.3E-03)
Total from all Pathways	6.8E-02 (6.8E-04)	2.4E-01 (2.4E-03)
% DOE standard (100 mrem) — air and water combined	0.068%	
% natural background (295 mrem; 380,000 person-rem) — air and water combined	0.023%	0.00006%

Exponents are expressed as "E" in this report: a value of 1.2 x 10^{-4} in scientific notation is reported as 1.2E-04 in the text and tables.

NA — Not applicable. Numerical regulatory standards are not set for the collective EDE to the population.

[1] *Maximum exposure to air discharges occurs at a residence 2.4 kilometers east of the main plant.*
[2] *Population of 1.3 million within 80 kilometers of the site.*
[3] *From atmospheric release point sources. Calculated using CAP88-PC for individual and population.*
[4] *Calculated using methodology described in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).*

tection limits or not statistically different from control concentrations. Strontium-90 and cesium-137 concentrations in individual fish collected downstream of the site, above the Springville dam, were detectable but not above average control sample concentrations. Average cesium-137 values for the May 1999 fish samples were slightly above the average background values. The calculated maximum dose to an individual from consuming 21 kilograms (46 lbs) of near-site fish was 0.007 mrem (0.00007 mSv). This annual dose is roughly equivalent to the dose received every twelve minutes from natural background radiation.

Milk. Milk samples were collected from various nearby dairy farms throughout 1999. Control samples were collected from farms 25 to 30 kilometers (15-20 mi) to the south and north of the WVDP. Milk samples were analyzed for tritium, strontium-90, iodine-129, cesium-137, and potassium-40. (See Table F-1 [p.F-3].) Ten near-site milk samples were collected and compared with eight background samples. Average values for tritium, strontium-90, iodine-129, and cesium-137 were either below detection limits or not statistically different from control concentrations.

Beef. Near-site and control samples of locally raised beef were collected in 1999. These samples were analyzed for tritium, strontium-90, and cesium-137. Two samples of beef muscle tissue were collected from background locations and two from near-site locations.

Individual concentrations of measured radionuclides in near-site samples were either below detection limits or not statistically different from concentrations at control locations. (See Table F-2 [p.F-4].) The strontium-90 concentration in one near-site beef sample was detectable above the control concentration. The hypothetical maximum additional dose to an individual from consuming 110 kilograms (243 lbs) of beef from this location was 0.003 mrem (0.00003 mSv). This annual dose is roughly equivalent to the dose received every six minutes from natural background radiation.

Venison. Meat samples from three near-site and three control deer were collected in 1999. (See Table F-2 [p.F-4].) These samples were measured for tritium, strontium-90, cesium-137, and other gamma-emitting radionuclides. Individual concentrations of measured radionuclides in near-site venison samples were either below detection limits or not statistically different than concentrations at control locations.

Produce (corn, beans, and apples). Near-site and background samples of corn, beans, and apples were collected during 1999 and analyzed for tritium, cobalt-60, strontium-90, potassium-40, and cesium-137. (See Appendix F, Table F-3 [p.F-5].)

Individual concentrations of tritium, cobalt-60, and cesium-137 in near-site produce samples were either below detection limits or not statistically different from concentrations at control locations. Strontium-90 concentrations in annual near-site corn samples were above the control concentrations. The hypothetical maximum dose to an individual from consuming 52 kilograms (115 lbs) of near-site corn was 0.020 mrem (0.00020 mSv). This annual dose is roughly equivalent to the dose received every thirty-six minutes from natural background radiation.

See Appendix B (pp.B-37 through B-40) for the locations from which background biological samples are collected.

Predicted Dose from Airborne Emissions

Airborne emissions of radionuclides are regulated by the EPA under the Clean Air Act and its implementing regulations. DOE facilities are subject to 40 CFR 61, Subpart H, National Emission Standards for Hazardous Air

The Main Plant Ventilation Stack at the WVDP

Pollutants (NESHAP). The applicable standard for radionuclides is a maximum of 10 mrem (0.1 mSv) EDE to any member of the public in any year.

Releases of airborne radioactive materials from nominal ground level (1 to 24 meters high) stacks and from the main 60-meter stack are modeled using the EPA-approved CAP88-PC computer code (U.S. Environmental Protection Agency March 1992). This air dispersion code estimates effective dose equivalents for the ingestion, inhalation, air immersion, and ground surface pathways. Site-specific data for radionuclide release rates in curies per year, wind data, and the current local population distribution are used as input parameters. Resulting output from the CAP88-PC code is then used to determine the total EDE to a maximally exposed individual and the collective dose to the population within an 80-kilometer (50-mi) radius of the WVDP.

As reported in Chapter 2, Environmental Monitoring, the main 60-meter stack and several shorter stacks were monitored for radioactive air emissions during 1999. The activity that was released to the atmosphere from these emission points is listed in Tables D-1 through D-11 and D-15. (See Appendix D [pp.D-3 through D-12 and D-16].) Appropriate information from these tables was used as input to the CAP88-PC code.

Wind data collected from the on-site meteorological tower during 1999 were used as input to the CAP88-PC code. Data collected at the 60-meter and 10-meter heights were used in combination with the main plant stack and ground-level effluent release data, respectively.

Maximum Dose to an Off-site Individual. Based on the airborne radioactivity released from the permitted point sources at the site during 1999, it was estimated that a person living in the vicinity of the WVDP could have received a total EDE of 0.011 mrem (0.00011 mSv). The computer model has established that this maximally exposed off-site individual is located 2.4 kilometers east of the site and is assumed to eat only locally produced foods. Approximately 99% of the dose is from iodine-129, emitted from the main stack.

The maximum total EDE of 0.011 mrem (0.00011 mSv) from the permitted stacks and vents is far below levels that could be measured at the exposed individual's residence. This dose is comparable to about twenty minutes of natural background radiation received by an average member of the U.S. population and is well below the 10 mrem (0.1 mSv) NESHAP limit promulgated by the EPA and required by DOE Order 5400.5.

Collective Population Dose. The CAP88-PC version of AIRDOS-EPA was used to estimate the collective EDE to the population. The population data that were used for the 1999 assessment are from the 1990 census projection for the year 1995. In this five-year projection, 1.3 million people were estimated to reside within 80 kilometers (50 mi) of the WVDP. This population received an estimated 0.11 person-rem (0.0011 person-Sv) total EDE from radioactive airborne effluents released from the permitted WVDP point sources during 1999. The resulting average EDE per individual was 0.0001 mrem (0.000001 mSv).

Predicted Dose from Waterborne Releases

Currently there are no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents except as applied in 40 CFR 141 and 40 CFR 143, Drinking Water Guidelines (U.S. Environmental Protection Agency 1984a; 1984b). The potable-water wells sampled for radionuclides are upgradient of the WVDP and therefore are not a potential source of exposure to radiation from Project activities. Since Cattaraugus Creek is not used as a drinking water supply, a comparison of the predicted concentrations and doses to the EPA drinking water limits established in 40 CFR 141 and 40 CFR 143 is not truly appropriate (although the values in creek samples are well below the EPA drinking water limits). The estimated radiation dose was compared to the applicable guidelines provided in DOE Order 5400.5. The EDE to the maximally exposed off-site individual and the collective EDE to the population due to routine waterborne releases and natural drainage are calculated using dose conversion factors as reported in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).

Since the effluents eventually reach Cattaraugus Creek, which is not used directly as a source of drinking water, the most important individual exposure pathway is the consumption of fish by local sportsmen. It is assumed that a person may consume annually as much as 21 kilograms (46 lbs) of fish caught in the creek. Exposure to external radiation from shoreline or water contamination also is included in the model for estimating radiation dose. Population dose estimates assumed that radionuclides were further diluted in Lake Erie before reaching municipal drinking water supplies. The computer code LADTAP II (Simpson and McGill 1980) was used to calculate the dose conversion factors for routine waterborne releases and dispersion of these effluents. Input data included site-specific stream flow and dilution, drinking water usage, and stream usage factors. A detailed description of LADTAP II is given in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).

Four planned batch releases of liquid radioactive effluents from lagoon 3 occurred during 1999. The radioactivity discharged in these effluents, listed in Appendix C, Table C-1 [p. C-3], was used with the dose conversion factors to calculate the EDE to the maximally exposed off-site individual and the collective EDE to the population.

In addition to the batch releases from lagoon 3 (WNSP001), effluents from the sewage treatment facility (WNSP007) and the french drain (WNSP008) are routinely released. The activities measured from these release points were included in the EDE calculations. The measured radioactivity concentrations from the sewage treatment facility and french drain are presented in Appendix C, Tables C-5 and C-6 (pp.C-7 and C-8).

In addition to the above discharges there are two natural drainage channels originating on the Project premises with measurable amounts of radioactivity. These are drainages from the northeast swamp (WNSWAMP) and north swamp (WNSW74A). The measured radioactivity from these points is reported in Tables C-7 and C-8 (pp.C-9 and C-10). These release points are included in the EDE calculations for the maximally exposed off-site individual and the collective population.

Maximum Dose to an Off-site Individual. Based on the radioactivity in liquid effluents released from the WVDP (lagoon 3, sewage treatment plant, and french drain) during 1999, an off-site individual could have received a maximum EDE of 0.0283 mrem (0.000283 mSv). Approximately 95% of this dose would be from cesium-137. This dose of 0.0283 mrem (0.000283 mSv) is negligible in comparison to the 295 mrem (2.95 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

The maximum off-site individual EDE due to drainage from the north plateau (north swamp and northeast swamp) is 0.0282 mrem (0.000282 mSv). The combined EDE to the maximally exposed individual from liquid effluents and drainage is 0.056 mrem (0.00056 mSv). This annual dose is negligible in comparison to the 295 mrem (2.95 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

Collective Dose to the Population. As a result of radioactivity released in liquid effluents from the WVDP (lagoon 3, sewage treatment plant, and french drain) during 1999, the population living within 80 kilometers (50 mi) of the site received a collective EDE of 0.024 person-rem (0.00024 person-Sv). The collective dose to the population from the north plateau drainage is 0.10 person-rem (0.0010 person-Sv). This estimate is based on a population of 1.3 million living within the 80-kilometer radius. The resulting average EDE from lagoon 3, the sewage treatment plant, the french drain, and north plateau drainage (north swamp and northeast swamp) per individual is 9.6E-05 mrem (9.6E-07 mSv). This dose of 0.000096 mrem (0.00000096 mSv) is an inconsequential addition to the dose that an average person receives in one year from natural background radiation.

Predicted Dose from All Pathways

The potential dose to the public from both airborne and liquid effluents released from the Project during 1999 is the sum of the individual dose contributions. The calculated maximum EDE from all pathways to a nearby resident was 0.068 mrem (0.00068 mSv). This dose is approximately 0.068% of the 100 mrem (1 mSv) annual limit in DOE Order 5400.5.

The total collective EDE to the population within 80 kilometers (50 mi) of the site was 0.24 person-rem (0.0024 person-Sv), with an average EDE of 0.00018 mrem (0.0000018 mSv) per individual.

Table 4-2 (p.4-7) summarizes the dose contributions from all pathways and compares the individual doses to the applicable standards.

Figure 4-2 (p.4-12) shows the calculated annual dose to the hypothetical maximally exposed individual over the last eleven years. The estimated dose for 1999 (0.068 rmem) is higher than the annual dose reported for 1998 (0.065). The decrease in dose fraction from air emissions in 1999 is attributed to the decrease in iodine-129 emissions. The increased dose from the liquid pathway is the result of a combined increase in strontium-90 released from the north plateau drainage and releases from the water treatment system. This small increase is a continuing effect of the migration of the gross beta

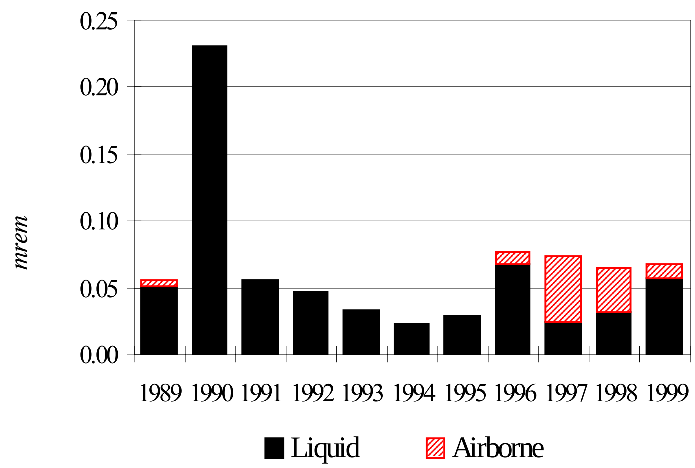


Figure 4-2. Effective Dose Equivalent from Liquid and Airborne Effluents to a Maximally Exposed Individual Residing near the WVDP

plume. (See Special Groundwater Monitoring in Chapter 3, p.3-15.)

Figure 4-3 (*this page*) shows the collective dose to the population over the last eleven years. (See Fig. A-13 [p.A-15] for a map of the population sectors.) A five-year upward trend, primarily from an increase in vitrification activities, reversed in 1998 and in 1999 continued down towards pre-vitrification levels.

An upward trend in dose from liquid effluents, directly linked to a noticeable increase in water treatment activity, continued in 1999.

The overall radioactivity represented by these data confirm the continued inconsequential addition to the natural background radiation dose that the individuals and population around the WVDP receive from Project activities.

Unplanned Releases

No off-site unplanned releases (as defined by DOE Order 5400.1) of radioactive materials in air or liquid effluents were identified or reported in 1999.

Risk Assessment

Estimates of cancer risk from ionizing radiation have been presented by the International Commission on Radiological Protection and Measurement (1987), and the National Research Council Committee on Biological Effects of Ionizing Radiation (1990). These reports estimate that the probability of fatal cancer induction to the public, averaged over all ages, ranges from 0.0001 to 0.0005 cancer fatalities/rem. The most recent risk coefficient of 0.0005 (International Commission

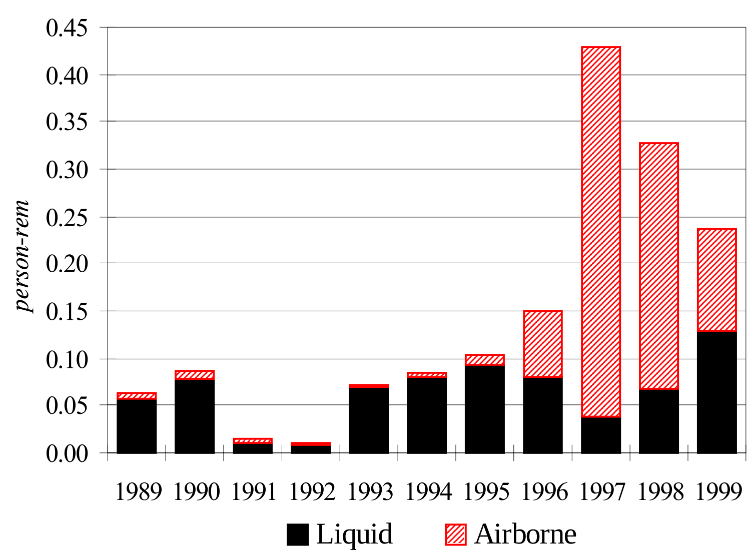


Figure 4-3. Collective Effective Dose Equivalent from Liquid and Airborne Effluents to the Population Residing within 80 Kilometers of the WVDP

on Radiological Protection 1991) was used to estimate risk to a maximally exposed off-site individual. The resulting risk to this hypothetical individual from airborne and waterborne releases was a 0.000000034 probability of a cancer fatality (1 chance in 29 million). This risk is well below the range of 0.000001 to 0.00001 per year considered acceptable by the International Commission on Radiological Protection Report 26 (1977) for any individual member of the public.

Summary

Predictive computer modeling of airborne and waterborne releases resulted in estimated hypothetical doses to the maximally exposed individual that were orders of magnitude below all applicable EPA standards and DOE Orders, which place limitations on the release of radioactive materials and dose to individual members of the public. The collective population dose also was assessed and found to be orders of magnitude below natural background radiation doses. Based on the dose assessment, the WVDP was found to be in compliance with all applicable effluent radiological guidelines and standards during 1999.

QUALITY ASSURANCE

The quality assurance (QA) program at the West Valley Demonstration Project (WVDP) provides for and documents consistency, precision, and accuracy in collecting and analyzing environmental samples and in interpreting and reporting environmental monitoring data.

Organizational Responsibilities

West Valley Nuclear Services Company (WVNS) is contractually obligated to implement a nuclear quality assurance program at the WVDP. Managers of programs, projects, and tasks are responsible for determining and documenting the applicability of quality assurance requirements to their activities and for implementing those requirements. For example, Environmental Laboratory management and staff are directly responsible for carrying out sampling and analytical activities in a manner consistent with good quality assurance practices and for following approved procedures.

Program Design

The quality assurance rule 10 CFR Part 830.120, Quality Assurance (U.S. Department of Energy [DOE] 1999), and DOE Order 414.1A, Quality Assurance (U.S. Department of Energy 1999) provide the quality assurance program policies and requirements applicable to activities at the WVDP. The integrated quality assurance program applicable to environmental monitoring at the WVDP also incorporates requirements from Quality Assurance Program Requirements for Nuclear Facilities (American Society of Mechanical Engineers [ASME NQA-1] 1989) and Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (American National Standards Institute and American Society for Quality Control [ANSI/ASQC E4-1994] 1994).

The quality assurance program focuses on assigning responsibilities and on thorough planning, specification, control, and documentation of all aspects of an activity in order to ensure the quality of both radiological and nonradiological monitoring data. The quality assurance program includes requirements in the following areas:

√ *Responsibility*. Responsibilities involved in overseeing, managing, and conducting an activity must be clearly defined. Personnel who verify that the activity has been completed correctly must be independent of those who performed it.

√ *Planning*. An activity must be planned beforehand and the plan followed. All activities must be documented. Similarly, purchases of any equipment or items must be planned, specified precisely, and verified for correctness upon receipt.

√ *Control of design, procedures, items, and documents*. Any activity, equipment, or construction must be clearly described or defined and tested, and changes in the design must be tested and documented. Procedures must clearly state how activities will be conducted. Only approved procedures may be used. Equipment or particular items affecting the quality of environmental data must be identified, inspected, calibrated, and tested before use. Calibration status must be clearly indicated. Items that do not conform to requirements must be identified and separated from other items and the nonconformity documented.

√ *Documentation*. Records of all activities must be kept in order to verify what was done and by whom. Records must be clearly traceable to an item or activity.

√ *Corrective action*. If a problem should arise the cause of the problem must be identified, a corrective action planned, responsibility assigned, and the problem remedied.

√ *Audits*. Scheduled audits and assessments must be conducted to verify compliance with all aspects of the quality assurance program and determine its effectiveness.

Subcontractor laboratories providing analytical services for the environmental monitoring program are contractually required to maintain a quality assurance program consistent with WVDP requirements.

Procedures

Those activities that affect the quality of environmental monitoring data are conducted according to approved procedures that clearly describe how the activity should be performed and what precautions are to be taken in connection with the activity. Any person performing an activity that could affect the quality of environmental monitoring data is trained in that procedure and must demonstrate proficiency.

New procedures are developed each time an activity is added to the monitoring program. Procedures are reviewed periodically and updated when necessary. Documents are controlled so that only current procedures are used.

Quality Control in the Field

Quality control (QC), an integral component of environmental monitoring quality assurance, is a way of verifying that samples are being collected and analyzed according to established quality assurance procedures. Quality control ensures that sample collection and analysis are consistent and repeatable and is a means of tracking down possible sources of error. For example, at the WVDP sample locations are clearly marked in the field to ensure that future samples are collected in the same locations; collection equipment in place in the field is routinely inspected, calibrated, and maintained; and automated sampling stations are kept locked to prevent tampering and to ensure sample integrity. Samples are collected into certified pre-cleaned containers of an appropriate material and capacity and are labeled immediately with the pertinent information. Date, time, person doing the collecting, and special field sampling conditions are recorded and kept as part of the record for that sample.

Chain-of-custody protocols are followed to ensure that samples are controlled and tracked for traceability. If necessary, samples are preserved as soon as possible after collection.

In order to assess quality problems that might be introduced by the sampling process, duplicate field samples, field blank samples, and trip blank samples are collected. Background samples are collected for baseline environmental information.

Field Duplicates. Field duplicates are samples collected simultaneously for the same analyte at one location, after which they are treated as separate samples. If the sampling matrix is homogeneous, field duplicates provide a means of assessing the precision of collection methods. Field duplicates are collected at a minimum rate of one per twenty analyses.

Field Blanks. A field blank is a sample of laboratory-distilled water that is put into a sample container at a field collection site and is processed from that point as a routine sample. Field blanks are used to detect contamination introduced by the sampling procedure. They are processed at a minimum rate of one per twenty analyses.

If the same collection equipment is used for more than one site, a special form of field blank known as an equipment blank may be collected by pouring laboratory-distilled water through cleaned collecting equipment and into a sample container. Equipment blanks are collected to detect any cross-contamination that may be passed from one sampling location to another by the equipment. Many wells and surface water collection stations have dedicated collecting equipment that remains at that location; equipment blanks are not necessary at these locations.

Trip Blanks. Trip blanks are prepared by pouring laboratory-distilled water into sample bottles in the laboratory. The bottles are then placed into sample coolers where they remain throughout the sampling event. Trip blanks are collected in order to detect any volatile organic contamination that may be introduced from handling during collection, storage, or shipping. Trip blanks are prepared once per day when volatile organic samples are being collected.

Environmental Background Samples. To monitor each pathway for possible radiological contamination, samples of air, water, vegetation, meat, and milk are taken from locations remote from the site for comparison with samples from near-site locations. Samples that are clearly outside site influence show ambient radiological concentrations and serve as backgrounds or "controls," another form of field quality control sample. Background samples provide baseline information to compare with information from near-site or on-site samples so that site influences can be evaluated.

Quality Control in the Laboratory

More than 10,000 samples were handled as part of site monitoring in 1999. Samples for routine radiological analysis were analyzed on-site, with the rest being sent to subcontract laboratories. Off-site laboratories must maintain a level of quality control as specified in contracts with WVNS. Subcontract laboratories are required to participate in all applicable crosscheck programs and to maintain all relevant certifications.

In order to monitor the accuracy and precision of data, laboratory quality control practices specific to each analytical method are clearly described in approved references or procedures. Examples of laboratory quality control activities at the WVDP include proper training of analysts, maintaining and calibrating measuring equipment and instrumentation, and processing samples in accordance with specific methods as a means of monitoring laboratory performance.

Analytical instruments and counting systems are calibrated at specified frequencies and logs of instrument calibration and maintenance are kept. Calibration methods for each instrument are specified in procedures or in manufacturers' instruction manuals. Standards traceable to the National Institute of Standards and Technology (NIST) are used to calibrate counting and test instrumentation.

Laboratory quality control samples consist of three general types: standards (including spikes), used to assess accuracy; blanks, to assess the possibility of contamination; and duplicates, to assess precision.

Standards. Laboratory standards are materials containing known concentrations of an analyte of interest such as a pH buffer or a plutonium-239 counting standard. Standards used at the WVDP for environmental monitoring activities are either NIST-traceable or reference materials from other nationally recognized sources.

At a minimum, one reference standard is analyzed for every twenty sample analyses. The results of the analyses are plotted on control charts, which specify acceptable limits. If the results lie within these limits, then analysis of actual environmental samples may proceed and the results are deemed usable.

Spikes. Another form of standard analysis is a laboratory spike. In a laboratory spike, a known amount of analyte is added to a sample or blank before the sample is analyzed. The percent recovery of the analyte indicates how much of the analyte of interest is being detected in the analysis of actual samples; hence, a spike also is an assessment of the accuracy of the method. Spike recoveries are recorded on control charts with documented acceptance limits.

Blanks. Laboratory blanks are prepared from a matrix similar to that of the sample but known to contain none of the analyte of interest. For instance, distilled water, taken through the same preparatory procedure as a sample, may serve as a laboratory blank for both radiological and chemical analyses of water samples. A positive result for an analyte in a blank indicates that something is wrong with the analysis and that corrective action should be taken. In general, one laboratory blank is processed daily or with each batch of samples for a given analyte.

A special form of laboratory blank for radiological samples is an instrument background count, which is a count taken of a planchet or vial containing no sample. The count serves three purposes: to determine if contamination is present in the counting instrument; to determine if the instrument is responding in an acceptable manner; and to determine the background correction that should be applied when calculating radiological activity in certain samples.

Environmental samples containing little or no radioactivity must be measured with very sensitive instruments. For example, gross alpha and gross beta measurements must be made with a low-background proportional counter. An instrument background count is taken before each day's counting or with each batch of twenty samples. Background counts are recorded on control charts with defined acceptance limits. An unacceptable count requires corrective action before analyses can proceed.

Duplicates. Duplicates are analyzed to assess precision in the analytical process. Laboratory duplicates are created by splitting existing samples before analysis; each split is treated as a separate sample. If the analytical process is in control, results for each split should be within documented acceptance criteria.

Crosschecks. WVNS participates in a formal radiological crosscheck program conducted by the U.S. Department of Energy (DOE). The DOE requires all organizations performing effluent or environmental monitoring to participate in the semiannual Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP), which is designed to test the quality of environmental measurements being reported to the DOE by its contractors.

An informal crosscheck program uses results from samples of air filters, water, milk, fish, vegetation, and sediments that have been split or separately collected and sent to the New York State Department of Health (NYSDOH) for independent measurement. (Co-located samples are listed in Appendix B of this report.) Results from NYSDOH are compared with WVDP results as an independent verification of environmental monitoring program data.

Crosscheck samples for radiological analyses are analyzed by both the Environmental Laboratory on-site and by the subcontract laboratory. Results from radiological crosschecks are summarized in Appendix J, Tables J-1 and J-2 (pp.J-3 through J-6). A total of 120 radiological crosscheck analyses were performed by or for the WVDP and reported in 1999. One hundred nineteen results (99.2%) were within control limits. Twenty-five of the results were produced by the on-site Environmental Laboratory; 100% were within control limits.

The EPA's National Exposure Research Laboratory, Environmental Sciences Division (NERL-ESD) radiological crosscheck program is being converted to a private, commercial program, and samples were not distributed in 1999. The EPA's nonradiological crosscheck program also is being privatized, and samples for the Discharge Monitoring Report - Quality Assurance (DMR-QA) Study 19 for the National Pollutant Discharge Elimination System (NPDES) program were not available in 1999.

WVNS subcontracted laboratories are required to perform satisfactorily on crosschecks, defined as 80% of results falling within control limits. Crosscheck results that fall outside control limits are addressed by formal corrective actions in order to determine any conditions that could adversely affect sample data and to ensure that actual sample results are reliable.

Personnel Training

Anyone performing environmental monitoring program activities is trained in the appropriate procedures and qualified accordingly before carrying out the activity as part of the site environmental monitoring program.

Record Keeping

Control of records is an integral part of the environmental monitoring program. Field data sheets, chain-of-custody forms, requests for analysis, sample-shipping documents, sample logs, bench logs, laboratory data sheets, equipment maintenance logs, calibration logs, training records, crosscheck performance records, data packages, and weather measurements, in addition to other records, are maintained as documentation of the environmental monitoring program. All records pertaining to the program are routinely reviewed and securely stored.

A Laboratory Information Management System (LIMS) is used to log samples, print labels, store and process data, track quality control samples, track samples, produce sampling and analytical worklists, and generate reports. Subcontract laboratories, where possible, provide data in electronic form for direct entry into the LIMS.

Chain-of-Custody Procedures

Chain-of-custody records begin with sample collection. Samples brought in from the field are transferred under signature from the sampler to the sample custodian and are logged at the sample receiving station, after which they are stored in a sample lockup before analysis or shipping. Samples sent off-site for analysis are accompanied by an additional chain-of-custody/analytical request form. Subcontract laboratories are required by contract to maintain internal chain-of-custody records and to store the samples under secure conditions.

Audits and Appraisals

In 1999 the WVNS Quality Assurance and Environmental Affairs departments provided oversight by conducting audits, assessments, surveillances, and inspections.

Some of the areas examined were NESHAP reporting procedures, compliance with NESHAP requirements, preparation of the SPDES discharge monitoring report, testing of filters in the portable ventilation units, the potable water system in the utility room, software verification procedures for the Environmental Laboratory Information Management System, switchover of the stack monitoring equipment for the supernatant treatment system/permanent ventilation system, meteorological tower calibration activities, the environmental monitoring quality assurance program, and implementation of the integrated safety management system in the environmental monitoring program. The DOE's Ohio Field Office also audited the environmental management and waste management systems. Any corrective actions were addressed and tracked to closure.

Self-Assessments

Routine Self-Assessments. Routine self-assessments of the environmental monitoring program were conducted in 1999. The primary topics addressed by the assessments were as follows:

- conformance of the environmental monitoring program with requirements applicable to quality assurance, worker safety, incident reporting, and trend analysis

- adherence to the schedule for collecting samples of soils, sediments, and biota

- adequacy of the WVDP environmental monitoring program in monitoring systems and processes associated with vitrification

- adequacy of conduct of operations and attention to worker safety during laboratory, office, and field activities

- implementation of the Integrated Safety Management System (ISMS).

No findings or observations were noted. Several commendable practices were identified and comments regarding possible program improvements were made. Nothing was found during the course of these routine self-assessments that would compromise the data in this report or in the program in general.

Year-2000 Compliance Assessment. A special assessment was conducted in 1998 to determine if environmental monitoring program computer hardware and software were capable of handling data correctly when the year 2000 arrived. Several systems were examined, including the meteorological system, water samplers, air samplers, radiological instruments, emergency response equipment, laboratory and field instruments, laboratory and field support equipment, and data management and reporting systems. Corrective actions were identified, and a schedule for completing the corrective actions, which included purchasing new equipment and software, was developed so that all systems were year-2000 compliant in 1999. No problems were noted with the year-2000 turnover.

Lessons Learned Program

Information from audits, appraisals, and self-assessments are shared with other departments through the WVDP Lessons Learned Program. The WVDP maintains this system in order to identify, document, disseminate, and use this information to improve the safety, efficiency, and effectiveness of all WVNS operations.

Data Management and Data Validation

Information about environmental monitoring program samples is maintained and tracked in the LIMS and includes date and time of collection, chain-of-custody transfer, shipping information, analytical results, and final validation status.

All software used to generate data is subjected to verification and validation before use. All analytical data produced in the Environmental Laboratory at the bench level are reviewed and signed off by a qualified person other than the one who performed the analysis. A similar in-house review is contractually required from subcontractor laboratories.

Analytical data from both on- and off-site laboratories are formally validated by the data validation group. As part of the validation procedure, quality control samples analyzed in conjunction with a batch of samples are checked for acceptability. After validation is complete and transcription between hard copy and the LIMS is verified, the sample result is formally approved and released for use in reports.

Data Assessment and Reporting

Radiological and nonradiological data from the environmental monitoring program are evaluated in order to assess the effect, if any, of the site on the environment and the public. Data from each sampling location are compared to applicable standards or background measurements.

• Radiological concentrations in liquid effluent releases or air emissions are compared to DOE derived concentration guides (DCGs) for release of water or air to an unrestricted environment. DCGs for specific radionuclides are listed in Table K-1 (p.K-3).

• Calculated doses from air emissions are compared to National Emission Standards for Hazardous Air Pollutants (NESHAP) limits.

• Nonradiological releases from liquid effluents covered by the SPDES permit are compared to the limits specified in the permit. (See Table G-1 [pp.G-3 and G-4].)

• Near-site radiological results are compared to results from background locations far from the site.

• Results from surface waters downgradient of the site are compared to results from upgradient locations.

Standard statistical methods are used to compare the data. Where possible, the underlying distribution of the data set is assessed before determining the appropriate statistical tests to be used.

Once the data have been evaluated, reports are prepared. Calculations summarizing the data, e.g., summing the total curies released from an effluent point, averaging the annual concentration of a radionuclide at a monitoring point, or pooling confidence intervals from a series of measurements, are made in accordance with formally approved procedures. Final data are reported as described elsewhere in this report. (See Data Reporting [p.1-4] and the section on Scientific Notation at the back of this report.)

Before each technical report is issued the document, including the data, is comprehensively reviewed by one or more persons who are knowledgeable in the necessary technical aspects of the field of work.

Summary

The multiple levels of scrutiny built into generating, validating, evaluating, and reporting data from the environmental monitoring program ensure that reliable data are reported. The quality assurance elements described in this chapter ensure that environmental monitoring data are consistent, precise, and accurate. The effectiveness of the monitoring program is evidenced by continuing favorable quality assurance assessments.

Appendix A

Maps

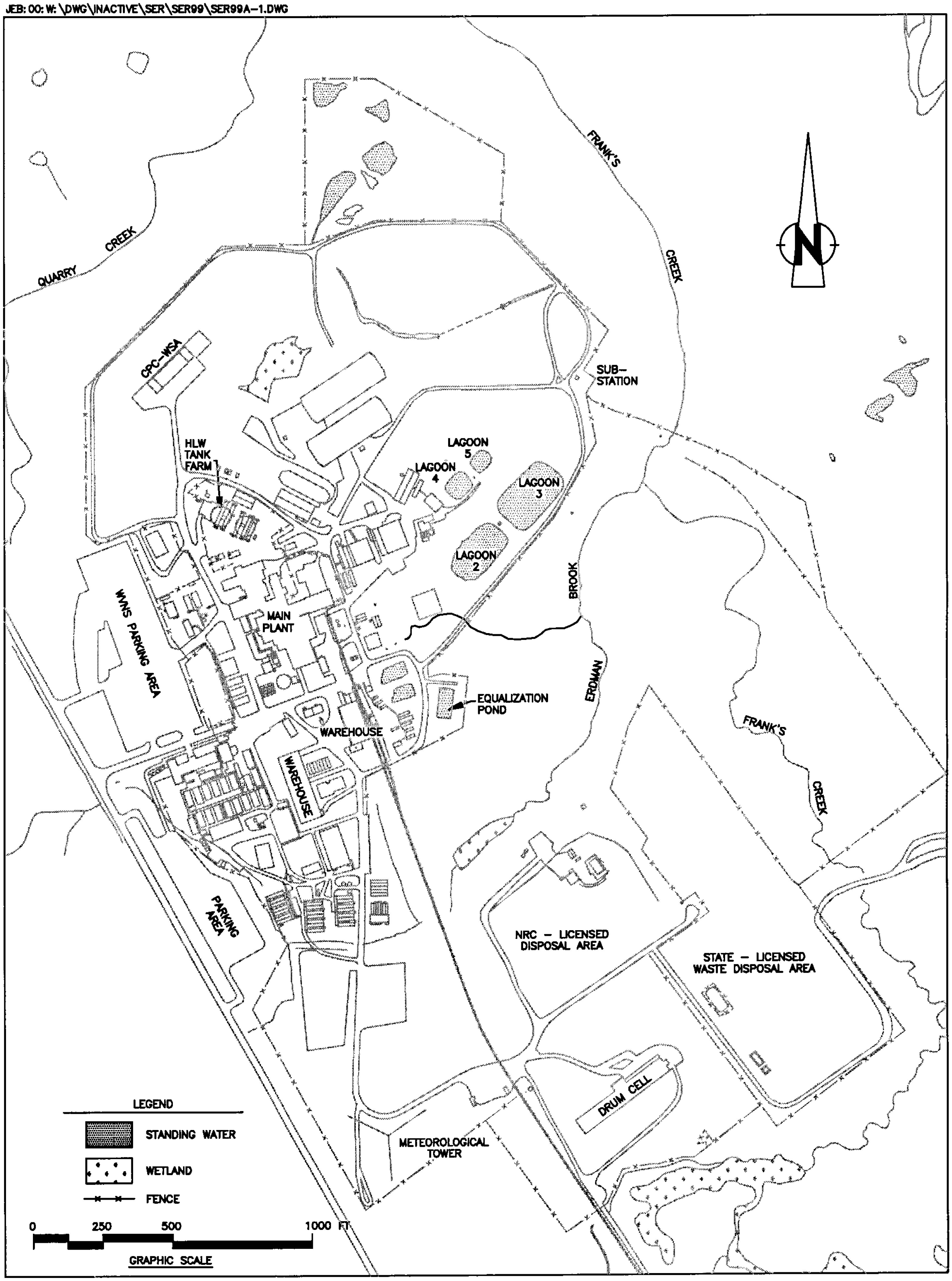


Figure A-1. Project Base Map.

JEB: OO: W: \DWG\INACTIVE\SER\SER99\SER99A-2.DWG

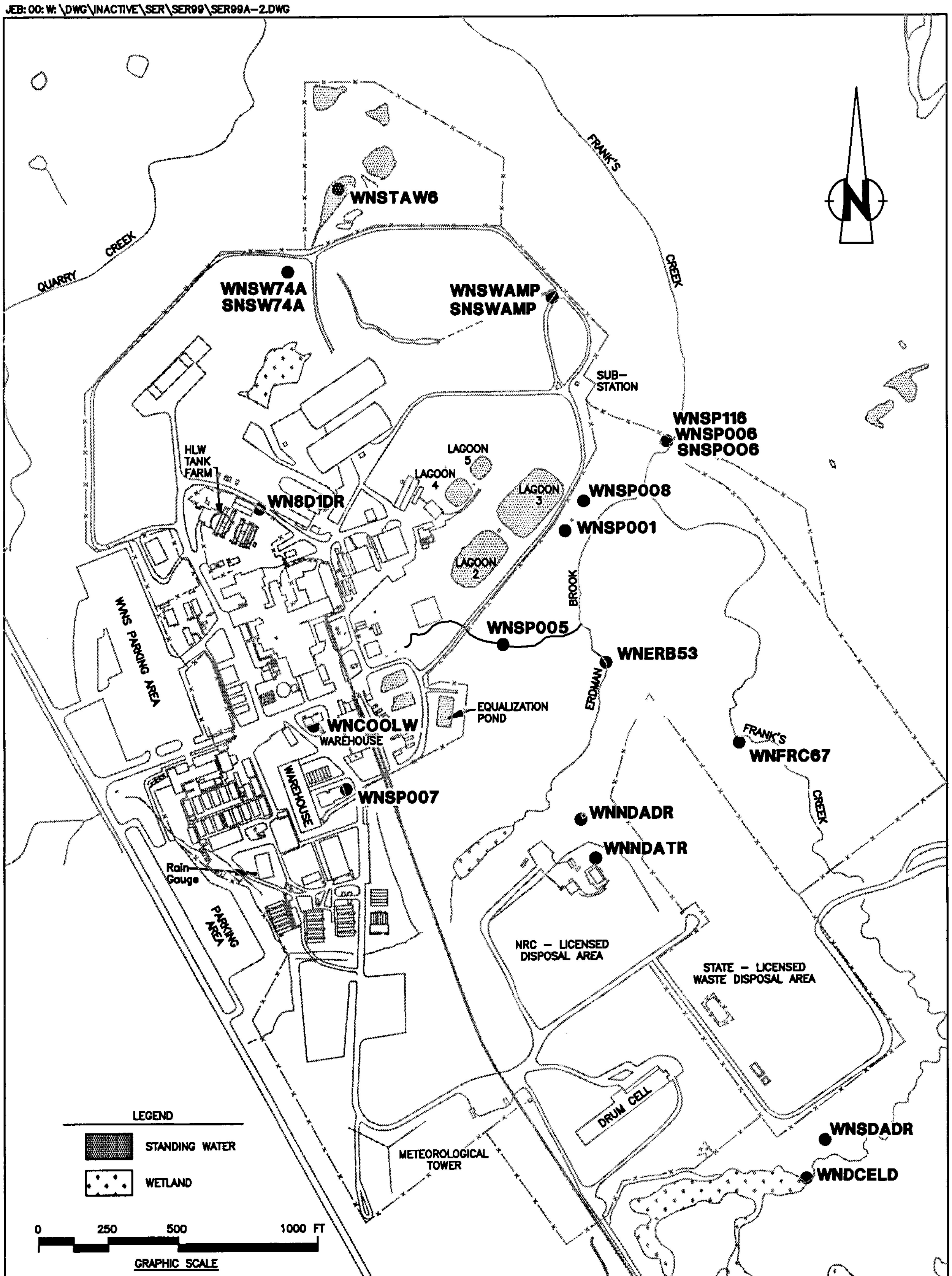


Figure A-2. On-site Surface Water and Soil Sampling Locations.

JEB: OO: W: \DWG\INACTIVE\SER\SER99\SER99A-3.DWG

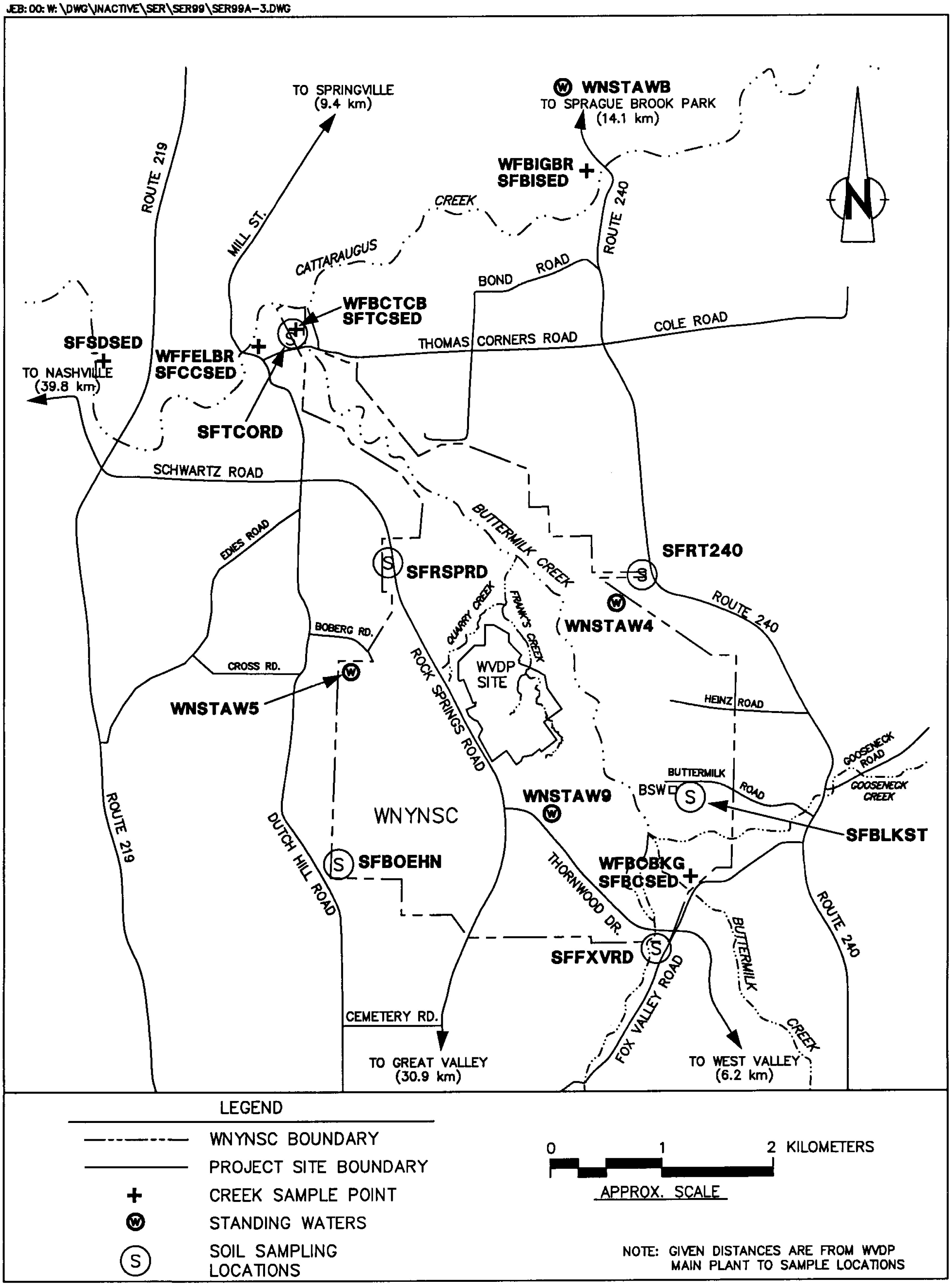


Figure A-3. Off-site Surface Water, Soil, and Sediment Sampling Locations.

JEB: OO: W: \DWG\INACTIVE\SER\SER99\SER99A-4.DWG

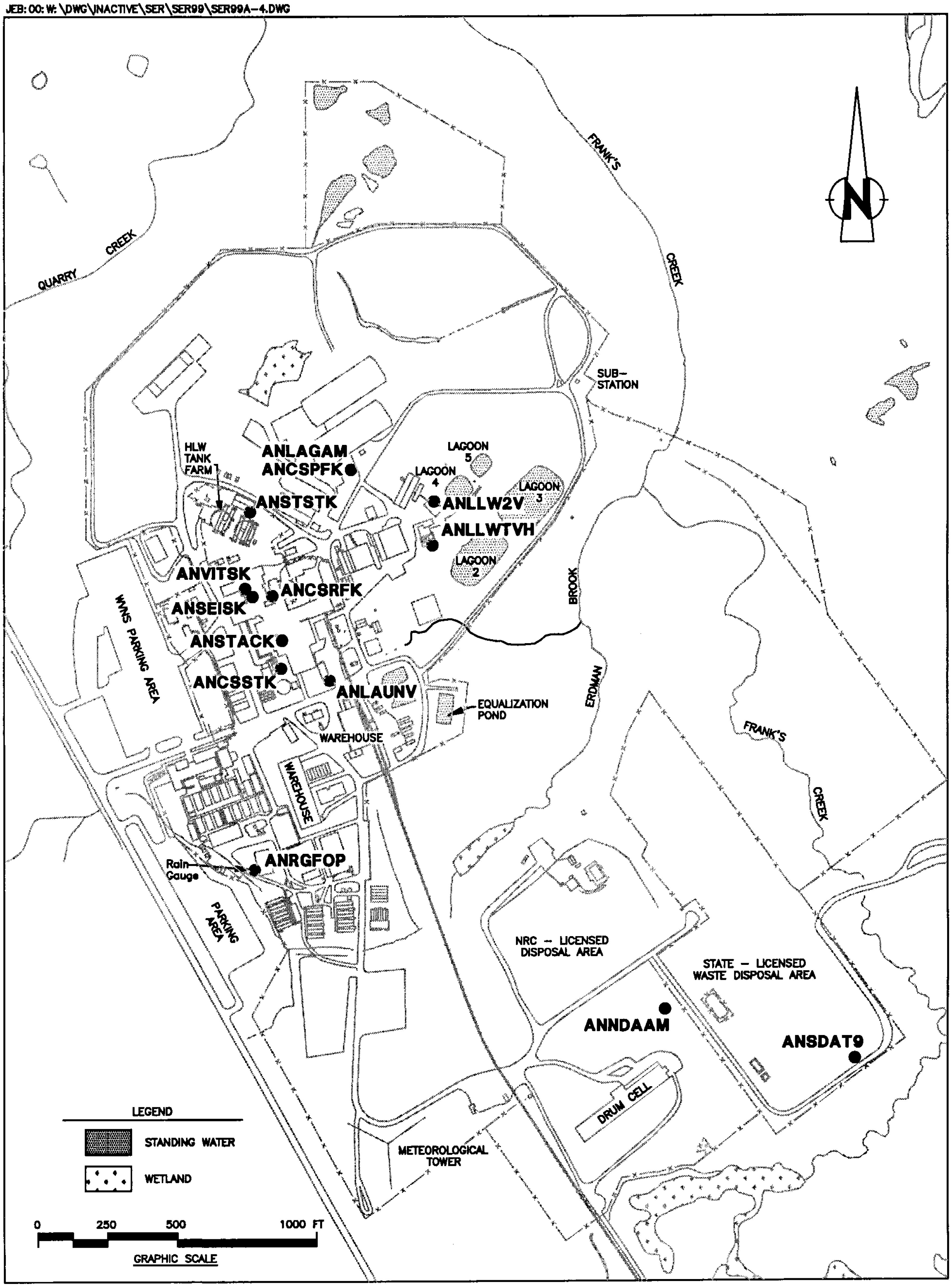


Figure A-4. On-site Air Monitoring and Sampling Points.

JEB: OO: W: \DWG\INACTIVE\SER\SER99\SER99A-5.DWG

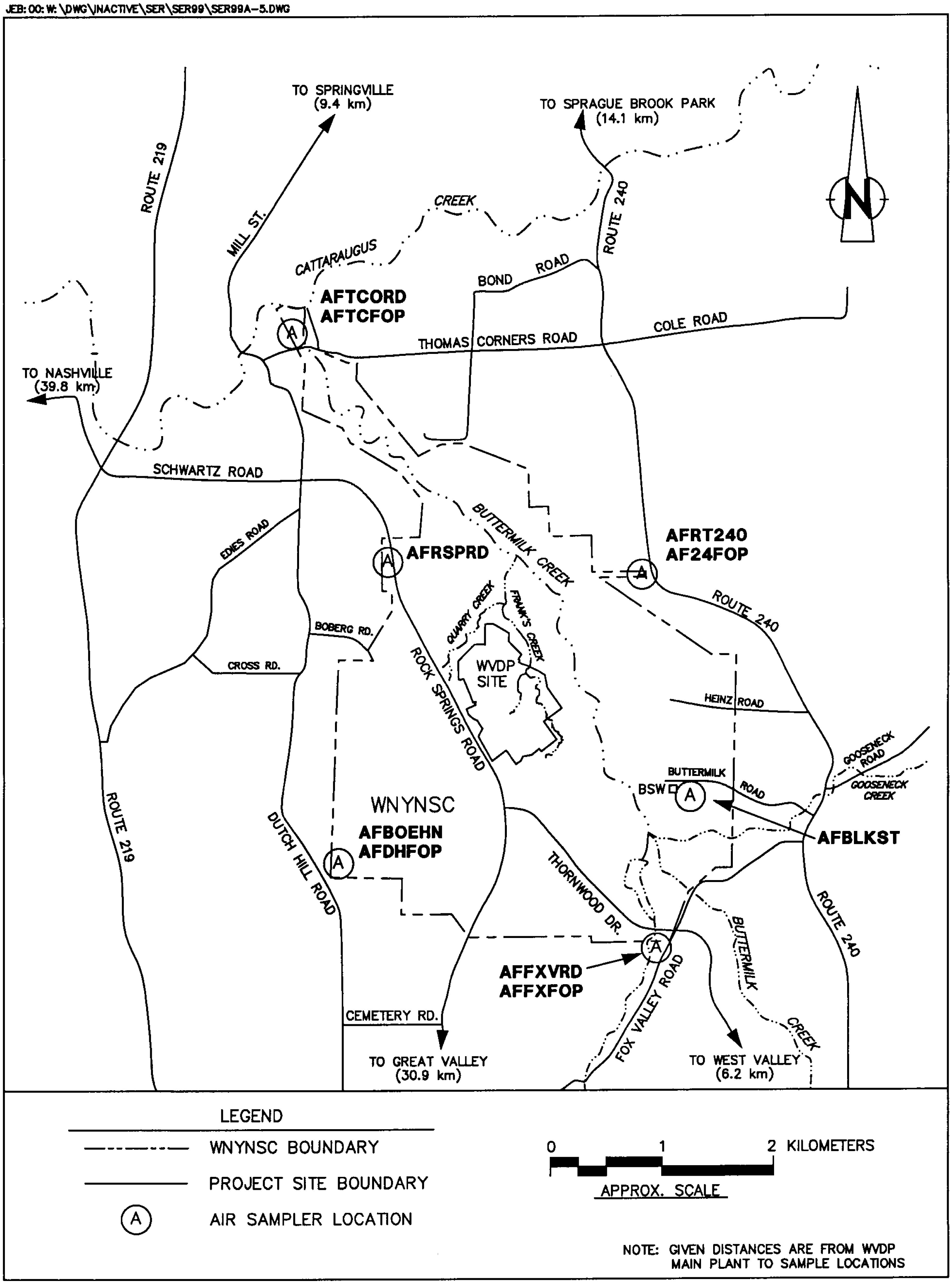


Figure A-5. Off-site Air and Fallout Sampling Points.

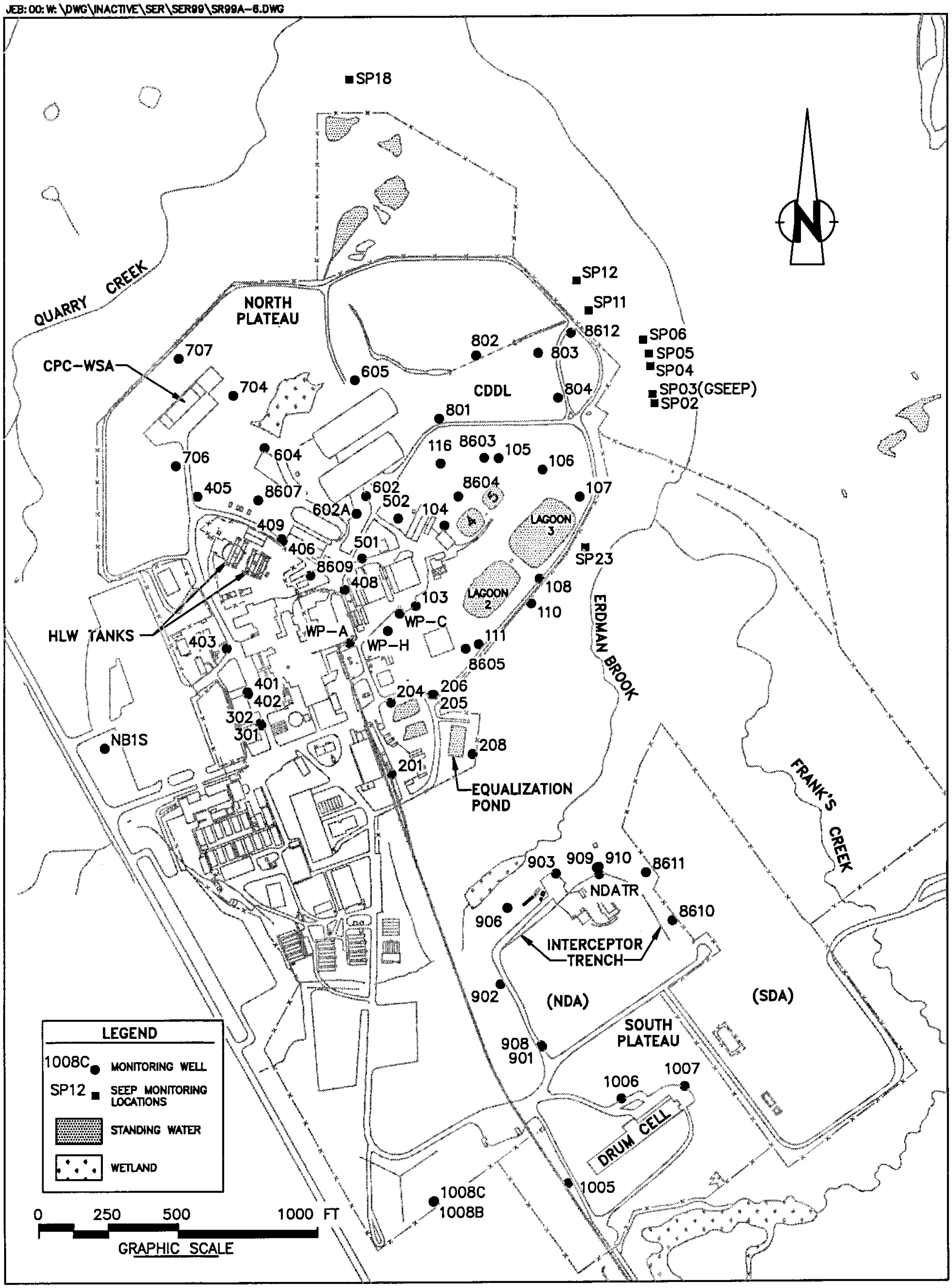


Figure A-6. Active WVDP Groundwater Monitoring Points.

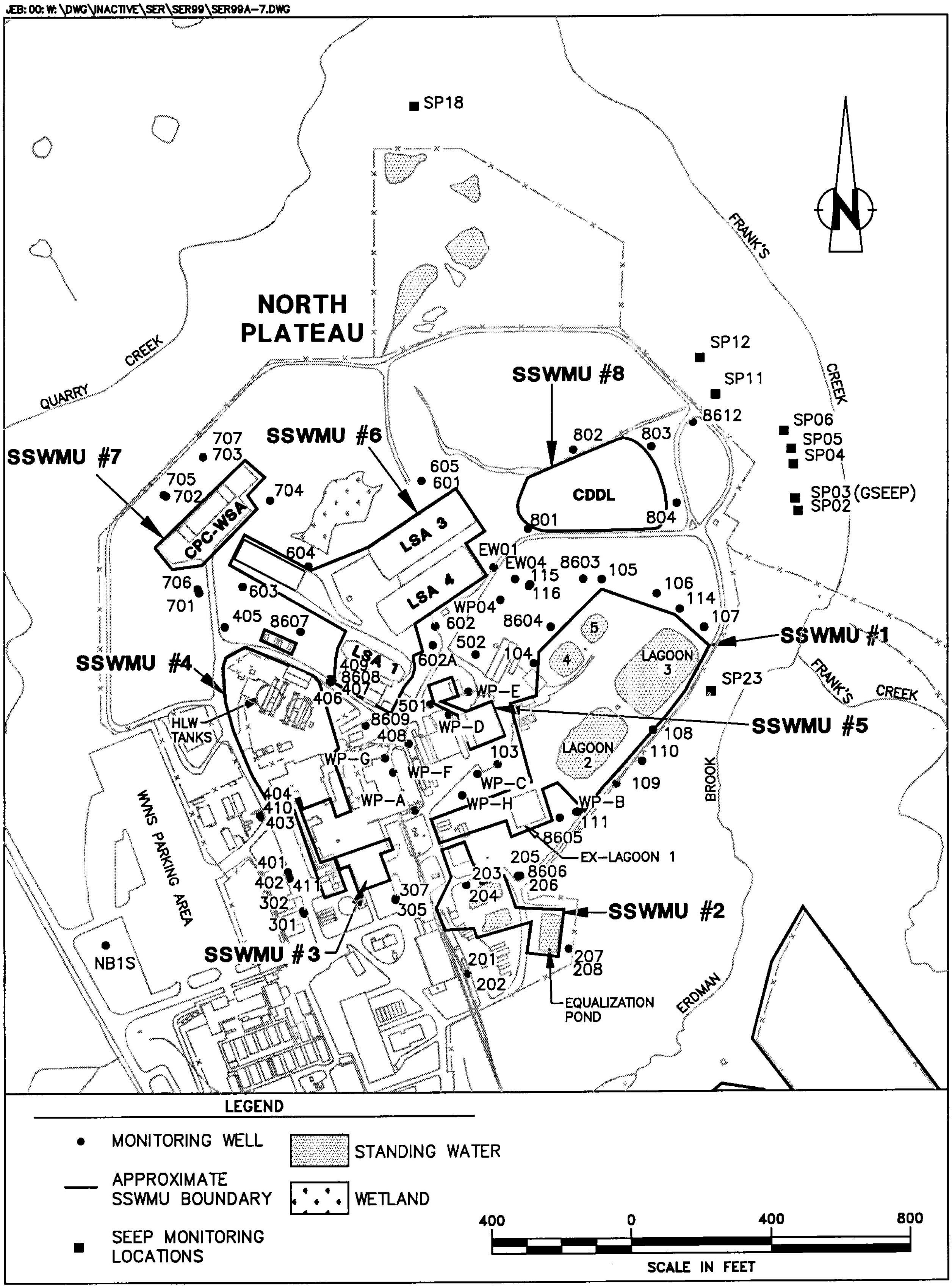


Figure A-7. North Plateau On-Site Groundwater Monitoring Network.
(Includes wells used for water-level measurements)

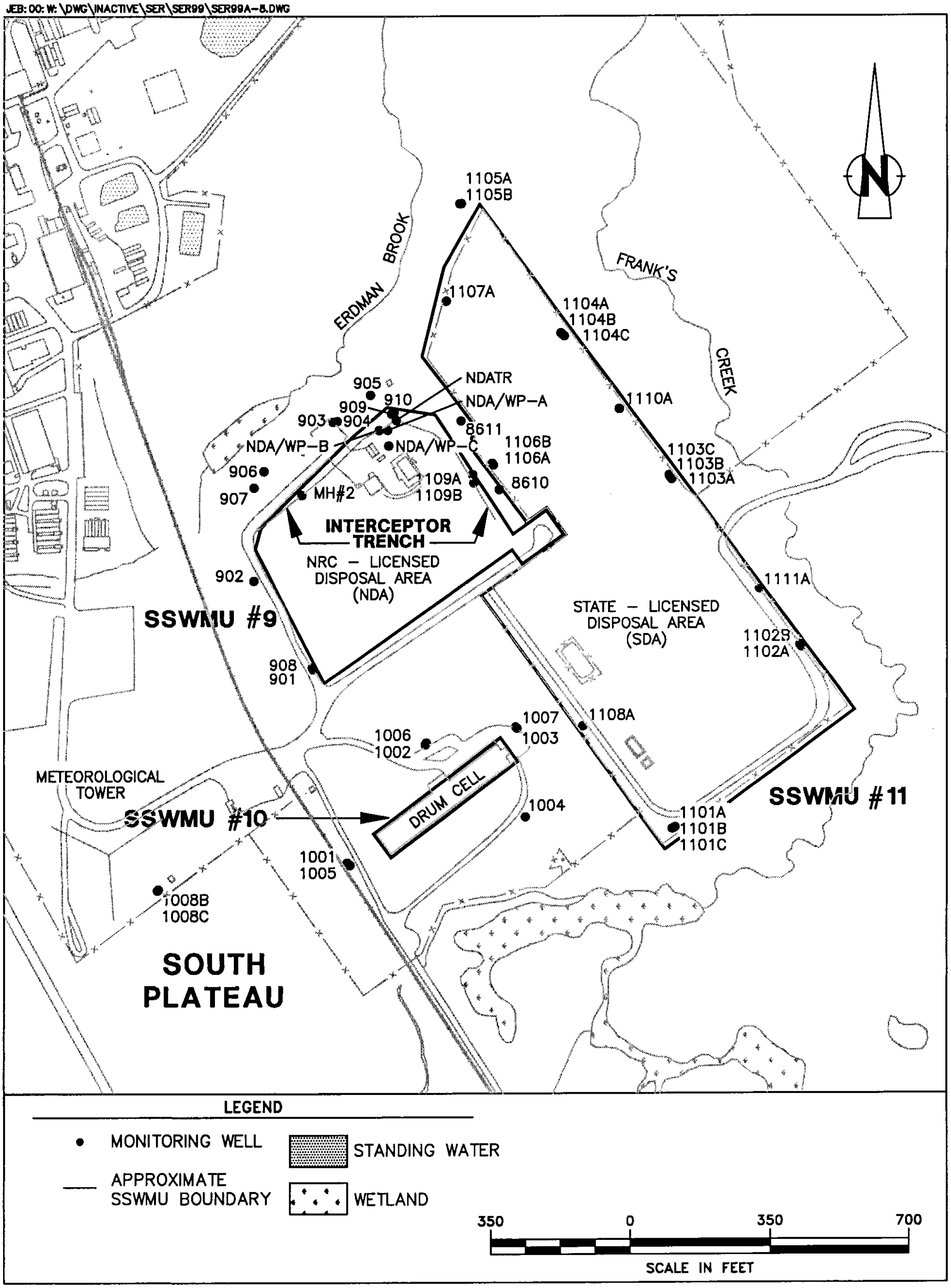


Figure A-8. South Plateau On-Site Groundwater Monitoring Network.
(Includes wells used for water-level measurements)

JEB: 00: W: \DWG\INACTIVE\SER\SER99\SER99A-9.DWG

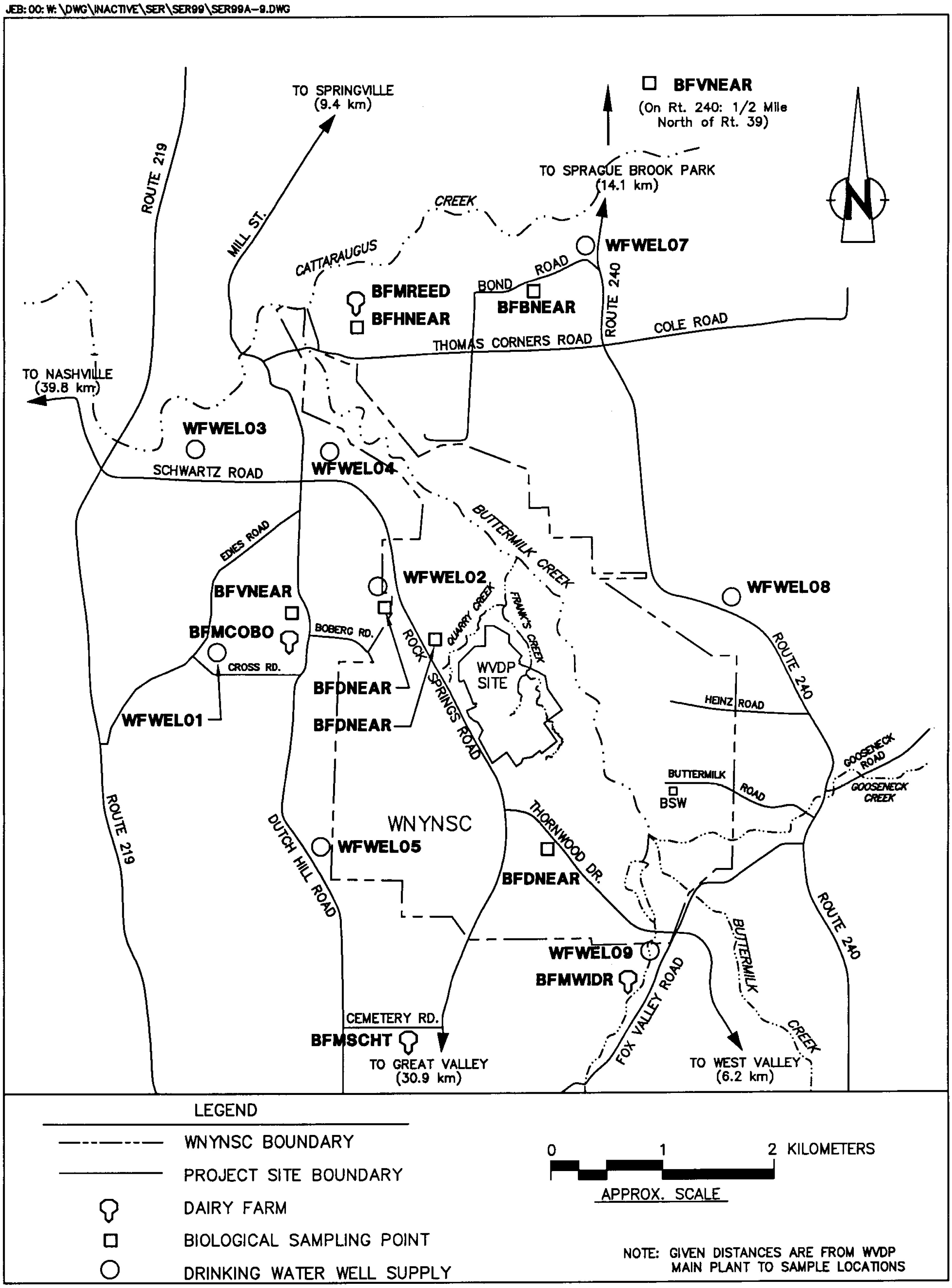


Figure A-9. Near-site Drinking Water and Biological Sampling Points.

JEB: 00: W: \DWG\INACTIVE\SER\SER99\SER99A-10.DWG

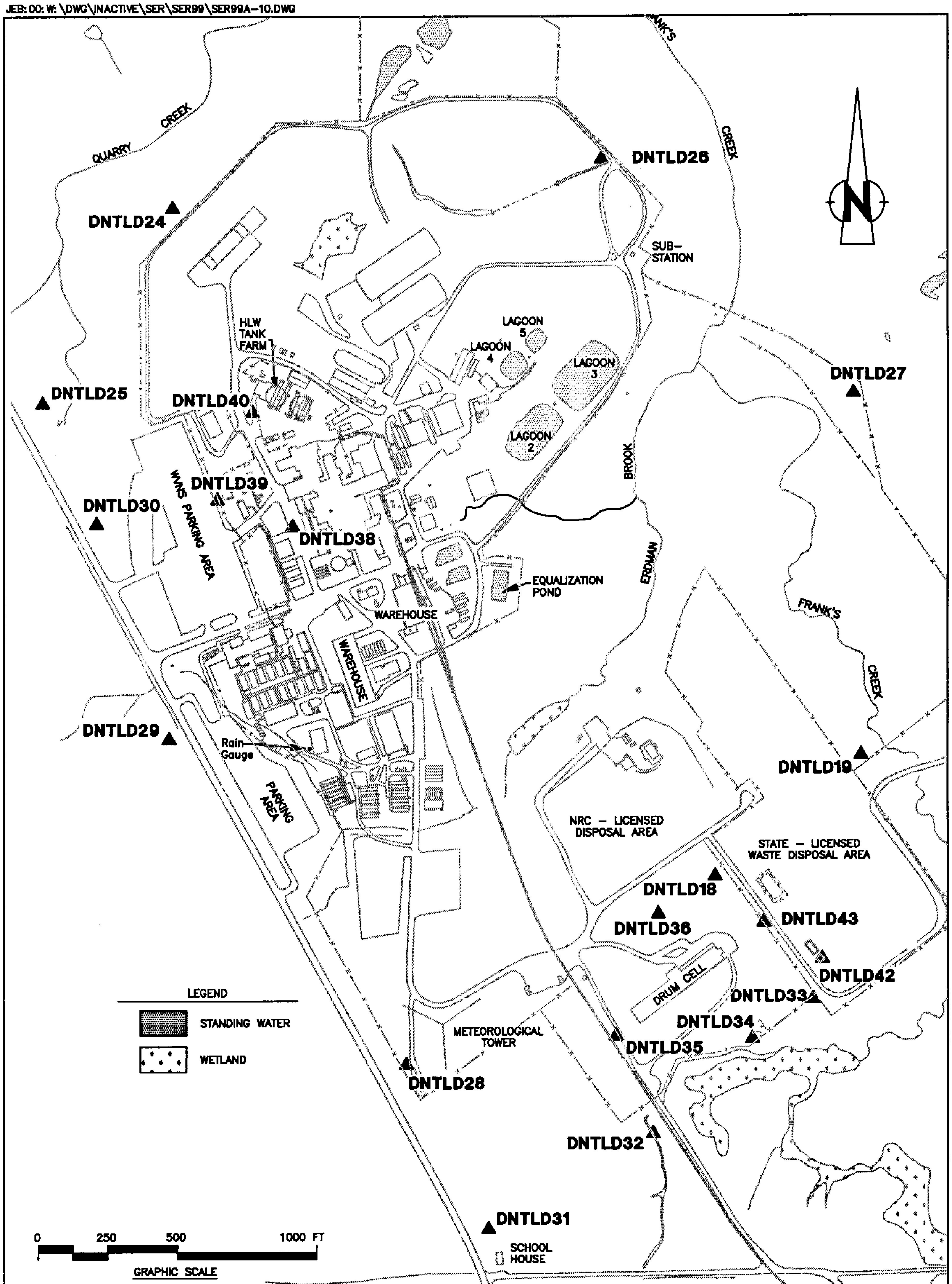


Figure A-10. Location of On-site Thermoluminescent Dosimeters (TLDs).

JEB: OO: W: \DWG\INACTIVE\SER\SER99\SER99A-11.DWG

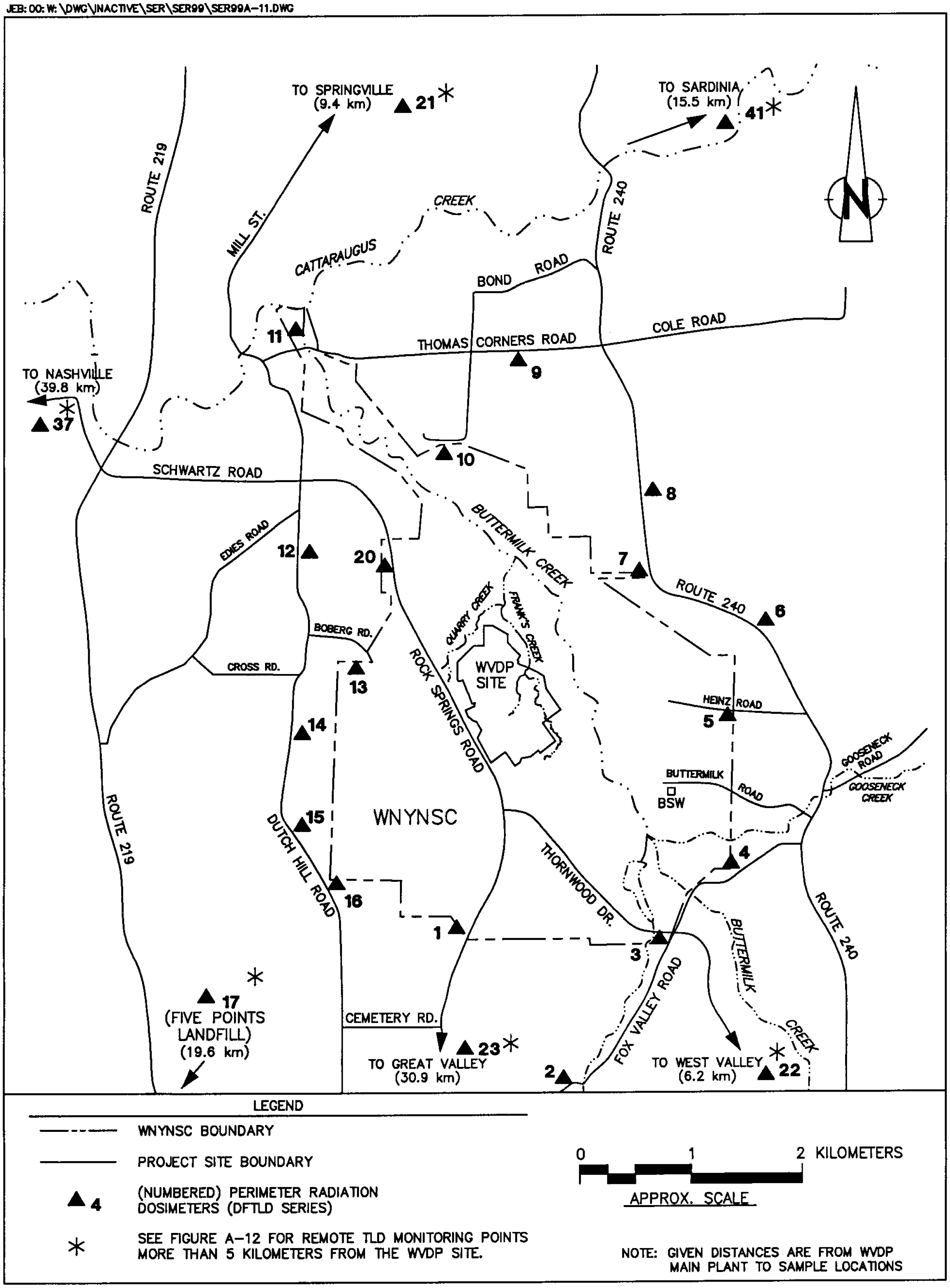
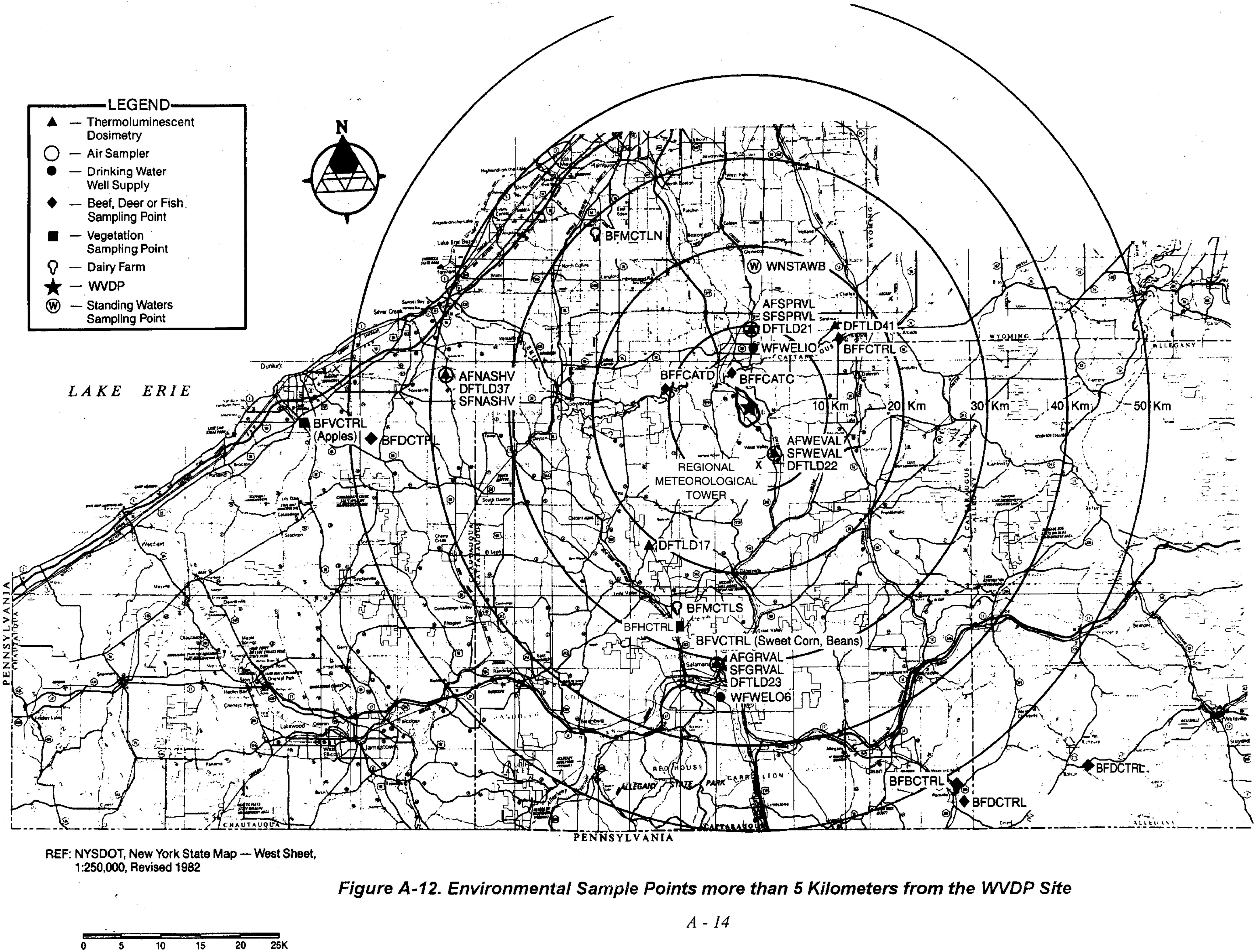


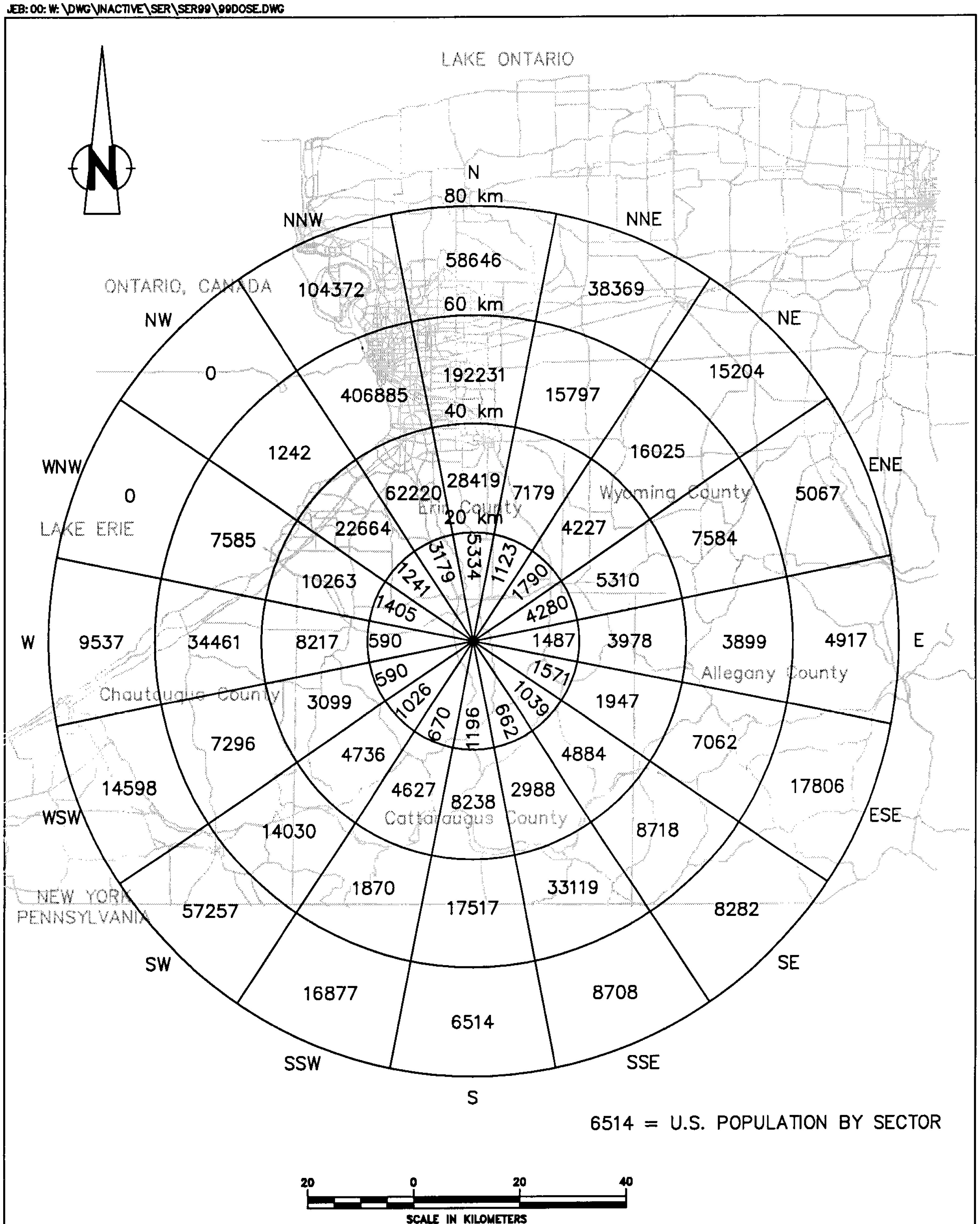
Figure A-11. Location of Off-site Thermoluminescent Dosimeters (TLDs).



REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

Figure A-12. Environmental Sample Points more than 5 Kilometers from the WVDP Site

JEB: 00: W:\DWG\INACTIVE\SER\SER99\99DOSE.DWG



REFERENCE:
U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS,
TIGER/LINE CENSUS FILES, PUBLIC LAW 94-171 CENSUS FILES, 1990.
POPULATION COUNT 10-20 KM INCLUDES 1992 SURVEY ESTIMATES.

Figure A-13. Projected 2000 Census Population by Sector Within 80 Kilometers of the Site.

Appendix B

1999 Environmental Monitoring Program

The WVDP Supports a Bluebird and Wood Duck Nesting-box Program
Sponsored by the Springville Field and Stream Club

1999 Environmental Monitoring Program

The following schedule represents the West Valley Demonstration Project (WVDP) routine environmental monitoring program for 1999. This schedule met or exceeded the minimum program specifications needed to satisfy the requirements of DOE Order 5400.1. It also met the requirements of DOE 5400.5 and DOE/EH-0173T. Specific methods and recommended monitoring program elements are found in DOE/EP-0096, *A Guide for Effluent Radiological Measurements at DOE Installations*, and DOE/EP-0023, *A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations,* which were the bases for selecting most of the schedule specifics. Additional monitoring was mandated by air and water discharge permits (40 CFR 61 and SPDES), which also required formal reports. Specifics are identified in the schedule under Monitoring/Reporting Requirements.

A computerized environmental data-screening system identifies analytical data that exceed pre-set limits. All locations are checked monthly for trends or notable results in accordance with criteria established in Documentation and Reporting of Environmental Monitoring Data (West Valley Nuclear Services Co., Inc. August 19, 1998). Reportable results are then described in the Monthly Trend Analysis Report (MTAR) together with possible causes and corrective actions, if indicated. A WVDP Effluent Summary Report (ESR) is transmitted with each MTAR.

Schedule of Environmental Sampling

The index on pp. B-v through B-vii is a list of the codes used to identify the various sampling locations, which are shown on Figures A-1 through A-12 (pp.A-3 through A-14 in Appendix A). The schedule of environmental sampling at the WVDP is found in this appendix on pages B-1 through B-44. Table headings in the schedule are as follows:

- ***Sample Location Code.*** Describes the physical location where the sample is collected. The code consists of seven or eight characters: The first character identifies the sample medium as **A**ir, **W**ater, **S**oil/**S**ediment, **B**iological, or **D**irect Measurement. The second character specifies o**N**-site or o**F**f-site. The remaining characters describe the specific location (e.g., **AFGRVAL** is **A**ir o**F**f-site at **GR**eat **VAL**ley). Distances noted at sampling locations are as measured in a straight line from the main stack on-site.

- ***Monitoring/Reporting Requirements***. Notes the bases for monitoring the location, any additional references to permits, and the reports that are generated from the sample data. Routine reports cited in this appendix are the Effluent Summary Report (ESR), the Monthly Trend Analysis Report (MTAR), the Air Emissions Report (NESHAP), and the annual Site Environmental Report (SER).

- ***Sampling Type/Medium.*** Describes the collection method and the physical characteristics of the medium.

- ***Collection Frequency.*** Indicates how often the samples are collected or retrieved.

- ***Total Annual Sample Collections.*** Specifies the number of discrete physical samples collected annually for each group of analytes.

- ***Analyses Performed/Composite Frequency.*** Notes the type of analyses of the samples taken at each collection, the frequency of composite, and the analytes determined for the composite samples.

Summary of Monitoring Program Changes in 1999

Location Code	Description of Changes
ANSTSTK	Stack monitoring equipment for the supernatant treatment system (STS)/permanent ventilation system (PVS) was upgraded in September 1999. Although the point of sample withdrawal remained the same in the PVS stack, associated equipment for real-time monitoring of stack effluents was relocated from the PVS building to a dedicated shelter nearby.
ANLAGAM	To accommodate replacement of the lag storage area (LSA)-4 waste storage structure, the on-site ambient air monitoring location for diffuse source emissions from the lag storage areas was co-located with stack monitoring equipment for the container sorting and packaging facility (ANCSPFK).

Index of Environmental Monitoring Program Sample Points

Air Effluent and On-site Ambient Air (Fig. A-4 [p. A-6])

Liquid Effluent and On-site Water (Figs.A-2 [p. A-4], A-3 [p.A-5], and A-12 [p. A-14])

* *Not detailed on map*

Index of Environmental Monitoring Program Sample Points

(continued)

On-site Groundwater and Seeps (Figs.A-7 and A-8 [pp.A-9 and A-10)

Off-site Surface Water (Fig.A-3 [p.A-5])

Off-site Drinking Water (Figs.A-9 and A-12 [pp.A-11 and A-14])

Off-site Ambient Air (Figs.A-5 and A-12 [pp. A-7 and A-14])

Index of Environmental Monitoring Program Sample Points

(concluded)

Fallout, Sediment, and Soil (Figs. A-2 through A-5 [pp.A-4 through A-7] and A-12 [p.A-14]

Off-site Biological (Figs. A-9 and A-12 [pp. A-11 and A-14])

Direct Measurement Dosimetry (Figs. A-10 through A-12 [pp. A-12 through A-14])

1999 Monitoring Program
On-site Effluent Monitoring

Air Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
ANSTACK *Main Plant Ventilation Exhaust Stack* **ANSTSTK** *Supernatant Treatment System (STS) Ventilation Exhaust* **ANCSSTK** *01-14 Building Ventilation Exhaust* **ANCSRFK** *Contact Size-reduction Facility Exhaust* **ANCSPFK** *Container Sorting and Packaging Facility Exhaust* **ANVITSK** *Vitrification HVAC Exhaust*	Airborne radioactive effluent points, including the LWTS and vitrification off-gas Required by: • 40 CFR 61 Reported in: • ESR • MTAR • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitors →	Continuous measurement of fixed filter; replaced weekly →	NA →	Real-time alpha and beta monitoring
		Continuous off-line air particulate filters →	Weekly →	52 each location →	Gross alpha/beta, gamma isotopic*
				Weekly filters composited to 4 each location →	Quarterly composites for Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic
		Continuous off-line desiccant columns for water vapor collection →	Weekly →	52 at each of two locations →	H-3 (**ANSTACK** and **ANSTSTK** only)
		Continuous off-line charcoal cartridges →	Weekly →	Weekly cartridges composited to 4 each location →	Quarterly composite for I-129
ANSEISK *Seismic Sampler, Vitrification Backup*	Airborne radioactive effluent point Required by: • 40 CFR 61 Reported in: • ESR • MTAR • SER	Continuous off-line air particulate filter →	Weekly →	52 →	Filters for gross alpha/ beta, gamma isotopic* upon collection

* Weekly gamma isotopic only if gross activity rises significantly.
NA Not applicable.

Sampling Rationale

ANSTACK DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Monitors and samples HEPA-filtered ventilation from most process areas, including cell ventilation, vessel off-gas, fuel receiving and storage (FRS), head end ventilation, and an analytical aisle. Requires continuous effluent monitoring per 40 CFR Subpart H, Section 61.93(b) because potential emissions may exceed the 0.1 mrem limit.

ANSTSTK DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Monitors and samples HEPA-filtered ventilation from building areas involved in treatment of high-level waste supernatant. Requires continuous effluent monitoring per 40 CFR Subpart H, Section 61.93(b) because potential emissions may exceed the 0.1 mrem limit.

ANCSSTK DOE/EH-0173T, 3.0; DOE-EP-0096, 3.3

Monitors and samples HEPA-filtered ventilation from the 01-14 building, which houses equipment used to treat the ceramic melter off-gas. Requires continuous effluent monitoring per 40 CFR Subpart H, Section 61.93(b) because potential emissions may exceed the 0.1 mrem limit.

ANCSRFK DOE/EH-0173T, 3.0; DOE-EP-0096, 3.3

Monitors and samples HEPA-filtered ventilation from a process area where radioactive tanks, pipes, and other equipment are cut up with a plasma torch to reduce volume.

ANCSPFK DOE/EH-0173T, 3.0; DOE-EP-0096, 3.3

Monitors and samples ventilation from lag storage area 4, the container sorting and packaging facility.

ANVITSK DOE/EH-0173T, 3.0; DOE-EP-0096, 3.3

Vitrification facility heating, ventilation, and air conditioning (HVAC) effluent exhaust stack. Sampler brought on-line in late 1995 when nonradioactive operations began. Radioactive operation began with the first high-level waste transfer in June 1996 and vitrification startup in July 1996.

ANSEISK DOE/EH-0173T, 3.0; DOE-EP-0096, 3.3

Vitrification system back-up filter for catastrophic-event monitoring in case the primary vitrification HVAC stack ventilation fails.

- Sampling locations are shown on Figure A-4 (p.A-6).

1999 Monitoring Program
On-site Effluent Monitoring

Air Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
OVEs/PVUs *Outdoor Ventilated Enclosures/Portable Ventilation Units*	Airborne radioactive effluent points Required by: • 40 CFR 61 Reported in: • ESR • MTAR • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter →	As required →	1 each location →	Filters for gross alpha/ beta, gamma isotopic* upon collection
				Collected filters** composited to 4 →	Quarterly composites for Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic

* Gamma isotopic only if gross activity rises significantly.

** If gross determination of individual filter is significantly higher than background, the individual sample would be submitted immediately for isotopic analysis.

Sampling Rationale

OVEs/PVUs DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Outdoor ventilated enclosures; portable ventilation units used for handling radioactive materials or for decontamination in areas not having containment ventilation.

■ Sampling locations are not shown on figures.

1999 Monitoring Program
On-site Effluent Monitoring

Air Effluents and On-site Ambient Air

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
ANLLW2V *Low-level Waste Treatment and Ventilation (new facility)* **ANLLWTVH** *Low-level Waste Treatment and Ventilation, "hot" side (former facility)* **ANLAUNV** *Laundry Change Room Ventilation*	Airborne radioactive effluent point Required by: • 40 CFR 61 Reported in: • ESR • MTAR • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter →	Quarterly →	4	Gross alpha/beta, gamma isotopic* upon collection
		Continuous off-line air particulate filter →	Weekly →	52	
		Continuous off-line air particulate filter →	Monthly →	12	
ANLAGAM *Lag Storage Area Ambient Air* **ANNDAAM** *NDA Ambient Air*	Ambient "diffuse source" air emissions Reported in: • MTAR • SER • Air Emissions Annual Report (NESHAP)	Continuous air particulate filter →	Weekly →	52 each location →	Gross alpha/beta
				Weekly filter composited to 4 each location →	Quarterly composites for Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic
ANSDAT9** *SDA Trench 9 Ambient Air*	Ambient "diffuse source" air emissions Reported in: • MTAR • SER • Reported to NYSERDA	Continuous air particulate filter →	Weekly →	52 →	Gross alpha/beta
				Weekly filter composited to 4 →	Quarterly composite for gamma isotopic
		Continuous off-line desiccant columns for water vapor →	Weekly →	52 →	H-3
		Continuous off-line charcoal cartridges →	Monthly →	Monthly cartridges composited to 4 →	Quarterly composite for I-129

* Gamma isotopic only if gross activity rises significantly.
** Sampling frequency and analytical parameters as directed by NYSERDA.

Sampling Rationale

ANLLW2V DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Samples ventilation exhaust from the new low-level waste treatment facility. System started up in April 1998.

ANLLWTVH DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Samples radioactive side of ventilation exhaust from the former low-level waste treatment facility.

ANLAUNV DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3

Samples ventilation from the contaminated clothing laundry.

ANLAGAM DOE/EH-0173T, 3.3.2

Monitors ambient air in the lag storage area, a possible diffuse source of air emissions.

ANNDAAM DOE/EH-0173T, 3.3.2

Monitors ambient air in the NDA area, a possible diffuse source of air emissions.

ANSDAT9 DOE/EH-0173T, 3.3.2

Monitors ambient air by SDA trench 9, a possible diffuse source of air emissions. WVDP support of NYSERDA.

- Sampling locations are shown on Figure A-4 (p. A-6).

1999 Monitoring Program
On-site Effluent Monitoring

Liquid Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP001 *Lagoon 3 Discharge Weir*	Primary point of liquid effluent batch release Required by: • SPDES permit Reported in: • Monthly SPDES DMR • ESR • MTAR • SER	Grab liquid →	Daily, during lagoon 3 discharge* →	28-80 →	Daily for gross beta, conductivity, flow
				5-14 →	Every 6 days a sample is analyzed for gross alpha/ beta, H-3, Sr-90, gamma isotopic
				Composite of daily samples for each discharge, 4-8 →	Weighted composite for gross alpha/beta, H-3, C-14, Tc-99, Sr-90, I-129, gamma isotopic, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, and Am-241 for each month of discharge
		Composite liquid →	Twice during discharge, near start and near end →	8-16 →	Two 24-hour composites for BOD_5, suspended solids, SO_4, NO_3, NO_2, NH_3, total Al, Fe, and Mn, total recoverable Cd, Cr, Cu, Ni, Pb, and Zn, dissolved As and Cu, dissolved sulfide
		Grab liquid →	Twice during discharge, near start and near end →	8-16 →	Settleable solids, total dissolved solids, pH, cyanide amenable to chlorination, oil & grease, surfactant (as LAS), total recoverable Co, Cr^{+6}, Se, and V, dichlorodifluoromethane, trichlorofluoromethane, 3,3-dichlorobenzidine, tributyl phosphate, hexachlorobenzene, alpha-BHC, heptachlor, xylene, 2-butanone
		Composite liquid →	Semiannual →	2 →	A 24-hour composite for titanium
		Composite liquid →	Annual →	1 →	A 24-hour composite for Ba and Sb
		Grab liquid →	Semiannual →	2 →	Bis(2-ethylhexyl) phthalate, 4-dodecene
		Grab liquid →	Annual →	1 →	Chloroform

* Lagoon 3 is discharged four to eight times per year, as necessary, averaging seven to ten days per discharge.

Sampling Rationale

WNSP001 DOE 5400.5; DOE/EH-0173T, 2.3.3; SPDES permit no. NY0000973

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

These requirements for radiological parameters are met by daily grab sampling during periods of lagoon 3 discharge. Sampling for chemical constituents is performed near the beginning and end of each discharge period to meet the site SPDES permit. Both grab samples and 24-hour composite samples are collected.

■ Sampling location is shown on Figure A-2 (p. A-4).

1999 Monitoring Program
On-site Effluent Monitoring

Liquid Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP006 *Frank's Creek at the Security Fence*	Combined facility liquid discharge Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • MTAR • SER	Timed continuous composite liquid →	Weekly →	52 →	Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12 →	Monthly composite for gamma isotopic and Sr-90 (shared with NYSDOH)
				Weekly samples composited to 4 →	Quarterly composite for C-14, I-129, U-232,U-233/234,U-235/236,U-238, total U, Pu-238, Pu-239/240, Am-241, Tc-99
		Grab liquid →	4 times during lagoon 3 discharge, 2 near start, 2 near end; 1 after discharge is complete →	8-16 →	TDS
		Grab liquid →	Semiannual →	2 →	NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WNURRAW *Utility Room Raw Water*	Source water Required by: • SPDES Permit Reported in: • Monthly SPDES DMR	Grab liquid →	Weekly →	52 →	Total Fe
		Grab liquid →	Once before discharge of lagoon 3 and twice during discharge, near start and near end →	8-16 →	TDS
WNSP007 *Sanitary Waste Discharge*	Liquid effluent point for sanitary and utility plant combined discharge Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • ESR • MTAR • SER	24-hour composite liquid →	3 each month →	36 →	Gross alpha/beta, H-3, pH, suspended solids, NH_3, NO_2-N, BOD_5, total Fe
				Monthly samples composited to 4 →	Quarterly composite for gamma isotopic
		Grab liquid →	3 each month →	36 →	Oil & grease
		Grab liquid →	Weekly →	52 →	pH, settleable solids, total residual chlorine
		Grab liquid →	Annual →	1 →	Chloroform

Sampling Rationale

WNSP006 DOE/EH-0173T, 5.10.1.1; SPDES permit no. NY0000973

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

In accordance with the WVDP SPDES permit no. NY0000973, outfall 116 (pseudo-monitoring point) uses flow data from WNSP006. Flow augmentation parameters (flow and total dissolved solids [TDS]) are monitored at location WNSP006; calculated TDS and flow data related to sample point WNSP006 are reported for pseudo-monitoring point 116 in the monthly SPDES Discharge Monitoring Report (DMR).

WNURRAW SPDES permit no. NY0000973

TDS is measured near the beginning and end of each lagoon 3 discharge. Results are used for outfall 116 calculations. (See **WNSP006**, above.)

WNSP007 DOE 5400.5; DOE/EH-0173T, 2.3.3

Sampling rationale is based on New York State SPDES permit no. NY0000973 and DOE 5400.5 criteria.

■ Sampling locations are shown on Figure A-2 (p. A-4).

1999 Monitoring Program
Environmental Surveillance

On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSWAMP *Northeast Swamp Drainage*	Site surface drainage Reported in: • ESR • MTAR • SER	Timed continuous composite liquid →	Weekly →	52 →	Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12 →	Monthly composite for gamma isotopic and Sr-90 (shared with NYSDOH)
				Weekly samples composited to 4 →	Quarterly composite for C-14, I-129, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
		Grab liquid →	Semiannual →	2 →	NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WNSW74A *North Swamp Drainage*	Site surface drainage Reported in: • ESR • MTAR • SER	Timed continuous composite liquid →	Weekly →	52 →	Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12 →	Monthly composite for gamma isotopic and Sr-90
				Weekly samples composited to 4 →	Quarterly composite for C-14, I-129, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
		Grab liquid →	Semiannual →	2 →	NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WN8D1DR *High-level Waste Farm Underdrain*	Drains subsurface water from HLW storage tank area Reported in: • MTAR • SER	Grab liquid →	Weekly →	52 →	Gross alpha/beta, H-3, pH
				Weekly samples composited to 12 →	Monthly composite for gamma isotopic and Sr-90
WNSDADR *SDA Run-off*	Surface water run-off from south portion of SDA Required by: • Interim Measures Compliance Reported in: • MTAR • SER • Reported to NYSERDA	Grab liquid →	Monthly →	12 maximum →	pH, total suspended solids, oil & grease, flow, gross alpha/beta, H-3, gamma isotopic

Sampling Rationale

WNSWAMP DOE/EH-0173T, 5.10.1.1

Northeast site surface water drainage; provides for sampling of uncontrolled surface waters from this discrete drainage path just before they leave the site's controlled boundary. Waters represent surface and subsurface drainages from the construction and demolition debris landfill (CDDL), old hardstand areas, and other possible north plateau sources of radiological or nonradiological contamination.

WNSW74A DOE/EH-0173T, 5.10.1.1

North site surface water drainage; provides for sampling of uncontrolled surface waters from this discrete drainage path just before they leave the site's controlled boundary. Waters represent surface and subsurface drainages from lag storage areas and other possible north plateau sources of radiological or nonradiological contamination.

WN8D1DR DOE/EH-0173T, 5.10.1.3

Monitors the potential influence on subsurface drainage surrounding the high-level waste tank farm.

WNSDADR NYSERDA interim measures compliance.

WVDP support of NYSERDA. Monitors surface water run-off from south portion of the SDA.

■ Sampling locations are shown on Figure A-2 (p. A-4).

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On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP008 *French Drain*	Drains subsurface water from LLWTF lagoon area Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • ESR • MTAR • SER	Grab liquid →	Monthly →	12 →	Gross alpha/beta, H-3
		Grab liquid →	3 each month →	36 →	Conductivity, pH, BOD_5, total Fe, total recoverable Cd and Pb
		Grab liquid →	Annual →	1 →	As, Cr, total Ag and Zn
WNSP005 *Facility Yard Drainage*	Combined drainage from facility yard area Reported in: • MTAR • SER	Grab liquid →	Monthly →	12 →	Gross alpha/beta, H-3, pH
WNCOOLW *Cooling Tower Basin*	Cools plant utility steam system water Reported in: • MTAR • SER	Grab liquid →	Monthly →	12 →	Gross alpha/beta, H-3, pH
				Monthly samples composited to 4 →	Quarterly composite for gamma isotopic

Sampling Rationale

WNSP008 DOE/EH-0173T, 5.10.1.3; SPDES permit no. NY0000973.

French drain of subsurface water from lagoon (LLWTF) area. The SPDES permit also provides for sampling of uncontrolled subsurface water from this discrete drainage path before these waters flow into Erdman Brook. Waters represent subsurface drainages from downward infiltration around the LLWTF and lagoon systems. This point would also monitor any subsurface spillover from the overfilling of lagoons 2 and 3. Sampling is of significance for both radiological and nonradiological contamination.

WNSP005 Facility yard surface water drainage; generally in accordance with DOE/EH-0173T, 5.10.1.1. Previously in accordance with SPDES permit no. NY0000973.

Provides for the sampling of uncontrolled surface waters from this discrete drainage path after outfall 007 discharge into the drainage and before these waters flow into Erdman Brook. Waters represent surface and subsurface drainages primarily from the main plant yard area. Historically, this point was used to monitor sludge pond and utility room discharges to the drainage. These two sources have been rerouted. Migration of residual site contamination around the main plant dictates surveillance of this point, primarily for radiological parameters.

WNCOOLW Facility cooling tower circulation water; generally in accordance with DOE/EH-0173T, 5.10.1.1.

Operational sampling carried out to confirm that radiological contamination is not migrating into the primary coolant loop of the HLWTF and/or plant utility steam systems. Migration from either source might indicate radiological control failure.

■ Sampling locations are shown on Figure A-2 (p. A-4).

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On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNFRC67* *Frank's Creek East of the SDA*	Drains NYS Low-level Waste Disposal Area Reported in: • MTAR • SER • Reported to NYSERDA	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNERB53* *Erdman Brook North of Disposal Areas*	Drains NYS and WVDP disposal areas Reported in: • MTAR • SER • Reported to NYSERDA	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
WNNDADR *Drainage between NDA and SDA*	Drains WVDP disposal and storage area Reported in: • MTAR • SER • Reported to NYSERDA	Timed continuous composite liquid	→ Weekly	→ 52	→ pH
				Weekly samples composited to 12	→ Monthly composite for gross alpha/beta, gamma isotopic, H-3
				Weekly samples composited to 4	→ Quarterly composite for Sr-90, I-129
		Grab liquid	→ Weekly	→ 52	→ NPOC, TOX
WNDCELD *Drainage South of Drum Cell*	Drains WVDP storage area Reported in: • MTAR • SER • Reported to NYSERDA	Grab liquid	→ Monthly	→ 12	→ pH, gross alpha/beta
				Monthly samples composited to 4	→ Quarterly composite for Sr-90, I-129, gamma isotopic, H-3
WNNDATR** *NDA Trench Interceptor Project*	On-site groundwater interception Reported in: • MTAR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, gamma isotopic, NPOC, TOX
				Monthly samples composited to 4	→ Quarterly composite for I-129

* Monthly sample shared with NYSDOH.
** Coordinated with Waste Management Operations.

Sampling Rationale

WNFRC67 DOE/EH-0173T, 5.10.1.1

Monitors the potential influence of both the SDA and drum cell drainage into Frank's Creek east of the SDA and upstream of its confluence with Erdman Brook.

WNERB53 DOE/EH-0173T, 5.10.1.1

Monitors the potential influence of the drainages from the SDA and the WVDP storage and disposal area into Erdman Brook upstream of its confluence with Frank's Creek.

WNNDADR DOE/EH-0173T, 5.10.1.1

Monitors the potential influence of the drainages from the SDA and the WVDP storage and disposal area into Lagoon Road Creek upstream of the creek's confluence with Erdman Brook.

WNDCELD DOE/EH-0173T, 5.10.1.1

Monitors the potential influence of drum cell drainage into Frank's Creek south of the SDA and upstream of WNFRC67.

WNNDATR DOE 5400.1, IV.9

Monitors groundwater in the vicinity of the NDA interceptor trench project. The grab sample is taken directly from the trench collection system.

■ Sampling locations are shown on Figure A-2 (p. A-4).

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On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSTAW Series *On-site standing water ponds not receiving effluent* **WNSTAW4** *Border Pond Southwest of AFRT240* **WNSTAW5** *Border Pond Southwest of DFTLD13* **WNSTAW6** *Borrow Pit Northeast of Project Facilities* **WNSTAW9** *North Reservoir near Intake* **WNSTAWB** *Background Pond at Sprague Brook Maintenance Building*	Water within vicinity of airborne or water effluent from the plant <u>Reported in:</u> • MTAR • SER	Grab liquid →	Annual →	1 each location* →	Gross alpha/beta, H-3, pH, conductivity, Cl, Fe, Mn, Na, NO_3+NO_2-N, SO_4

* Sampling depends upon on-site ponding conditions during the year.

Sampling Rationale

WNSTAW Series DOE/EH-0173T, 5.10.1.1

Monitoring of on- and off-site standing waters at locations listed below. Although none receive effluent directly, the potential for contamination is present except at the background location. Former collecting sites 1,2,3,7, and 8 were deleted from the monitoring program because they were either built over or are now dry.

WNSTAW4 Border pond located south of AFRT240. Chosen as a location for showing potentially high concentrations, based on meteorological data. This perimeter location is next to a working farm. Drainage extends through private property and is accessible by the public.

WNSTAW5 Border pond located west of Project facilities near the perimeter fence and DFTLD13. Chosen as a location for showing potentially high concentrations, based on meteorological data. Location is next to a private residence and potentially accessible by the general public.

WNSTAW6 Borrow pit northeast of Project facilities just outside the inner security fence. Considered the closest standing water to the main plant and high-level waste facilities. (Used in lieu of WNSTAW1.)

WNSTAW9 North reservoir near intake. Chosen to provide data in the event of potentially contaminated site potable water supply. Location is south of main plant facilities.

WNSTAWB Pond located near the Sprague Brook maintenance building. Considered a background location; approximately 14 kilometers north of the WVDP.

■ Sampling locations are shown on Figures A-2, A-3, and A-12 (pp. A-4, A-5, and A-14).

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On-site Potable Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNDNK Series *Site Potable Water*	Sources of potable water within site perimeter	Grab liquid →	Monthly →	12 per location →	Gross alpha/beta, H-3, pH, conductivity
WNDNKMS *Maintenance Shop Drinking Water*	Reported in: • MTAR • SER • Also reported to Cattaraugus County				
WNDNKMP *Main Plant Drinking Water*					
WNDNKEL *Environmental Laboratory Drinking Water*					
WNDNKUR *Utility Room (EP-1) Potable Water Storage Tank*		Grab liquid* →	Annual →	1 →	As, Ba, Cd, Cr, Hg, Se, fluoride, NO_3 (as total nitrate)

* WNDNKUR only. Sample for NO_3 to be collected in March. Pb and Cu also are sampled at this site based upon Cattaraugus County Health Department guidance.

Sampling Rationale

WNDNK Series Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2

Potable-water sampling to confirm no migration of radiological and/or nonradiological contamination into the site's drinking water supply.

WNDNKMS Potable water sampled at the maintenance shop in order to monitor a point that is at an intermediate distance from the point of potable water generation and that is used heavily by site personnel.

WNDNKMP Same rationale as WNDNKMS but sampled at the break room sink.

WNDNKEL Potable water sampled at the Environmental Laboratory.

WNDNKUR Sampled at the utility room potable water storage tank before the site drinking water distribution system. Sample location is entry point EP-1.

■ Sampling locations are within the site facilities and are not detailed on figures.

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On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
Low-level Waste Treatment Facilities *(SSWMU #1)* 103 104 U 105 106 107 108 110 111 116 U 8604 U 8605 **Miscellaneous Small Units** *(SSWMU #2)* 201 U 204 U 205 206 208 **Liquid Waste Treatment System** *(SSWMU #3)* 301 B 302 U	Groundwater monitoring points around site super solid waste management units (SSWMUs) Reported in: • SER • Quarterly Groundwater Reports	Grab liquid →	4 times per year (generally)* →	4 each well (generally)* →	Gross alpha, gross beta, H-3 *
		Direct field measurement of sample discharge water →	Each sampling event* →	Twice each sampling event →	Conductivity, pH

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells. The remainder are downgradient.

* Sampling frequency and analytes vary from point to point. See Table 3-1 (p.3-6) for a summary sampling schedule and a listing of analytes. See Table E-1 (Appendix E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for results from each location.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F The on-site WVDP groundwater monitoring program provides for the determination of water quality, focusing on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Plan, WVDP-091. Groundwater monitoring is detailed in the Groundwater Monitoring Plan, WVDP-239.
SSWMU #1	Low-level waste treatment facilities, including four active lagoons — lagoons 2, 3, 4, and 5 — and an inactive, filled-in lagoon — lagoon 1.
SSWMU #2	Miscellaneous small units, including the sludge pond, the solvent dike, the paper incinerator, the equalization basin, and the kerosene tank.
SSWMU #3	Liquid waste treatment system containing effluent from the supernatant treatment system.

■ Sampling locations are shown on Figure A-7 (p.A-9).

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On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
HLW Storage and Processing Tank *(SSWMU #4)* 401 B 402 U 403 U 405 C 406 408 409 **Maintenance Shop Leach Field** *(SSWMU #5)* 501 U 502 **Low-level Waste Storage Area** *(SSWMU #6)* 602A 602 604 605 8607 U 8609 U **Chemical Process Cell Waste Storage Area** *(SSWMU #7)* 704 706 B 707	Groundwater monitoring points around site super solid waste management units (SSWMUs) Reported in: • SER • Quarterly Groundwater Reports	Grab liquid →	4 times per year (generally)* →	4 each well (generally)* →	Gross alpha, gross beta, H-3 *
		Direct field measurement of sample discharge water →	Each sampling event* →	Twice each sampling event →	Conductivity, pH

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells. The remainder are downgradient.

* Sampling frequency and analytes vary from point to point. See Table 3-1 (p. 3-6) for a summary sampling schedule and a listing of analytes. See Table E-1 (Appendix E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for results from each location.

Sampling Rationale

On-site Groundwater

DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F

The on-site WVDP groundwater monitoring program provides for the determination of water quality, focusing on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Plan, WVDP-091. Groundwater monitoring is detailed in the Groundwater Monitoring Plan, WVDP-239.

SSWMU #4 High-level waste storage and processing area, including the high-level radioactive waste tanks, the supernatant treatment system, and the vitrification facility.

SSWMU #5 Maintenance shop sanitary leach field, formerly used by NFS and the WVDP to process domestic sewage generated by the maintenance shop.

SSWMU #6 Low-level waste storage area; includes metal and fabric structures housing low-level radioactive waste being stored for future disposal.

SSWMU #7 Chemical process cell (CPC) waste storage area, which contains packages of pipes, vessels, and debris from decontamination and cleanup of the chemical process cell in the former reprocessing plant.

■ Sampling locations are shown on Figure A-7 (p.A-9).

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On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
Construction and Demolition Debris Landfill (CDDL) *(SSWMU #8)* 801 U 802 803 804 8603 U 8612	Groundwater monitoring points around site super solid waste management units (SSWMUs)	Grab liquid →	4 times per year (generally)* →	4 each well (generally)* →	Gross alpha, gross beta, H-3 *
NRC-licensed Disposal Area (NDA) *(SSWMU #9)* 901 U 902 U 903 906 908 U 909 910 8610 8611 NDATR	Reported in: • SER • Quarterly Groundwater Reports	Direct field measurement of sample discharge water →	Each sampling event* →	Twice each sampling event →	Conductivity, pH
IRTS Drum Cell *(SSWMU #10)* 1005 U 1006 1007 1008b B 1008c B					

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells. The remainder are downgradient.

* Sampling frequency and analytes vary from point to point. See Table 3-1 (p.3-6) for a summary sampling schedule and a listing of analytes. See Table E-1 (Appendix E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for results from each location.

Sampling Rationale

On-site Groundwater

DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F

The on-site WVDP groundwater monitoring program provides for the determination of water quality, focusing on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Plan, WVDP-091. Groundwater monitoring is detailed in the Groundwater Monitoring Plan, WVDP-239.

SSWMU #8 The construction and demolition debris landfill (CDDL); used by NFS and the WVDP to dispose of nonhazardous and nonradioactive materials.

SSWMU #9 The NRC-licensed disposal area (NDA); contains radioactive wastes generated by NFS and the WVDP.

SSWMU #10 The integrated radioactive waste system (IRTS) treatment drum cell; stores cement-stablized low-level radioactive waste.

■ Sampling locations are shown on Figures A-6 and A-7 (pp.A-9 and A-10).

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On-site Groundwater and Seeps

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
State-licensed Disposal Area *(SSWMU #11)** 1101a U 1101b U 1101c U 1102a 1102b 1103a 1103b 1103c 1104a 1104b 1104c 1105a 1105b 1106a U 1106b U 1107a 1108a U 1109a U 1109b U 1110a 1111a	Groundwater monitoring points around site super solid waste management units (SSWMUs) Reported in: • SER	Grab liquid →	Semiannual →	2 each well →	Gross alpha/beta, H-3, pH, conductivity, turbidity
		Grab liquid →	Annual →	1 each well →	Gamma scan, beta-emitters (C-14, Sr-90, I-129, Tc-99), VOCs
North Plateau Seeps *(Not in a SSWMU)* GSEEP SP02 SP04 SP05 SP06 SP11 SP12 SP18 SP23	Groundwater seepage points along the northeastern edge of the north plateau Reported in: • SER • Quarterly Groundwater Reports	Grab liquid →	Semiannual →	2 each seep →	Gross alpha/beta, H-3 (pH, conductivity, and VOCs at SP12)
Miscellaneous *Well Points (Not in a SSWMU)* WP-A WP-C WP-H	Well points downgradient of main plant and the former sand and gravel unit background well Reported in: • SER • Quarterly Groundwater Reports	Grab liquid →	Annual →	1 each well →	Gross alpha/beta, H-3, pH, conductivity
NB1S *(Former background well)*		Field measurement →	Quarterly →	4 →	pH, conductivity
		Grab liquid →	Quarterly →	4 →	Gross alpha/beta, H-3

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells. The remainder are downgradient.
* SSWMU #11 is sampled by NYSERDA under a separate program.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F The on-site WVDP groundwater monitoring program provides for the determination of water quality, focusing on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Plan, WVDP-091. Groundwater monitoring is detailed in the Groundwater Monitoring Plan, WVDP-239.
SSWMU #11	The New York State-licensed disposal area (SDA) was operated by NFS as a commercial low-level disposal facility; it also received wastes from NFS reprocessing operations.
North Plateau Seeps	Monitor groundwater emanating from the ground surface along the edge of the site's north plateau.
Well Points	Monitor groundwater of known subsurface contamination in the north plateau area. All well points are downgradient of the main plant.
WNWNB1S	Former background well on the north plateau.

■ Sampling locations are shown on Figures A-7 and A-8 (pp.A-9 and A-10).

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Off-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WFBCTCB* *Buttermilk Creek Upstream of Confluence with Cattaraugus Creek at Thomas Corners Road*	Restricted surface waters receiving plant effluents Reported in: • MTAR • SER	Timed continuous composite liquid →	Weekly →	52 →	pH, conductivity
				Weekly samples composited to 12 →	Monthly composite for gross alpha/beta, H-3
				Weekly samples composited to 4 →	Quarterly composite for gamma isotopic and Sr-90
WFFELBR* *Cattaraugus Creek at Felton Bridge*	Unrestricted surface waters receiving plant effluents Reported in: • MTAR • SER	Timed continuous composite liquid →	Weekly →	52 →	Gross alpha/beta, H-3, pH
				Weekly samples composited to 12 →	Flow-weighted monthly composite for gamma isotopic and Sr-90, gross alpha/beta, H-3
WFBCBKG* *Buttermilk Creek near Fox Valley (back-ground)*	Unrestricted surface water, background Reported in: • MTAR • SER • Reported to NYSERDA	Timed continuous composite liquid →	Weekly →	52 →	pH, conductivity
				Weekly samples composited to 12 →	Monthly composite for gross alpha/beta, H-3
				Weekly samples composited to 4 →	Quarterly composite for gamma isotopic, Sr-90, C-14, I-129, U-232, U-233/234,U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, Tc-99
		Grab liquid →	Semiannual →	2 →	NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WFBIGBR *Cattaraugus Creek at Bigelow Bridge (background)*	Unrestricted surface water, background Reported in: • MTAR • SER	Grab liquid →	Monthly →	12 →	Gross alpha/beta, H-3, Sr-90, gamma isotopic

* Monthly composites are also sent to NYSDOH.

Sampling Rationale

WFBCTCB DOE/EH-0173T, 5.10.1.1

Buttermilk Creek is the surface water that receives all WVDP effluents. WFBCTCB monitors the potential influence of WVDP drainage into Buttermilk Creek upstream of Buttermilk Creek's confluence with Cattaraugus Creek.

WFFELBR DOE/EH-0173T, 5.10.1.1

Because Buttermilk Creek empties into Cattaraugus Creek, WFFELBR monitors the potential influence of WVDP drainage into Cattaraugus Creek directly downstream of the Cattaraugus Creek confluence with Buttermilk Creek.

WFBCBKG DOE/EH-0173T, 5.10.1.1

Monitors background conditions of Buttermilk Creek upstream of the WVDP; allows comparison to downstream conditions.

WFBIGBR DOE/EH-0173T, 5.10.1.1

Monitors background conditions of Cattaraugus Creek at Bigelow Bridge, upstream of the WVDP; allows comparison to downstream conditions.

■ Sampling locations are shown on Figure A-3 (p. A-5).

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Off-site Drinking Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WFWEL Series *Wells outside the WNYNSC perimeter but near the WVDP* **WFWEL01** *3.0 km West-Northwest* **WFWEL02** *1.5 km Northwest* **WFWEL03** *3.5 km Northwest* **WFWEL04** *3.0 km Northwest* **WFWEL05** *2.5 km Southwest* **WFWEL06** *(background)* *29 km South* **WFWEL07** *4.4 km North-Northeast* **WFWEL08** *2.5 km East-Northeast* **WFWEL09** *3.0 km Southeast* **WFWEL10** *7.0 km North*	Drinking water supply; groundwater near facility* Reported in: • MTAR • SER	Grab liquid →	Annual →	1 each location →	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

* No drinking water wells are located in hydrogeological units affected by site activity.

Sampling Rationale

Off-site
Drinking Water
WFWEL Series DOE 5400.1, IV.9; DOE/EH-0173T, 5.10.1.2

Eight of the ten listed off-site private residential drinking water wells represent the nearest unrestricted uses of groundwater close to the WVDP. The ninth sample (**WFWEL10**) is taken from a public water supply from deep wells. The tenth drinking water well, **WFWEL06**, is located 29 kilometers south of the Project and is considered a background drinking water source.

■ Sampling locations are shown on Figures A-9 and A-12 (pp. A-11 and A-14).

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Off-site Air

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
AFFXVRD *3.0 km South-Southeast at Fox Valley* **AFTCORD** *3.7 km North-Northwest at Thomas Corners Road* **AFRT240*** *2.0 km Northeast on Route 240* **AFSPRVL** *9.4 km North at Springville* **AFWEVAL** *6.2 km South-Southeast at West Valley* **AFNASHV** *39.8 km West at Village of Nashville, Town of Hanover (background)* **AFBOEHN** *2.3 km Southwest on Dutch Hill Road* **AFRSPRD** *1.5 km Northwest on Rock Springs Road* **AFGRVAL** *30.9 km South at Great Valley (background)* **AFBLKST** *Bulk Storage Warehouse 2.2 km East-Southeast at Buttermilk Road*	Particulate air samples around WNYNSC perimeter Reported in: • MTAR • SER	Continuous air particulate filter →	Weekly →	52 each location →	Gross alpha/beta
				Weekly filters composited to 4 each location →	Quarterly composite for Sr-90 and gamma isotopic (plus U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, and Am-241 at **AFRSPRD** and **AFGRVAL)**
		Continuous desiccant column for water vapor collection at **AFRSPRD** and **AFGRVAL** →	Weekly →	52 each location →	H-3
		Continuous charcoal cartridge at **AFRSPRD** and **AFGRVAL** →	Monthly →	12 composited to 4 each location →	Quarterly composite for I-129

* Filter from duplicate sampler sent to NYSDOH.

Sampling Rationale

AFFXVRD
AFTCORD
AFRT240 DOE/EH-0173T, 5.7.4

Air samplers put into service by NFS as part of the site's original monitoring program at perimeter locations chosen to obtain data from places most likely to provide highest concentrations. Choice of location based on meteorological data.

AFSPRVL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3

Off-site (remote) sampler located on private property in nearby community within 15 kilometers of the site (north).

AFWEVAL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3

Off-site (remote) sampler located on private property in nearby community within 15 kilometers of the site (southeast).

AFNASHV DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3

Off-site (remote) sampler considered representative of natural background radiation. Located 39.8 kilometers west of the site (upwind) on privately owned property.

AFBOEHN DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3

Perimeter location chosen to obtain data from the place most likely to provide the highest elevated release concentrations. AFBOEHN is located on NYSERDA property at the perimeter. Choice of location based on meteorological data.

AFRSPRD DOE/EH-0173T, 5.7.4

Perimeter location chosen to obtain data from the place most likely to provide the highest ground-level release concentrations. AFRSPRD is on WNYNSC property outside the main plant operations fenceline. I-129 and H-3 are sampled here because the sampling trains were easy to incorporate and the location was most likely to receive effluent releases. Choice of location based on meteorological data.

AFGRVAL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3

Off-site (remote) sampler considered representative of natural background radiation. Located on privately owned property 30.9 kilometers south of the site (typically upwind). I-129 and H-3 sampled here also.

AFBLKST DOE/EH-0173T, 5.7.4

Off-site monitoring of bulk storage warehouse, near the site perimeter.

■ Sampling locations are shown on Figures A-5 and A-12 (pp. A-7 and A-14).

1999 Monitoring Program
Environmental Surveillance

Fallout, Sediment, and Soil

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
AFDHFOP *2.3 km Southwest* **AFFXFOP** *3.0 km South-Southeast* **AFTCFOP** *3.7 km North-Northwest* **AF24FOP** *2.0 km Northeast* **ANRGFOP** *Rain gauge on-site*	Collection of fallout particulates and precipitation around the WNYNSC perimeter Reported in: • MTAR • SER	Integrated precipitation →	Monthly →	12 each location →	Gross alpha/beta, H-3, pH, gamma isotopic
SF Soil Series *Surface soil at each of 10 air samplers*	Long-term fallout accumulation Reported in: • MTAR • SER	Surface plug composite soil →	Annual →	1 each location →	Gross alpha/beta, gamma isotopic, Sr-90, Pu-239/240, and Am-241 (plus U-232, U-233/234, U-235/236, U-238, and total U at **SFRSPRD**, **SFBOEHN**, and **SFGRVAL)**
SFCCSED *Cattaraugus Creek at Felton Bridge* **SFSDSED** *Cattaraugus Creek at Springville Dam* **SFBISED** *Cattaraugus Creek at Bigelow Bridge (background)* **SFTCSED** *Buttermilk Creek at Thomas Corners Road* **SFBCSED** *Buttermilk Creek at Fox Valley Road (background)*	Deposition in sediment downstream of facility effluents Reported in: • MTAR • SER	Grab stream sediment →	Annual (Split **SFSDSED** and **SFBCSED** with NYSDOH) →	1 each location →	Gross alpha/beta, gamma isotopic, Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, and Am-241
SN On-site Soil Series: **SNSW74A** *(Near WNSW74A)* **SNSWAMP** *(Near WNSWAMP)* **SNSP006** *(Near WNSP006)*	Reported in: • MTAR • SER	Surface plug or grab →	Annual →	1 each location →	Gross alpha/beta, gamma isotopic, Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-239/240, and Am-241, Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn

Sampling Rationale

AFDHFOP
AFFXFOP
AFTCFOP
AF24FOP DOE/EP-0023, 4.7

Collection of fallout particles and precipitation around the site perimeter at established air sampling locations: **AFDHFOP** (Dutch Hill at Boehn Road), **AFFXFOP** (Fox Valley Road), **AFTCFOP** (Thomas Corners), **AF24FOP** (Route 240). Indicates short-term effects.

ANRGFOP Fallout particles and precipitation collected on-site by the Environmental Laboratory at the rain gauge. Indicates short-term effects.

SF Soil Series DOE/EH-0173T, 5.9.1

Off-site soils collected at air sampling locations. **SFWEVAL** (West Valley), **SFFXVRD** (Fox Valley Road), **SFSPRVL** (Springville), **SFTCORD** (Thomas Corners), **SFRT240** (Route 240), **SFNASHV** (Nashville), **SFBOEHN** (Boehn Road-Dutch Hill), **SFGRVAL** (Great Valley), **SFRSPRD** (Rock Springs Road), **SFBLKST** (bulk storage warehouse): Collection of long-term fallout data at established air sampler locations via soil sampling.

SFCCSED DOE/EH-0173T, 5.12.1

Sediment deposition at Cattaraugus Creek at Felton Bridge. Location is first point of public access to Cattaraugus Creek downstream of its confluence with Buttermilk Creek.

SFSDSED DOE/EH-0173T, 5.12.1

Sediment deposition in Cattaraugus Creek at Springville Dam. Reservoir provides ideal settling and collection location for sediments downstream of Buttermilk Creek confluence with Cattaraugus Creek. Located downstream of **SFCCSED**.

SFBISED DOE/EH-0173T, 5.12.1

Sediment deposition in Cattaraugus Creek at Bigelow Bridge. Location is upstream of the Buttermilk Creek confluence and serves as the Cattaraugus Creek background location.

SFTCSED DOE/EH-0173T, 5.12.1

Sediment deposition in Thomas Corners in Buttermilk Creek immediately downstream of all facility liquid effluents.

SFBCSED DOE/EH-0173T, 5.12.1

Sediment deposition in Buttermilk Creek upsteam of facility effluents (background).

SN Soil Series DOE/EH-0173T, 5.9.1.

On-site soil. (Samples may be partially composed of sediments.) **SNSW74A** (surface soil near **WNSW74A**), **SNSWAMP** (surface soil near **WNSWAMP**), and **SNSP006** (surface soil near **WNSP006**): Locations to be specifically defined by geographic coordinates. Correspond to site drainage pattern flows (i.e., most likely area of radiological deposition/accumulation).

■ Sampling locations are shown on Figures A-2 through A-5 and A-12 (pp.A-4 through A-7 and A-14).

1999 Monitoring Program
Environmental Surveillance

Off-site Biological

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
BFFCATC *Fish from Cattaraugus Creek downstream of its confluence with Buttermilk Creek* **BFFCATD** *Fish from Cattaraugus Creek downstream of the Springville Dam* **BFFCTRL** *Control fish sample from nearby stream not affected by the WVDP (7 km or more upstream of site effluent point; background)*	Fish in waters up- and downstream of facility effluents Reported in: • MTAR • SER	Individual collection, biological →	Semiannual (samples at **BFFCATC** and **BFFCTRL** shared with NYSDOH) →	20 fish each location →	Gamma isotopic and Sr-90 in edible portions of each individual fish; % moisture
			Annual (**BFFCATD** only) →	10 fish →	Gamma isotopic and Sr-90 in edible portions of each individual fish; % moisture
BFMREED *Dairy farm 3.8 km North-Northwest* **BFMCOBO** *Dairy farm 1.9 km West-Northwest* **BFMCTLS** *Control location 25 km South (background)* **BFMCTLN** *Control location 30 km North (background)*	Milk from animals foraging at locations near the facility perimeter and at background sites Milk from animals foraging at background sites Reported in: • MTAR • SER	Grab biological →	Monthly (samples at **BFMREED** and **BFMCOBO** shared with NYSDOH) →	12 monthly samples composited to 4 each location →	Quarterly composite for gamma isotopic, Sr-90, H-3, and I-129
BFMWIDR *Dairy farm 3.0 km Southeast* **BFMSCHT** *Dairy farm 4.8 km South*	Milk from animals foraging near the site perimeter Reported in: • MTAR • SER	Grab biological →	Annual →	1 each location →	Gamma isotopic, Sr-90, H-3, and I-129

Sampling Rationale

BFFCATC **BFTCATD**	DOE/EH-0173T, 5.11.1.1 Radioactivity may enter a food chain in which fish are a major component and are consumed by the local population.
BFFCTRL	Control fish sample; provide background data for comparison with data from fish caught downstream of facility effluents.
BFMREED **BFMCOBO** **BFMCTLS** **BFMCTLN**	DOE/EH-0173T, 5.8.2.1 Milk is consumed by all age groups and is frequently the most important food that could contribute to the radiation dose. Dairy animals pastured near the site and at two background locations allow adequate monitoring. Control milk samples are collected far from the site to provide background data for comparison with data from near-site milk samples.
BFMWIDR **BFMSCHT**	Milk from animals foraging around facility perimeter.

■ Sampling locations are shown on Figures A-9 and A-12 (pp. A-11 and A-14).

1999 Monitoring Program
Environmental Surveillance

Off-site Biological

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
BFVNEAR *Nearby locations* **BFVCTRL** *Remote locations (16 km or more from facility; background)*	Fruit and vegetables grown near facility perimeter, downwind if possible, and at background locations. Reported in: • MTAR • SER	Grab biological (fruits and vegetables)	→ Annual (at harvest)	→ 3 each (split with NYSDOH)	→ Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture; % moisture
BFHNEAR *Forage for beef cattle/ milk cows from near-site location* **BFHCTLS or BFHCTLN** *Forage for beef cattle/ milk cows from control location south or north (background)*	Forage (hay) grown near facility perimeter, downwind if possible, and at background locations. Reported in: • MTAR • SER	Grab biological	→ Annual	→ 1 each location	→ Gamma isotopic, Sr-90
BFBNEAR *Beef animal from nearby farm in downwind direction* **BFBCTRL** *Beef animal from control location 16 km or more from facility (background)*	Meat (beef foraging near facility perimeter, downwind if possible, and a background location). Reported in: • MTAR • SER	Grab biological	→ Semiannual	→ 2 each location	→ Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture; % moisture
BFDNEAR *Deer in vicinity of the site* **BFDCTRL** *Control deer 16 km or more from the facility (background)*	Venison (deer foraging near facility perimeter and at background locations). Reported in: • MTAR • SER	Individual collection, biological	→ Annual, during hunting season (**BFDNEAR** sample split with NYSDOH); During year as available (**BFDCTRL** sample split with NYSDOH)	→ 3; → 3	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture; % moisture

Sampling Rationale

BFVNEAR DOE/EH-0173T, 5.8.2.2

Fruits and vegetables (corn, apples, and beans or leafy vegetables, if available) collected from areas near the site. These samples are collected, if possible, from areas near the site predicted to have worst-case downwind concentrations of radionuclides in air and soil. Sample analysis reflects steady state/chronic uptake or contamination of foodstuffs as a result of site activities. Possible pathway directly to humans or indirectly through animals.

BFVCTRL DOE/EH-0173T, 5.8.2.2

Fruits and vegetables collected from an area remote from the site. Background fruits and vegetables collected for comparison with near-site samples. Collected in area(s) of no possible site effects.

BFHNEAR DOE/EH-0173T, 5.8.2.2

Hay collected from area near the site. Same as for near-site fruits and vegetables (**BFVNEAR**). Indirect pathway to humans through animals. Collected from same location as beef or milk sample.

BFHCTLS
BFHCTLN DOE/EH-0173T, 5.8.2.2

Hay collected from areas remote from the site. Background hay collected for comparison with near-site samples. Collected in area(s) of no possible effects from the site.

BFBNEAR DOE/EH-0173T, 5.8.2.3

Beef collected from animals raised near the site and foraging downwind of the site in areas of maximum probable effects. Following the rationale for vegetable matter collected near the site (**BFVNEAR** and **BFHNEAR**), edible flesh portion of beef animals is analyzed to determine possible radionuclide content passable directly to humans.

BFBCTRL DOE/EH-0173T, 5.8.2.3

Beef collected from animals raised far from the site. Background beef collected for comparison with near-site samples. Collected in area(s) of no possible site effects.

BFDNEAR DOE/EH-0173T, 5.8.3

Venison from deer herd found living near the site. Same as for beef (**BFBNEAR**).

BFDCTRL DOE/EH-0173T, 5.8.3

Venison from deer herd found living far from the site. Background deer meat collected for comparison with near-site samples. Collected in area(s) of no possible site effects.

■ Sampling locations are shown on Figures A-9 and A-12 (pp. A-11 and A-14).

1999 Monitoring Program
Environmental Surveillance

Off-site Direct Radiation

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
DFTLD Series *Thermoluminescent Dosimetry (TLD) Off-site:* **#1-#16** *Each of 16 Compass Sectors at Nearest Accessible Perimeter Point* **#17** *"5 points" Landfill 19.6 km Southwest (background)* **#20** *1,500 m Northwest (downwind receptor)* **#21** *Springville 9.4 km North* **#22** *West Valley 6.2 km South-Southeast* **#23** *Great Valley 30.9 km South (background)* **#37** *Nashville 39.8 km Northwest (background)* **#41** *Sardinia-Savage Road 15.5 km Northeast (background)*	Direct radiation around facility Reported in: • MTAR • SER	Integrating LiF TLD →	Quarterly →	TLD cards at each of 23 locations collected 4 times per year →	Quarterly gamma radiation exposure

Sampling Rationale

Dosimetry Off-site	DOE/EH-0173T, 5.5; DOE/EP-0023, 4.6.3 TLDs offer continuous integrated environmental gamma-ray monitoring and have been deployed systematically about the site. Off-site TLDs are used to verify that site activities have not adversely affected the surrounding environs. A biennial HPIC gamma radiation measurement is completed at all locations in order to confirm TLD measurements.

■ Sampling locations are shown on Figures A-11 and A-12 (pp. A-13 and A-14).

1999 Monitoring Program
Environmental Surveillance

On-site Direct Radiation

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
DNTLD Series *Thermoluminescent Dosimetry (TLD) On-site:* **#18, #19, #33** *At three corners of the SDA* **#24, #26-#32, #34** *9 TLDS at the security fence around the site* **#35, #36, #38-#40** *5 TLDs on-site near operational areas* **#25** *Rock Springs Road 500 m North-Northwest of the plant* **#42** *SDA T-1 building* **#43** *SDA west perimeter fence*	Direct radiation around facility Reported in: • MTAR • SER	Integrating LiF TLD →	Quarterly →	TLD cards at each of 20 locations collected 4 times per year →	Quarterly gamma radiation exposure

Sampling Rationale

Dosimetry On-site

DOE/EH-0173T, 5.4 and 5.5

On-site TLDs monitor waste management units and verify that the potential dose rate to the general public (i.e., at Rock Springs Road) is below 100 mrem/year (1 mSv/year) from site activities.

A biennial HPIC gamma radiation measurement is completed at all locations in order to confirm TLD measurements.

Potential TLD sampling locations are continually evaluated with respect to site activities.

■ Sampling locations are shown on Figure A-10 (p. A-12).

Appendix C

Summary of Water, Sediment, and Soil Monitoring Data

Collecting a Sample at a WVDP Stream Sampling Location

Table C - 1

Total Radioactivity (curies) of Liquid Effluents Released from Lagoon 3 (WNSP001) in 1999

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Alpha	0.33±1.03E-04	9.53±1.85E-05	9.36±1.83E-05	2.07±0.39E-04	4.29±1.13E-04
Beta	4.66±0.26E-03	4.30±0.09E-03	8.65±0.39E-04	2.11±0.10E-03	1.19±0.03E-02
H-3	2.71±0.08E-02	3.00±0.14E-02	1.71±0.07E-02	3.46±0.15E-02	1.09±0.02E-01
C-14	1.31±0.37E-04	1.08±0.56E-04	1.49±0.23E-04	4.21±0.85E-04	8.10±1.11E-04
K-40	3.34±2.67E-04	4.08±3.61E-04	0.51±2.08E-04	-0.62±3.57E-04	7.30±6.10E-04
Co-60	0.13±2.44E-05	0.39±3.46E-05	8.13±8.88E-06	0.76±2.19E-05	2.10±4.84E-05
Sr-90	1.57±0.06E-03	1.38±0.05E-03	1.25±0.14E-04	3.33±0.47E-04	3.41±0.09E-03
Tc-99	5.82±0.33E-04	1.70±0.27E-04	4.72±0.16E-04	9.40±0.40E-04	2.16±0.06E-03
I-129	2.42±0.99E-05	1.90±0.83E-05	3.70±1.22E-05	5.00±1.32E-05	1.30±0.22E-04
Cs-137	1.15±0.06E-03	1.76±0.12E-03	3.06±0.24E-04	9.62±0.63E-04	4.18±0.15E-03
U-232	5.68±1.09E-05	7.36±0.82E-05	5.76±0.67E-05	1.17±0.13E-04	3.05±0.20E-04
U-233/234	3.59±0.47E-05	4.52±0.33E-05	3.42±0.24E-05	7.40±0.47E-05	1.89±0.08E-04
U-235/236	1.21±2.34E-06	1.21±0.55E-06	1.07±0.43E-06	2.95±1.03E-06	6.44±2.65E-06
U-238	2.46±0.65E-05	2.69±0.25E-05	1.71±0.17E-05	3.91±0.34E-05	1.08±0.08E-04
Total U (g)	6.36±0.07E+01	8.49 ±0.16E+01	4.26±0.14E+01	1.18±0.01E+02	3.09±0.03E+02
Pu-238	1.65±0.87E-06	6.10±3.80E-07	1.61±1.62E-07	2.93±1.02E-06	5.35±1.40E-06
Pu-239/240	9.84±6.49E-07	3.91±3.28E-07	4.01±2.59E-07	8.46±5.34E-07	2.62±0.94E-06
Am-241	3.07±0.76E-06	7.84±6.58E-07	1.73±2.46E-07	6.30±4.97E-07	4.66±1.15E-06

Table C - 2

Comparison of 1999 Lagoon 3 (WNSP001) Liquid Effluent Radioactivity Concentrations with Department of Energy Guidelines

Isotope [a]	Discharge Activity [b] (Ci)	Radioactivity [c] (Becquerels)	Average Concentration (µCi/mL)	DCG (µCi/mL)	% of DCG
Alpha	4.29±1.13E-04	1.59±0.42E+07	1.48±0.39E-08	NA [d]	NA
Beta	1.19±0.03E-02	4.42±0.11E+08	4.11±0.10E-07	NA [d]	NA
H-3	1.09±0.02E-01	4.03±0.09E+09	3.75±0.08E-06	2E-03	0.19
C-14	8.10±1.11E-04	3.00±0.41E+07	2.79±0.38E-08	7E-05	0.04
K-40 [e]	7.30±6.10E-04	2.70±2.26E+07	2.51±2.10E-08	NA [d]	NA
Co-60	2.10±4.84E-05	0.78±1.79E+06	0.72±1.67E-09	5E-06	<0.03
Sr-90	3.41±0.09E-03	1.26±0.03E+08	1.17±0.03E-07	1E-06	11.75
Tc-99	2.16±0.06E-03	8.01±0.22E+07	7.45±0.21E-08	1E-04	0.07
I-129	1.30±0.22E-04	4.82±0.82E+06	4.48±0.76E-09	5E-07	0.90
Cs-137	4.18±0.15E-03	1.54±0.05E+08	1.44±0.05E-07	3E-06	4.79
U-232 [f]	3.05±0.20E-04	1.13±0.07E+07	1.05±0.07E-08	1E-07	10.50
U-233/234 [f]	1.89±0.08E-04	7.00±0.29E+06	6.52±0.27E-09	5E-07	1.30
U-235/236 [f]	6.44±2.65E-06	2.38±0.98E+05	2.22±0.91E-10	5E-07 [g]	0.04
U-238 [f]	1.08±0.08E-04	3.98±0.29E+06	3.71±0.27E-09	6E-07	0.62
Pu-238	5.35±1.40E-06	1.98±0.52E+05	1.84±0.48E-10	4E-08	0.46
Pu-239/240	2.62±0.94E-06	9.70±3.47E+04	9.02±3.23E-11	3E-08	0.30
Am-241	4.66±1.15E-06	1.72±0.42E+05	1.60±0.40E-10	3E-08	0.53
Total % of DCGs					31.52

[a] *Half-lives are listed in Table K-1.*

[b] *Total volume released: 2.91E+10 mL*

[c] *1 curie (Ci) = 3.7E+10 becquerels (Bq); 1Bq = 2.7E-11 Ci.*

[d] *Derived concentration guides (DCGs) are not applicable (NA) to gross alpha and gross beta.*

[e] *Potassium-40 activity is not applicable because of its natural origin.*

[f] *Total U (g) = 3.09±0.03E+02; Average U (µg/mL) = 1.06E-02.*

[g] *DCG for U-236 is used for this comparison.*

Table C - 3

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Facility Yard Drainage (WNSP005)

Month	Alpha	Beta	H-3	pH (standard units)
January	-1.76±2.16E-09	1.57±0.11E-07	-0.65±7.41E-08	7.55
February	1.49±1.52E-09	2.18±0.08E-07	-8.30±7.82E-08	7.83
March	1.28±2.62E-09	8.66±0.85E-08	-3.02±5.65E-08	7.82
April	-2.41±2.82E-09	2.63±0.13E-07	1.17±0.82E-07	7.30
May	1.83±2.37E-09	1.36±0.10E-07	6.69±8.60E-08	7.67
June	2.15±3.02E-09	8.84±0.85E-08	-6.55±8.13E-08	7.93
July	4.35±4.22E-09	6.54±0.79E-08	-7.15±8.42E-08	7.55
August	-3.93±4.69E-09	4.61±0.75E-08	1.42±0.82E-07	7.84
September	0.73±3.03E-09	6.32±0.75E-08	6.98±8.23E-08	7.27
October	-0.22±2.13E-09	8.45±0.82E-08	3.97±8.14E-08	7.38
November	4.99±2.95E-09	2.21±0.12E-07	5.41±8.12E-08	7.62
December	1.06±4.94E-09	1.38±0.10E-07	8.62±8.35E-08	7.73

Table C - 4

1999 Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP at Frank's Creek (WNSP006)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	5.05±8.46E-10	1.45±0.30E-08	4.78±7.31E-08	5.79±2.43E-09	0.36±1.31E-08
*February**	1.47±0.95E-09	5.93±0.45E-08	3.13±0.82E-07	3.14±0.41E-08	1.40±0.94E-08
March	-1.26±9.73E-10	2.80±0.35E-08	8.45±7.44E-08	1.35±0.25E-08	-1.59±1.41E-08
*April**	0.98±1.13E-09	5.09±0.43E-08	2.99±0.78E-07	1.74±0.34E-08	5.87±2.05E-08
May	0.73±1.49E-09	4.86±0.44E-08	3.40±8.49E-08	2.33±0.43E-08	2.46±1.20E-08
June	-0.14±1.98E-09	5.49±0.44E-08	4.53±8.28E-08	2.47±0.30E-08	9.30±8.72E-09
*July**	1.28±2.48E-09	7.60±0.51E-08	3.03±0.88E-07	3.31±0.40E-08	-0.40±7.89E-09
August	0.51±2.07E-09	5.98±0.53E-08	4.44±0.81E-07	1.95±0.38E-08	4.79±7.98E-09
September	-0.10±1.60E-09	5.73±0.49E-08	8.28±8.43E-08	1.81±0.27E-08	3.40±8.64E-09
October	0.34±1.62E-09	4.70±0.43E-08	6.22±8.44E-08	2.19±0.38E-08	3.80±7.64E-09
*November**	1.61±1.48E-09	4.23±0.41E-08	4.16±0.81E-07	1.95±0.32E-08	-2.52±6.30E-09
December	0.34±1.02E-09	2.46±0.34E-08	1.38±8.07E-08	8.59±2.01E-09	1.06±0.84E-08

Quarter	C-14	Tc-99	I-129	U-232	U-233/234
1st Quarter	4.53±4.09E-09	3.82±2.43E-09	3.70±7.54E-10	3.17±1.70E-10	3.12±0.84E-10
2nd Quarter	-2.19±4.31E-09	1.83±2.30E-09	1.65±0.97E-09	0.28±1.64E-10	3.35±0.77E-10
3rd Quarter	8.50±7.90E-09	3.97±2.92E-09	4.12±7.41E-10	5.28±1.14E-10	5.98±1.17E-10
4th Quarter	-3.89±7.70E-09	4.25±2.13E-09	5.37±6.38E-10	3.78±2.20E-10	4.70±1.59E-10

	U-235/236	U-238	Total U (µg/mL)	Pu-238	Pu-239/240
1st Quarter	1.30±1.62E-11	1.92±0.65E-10	4.92±0.08E-04	-1.08±4.10E-11	-0.01±1.77E-11
2nd Quarter	2.16±2.53E-11	2.36±0.62E-10	7.58±0.28E-04	-4.55±9.13E-12	1.89±3.80E-11
3rd Quarter	3.35±3.48E-11	3.16±0.83E-10	9.72±0.19E-04	5.97±4.90E-11	-0.45±1.56E-11
4th Quarter	1.10±3.52E-11	2.10±1.06E-10	5.62±0.06E-04	3.55±5.06E-11	0.00±5.32E-11

	Am-241
1st Quarter	4.19±4.50E-11
2nd Quarter	0.94±2.83E-11
3rd Quarter	2.43±2.30E-11
4th Quarter	1.95±1.61E-11

**Month of discharge from WNSP001. See Table C-27 for a summary of water quality data at WNSP006.*

Table C - 5

1999 Radioactivity Concentrations (µCi/mL) in Surface Water Sewage Treatment Facility (WNSP007)

Month	Alpha	Beta	H-3
January	0.80±1.72E-09	1.53±0.39E-08	1.32±7.78E-08
February	0.56±2.32E-09	1.94±0.54E-08	9.81±7.73E-08
March	-1.40±2.80E-09	1.85±0.45E-08	3.67±7.17E-08
April	-0.66±1.94E-09	2.09±0.51E-08	-0.99±8.54E-08
May	0.78±2.53E-09	1.97±0.45E-08	0.28±8.45E-08
June	2.79±5.07E-09	1.50±0.60E-08	-0.70±8.36E-08
July	-1.35±4.89E-09	1.64±0.72E-08	1.35±8.55E-08
August	-0.55±2.82E-09	1.61±0.62E-08	-1.98±8.55E-08
September	-0.76±2.32E-09	1.93±0.57E-08	-5.64±7.63E-08
October	0.51±2.21E-09	1.36±0.41E-08	4.41±8.36E-08
November	2.76±3.11E-09	1.86±0.46E-08	-1.46±8.09E-08
December	-0.84±2.76E-09	1.83±0.47E-08	-4.60±8.15E-08

Quarter	Cs-137
1st Quarter	4.44±2.92E-09
2nd Quarter	-1.00±1.28E-08
3rd Quarter	1.31±2.15E-09
4th Quarter	1.95±2.25E-09

Table C - 6

1999 Radioactivity Concentrations (µCi/mL) in Surface Water French Drain (WNSP008)

Month	Alpha	Beta	H-3
January	-0.78±1.95E-09	2.12±0.36E-08	1.42±0.10E-06
February	0.12±1.62E-09	2.34±0.33E-08	9.66±0.91E-07
March	-0.22±1.32E-09	2.44±0.26E-08	1.27±0.11E-06
April	-1.35±1.58E-09	1.80±0.33E-08	1.13±0.07E-06
May	0.94±1.85E-09	3.00±0.39E-08	1.45±0.11E-06
June	1.87±2.41E-09	3.55±0.41E-08	2.12±0.11E-06
July	1.63±2.51E-09	3.25±0.40E-08	2.05±0.08E-06
August	2.16±2.62E-09	3.50±0.43E-08	2.46±0.13E-06
September	-0.92±2.08E-09	3.61±0.40E-08	1.59±0.11E-06
October	-0.54±1.70E-09	3.97±0.41E-08	2.02±0.12E-06
November	0.36±1.74E-09	4.25±0.41E-08	1.52±0.11E-06
December	0.88±2.52E-09	3.63±0.40E-08	1.45±0.11E-06

Table C - 7

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Northeast Swamp (WNSWAMP)

Month	Alpha	Beta	H-3	Sr-90	Cs-137	pH (standard units)
January	2.68±8.21E-10	2.22±0.02E-06	1.19±0.77E-07	1.15±0.02E-06	0.27±3.94E-09	7.48
February	0.86±1.09E-09	2.53±0.03E-06	8.89±8.10E-08	1.30±0.03E-06	-0.02±3.97E-09	7.17
March	-0.97±1.25E-09	2.77±0.03E-06	1.96±0.80E-07	1.36±0.03E-06	1.73±2.82E-09	7.27
April	-0.41±1.21E-09	2.68±0.03E-06	-2.94±8.67E-08	1.34±0.03E-06	0.55±2.18E-09	7.33
May	-0.26±1.64E-09	4.13±0.04E-06	1.54±0.84E-07	2.06±0.05E-06	-3.57±3.60E-09	7.24
June	0.14±1.93E-09	4.89±0.04E-06	1.83±0.83E-07	2.36±0.05E-06	-0.45±2.31E-09	7.11
July	-0.94±2.57E-09	6.22±0.04E-06	2.38±0.82E-07	3.22±0.05E-06	0.30±2.30E-09	7.15
August	0.75±2.32E-09	6.10±0.04E-06	2.48±0.87E-07	2.72±0.05E-06	-0.26±2.38E-09	7.17
September	-0.04±1.90E-09	5.44±0.04E-06	1.86±0.87E-07	2.62±0.04E-06	1.28±2.26E-09	7.38
October	-0.25±1.43E-09	4.03±0.04E-06	1.22±0.83E-07	1.91±0.04E-06	1.56±2.27E-09	7.23
November	0.05±1.93E-09	2.60±0.03E-06	1.85±0.72E-07	1.34±0.03E-06	0.86±2.26E-09	7.48
December	-0.23±1.46E-09	1.41±0.02E-06	5.49±8.48E-08	6.07±0.22E-07	0.20±2.16E-09	7.23

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	2.55±4.04E-09	5.28±4.73E-10	1.97±2.48E-10	6.87±3.87E-11	-0.01±4.23E-11
2nd Quarter	3.79±4.60E-09	1.27±1.14E-09	-4.93±7.32E-11	1.27±0.50E-10	0.00±1.26E-11
3rd Quarter	6.83±7.82E-09	0.61±1.63E-09	-0.97±2.81E-11	7.17±3.66E-11	-0.40±1.75E-11
4th Quarter	-1.43±6.31E-09	6.45±7.28E-10	-4.48±7.32E-11	2.12±0.98E-10	0.50±3.45E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	7.14±3.95E-11	1.12±0.02E-04	-0.28±1.70E-11	0.00±9.86E-12	1.51±2.16E-11
2nd Quarter	4.08±3.20E-11	2.40±0.10E-04	2.69±2.72E-11	1.57±2.50E-11	3.55±3.57E-11
3rd Quarter	4.38±2.81E-11	1.00±0.02E-04	9.28±5.14E-11	1.24±1.75E-11	0.00±9.68E-12
4th Quarter	6.69±6.66E-11	4.64±0.07E-04	-0.01±2.89E-11	0.00±3.53E-11	2.25±3.19E-11

See Table C-27 for a summary of water quality data at WNSWAMP.

Table C - 8

1999 Radioactivity Concentrations (µCi/mL) in Surface Water North Swamp (WNSW74A)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	0.28±2.39E-09	7.96±4.87E-09	-4.68±7.58E-08	2.14±2.10E-09	3.81±8.25E-09
February	1.43±2.35E-09	9.29±4.14E-09	-2.11±6.74E-08	1.25±0.29E-08	-0.21±1.30E-08
March	-1.53±3.03E-09	1.14±0.51E-08	-1.16±7.87E-08	5.56±1.87E-09	5.95±9.39E-09
April	-0.55±1.90E-09	1.19±0.49E-08	-9.17±8.39E-08	2.19±2.18E-09	0.55±1.18E-08
May	-0.10±1.34E-09	9.86±2.61E-09	-0.69±8.41E-08	3.69±2.10E-09	0.55±1.05E-08
June	0.32±1.63E-09	6.79±2.78E-09	-7.60±8.03E-08	3.99±1.50E-09	-2.64±7.78E-09
July	-0.17±2.30E-09	6.64±3.83E-09	-6.82±8.21E-08	2.26±1.91E-09	0.54±6.44E-09
August	-1.40±1.97E-09	6.70±3.79E-09	1.49±7.85E-08	2.29±2.38E-09	4.39±7.55E-09
September	-0.10±1.90E-09	1.17±0.37E-08	-4.43±7.74E-08	5.35±1.78E-09	-3.78±6.04E-09
October	0.00±1.44E-09	1.28±0.26E-08	-4.95±8.30E-08	7.87±2.78E-09	9.30±5.51E-09
November	0.37±1.20E-09	2.29±0.29E-08	4.19±7.70E-08	5.41±2.29E-09	-1.12±5.33E-09
December	0.00±1.72E-09	1.28±0.25E-08	-6.83±8.33E-08	6.81±1.86E-09	0.78±6.32E-09

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	5.23±4.11E-09	2.50±4.53E-10	-0.02±1.92E-10	9.58±4.53E-11	1.33±1.66E-11
2nd Quarter	1.01±5.00E-09	1.29±6.06E-10	0.06±1.27E-10	8.42±4.23E-11	-5.00±9.70E-12
3rd Quarter	9.60±7.89E-09	2.96±8.08E-10	0.00±4.58E-11	1.02±0.49E-10	1.28±2.21E-11
4th Quarter	-0.57±4.74E-09	1.00±1.13E-09	0.72±1.16E-10	1.82±0.94E-10	-0.01±2.72E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	1.44±0.56E-10	2.33±0.04E-04	-1.56±2.22E-11	0.81±1.63E-11	2.71±3.15E-11
2nd Quarter	5.95±3.89E-11	2.11±0.09E-04	0.82±1.91E-11	-4.01±8.05E-12	2.81±3.26E-11
3rd Quarter	1.02±0.42E-10	2.34±0.06E-04	1.12±4.21E-11	-0.28±1.26E-11	2.34±1.78E-11
4th Quarter	9.90±7.72E-11	2.95±0.04E-04	0.00±1.99E-11	-1.00±1.17E-11	1.08±1.92E-11

See Table C-27 for a summary of water quality data at WNSW74A.

Table C - 9

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Frank's Creek East of the SDA (WNFRC67)

Month	Alpha	Beta	H-3	pH (standard units)
January	-0.99±5.88E-10	1.45±1.30E-09	-4.38±7.36E-08	6.84
February	3.64±4.36E-10	0.79±1.17E-09	-1.00±0.55E-07	7.75
March	-0.37±4.92E-10	2.55±1.32E-09	-1.40±0.78E-07	8.42
April	-2.39±3.44E-10	3.42±0.91E-09	0.63±8.54E-08	7.40
May	1.32±7.56E-10	2.21±1.25E-09	-2.92±8.34E-08	7.33
June	1.30±1.20E-09	3.75±1.46E-09	-1.36±0.93E-07	7.65
July	5.56±8.58E-10	4.04±1.38E-09	8.94±8.63E-08	7.00
August	-1.14±0.88E-09	2.54±1.43E-09	3.46±0.84E-07	6.89
September	0.50±6.10E-10	4.01±1.32E-09	1.14±0.84E-07	7.40
October	0.00±6.92E-10	6.30±1.46E-09	1.95±0.84E-07	6.94
November	1.06±5.08E-10	4.42±1.25E-09	-0.44±8.09E-08	7.33
December	-6.39±7.71E-10	7.08±1.51E-09	-6.68±8.10E-08	7.98

Table C - 10

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Erdman Brook (WNERB53)

Month	Alpha	Beta	H-3	pH (standard units)
January	5.16±9.48E-10	1.73±0.26E-08	0.80±7.30E-08	7.48
February	7.16±8.84E-10	1.24±0.21E-08	3.09±7.84E-08	7.19
March	0.59±1.38E-09	1.80±0.26E-08	2.09±7.54E-08	7.36
April	-1.48±8.63E-10	1.15±0.22E-08	-1.48±8.39E-08	7.76
May	0.51±1.24E-09	1.36±0.25E-08	6.67±7.45E-08	7.42
June	0.31±1.93E-09	1.85±0.28E-08	0.46±7.74E-08	7.30
July	0.48±2.08E-09	2.85±0.37E-08	-0.84±8.49E-08	7.03
August	-0.62±1.84E-09	2.68±0.30E-08	-0.02±8.61E-08	7.16
September	-0.14±1.92E-09	2.24±0.43E-08	6.53±8.44E-08	7.51
October	-0.57±1.56E-09	2.36±0.28E-08	2.40±8.01E-08	7.46
November	1.03±1.05E-09	1.97±0.27E-08	8.01±8.33E-08	7.73
December	2.49±9.66E-10	2.10±0.27E-08	1.13±7.50E-08	7.25

Table C - 11

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Cooling Tower Basin (WNCOOLW)

Month	Alpha	Beta	H-3	pH (standard units)
January	-0.81±1.69E-09	4.35±3.90E-09	0.56±7.63E-08	8.65
February	-0.17±1.21E-09	6.37±3.37E-09	-5.34±7.94E-08	8.49
March	-0.42±1.33E-09	7.06±3.90E-09	-1.60±0.78E-07	8.45
April	-0.70±1.57E-09	1.06±0.39E-08	-0.52±8.50E-08	8.38
May	8.01±9.42E-10	7.95±2.82E-09	5.11±8.35E-08	8.30
June	0.47±2.08E-09	6.68±3.95E-09	3.88±8.18E-08	8.66
July	0.87±2.42E-09	2.10±0.46E-08	0.06±8.04E-08	8.48
August	-2.45±2.42E-09	5.12±4.12E-09	-2.22±7.92E-08	8.32
September	0.81±2.56E-09	6.83±3.74E-09	-3.26±8.07E-08	8.25
October	0.38±1.96E-09	6.86±3.69E-09	1.51±0.59E-07	8.82
November	1.91±2.11E-09	9.58±3.57E-09	2.16±8.09E-08	8.70
December	2.10±2.66E-09	7.78±3.78E-09	2.95±8.22E-08	8.79

Quarter	Cs-137
1st Quarter	9.15±6.93E-09
2nd Quarter	-8.11±6.86E-09
3rd Quarter	-2.20±6.36E-09
4th Quarter	1.10±6.10E-09

Table C - 12

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water SDA Drainage (WNSDADR)

Month	Alpha	Beta	H-3	Cs-137	pH (standard units)
January	2.65±1.92E-10	8.74±1.02E-09	7.07±8.00E-08	-0.51±1.20E-08	7.15
February	7.16±2.86E-10	2.00±0.14E-08	-2.72±7.86E-08	2.15±5.66E-09	7.16
March	0.00±6.04E-10	2.20±0.79E-09	1.81±0.86E-07	0.22±1.29E-08	7.63
April	4.14±2.69E-10	2.39±0.74E-09	2.04±8.76E-08	-2.65±6.57E-09	6.19
May	3.28±2.53E-10	2.85±0.79E-09	2.35±8.34E-08	3.27±6.80E-09	6.63
June	4.22±2.70E-10	2.49±0.80E-09	-0.21±5.86E-08	-4.86±7.02E-09	7.19
July	4.40±2.89E-10	2.27±0.76E-09	9.29±6.02E-08	7.19±8.35E-09	6.57
August	2.14±1.03E-09	1.95±0.15E-08	5.78±0.90E-07	3.30±8.11E-09	7.15
September	3.19±2.71E-10	1.12±0.51E-09	3.39±0.85E-07	-5.46±6.83E-09	6.66
October	1.25±1.00E-09	4.47±0.99E-09	3.84±0.89E-07	-5.54±6.38E-09	7.07
November	2.68±2.39E-10	3.34±0.77E-09	7.66±8.13E-08	0.60±6.68E-09	7.27
December	4.00±2.87E-10	3.75±0.84E-09	1.54±0.82E-07	1.72±7.86E-09	8.57

Table C - 13

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Waste Tank Farm Underdrain (WN8D1DR)

Month	Alpha	Beta	H-3	Sr-90	Cs-137	pH (standard units)
January	0.84±2.42E-09	1.36±0.44E-08	-4.43±7.14E-08	1.60±2.04E-09	0.89±1.41E-08	7.36
February	4.00±4.01E-09	1.24±0.52E-08	-2.62±7.71E-08	3.09±1.96E-09	0.09±1.40E-08	7.32
March	-2.94±5.72E-09	1.81±0.81E-08	-0.76±7.82E-08	2.78±1.56E-09	0.92±1.32E-08	7.49
April	-3.22±5.37E-09	1.86±0.71E-08	-3.94±8.27E-08	3.18±1.64E-09	8.38±6.67E-09	7.30
May	0.64±4.08E-09	6.95±7.53E-09	-4.09±7.76E-08	5.38±2.47E-09	2.00±6.34E-09	7.17
June	0.37±5.52E-09	7.25±7.27E-09	-6.94±8.00E-08	2.59±1.40E-09	0.08±1.01E-08	7.24
July	0.58±3.52E-09	1.08±0.67E-08	-9.19±8.05E-08	2.89±1.59E-09	-3.35±6.78E-09	7.04
August	-1.88±4.60E-09	4.40±7.72E-09	1.74±8.27E-08	3.11±2.47E-09	1.12±6.10E-09	7.18
September	0.00±4.02E-09	1.17±0.74E-08	5.82±8.35E-08	4.08±1.65E-09	-0.05±6.55E-09	7.26
October	-0.62±4.01E-09	1.47±0.75E-08	-5.70±8.25E-08	4.51±3.19E-09	-7.23±7.13E-09	7.27
November	0.51±2.78E-09	1.14±0.58E-08	-1.02±8.21E-08	2.56±1.70E-09	-1.61±6.11E-09	7.25
December	-1.10±4.31E-09	1.25±0.63E-08	-5.69±7.53E-08	2.80±2.12E-09	-1.56±5.72E-09	7.49

Table C - 14

1999 Radioactivity Concentrations (µCi/mL) in Surface Water Drum Cell Drainage (WNDCELD)

Month	Alpha	Beta
January	2.32±3.25E-10	0.99±1.11E-09
February	1.65±3.01E-10	2.41±1.16E-09
March	-0.84±3.40E-10	3.71±0.88E-09
April	-2.21±3.78E-10	2.70±1.18E-09
May	-1.30±6.25E-10	2.68±1.31E-09
June	4.04±7.90E-10	3.67±1.40E-09
July	*Dry - Not sampled*	
August	4.16±1.37E-09	1.48±0.19E-08
September	1.70±1.30E-09	1.12±0.18E-08
October	2.54±1.67E-09	1.42±0.19E-08
November	2.02±5.03E-10	3.13±1.28E-09
December	1.17±5.35E-10	6.81±1.43E-09

Quarter	H-3	Sr-90	I-129	Cs-137
1st Quarter	0.28±8.34E-08	1.40±1.39E-09	1.53±4.88E-10	5.11±9.12E-09
2nd Quarter	-1.74±8.14E-08	1.20±1.18E-09	2.85±1.94E-10	-2.26±5.21E-09
3rd Quarter	3.17±8.59E-08	8.17±2.57E-09	1.49±4.30E-10	-2.68±7.12E-09
4th Quarter	-8.14±8.44E-08	2.33±1.38E-09	-1.26±6.71E-10	-0.35±5.03E-09

Table C - 15

1999 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Environmental Laboratory Potable Water Sampling Location (WNDNKEL)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25^{0}C)
January	1.85±3.99E-10	1.00±0.78E-09	-9.70±7.22E-08	7.65	231
February	1.82±2.28E-10	2.74±0.78E-09	-8.13±7.76E-08	8.15	172
March	-0.49±3.16E-10	3.36±0.89E-09	-2.00±0.77E-07	7.78	186
April	-0.30±3.60E-10	1.03±0.72E-09	-2.47±7.93E-08	7.51	159
May	1.73±3.39E-10	1.65±0.82E-09	-2.71±8.09E-08	7.77	192
June	0.44±4.47E-10	1.46±0.82E-09	-7.22±5.67E-08	8.20	234
July	-2.40±5.08E-10	2.43±0.84E-09	-1.21±0.81E-07	7.47	259
August	-7.78±6.50E-10	8.69±8.39E-10	-3.84±7.81E-08	7.22	267
September	2.27±7.19E-10	2.59±0.84E-09	1.19±0.81E-07	7.72	284
October	-2.64±7.01E-10	3.28±0.91E-09	5.41±8.10E-08	7.50	289
November	0.00±4.29E-10	3.60±0.83E-09	1.70±8.03E-08	7.79	277
December	-1.16±5.07E-10	4.16±0.90E-09	-4.31±8.06E-08	7.96	257

Table C - 16

1999 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Maintenance Shop Potable Water (WNDNKMS)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25^{0}C)
January	4.19±4.26E-10	7.24±7.62E-10	-2.21±7.36E-08	7.27	236
February	2.15±2.37E-10	1.15±0.69E-09	-9.22±7.76E-08	7.65	183
March	-1.93±2.91E-10	4.99±0.96E-09	-9.49±7.80E-08	8.26	194
April	-0.59±3.45E-10	2.05±0.78E-09	-8.36±7.90E-08	7.38	182
May	-0.99±2.67E-10	2.55±0.86E-09	-0.17±8.20E-08	8.45	229
June	0.88±4.55E-10	1.92±0.85E-09	-1.50±0.80E-07	8.66	255
July	3.94±6.09E-10	2.00±0.82E-09	-6.94±8.17E-08	7.45	290
August	-7.37±6.68E-10	1.20±0.86E-09	4.96±7.96E-08	6.97	221
September	-5.51±5.70E-10	2.34±0.82E-09	7.20±8.17E-08	7.54	281
October	-3.06±6.89E-10	2.14±0.85E-09	3.63±8.26E-08	7.64	297
November	-0.48±4.26E-10	3.93±0.84E-09	-0.33±7.99E-08	7.82	280
December	2.36±5.65E-10	1.49±0.76E-09	1.35±0.83E-07	7.93	272

Table C - 17

1999 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Main Plant Potable Water (WNDNKMP)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25^{0}C)
January	-0.21±3.51E-10	7.24±7.62E-10	-1.50±7.34E-08	8.10	228
February	3.48±2.67E-10	1.90±0.73E-09	-3.79±7.84E-08	7.84	176
March	-0.26±3.38E-10	1.60±0.81E-09	-9.79±7.85E-08	8.15	193
April	-2.65±3.11E-10	1.47±0.75E-09	5.42±8.08E-08	8.20	175
May	2.66±3.44E-10	1.01±0.78E-09	-2.50±8.15E-08	8.23	195
June	1.36±4.77E-10	1.95±0.85E-09	-3.24±8.08E-08	7.99	247
July	1.64±5.75E-10	2.35±0.84E-09	-6.94±8.16E-08	7.99	268
August	-4.29±7.28E-10	1.60±0.88E-09	-1.38±7.86E-08	6.95	253
September	-1.46±5.62E-10	2.50±0.84E-09	2.80±8.10E-08	7.56	283
October	-6.71±6.61E-10	2.22±0.85E-09	-0.51±8.07E-08	7.07	286
November	-1.35±3.84E-10	2.53±0.76E-09	-2.06±7.96E-08	7.67	279
December	-0.80±5.31E-10	1.48±0.76E-09	6.60±8.25E-08	7.88	257

Table C - 18

1999 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters Utility Room Potable Water (WNDNKUR)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25^{0}C)
January	2.08±3.74E-10	2.20±0.84E-09	3.83±7.36E-08	8.54	228
February	1.49±2.20E-10	1.11±0.69E-09	-1.02±0.77E-07	7.93	178
March	-0.49±3.16E-10	4.23±0.93E-09	-4.86±7.91E-08	7.67	187
April	-2.16±3.36E-10	4.93±6.93E-10	0.00±7.97E-08	7.70	193
May	0.33±2.96E-10	4.17±0.94E-09	2.28±8.42E-08	8.25	192
June	3.65±5.21E-10	1.49±0.83E-09	-3.24±8.09E-08	8.32	243
July	4.68±6.53E-10	1.16±0.78E-09	-1.04±0.81E-07	7.28	275
August	-5.76±6.87E-10	1.66±0.88E-09	0.14±8.53E-08	7.00	276
September	-2.12±6.06E-10	2.08±0.81E-09	9.91±8.17E-08	7.62	278
October	-2.17±6.95E-10	2.03±0.84E-09	5.97±8.12E-08	7.63	283
November	1.43±4.67E-10	2.93±0.79E-09	0.84±5.71E-08	7.71	271
December	0.00±5.24E-10	2.08±0.79E-09	3.56±8.19E-08	8.07	252

	Fluoride (mg/L)	Nitrate-N (mg/L)	Arsenic Total (µg/L)	Barium Total (µg/L)	Cadmium Total (µg/L)
March	<0.1	0.49	<25	<200	<2

	Chromium Total (µg/L)	Mercury Total (µg/L)	Selenium Total (µg/L)
March	<10	<0.4	<2

Table C - 19

1999 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters Storage and Disposal Area Drainage (WNNDADR)

Month	Alpha	Beta	H-3	Cs-137	NPOC* (mg/L)
January	8.95±9.51E-10	1.35±0.06E-07	1.10±0.09E-06	4.33±6.37E-09	5.54
February	1.34±0.63E-09	1.28±0.04E-07	9.79±0.88E-07	-0.99±9.70E-09	4.58
March	0.00±1.18E-09	1.21±0.05E-07	1.06±0.09E-06	-1.53±8.78E-09	5.92
April	0.69±1.08E-09	1.40±0.06E-07	1.55±0.10E-06	-0.36±4.72E-09	6.20
May	0.33±1.08E-09	1.32±0.04E-07	3.02±0.14E-06	0.80±7.68E-09	6.40
June	1.55±1.77E-09	1.53±0.06E-07	2.60±0.13E-06	4.82±8.23E-09	7.40
July	-0.53±1.34E-09	1.38±0.04E-07	2.33±0.13E-06	-6.08±8.25E-09	7.92
August	2.65±2.10E-09	1.40±0.06E-07	1.76±0.11E-06	-1.86±8.19E-09	8.32
September	-1.52±1.62E-09	1.48±0.06E-07	1.28±0.10E-06	-2.75±6.70E-09	7.70
October	0.79±1.23E-09	1.67±0.06E-07	1.47±0.11E-06	-1.27±6.55E-09	6.84
November	1.41±1.34E-09	1.73±0.06E-07	1.62±0.11E-06	-2.36±6.59E-09	6.18
December	1.07±1.18E-09	1.88±0.05E-07	7.46±0.94E-07	3.01±4.66E-09	6.10

	TOX* (µg/L)	pH * (standard units)
January	14.8	7.73
February	22.5	7.40
March	24.2	7.39
April	10.4	7.71
May	16.4	7.21
June	17.0	7.56
July	25.6	7.23
August	22.0	7.05
September	26.2	7.31
October	15.9	7.38
November	19.6	7.70
December	11.7	7.51

Quarter	Sr-90**	I-129**
1st Quarter	6.67±0.42E-08	0.50±1.35E-09
2nd Quarter	6.71±0.47E-08	0.85±4.95E-10
3rd Quarter	6.70±0.35E-08	0.48±1.22E-09
4th Quarter	7.82±0.64E-08	8.64±6.62E-10

* *Monthly average of weekly measurements.*
* * *Monthly samples are composited and analyzed quarterly.*

Table C - 20

1999 Radioactivity Concentrations (µCi/mL), NPOC, and TOX in Groundwater at the NDA Interceptor Trench (WNNDATR)

Month	Alpha	Beta	H-3	Cs-137	NPOC (mg/L)	TOX (µg/L)
January	2.04±2.02E-09	8.99±0.56E-08	1.09±0.03E-05	-0.07±1.18E-08	5.7	34.0
February	2.77±1.27E-09	1.15±0.04E-07	6.74±0.23E-06	-7.37±9.17E-09	5.7	15.0
March	4.95±7.43E-10	1.32±0.05E-07	2.00±0.11E-06	3.31±8.18E-09	4.7	5.0
April	-0.34±1.32E-09	2.97±0.10E-07	3.74±0.16E-06	-0.60±1.28E-08	6.7	35.0
May	2.38±1.30E-09	8.76±0.40E-08	1.99±0.04E-05	-0.19±1.02E-08	3.8	12.0
June	1.44±2.06E-09	8.78±0.56E-08	1.05±0.03E-05	2.60±7.20E-09	5.9	36.0
July	3.84±2.40E-09	8.65±0.56E-08	9.73±0.32E-06	2.30±7.45E-09	6.4	19.0
August	1.82±1.28E-09	6.71±0.35E-08	9.35±0.33E-06	2.13±6.75E-09	4.9	19.0
September	-1.10±1.47E-09	1.83±0.08E-07	3.18±0.15E-06	9.18±7.20E-09	8.9	14.0
October	1.08±1.53E-09	1.40±0.07E-07	4.43±0.18E-06	3.20±7.54E-09	5.1	20.4
November	1.85±1.17E-09	8.24±0.45E-08	1.64±0.11E-06	-0.87±7.04E-09	5.3	20.7
December	1.15±1.73E-09	9.87±0.59E-08	3.27±0.15E-06	-2.13±7.20E-09	4.1	15.9

Quarter	I-129
1st Quarter	1.02±0.77E-09
2nd Quarter	2.28±4.86E-10
3rd Quarter	8.95±5.28E-10
4th Quarter	6.60±7.60E-10

Table C - 21

1999 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters in Surface Water at the Standing Water (WNSTAW-series) Sampling Locations

Location	**Date**	**Alpha**	**Beta**	**H-3**	**pH** (standard units)	**Conductivity** (µmhos/cm@25°C)
WNSTAW4	*10/26*	-5.24±6.93E-10	4.49±1.25E-09	-1.65±8.52E-08	7.80	117
WNSTAW5	*10/26*	1.93±2.67E-10	2.16±0.91E-09	-1.19±0.82E-07	7.65	66
WNSTAW6	*10/26*	-5.14±6.80E-10	6.53±1.25E-09	-4.91±8.22E-08	7.70	298
WNSTAW9	*10/26*	-5.41±5.65E-10	2.94±1.06E-09	-1.20±0.82E-07	7.87	277
WNSTAWB*	*10/26*	2.26±7.67E-10	3.27±1.06E-09	-6.57±8.21E-08	8.02	405

	Date	**Chloride** (mg/L)	**Nitrate+Nitrite** (mg/L)	**Sulfate** (mg/L)	**Iron Total** (µg/L)	**Manganese Total** (µg/L)	**Sodium Total** (µg/L)
WNSTAW4	*10/26*	12.2	<0.05	9.2	413	110	7430
WNSTAW5	*10/26*	0.6	<0.05	6.3	386	63	<1000
WNSTAW6	*10/26*	4.6	<0.05	23.0	132	101	<1000
WNSTAW9	*10/26*	9.8	<0.05	25.0	295	161	8850
WNSTAWB*	*10/26*	30.4	<0.05	16.7	235	110	20500

** Background location*

Table C - 22

*1999 Radioactivity Concentrations (µCi/mL), pH, and Conductivity in Surface Water Upstream of the WVDP in Buttermilk Creek at Fox Valley (WFBCBKG)**

Month	**Alpha**	**Beta**	**H-3**	**pH** (standard units)	**Conductivity** (µmhos/cm@25°C)
January	2.41±3.84E-10	2.32±1.18E-09	-2.49±7.93E-08	7.51	263
February	9.63±5.20E-10	4.71±1.30E-09	8.96±7.64E-08	7.44	230
March	1.65±5.70E-10	1.72±1.28E-09	5.75±7.76E-08	7.99	244
April	9.75±6.87E-10	4.03±1.28E-09	-5.86±8.10E-08	7.62	204
May	3.78±7.61E-10	4.04±1.36E-09	-7.86±7.99E-08	7.97	272
June	1.84±1.03E-09	2.16±1.35E-09	-0.29±8.16E-08	7.49	328
July	1.62±7.98E-10	3.48±1.30E-09	3.26±8.37E-08	7.07	332
August	3.58±1.54E-09	8.27±1.71E-09	8.59±8.08E-08	7.38	326
September	0.06±1.00E-09	2.23±1.31E-09	1.10±8.16E-08	7.57	347
October	1.30±6.51E-10	2.86±1.28E-09	2.35±8.43E-08	7.78	371
November	6.12±6.78E-10	2.54±1.26E-09	-0.69±8.15E-08	7.88	345
December	2.20±6.14E-10	5.73±1.39E-09	-4.88±8.40E-08	7.16	269

Quarter	**C-14**	**Sr-90**	**Tc-99**	**I-129**	**Cs-137**
1st Quarter	4.47±4.20E-09	1.30±1.37E-09	-0.86±2.55E-09	1.47±3.82E-10	3.26±3.93E-09
2nd Quarter	-1.26±6.11E-09	1.94±1.05E-09	-3.71±2.15E-09	4.28±7.87E-10	1.61±2.24E-09
3rd Quarter	1.11±0.11E-07	1.07±1.01E-09	1.38±2.88E-09	0.00±1.01E-09	0.84±2.24E-09
4th Quarter	-2.69±4.58E-09	0.49±1.75E-09	-0.11±1.90E-09	2.22±3.64E-10	1.14±2.28E-09

	U-232	**U-233/234**	**U-235/236**	**U-238**	**Total U** (µg/mL)
1st Quarter	1.48±9.98E-11	1.14±0.49E-10	0.78±1.24E-11	7.75±3.99E-11	1.07±0.02E-04
2nd Quarter	-1.10±0.99E-10	1.23±0.51E-10	0.52±1.53E-11	8.95±4.34E-11	3.29±0.13E-04
3rd Quarter	-1.46±2.07E-11	1.12±0.44E-10	1.70±1.77E-11	8.84±3.40E-11	1.49±0.04E-04
4th Quarter	0.08±1.00E-10	4.78±7.06E-11	-0.01±2.97E-11	6.00±6.86E-11	1.56±0.02E-04

	Pu-238	**Pu-239/240**	**Am-241**
1st Quarter	1.20±3.91E-11	1.23±2.79E-11	3.84±3.70E-11
2nd Quarter	0.00±3.91E-11	0.13±1.11E-11	2.60±3.25E-11
3rd Quarter	8.35±6.15E-11	0.76±2.15E-11	2.73±2.17E-11
4th Quarter	-0.73±1.04E-11	2.17±3.09E-11	0.00±3.04E-11

** Background location. See Table C-27 for a summary of water quality data at WFBCBKG.*

Table C - 23

1999 Radioactivity Concentrations (μCi/mL), pH, and Conductivity in Surface Water Downstream of the WVDP in Buttermilk Creek at Thomas Corners Road Bridge (WFBCTCB)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (μmhos/cm@25^{0}C)
January	1.84±0.79E-09	6.99±1.45E-09	3.06±8.04E-08	7.40	300
*February**	1.16±0.56E-09	5.24±1.33E-09	1.24±0.77E-07	7.55	268
March	6.86±6.61E-10	6.59±1.53E-09	2.01±8.16E-08	8.05	283
*April**	3.76±5.21E-10	5.63±1.36E-09	1.04±0.87E-07	7.90	228
May	2.44±7.18E-10	6.36±1.47E-09	-4.84±8.16E-08	7.97	317
June	6.14±8.76E-10	6.14±1.56E-09	-3.46±8.07E-08	7.42	385
*July**	4.35±9.40E-10	1.01±0.16E-08	-5.32±8.23E-08	7.22	407
August	1.19±1.06E-09	1.15±0.18E-08	2.25±0.83E-07	7.27	429
September	0.00±1.10E-09	9.79±1.70E-09	-3.30±8.11E-08	7.67	424
October	4.02±7.19E-10	1.44±0.18E-08	7.89±8.58E-08	7.84	418
*November**	1.90±0.99E-09	1.52±0.19E-08	7.33±8.26E-08	7.92	382
December	1.50±0.85E-09	6.41±1.44E-09	-0.61±8.52E-08	7.19	261

Quarter	Sr-90	Cs-137
1st Quarter	4.69±1.78E-09	-0.36±1.70E-09
2nd Quarter	2.86±1.39E-09	0.33±3.36E-09
3rd Quarter	3.46±1.28E-09	0.36±2.18E-09
4th Quarter	5.11±1.70E-09	0.53±2.36E-09

** Month of discharge from WNSP001.*

Table C - 24

1999 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)

Month	Alpha	Beta	H-3	Sr-90	Cs-137	pH (standard units)
January	8.95±7.36E-10	2.62±1.73E-09	-1.41±0.78E-07	0.89±1.51E-09	-1.69±4.11E-09	7.69
*February**	1.62±0.87E-09	1.80±1.68E-09	5.96±7.98E-08	0.81±1.26E-09	-0.88±2.59E-09	7.84
March	1.96±8.94E-10	3.20±1.96E-09	-6.66±7.84E-08	2.29±1.50E-09	-1.31±2.58E-09	8.20
*April**	7.85±7.68E-10	3.82±1.76E-09	9.81±8.78E-08	0.58±1.22E-09	-0.22±2.22E-09	7.81
May	9.78±7.87E-10	3.64±1.38E-09	-1.34±0.82E-07	3.15±2.47E-09	1.37±6.22E-09	7.95
June	4.06±2.11E-09	7.95±2.21E-09	-9.22±8.50E-08	0.81±1.44E-09	-0.05±2.35E-09	7.90
*July**	6.01±2.82E-09	1.47±0.26E-08	-3.40±8.98E-08	1.26±0.99E-09	2.14±2.10E-09	7.62
August	5.19±1.85E-09	5.90±2.03E-09	3.67±8.48E-08	1.76±1.33E-09	-0.71±2.29E-09	7.62
September	0.66±1.24E-09	7.96±1.58E-09	-1.19±0.83E-07	1.44±1.54E-09	0.35±2.18E-09	7.76
October	1.67±1.24E-09	5.17±1.96E-09	-3.38±8.32E-08	4.83±2.12E-09	-0.15±2.20E-09	7.83
*November**	0.93±1.03E-09	5.01±1.96E-09	-3.55±8.37E-08	1.24±1.59E-09	0.88±2.40E-09	8.02
December	4.54±2.10E-09	8.56±2.18E-09	-1.82±0.83E-07	3.06±2.08E-09	-1.52±2.30E-09	7.47

** Month of discharge from WNSP001.*

Table C - 25

1999 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP in Cattaraugus Creek at Bigelow Bridge (WFBIGBR)*

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	7.28±4.85E-10	1.46±1.16E-09	9.58±7.77E-08	-0.56±1.35E-09	-3.92±8.83E-09
February	6.69±6.01E-10	3.55±1.27E-09	9.51±5.38E-08	0.47±1.05E-09	2.83±2.74E-09
March	-1.88±4.22E-10	2.44±0.95E-09	-1.73±0.57E-07	1.19±1.35E-09	-3.16±4.19E-09
April	2.76±7.16E-10	4.00±1.30E-09	7.88±8.62E-08	-0.22±1.12E-09	-0.40±2.27E-09
May	1.46±1.16E-09	3.93±1.44E-09	-8.17±8.07E-08	2.86±1.84E-09	-0.80±3.36E-09
June	0.49±1.07E-09	2.71±1.43E-09	3.05±7.83E-08	1.16±1.07E-09	3.04±3.66E-09
July	-0.71±1.18E-09	3.08±1.33E-09	-5.16±8.40E-08	7.26±7.81E-10	1.94±2.25E-09
August	1.59±0.83E-09	2.06±1.00E-09	0.00±7.95E-08	-0.25±1.29E-09	0.90±2.08E-09
September	-4.72±8.07E-10	1.69±0.93E-09	-1.72±0.84E-07	0.00±1.16E-09	0.17±2.06E-09
October	-9.91±9.43E-10	1.64±1.32E-09	-7.36±5.77E-08	1.26±1.68E-09	1.98±2.20E-09
November	2.50±7.10E-10	1.85±1.32E-09	-7.24±8.07E-08	1.26±1.72E-09	0.17±2.22E-09
December	7.10±9.54E-10	3.99±1.34E-09	2.88±8.63E-08	1.07±1.22E-09	2.62±1.88E-09

** Background location.*

Table C - 26

1999 Radioactivity Concentrations (μCi/mL), pH, and Conductivity in Potable Well Water around the WVDP

Well	Alpha	Beta	H-3	Cs-137	pH (standard units)	Conductivity (μmhos/cm@25⁰C)
WFWEL01	1.09±0.79E-09	3.00±1.36E-09	9.56±8.09E-08	2.56±7.44E-09	7.32	432
WFWEL02	2.76±9.02E-10	5.39±1.54E-09	-2.14±8.05E-08	-1.77±7.08E-09	7.46	483
WFWEL03	1.76±1.35E-09	2.03±1.61E-09	1.28±0.81E-07	2.50±7.23E-09	6.98	844
WFWEL04	-1.60±2.15E-09	3.99±2.77E-09	-0.73±8.03E-08	-5.63±7.59E-09	8.22	1619
WFWEL05	1.36±0.53E-09	4.83±0.82E-09	1.83±8.09E-08	6.13±8.54E-09	6.42	353
WFWEL06*	-2.34±3.24E-10	1.46±0.90E-09	-1.83±0.81E-07	1.42±7.81E-09	7.77	277
WFWEL07	1.26±0.95E-09	1.12±0.95E-09	-8.44±8.06E-08	-4.60±6.56E-09	7.12	245
WFWEL08	6.43±8.62E-10	1.16±1.50E-09	8.80±8.10E-08	0.11±7.41E-09	7.34	479
WFWEL09	0.86±1.04E-09	4.53±1.50E-09	2.02±8.06E-08	2.35±6.35E-09	7.80	585
WFWEL10	-0.43±7.52E-10	2.21±1.07E-09	3.42±5.78E-08	1.15±6.34E-09	7.23	657

* *Background location.*

Table C - 27
1999 Surface Water Quality at Locations WFBCBKG, WNSP006, WNSWAMP, and WNSW74A*

Location	Date	pH ** (standard units)	Conductivity** (µmhos/cm@25°C)	Bicarbonate Alkalinity (as $CaCO_3$) (mg/L)	Carbonate Alkalinity (as $CaCO_3$) (mg/L)	Chloride (mg/L)	Fluoride (mg/L)
WFBCBKG	*05/18*	7.93	286	100	<1	10	0.11
WFBCBKG	*10/12*	7.76	373	130	<1	12	<0.10
WNSP006	*05/18*	7.45	585	150	<1	120	<0.10
WNSP006	*10/12*	7.63	1,033	285	<1	118	<0.10
WNSW74A	*05/18*	7.24	652	100	<1	485	<0.10
WNSW74A	*10/12*	6.91	803	130	<1	97	<0.10
WNSWAMP	*05/18*	7.31	930	184	<1	178	0.07
WNSWAMP	*10/12*	7.33	944	175	<1	158	0.04

Location	Date	Nitrate + Nitrite (mg/L)	Sulfate (mg/L)	NPOC (mg/L)	TOX (µg/L)	Barium Total (µg/L)	Calcium Total (µg/L)
WFBCBKG	*05/18*	0.06	20.0	2.9	26.0	87	37,000
WFBCBKG	*10/12*	<0.05	34.3	1.9	<5.0	<200	45,600
WNSP006	*05/18*	20.00	36.0	4.7	110.0	63	62,000
WNSP006	*10/12*	18.35	43.2	4.4	127.5	<200	71,300
WNSW74A	*05/18*	0.40	117.0	3.0	15.5	125	82,000
WNSW74A	*10/12*	0.51	84.9	3.2	38.6	<200	87,100
WNSWAMP	*05/18*	0.02	23.2	4.9	53.2	126	121,000
WNSWAMP	*10/12*	0.09	48.4	5.2	27.1	132	98,000

Location	Date	Iron Total (µg/L)	Magnesium Total (µg/L)	Manganese Total (µg/L)	Potassium Total (µg/L)	Sodium Total (µg/L)
WFBCBKG	*05/18*	160	5,200	16	1,200	6,800
WFBCBKG	*10/12*	283	6,780	38	1,150	7,980
WNSP006	*05/18*	150	8,800	18	6,800	100,000
WNSP006	*10/12*	173	10,220	17	6,535	116,000
WNSW74A	*05/18*	<30	12,500	30	1,450	93,000
WNSW74A	*10/12*	<100	11,600	29	<1,000	54,200
WNSWAMP	*05/18*	125	14,900	266	44	61,500
WNSWAMP	*10/12*	142	12,400	406	1,600	57,700

** Background location.*
*** pH and conductivity data are from a separate sample collected within one week of the sample analyzed for other nonradiological parameters.*

Table C - 28
1999 Radioactivity Concentrations (µCi/g dry weight from upper 5 cm) and Metals Concentrations (mg/kg dry) in On-site Soils/Sediments

Location	Alpha	Beta	K-40	Co-60	Sr-90
SNSP006	1.15±0.18E-05	1.65±0.04E-04	1.74±0.21E-05	1.02±0.37E-07	2.35±0.22E-06
SNSW74A	1.23±0.18E-05	2.33±0.16E-05	1.45±0.17E-05	-1.53±2.23E-08	3.64±1.20E-07
SNSWAMP	1.22±0.34E-05	3.64±0.41E-05	1.52±0.18E-05	0.71±2.40E-08	4.03±1.52E-06

Location	Cs-137	U-232	U-233/234	U-235/236	U-238
SNSP006	9.76±0.94E-05	7.49±3.99E-08	6.68±1.36E-07	4.25±3.51E-08	6.99±1.37E-07
SNSW74A	4.68±0.74E-07	3.08±3.04E-08	7.41±1.43E-07	5.47±4.19E-08	9.28±1.58E-07
SNSWAMP	2.13±0.23E-06	2.12±1.92E-08	6.73±1.39E-07	1.69±2.58E-08	7.56±1.47E-07

Location	Total U (µg/g)	Pu-238	Pu-239/240	Am-241
SNSP006	1.74±0.06E+00	1.40±0.42E-07	1.08±0.31E-07	2.40±0.71E-07
SNSW74A	1.67±0.08E+00	3.68±2.02E-08	4.48±1.88E-08	2.54±2.40E-08
SNSWAMP	2.08±0.07E+00	1.12±0.37E-07	1.09±0.32E-07	4.59±1.05E-07

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
SNSP006	7340	<3.2	8.1	49.2	0.4	<0.5
SNSW74A	8460	0.2	6.3	66.1	0.4	<0.5
SNSWAMP	9270	0.3	6.8	69.4	0.5	<0.5

Location	Calcium	Chromium	Cobalt	Copper	Iron	Lead
SNSP006	16650	9.8	9.3	17.2	20250	13.4
SNSW74A	11100	10.1	6	20.6	17800	13.7
SNSWAMP	3110	12	7.7	25.3	22300	15.7

Location	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
SNSP006	5625	559.5	<0.02	19.9	543.5	0.9
SNSW74A	4160	442	<0.02	15.9	515	0.8
SNSWAMP	3460	490	<0.02	19.5	604	1.1

Location	Silver	Sodium	Thallium	Vanadium	Zinc
SNSP006	0.4	96.1	<1	12.5	58.6
SNSW74A	0.4	69.7	<1	12.6	170
SNSWAMP	0.3	62.7	<1	14	80.6

Table C - 29

1999 Radioactivity Concentrations (µCi/g dry weight from upper 5 cm) in Surface Soil Collected at Air Sampling Stations around the WVDP

Location	Alpha	Beta	K-40	Co-60	Sr-90
SFBLKST	1.81±0.45E-05	2.47±0.34E-05	1.85±0.22E-05	-1.14±2.61E-08	5.25±6.12E-08
SFBOEHN	1.71±0.43E-05	2.53±0.32E-05	1.47±0.17E-05	-2.20±2.38E-08	1.19±0.54E-07
SFFXVRD	1.18±0.42E-05	1.98±0.33E-05	1.18±0.16E-05	2.39±2.76E-08	1.38±0.54E-07
SFGRVAL*	2.73±0.54E-05	2.33±0.36E-05	1.09±0.14E-05	0.25±2.23E-08	2.92±0.60E-07
SFNASHV*	1.80±0.50E-05	2.07±0.31E-05	1.04±0.14E-05	0.55±1.64E-08	2.22±4.62E-08
SFRSPRD	1.86±0.53E-05	2.28±0.36E-05	1.49±0.19E-05	-0.03±1.95E-08	8.53±4.76E-08
SFRT240	1.78±0.54E-05	1.85±0.34E-05	1.17±0.14E-05	0.40±2.15E-08	1.58±0.55E-07
SFSPRVL	2.22±0.54E-05	2.50±0.38E-05	1.27±0.17E-05	0.26±1.98E-08	1.06±0.72E-07
SFTCORD	1.83±0.41E-05	2.89±0.30E-05	2.01±0.23E-05	-1.61±2.59E-08	1.03±0.30E-07
SFWEVAL	1.43±0.39E-05	2.54±0.30E-05	1.27±0.16E-05	-0.09±2.15E-08	1.24±0.31E-07

	Cs-137	Pu-238	Pu-239/240	Am-241
SFBLKST	2.72±0.65E-07	1.88±1.35E-08	1.88±1.35E-08	1.24±1.20E-08
SFBOEHN	5.03±0.71E-07	-0.24±1.11E-08	3.01±1.86E-08	5.65±9.93E-09
SFFXVRD	3.76±0.64E-07	0.44±1.14E-08	0.20±1.03E-08	2.55±2.49E-08
SFGRVAL*	9.19±1.09E-07	5.67±9.37E-09	2.74±1.69E-08	1.21±1.24E-08
SFNASHV*	9.51±1.16E-07	1.65±1.46E-08	0.48±1.24E-08	0.61±1.07E-08
SFRSPRD	1.18±0.13E-06	5.94±9.81E-09	3.13±1.85E-08	1.03±0.92E-08
SFRT240	4.97±0.84E-07	0.58±5.10E-09	4.14±5.87E-09	1.04±1.15E-08
SFSPRVL	4.75±0.70E-07	0.00±7.89E-09	1.05±1.06E-08	2.35±4.71E-09
SFTCORD	3.87±0.66E-07	4.83±6.86E-09	2.66±1.63E-08	1.00±1.00E-08
SFWEVAL	3.86±0.64E-07	2.46±7.05E-09	0.98±1.06E-08	1.11±1.05E-08

	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)
SFBOEHN	0.87±1.54E-08	8.23±0.87E-07	3.13±2.02E-08	9.17±0.91E-07	2.28±0.04E+00
SFGRVAL*	-0.89±1.23E-08	6.39±0.76E-07	1.11±0.33E-07	6.31±0.75E-07	1.90±0.03E+00
SFRSPRD	0.84±1.53E-08	8.95±0.94E-07	9.23±3.05E-08	9.19±0.93E-07	2.26±0.04E+00

** Background location.*

Table C - 30

1999 Radioactivity Concentrations (µCi/g dry weight from upper 5 cm) in Stream Sediments around the WVDP

Location	Alpha	Beta	K-40	Co-60	Sr-90
SFBCSED*	7.96±3.44E-06	2.10±0.37E-05	1.70±0.21E-05	-0.25±2.58E-08	3.35±3.34E-08
SFBISED*	7.44±3.34E-06	1.57±0.31E-05	1.32±0.17E-05	1.40±1.99E-08	1.41±3.81E-08
SFCCSED	9.38±0.02E-06	1.87±0.35E-05	1.39±0.16E-05	1.41±2.50E-08	2.75±3.55E-08
SFSDSED	7.12±3.29E-06	1.96±0.34E-05	1.54±0.21E-05	1.56±2.47E-08	0.37±2.89E-08
SFTCSED	9.39±3.89E-06	2.03±0.36E-05	1.67±0.21E-05	-0.32±2.32E-08	5.49±3.20E-08

Location	Cs-137	U-232	U-233/234	U-235/236	U-238
SFBCSED*	4.59±2.71E-08	1.46±2.76E-08	6.77±1.00E-07	2.24±1.99E-08	8.45±1.10E-07
SFBISED*	2.04±2.52E-08	0.15±3.08E-08	5.98±0.90E-07	3.10±2.46E-08	6.88±0.96E-07
SFCCSED	9.04±4.50E-08	2.66±3.14E-08	6.27±0.91E-07	2.38±1.76E-08	7.15±0.97E-07
SFSDSED	0.04±3.75E-08	0.99±2.91E-08	7.99±1.03E-07	4.08±2.56E-08	6.97±0.96E-07
SFTCSED	1.09±0.13E-06	1.91±2.71E-08	8.37±1.59E-07	4.70±4.53E-08	6.71±1.42E-07

Location	Total U (µg/g)	Pu-238	Pu-239/240	Am-241
SFBCSED*	1.59±0.03E+00	0.00±9.03E-09	0.12±8.34E-09	0.00±2.02E-08
SFBISED*	1.17±0.04E+00	-2.25±4.52E-09	0.00±7.03E-09	0.45±1.16E-08
SFCCSED	1.66±0.03E+00	0.10±6.68E-09	-2.21±8.12E-09	0.64±1.28E-08
SFSDSED	1.83±0.04E+00	0.11±7.43E-09	0.00±8.03E-09	1.31±1.86E-08
SFTCSED	1.68±0.04E+00	-6.72±9.55E-09	3.50±7.01E-09	2.19±3.12E-08

* *Background location.*

Appendix D

Summary of Air Monitoring Data

Ambient Air and Atmospheric Fallout Samples are Collected from Numerous Locations in the West Valley Area

Table D-1
1999 Airborne Radioactive Effluent Totals (curies)
Released from the Main Ventilation Stack (ANSTACK)

Month	**Alpha**	**Beta**	**H-3**
January	7.61±2.48E-08	4.51±0.14E-06	-4.64±8.15E-05
February	6.71±2.15E-08	4.83±0.13E-06	2.60±0.33E-04
March	7.20±2.37E-08	1.30±0.02E-05	1.64±0.41E-04
April	4.98±2.80E-08	8.75±0.19E-06	5.54±1.27E-04
May	3.15±3.31E-08	4.55±0.17E-06	5.11±1.05E-04
June	3.32±0.49E-07	1.59±0.01E-04	9.21±0.79E-04
July	1.01±0.31E-07	3.79±0.04E-05	2.01±0.10E-03
August	9.43±3.43E-08	4.31±0.15E-06	9.75±0.73E-04
September	1.00±0.31E-07	2.53±0.10E-06	1.04±0.05E-03
October	6.18±3.45E-08	3.75±0.13E-06	5.75±1.36E-04
November	8.56±3.17E-08	2.41±0.11E-06	2.34±1.45E-04
December	8.22±3.14E-08	3.71±0.13E-06	-0.43±1.00E-03
Annual Total	1.15±0.11E-06	2.49±0.01E-04	6.77±1.05E-03

Quarter	**Co-60**	**Sr-90**	**I-129**	**Cs-137**	**Eu-154**
1st Quarter	1.66±3.08E-08	2.18±0.08E-06	6.74±0.78E-04	1.10±0.15E-05	0.77±6.86E-08
2nd Quarter	2.80±2.87E-08	1.25±0.01E-05	5.65±0.75E-04	7.08±0.69E-05	1.38±0.88E-07
3rd Quarter	0.38±3.55E-08	2.00±0.07E-06	1.35±0.18E-04	1.91±0.19E-05	6.97±9.37E-08
4th Quarter	-0.93±4.59E-08	9.83±1.13E-07	5.23±0.70E-04	2.01±0.24E-06	0.00±1.38E-07
Annual Total	3.90±7.17E-08	1.77±0.02E-05	1.90±0.13E-03	1.03±0.07E-04	2.15±2.01E-07

	U-232	**U-233/234**	**U-235/236**	**U-238**	**Total U (g)**
1st Quarter	5.64±4.56E-09	2.11±0.62E-08	0.84±1.56E-09	1.75±0.55E-08	4.67±0.06E-02
2nd Quarter	1.61±3.27E-09	1.93±0.41E-08	6.74±9.84E-10	1.91±0.42E-08	5.29±0.07E-02
3rd Quarter	1.57±1.75E-09	1.56±0.37E-08	0.00±5.60E-10	1.65±0.38E-08	2.21±0.02E-02
4th Quarter	1.22±3.18E-09	1.39±0.38E-08	1.79±1.39E-09	1.50±0.39E-08	2.28±0.03E-02
Annual Total	1.00±0.67E-08	6.99±0.91E-08	3.31±2.37E-09	6.80±0.88E-08	1.44±0.01E-01

	Pu-238	**Pu-239/240**	**Am-241**
1st Quarter	2.87±0.97E-08	3.80±1.16E-08	1.05±0.14E-07
2nd Quarter	4.24±0.74E-08	3.41±0.64E-08	2.10±0.25E-07
3rd Quarter	2.77±0.56E-08	4.72±0.81E-08	1.03±0.14E-07
4th Quarter	1.87±0.45E-08	2.42±0.53E-08	8.59±1.44E-08
Annual Total	1.17±0.14E-07	1.44±0.16E-07	5.03±0.35E-07

Table D - 2
Comparison of 1999 Main Stack (ANSTACK) Exhaust Radioactivity Concentrations with Department of Energy Guidelines

Isotope [a]	Exhaust Activity [b] (Ci)	Radioactivity [c] (Becquerels)	Concentration (µCi/mL)	DCG [d] (µCi/mL)	% of DCG
Alpha	1.15±0.11E-06	4.27±0.41E+04	1.52±0.15E-15	NA [e]	NA
Beta	2.49±0.01E-04	9.21±0.04E+06	3.29±0.01E-13	NA [e]	NA
H-3	6.77±1.05E-03	2.50±0.39E+08	8.94±1.39E-12	1E-07	0.01
Co-60	3.90±7.17E-08	1.44±2.65E+03	5.16±9.47E-17	8E-11	<0.01
Sr-90	1.77±0.02E-05	6.54±0.07E+05	2.34±0.03E-14	9E-12	0.26
I-129	1.90±0.13E-03	7.02±0.48E+07	2.51±0.17E-12	7E-11	3.58
Cs-137	1.03±0.07E-04	3.81±0.27E+06	1.36±0.10E-13	4E-10	0.03
Eu-154	2.15±2.01E-07	7.96±7.42E+03	2.84±2.65E-16	5E-11	<0.01
U-232 [f]	1.00±0.67E-08	3.72±2.47E+02	1.33±0.88E-17	2E-14	0.07
U-233/234 [f]	6.99±0.91E-08	2.59±0.34E+03	9.24±1.21E-17	9E-14	0.10
U-235/236 [f]	3.31±2.37E-09	1.22±0.88E+02	4.37±3.14E-18	1E-13	<0.01
U-238 [f]	6.80±0.88E-08	2.52±0.33E+03	8.99±1.16E-17	1E-13	0.09
Pu-238	1.17±0.14E-07	4.35±0.53E+03	1.55±0.19E-16	3E-14	0.52
Pu-239/240	1.44±0.16E-07	5.31±0.61E+03	1.90±0.22E-16	2E-14	0.95
Am-241	5.03±0.35E-07	1.86±0.13E+04	6.66±0.46E-16	2E-14	3.33
Total % of DCGs					**8.94**

[a] *Half-lives are listed in Table K-1 (p. K-3)*

[b] *Total volume released at 50,000 cfm = 7.57E+14 mL/yr*

[c] *1 curie (Ci) = 3.7 E+10 Becquerels (Bq); 1Bq = 2.7E-11 Ci.*

[d] *Derived concentration guides (DCGs) are listed for reference only. They are applicable to average concentrations at the site boundary but not to stack concentrations, as might be inferred from their inclusion in this table.*

[e] *NA - Not applicable: DCGs are not specified for gross alpha and gross beta activity.*

[f] *Total uranium = 1.44±0.01E-01 g ; average = 1.90E-10 µg/mL*

Table D - 3
1999 Airborne Radioactive Effluent Totals (curies)
from the Vitrification System (HVAC) Ventilation Stack (ANVITSK)

Month	**Alpha**	**Beta**
January	3.87±8.00E-09	1.28±2.14E-08
February	5.28±7.83E-09	1.47±1.96E-08
March	1.02±0.99E-08	-1.61±2.03E-08
April	-0.33±1.05E-08	-2.31±2.18E-08
May	-1.71±9.05E-09	-1.27±1.93E-08
June	-1.24±8.02E-09	0.01±1.87E-08
July	3.34±9.83E-09	0.45±1.99E-08
August	7.27±9.76E-09	-1.98±1.81E-08
September	-3.30±9.99E-09	1.23±1.88E-08
October	-0.80±1.08E-08	1.94±2.02E-08
November	0.20±1.06E-08	0.61±1.90E-08
December	0.79±1.08E-08	1.40±2.08E-08
Annual Total	2.22±3.35E-08	1.22±6.87E-08

Quarter	**Co-60**	**Sr-90**	**I-129**	**Cs-137**	**Eu-154**
1st Quarter	0.27±1.91E-08	-0.63±1.03E-08	2.68±2.74E-08	0.08±1.94E-08	-0.27±5.51E-08
2nd Quarter	0.32±1.17E-08	0.08±1.03E-08	8.40±6.04E-08	0.69±1.11E-08	-0.81±3.28E-08
3rd Quarter	1.76±1.83E-08	-6.07±7.46E-09	1.38±0.52E-07	-0.09±1.76E-08	-4.13±5.81E-08
4th Quarter	0.17±2.13E-08	-3.00±6.97E-09	5.16±0.99E-07	-0.98±1.88E-08	-0.10±6.21E-08
Annual Total	2.52±3.59E-08	-1.46±1.78E-08	7.65±1.30E-07	-0.30±3.41E-08	-0.53±1.07E-07

	U-232	**U-233/234**	**U-235/236**	**U-238**	**Total U (g)**
1st Quarter	-0.52±1.03E-09	8.77±3.21E-09	6.28±8.89E-10	8.15±2.90E-09	2.60±0.03E-02
2nd Quarter	0.31±1.10E-09	6.41±1.76E-09	5.45±6.39E-10	5.53±1.52E-09	1.79±0.03E-02
3rd Quarter	0.51±1.27E-09	5.29±1.68E-09	2.12±4.16E-10	5.82±1.57E-09	1.88±0.02E-02
4th Quarter	0.52±1.65E-09	7.72±2.28E-09	6.54±7.36E-10	6.27±1.92E-09	1.05±0.01E-02
Annual Total	0.82±2.57E-09	2.82±0.46E-08	2.04±1.38E-09	2.58±0.41E-08	7.32±0.05E-02

	Pu-238	**Pu-239/240**	**Am-241**
1st Quarter	1.23±1.83E-09	-2.02±4.05E-10	-0.93±5.72E-10
2nd Quarter	0.78±1.29E-09	2.60±3.90E-10	4.96±4.46E-10
3rd Quarter	3.86±5.48E-10	1.35±0.79E-09	6.89±6.57E-10
4th Quarter	-1.04±2.08E-10	1.04±4.64E-10	2.03±4.06E-10
Annual Total	2.30±2.32E-09	1.51±1.07E-09	1.30±1.06E-09

Table D - 4
1999 Airborne Radioactive Effluent Totals (curies) from the Seismic Sampler (ANSEISK) for the Vitrification System (HVAC) Ventilation Stack

Month	**Alpha**	**Beta**
January	9.43±8.20E-09	-0.46±1.90E-08
February	4.73±7.01E-09	2.15±1.80E-08
March	-1.16±7.57E-09	-0.20±1.90E-08
April	-0.27±1.00E-08	-2.49±2.08E-08
May	4.33±9.61E-09	-2.00±1.85E-08
June	6.42±8.92E-09	0.72±1.88E-08
July	0.97±1.08E-08	0.08±2.00E-08
August	0.66±1.00E-08	-1.71±1.89E-08
September	0.58±1.09E-08	-0.44±1.76E-08
October	-1.04±1.09E-08	1.77±2.10E-08
November	0.42±1.06E-08	0.20±1.83E-08
December	-3.58±9.75E-09	0.52±2.18E-08
Annual Total	3.34±3.33E-08	-1.85±6.70E-08

ANSEISK provides back-up samples for the primary vitrification sampler (ANVITSK).

Table D - 5
1999 Airborne Radioactive Effluent Totals (curies) from the 01-14 Building Ventilation Exhaust (ANCSSTK)

Month	**Alpha**	**Beta**
January	1.96±3.11E-09	1.23±0.85E-08
February	1.51±2.54E-09	1.15±0.68E-08
March	2.69±3.19E-09	-5.29±6.76E-09
April	1.66±4.46E-09	-4.46±8.87E-09
May	1.44±3.86E-09	0.46±7.88E-09
June	1.12±3.26E-09	2.66±7.24E-09
July	4.77±4.56E-09	1.39±0.88E-08
August	-0.96±3.94E-09	4.22±8.93E-09
September	0.23±4.70E-09	1.28±0.87E-08
October	-2.03±4.46E-09	1.12±0.83E-08
November	2.10±4.49E-09	1.88±7.69E-09
December	2.36±4.43E-09	2.05±8.73E-09
Annual Total	1.69±1.38E-08	6.32±2.82E-08

Quarter	**Co-60**	**Sr-90**	**I-129**	**Cs-137**	**Eu-154**
1st Quarter	-2.25±4.83E-09	-6.92±6.61E-09	5.35±1.78E-08	-1.04±4.44E-09	0.21±1.41E-08
2nd Quarter	1.75±5.38E-09	2.35±0.39E-08	1.34±0.44E-07	-1.17±7.28E-09	0.13±1.50E-08
3rd Quarter	6.34±7.41E-09	0.66±4.05E-09	5.09±2.01E-08	1.36±6.75E-09	0.71±1.68E-08
4th Quarter	-3.90±8.21E-09	0.37±2.93E-09	9.94±3.25E-08	-6.05±8.39E-09	-0.33±2.47E-08
Annual Total	0.20±1.32E-08	1.76±0.92E-08	3.38±0.61E-07	-0.69±1.37E-08	0.72±3.62E-08

	U-232	**U-233/234**	**U-235/236**	**U-238**	**Total U (g)**
1st Quarter	4.09±5.26E-10	2.52±1.05E-09	2.01±3.72E-10	2.78±1.08E-09	8.70±0.12E-03
2nd Quarter	0.96±3.30E-10	2.16±0.57E-09	1.05±1.19E-10	3.24±0.66E-09	8.44±0.13E-03
3rd Quarter	-0.37±3.39E-10	2.98±0.72E-09	2.05±2.12E-10	3.22±0.72E-09	8.98±0.11E-03
4th Quarter	1.30±6.75E-10	2.93±0.77E-09	2.21±2.26E-10	1.95±0.64E-09	5.58±0.07E-03
Annual Total	5.98±9.78E-10	1.06±0.16E-08	7.32±4.99E-10	1.12±0.16E-08	3.17±0.02E-02

	Pu-238	**Pu-239/240**	**Am-241**
1st Quarter	3.89±4.57E-10	-0.57±3.70E-10	1.34±2.28E-10
2nd Quarter	1.01±4.68E-10	-1.00±2.01E-10	1.36±1.58E-10
3rd Quarter	-0.92±3.18E-10	1.38±1.59E-10	1.76±1.77E-10
4th Quarter	-0.93±1.32E-10	0.00±1.86E-10	1.70±2.59E-10
Annual Total	3.05±7.39E-10	-0.20±4.87E-10	6.16±4.19E-10

Table D - 6
1999 Airborne Radioactive Effluent Totals (curies) from the Contact Size-reduction Facility Ventilation Stack (ANCSRFK)

Month	Alpha	Beta
January	NA	NA
February	NA	NA
March	NA	NA
April	7.59±8.58E-10	-0.62±1.83E-09
May	NA	NA
June	NA	NA
July	NA	NA
August	NA	NA
September	NA	NA
October	NA	NA
November	NA	NA
December	NA	NA
Annual Total	7.59±8.58E-10	-0.62±1.83E-09

Quarter	Co-60	Sr-90	I-129	Cs-137	Eu-154
1st Quarter	NA	NA	NA	NA	NA
2nd Quarter	0.84±2.44E-09	0.53±1.36E-09	-0.82±5.13E-09	0.73±2.14E-09	-2.84±6.17E-09
3rd Quarter	NA	NA	NA	NA	NA
4th Quarter	NA	NA	NA	NA	NA
Annual Total	0.84±2.44E-09	0.53±1.36E-09	-0.82±5.13E-09	0.73±2.14E-09	-2.84±6.17E-09

	U-232	U-233/234	U-235/236	U-238	Total U (g)
1st Quarter	NA	NA	NA	NA	NA
2nd Quarter	1.00±2.03E-10	2.68±1.35E-10	-3.17±4.39E-11	1.10±1.03E-10	2.88±0.11E-04
3rd Quarter	NA	NA	NA	NA	NA
4th Quarter	NA	NA	NA	NA	NA
Annual Total	1.00±2.03E-10	2.68±1.35E-10	-3.17±4.39E-11	1.10±1.03E-10	2.88±0.11E-04

	Pu-238	Pu-239/240	Am-241
1st Quarter	NA	NA	NA
2nd Quarter	0.87±1.05E-10	5.19±6.03E-11	1.34±1.10E-10
3rd Quarter	NA	NA	NA
4th Quarter	NA	NA	NA
Annual Total	0.87±1.05E-10	5.19±6.03E-11	1.34±1.10E-10

NA - Not applicable. Ventilation off.

Table D - 7
1999 Airborne Radioactive Effluent Totals (curies) from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

Month	Alpha	Beta	H-3
January	1.56±1.72E-09	5.31±4.44E-09	1.01±0.35E-06
February	0.79±1.50E-09	2.74±3.84E-09	3.77±2.25E-07
March	0.61±1.77E-09	0.36±4.17E-09	1.57±0.23E-06
April	0.31±2.25E-09	-0.54±4.61E-09	4.20±4.42E-07
May	0.02±1.95E-09	-1.23±4.12E-09	3.21±0.52E-06
June	1.84±1.93E-09	1.85±0.03E-06	-1.27±1.45E-06
July	1.99±2.27E-09	1.75±0.50E-08	2.94±0.27E-05
August	0.89±2.01E-09	-2.39±3.98E-09	1.37±0.04E-04
September	-0.44±2.11E-09	1.20±0.44E-08	1.19±0.04E-04
October	0.20±2.61E-09	1.32±0.48E-08	4.69±0.23E-05
November	-0.04±2.22E-09	6.48±4.30E-09	5.15±2.60E-06
December	1.43±2.32E-09	5.10±4.69E-09	2.75±3.53E-06
Annual Total	9.16±7.19E-09	1.91±0.03E-06	3.45±0.08E-04

Quarter	Co-60	Sr-90	I-129	Cs-137	Eu-154
1st Quarter	1.76±1.92E-09	-1.70±2.31E-09	1.92±0.45E-07	2.92±3.02E-09	5.75±8.77E-09
2nd Quarter	-0.30±2.01E-09	1.99±1.85E-09	4.83±0.62E-07	0.00±3.38E-09	2.55±6.02E-09
3rd Quarter	5.02±3.63E-09	0.18±1.98E-09	1.46±0.20E-06	1.69±0.58E-08	0.22±1.08E-08
4th Quarter	-0.37±5.32E-09	1.53±1.54E-09	3.00±0.40E-07	7.26±6.01E-09	-0.24±1.23E-08
Annual Total	6.11±7.01E-09	2.00±3.88E-09	2.44±0.22E-06	2.71±0.95E-08	0.82±1.95E-08

	U-232	U-233/234	U-235/236	U-238	Total U (g)
1st Quarter	0.57±2.41E-10	1.56±0.63E-09	3.77±3.02E-10	1.91±0.69E-09	5.20±0.07E-03
2nd Quarter	-1.57±2.22E-10	2.14±1.57E-10	0.00±4.97E-11	2.33±1.26E-10	7.59±0.10E-04
3rd Quarter	1.71±2.42E-10	1.20±0.34E-09	1.78±1.38E-10	8.90±2.82E-10	3.71±0.04E-03
4th Quarter	0.12±3.29E-10	1.24±0.40E-09	0.57±9.71E-11	1.52±0.43E-09	1.87±0.02E-03
Annual Total	0.84±5.24E-10	4.22±0.84E-09	5.61±3.50E-10	4.55±0.87E-09	1.15±0.01E-02

	Pu-238	Pu-239/240	Am-241
1st Quarter	3.64±3.59E-10	0.69±1.39E-10	1.10±0.99E-10
2nd Quarter	0.35±2.33E-10	0.35±1.11E-10	2.39±1.70E-10
3rd Quarter	2.15±4.30E-11	6.45±7.49E-11	2.26±7.83E-11
4th Quarter	0.71±1.07E-10	0.71±1.57E-10	-0.70±9.76E-11
Annual Total	4.92±4.43E-10	2.40±2.49E-10	3.64±2.33E-10

Table D - 8
1999 Airborne Radioactive Effluent Totals (curies) from the Container Sorting and Packaging Facility (ANCSPFK)

Month	Alpha	Beta
January	1.54±3.67E-10	1.03±1.02E-09
February	3.79±3.82E-10	7.57±8.30E-10
March	1.15±3.94E-10	-3.05±9.21E-10
April	1.98±5.25E-10	-0.42±1.03E-09
May	0.07±4.26E-10	-2.82±8.98E-10
June	3.86±3.97E-10	-1.80±7.24E-10
July	NA	NA
August	NA	NA
September	NA	NA
October	NA	NA
November	2.90±2.66E-10	1.71±4.76E-10
December	2.57±5.35E-10	0.56±1.07E-09
Annual Total	1.79±1.19E-09	1.33±2.52E-09

Quarter	Co-60	Sr-90	I-129	Cs-137	Eu-154
1st Quarter	1.69±2.19E-09	0.45±4.46E-10	0.00±2.09E-09	0.00±1.82E-09	0.53±2.77E-09
2nd Quarter	-1.40±6.28E-10	0.53±4.34E-10	0.00±1.22E-09	-4.81±5.78E-10	0.17±1.83E-09
3rd Quarter	NA	NA	NA	NA	NA
4th Quarter	-0.05±2.49E-09	-0.39±1.13E-09	7.34±3.34E-09	0.00±3.93E-09	4.05±7.42E-09
Annual Total	1.50±3.38E-09	-0.29±1.29E-09	7.34±4.13E-09	-0.48±4.37E-09	4.74±8.13E-09

	U-232	U-233/234	U-235/236	U-238	Total U (g)
1st Quarter	5.88±5.15E-11	3.42±1.31E-10	0.54±3.66E-11	5.71±1.57E-10	9.28±0.12E-04
2nd Quarter	4.82±6.77E-11	4.25±0.97E-10	1.62±2.80E-11	2.59±0.73E-10	9.00±0.13E-04
3rd Quarter	NA	NA	NA	NA	NA
4th Quarter	1.30±2.40E-10	3.72±1.51E-10	7.62±6.25E-11	3.28±1.33E-10	4.65±0.06E-04
Annual Total	2.37±2.55E-10	1.14±0.22E-09	9.78±7.77E-11	1.16±0.22E-09	2.29±0.02E-03

	Pu-238	Pu-239/240	Am-241
1st Quarter	-1.78±2.53E-11	1.58±3.92E-11	0.55±2.55E-11
2nd Quarter	0.43±2.28E-11	-0.86±1.22E-11	3.79±2.89E-11
3rd Quarter	NA	NA	NA
4th Quarter	-4.03±6.10E-11	-1.31±6.10E-11	5.77±8.89E-11
Annual Total	-5.38±6.99E-11	-0.58±7.35E-11	1.01±0.97E-10

NA - Not applicable. Ventilation off.

Table D - 9
1999 Airborne Radioactive Effluent Totals (curies) from the Former Low-level Waste Treatment Facility Hot Side Ventilation (ANLLWTVH)

Month	Alpha	Beta
January	1.67±5.17E-10	2.00±1.32E-09
February	-1.64±4.54E-10	1.52±1.32E-09
March	5.52±6.37E-10	-0.13±1.38E-09
April	3.84±7.04E-10	0.34±1.68E-09
May	NA	NA
June	NA	NA
July	0.09±1.45E-09	5.89±3.07E-09
August	2.82±8.90E-10	1.60±2.02E-09
September	1.94±5.37E-10	0.20±1.43E-09
October	NA	NA
November	NA	NA
December	NA	NA
Annual Total	1.50±2.13E-09	1.14±0.49E-08

Table D - 10
1999 Airborne Radioactive Effluent Totals (curies) from the New Low-level Waste Treatment Facility Ventilation (ANLLW2V)*

Month	Alpha	Beta
January	0.83±1.80E-10	-0.21±3.70E-10
February	NA	NA
March	2.02±2.33E-10	-2.37±4.86E-10
April	NA	NA
May	NA	NA
June	0.53±1.26E-10	-2.49±2.77E-10
July	NA	NA
August	NA	NA
September	0.00±1.68E-10	-1.89±4.94E-10
October	NA	NA
November	NA	NA
December	0.80±2.98E-10	-0.57±6.18E-10
Annual Total	4.19±4.69E-10	-0.75±1.04E-09

NA - Not applicable. Ventilation off.

** Air filters from LLW2 were also analyzed isotopically for a one-year characterization period ending in March 1999. Results of these analyses showed no positive detection for non-natural isotopes.*

Table D - 11
1999 Airborne Radioactive Effluent Totals (curies) from the Laundry Change Room (ANLAUNV)

Month	Alpha	Beta
January	0.00±8.97E-10	1.50±2.33E-09
February	-5.70±8.84E-10	-0.35±2.33E-09
March	-3.11±3.73E-10	0.13±1.38E-09
April	-0.86±3.77E-10	-0.42±1.25E-09
May	0.12±1.04E-09	-0.30±1.95E-09
June	0.00±2.97E-10	-0.79±8.02E-10
July	-1.81±3.92E-10	1.06±0.83E-09
August	1.59±2.85E-10	-1.30±5.33E-10
September	3.06±4.74E-10	-0.72±1.05E-09
October	-5.69±6.43E-10	1.72±1.32E-09
November	2.53±3.92E-10	-0.85±7.92E-10
December	-1.46±4.95E-10	-0.36±1.01E-09
Annual Total	-1.02±2.08E-09	1.96±4.92E-09

Table D - 12
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Lag Storage Area Air Sampler (ANLAGAM)

Month	Alpha	Beta
January	1.38±0.82E-15	2.05±0.27E-14
February	8.48±7.18E-16	1.90±0.26E-14
March	1.28±0.89E-15	1.69±0.26E-14
April	6.87±8.70E-16	1.34±0.24E-14
May	4.55±7.97E-16	1.29±0.24E-14
June	1.05±0.86E-15	1.82±0.26E-14
July	8.28±9.34E-16	2.02±0.30E-14
August	1.15±2.87E-15	2.06±0.70E-14
September	5.27±9.45E-16	2.33±0.30E-14
October	6.33±9.82E-16	1.70±0.26E-14
November	1.38±1.12E-15	3.06±0.33E-14
December	8.42±9.30E-16	1.94±0.28E-14

Quarter	K-40	Co-60	Sr-90	Cs-137	U-232
1st Quarter	3.71±4.14E-15	0.78±1.70E-16	-2.13±1.54E-16	0.47±1.40E-16	1.26±1.77E-17
2nd Quarter	1.40±3.64E-15	0.62±1.00E-16	-0.25±1.28E-16	0.05±1.21E-16	6.64±9.04E-18
3rd Quarter	4.98±3.04E-15	-1.30±2.75E-16	-0.99±1.39E-16	2.43±2.21E-16	-0.30±1.40E-17
4th Quarter	0.21±6.51E-15	-0.32±2.36E-16	-0.15±1.11E-16	3.81±6.58E-16	0.13±1.87E-17

	U-233/234	U-235/236	U-238	Total U (µg/mL)	Pu-238
1st Quarter	7.38±2.82E-17	-3.87±4.38E-18	1.27±0.36E-16	2.57±0.03E-10	6.20±8.09E-18
2nd Quarter	9.49±2.27E-17	-1.21±4.09E-18	9.72±2.14E-17	2.28±0.03E-10	0.00±5.57E-18
3rd Quarter	8.48±2.26E-17	3.04±7.29E-18	8.63±2.31E-17	2.77±0.03E-10	-0.32±1.11E-17
4th Quarter	8.45±2.32E-17	1.00±0.84E-17	8.61±2.37E-17	1.27±0.02E-10	0.01±3.06E-18

	Pu-239/240	Am-241
1st Quarter	0.53±4.66E-18	0.24±7.47E-18
2nd Quarter	9.10±7.93E-18	1.45±0.88E-17
3rd Quarter	4.78±5.55E-18	6.18±7.58E-18
4th Quarter	3.27±4.87E-18	7.65±9.63E-18

Table D - 13
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the NDA Air Sampler (ANNDAAM)

Month	Alpha	Beta
January	9.89±7.35E-16	2.10±0.27E-14
February	1.36±0.86E-15	1.93±0.27E-14
March	1.03±0.87E-15	1.55±0.26E-14
April	4.29±8.39E-16	1.39±0.25E-14
May	4.73±8.31E-16	1.29±0.25E-14
June	8.23±8.30E-16	1.51±0.25E-14
July	7.39±8.58E-16	1.87±0.27E-14
August	4.87±8.36E-16	1.69±0.27E-14
September	0.73±1.01E-15	2.32±0.30E-14
October	0.66±1.03E-15	1.63±0.26E-14
November	1.41±1.16E-15	2.78±0.33E-14
December	1.10±1.01E-15	1.88±0.28E-14

Quarter	K-40	Co-60	Sr-90	Cs-137	U-232
1st Quarter	7.21±2.48E-15	0.23±1.42E-16	-1.11±1.08E-16	-0.13±1.22E-16	-1.22±1.32E-17
2nd Quarter	0.71±4.76E-15	-1.70±2.03E-16	1.33±1.04E-16	-0.19±2.03E-16	-0.54±1.22E-17
3rd Quarter	0.73±3.80E-15	-0.34±1.98E-16	-0.02±1.25E-16	0.23±1.69E-16	0.37±1.29E-17
4th Quarter	0.09±6.90E-15	-0.14±2.29E-16	-4.71±9.00E-17	1.06±2.22E-16	-1.01±1.80E-17

	U-233/234	U-235/236	U-238	Total U (µg/mL)	Pu-238
1st Quarter	7.60±2.89E-17	0.81±1.13E-17	1.07±0.34E-16	2.60±0.04E-10	4.70±9.44E-18
2nd Quarter	8.91±2.27E-17	7.33±8.62E-18	9.64±2.36E-17	2.22±0.03E-10	5.14±6.19E-18
3rd Quarter	5.72±1.86E-17	8.02±6.41E-18	8.12±2.11E-17	2.35±0.03E-10	-1.17±4.06E-18
4th Quarter	7.79±2.26E-17	1.01±0.77E-17	8.48±2.35E-17	1.03±0.01E-10	-2.28±3.23E-18

	Pu-239/240	Am-241
1st Quarter	-0.90±1.29E-17	1.10±1.33E-17
2nd Quarter	3.07±3.56E-18	8.70±7.51E-18
3rd Quarter	-1.17±2.34E-18	0.11±1.81E-17
4th Quarter	6.94±6.56E-18	4.73±7.19E-18

Table D - 14
1999 Airborne Radioactivity Concentrations (µCi/mL) at the SDA Trench 9 Air Sampler (ANSDAT9)

Month	**Alpha**	**Beta**	**H-3**
January	6.99±8.86E-16	2.20±0.35E-14	2.58±2.26E-13
February	1.14±1.00E-15	1.75±0.32E-14	1.25±0.25E-12
March	0.67±1.03E-15	1.69±0.33E-14	2.81±0.29E-12
April	0.33±1.09E-15	1.21±0.30E-14	1.49±0.28E-12
May	0.49±1.19E-15	1.07±0.31E-14	4.64±5.40E-13
June	1.08±1.41E-15	1.50±0.37E-14	3.67±7.35E-13
July	1.11±1.19E-15	2.02±0.35E-14	1.47±1.04E-12
August	0.41±1.03E-15	1.53±0.31E-14	2.04±1.00E-12
September	0.69±1.21E-15	2.42±0.35E-14	9.44±9.14E-13
October	0.66±1.26E-15	2.13±0.34E-14	5.74±6.02E-13
November	1.09±1.34E-15	2.92±0.39E-14	1.09±0.38E-12
December	1.07±1.22E-15	2.14±0.35E-14	4.89±4.11E-13

Quarter	**K-40**	**Co-60**	**I-129**	**Cs-137**
1st Quarter	2.89±4.44E-15	0.70±2.43E-16	0.48±1.32E-16	0.53±1.95E-16
2nd Quarter	4.43±4.57E-15	-1.49±1.96E-16	1.77±1.71E-16	0.71±1.68E-16
3rd Quarter	7.47±6.87E-15	3.80±2.63E-16	-0.82±1.59E-16	-0.51±2.39E-16
4th Quarter	7.97±2.88E-15	0.93±1.73E-16	0.45±9.53E-17	-0.68±1.84E-16

Table D - 15
1999 Airborne Radioactive Effluent Totals (curies) from Outdoor Ventilation Enclosures/Portable Ventilation Units

Month	**Alpha**	**Beta**
January	NA	NA
February	2.69±3.45E-10	-2.21±6.17E-10
March	NA	NA
April	-9.55±8.10E-11	1.37±2.14E-10
May	NA	NA
June	NA	NA
July	-2.58±6.52E-11	0.28±1.36E-10
August	NA	NA
September	0.87±1.49E-10	0.44±2.74E-10
October	-0.60±7.30E-10	0.47±1.23E-09
November	NA	NA
December	3.36±2.93E-10	1.83±0.73E-09
Annual Total	5.11±8.78E-10	2.28±1.61E-09

Quarter	**Co-60**	**Sr-90**	**Cs-137**	**Eu-154**	**U-232**
1st Quarter	-4.20±9.38E-10	7.32±7.99E-10	-3.92±8.07E-10	0.86±2.53E-09	3.55±7.92E-11
2nd Quarter	2.58±4.24E-10	1.19±1.75E-10	0.00±3.60E-10	1.29±5.72E-10	0.21±1.81E-11
3rd Quarter	1.30±3.46E-10	0.95±1.40E-10	-0.55±2.88E-10	1.07±9.85E-10	1.31±1.00E-11
4th Quarter	-0.13±1.14E-09	-3.48±4.61E-10	2.71±2.19E-09	1.42±3.32E-09	-2.77±7.71E-11
Annual Total	-0.17±1.58E-09	5.97±9.50E-10	2.26±2.38E-09	2.52±4.32E-09	0.23±1.12E-10

	U-233/234	**U-235/236**	**U-238**	**Total U**	**Pu-238**
1st Quarter	9.15±9.22E-11	0.00±5.53E-11	1.01±0.90E-10	1.48±0.03E-04	0.00±5.68E-11
2nd Quarter	1.49±0.37E-10	0.67±1.15E-11	1.44±0.35E-10	4.32±0.07E-04	1.39±2.50E-11
3rd Quarter	1.24±1.66E-11	4.65±8.05E-12	1.39±1.00E-11	2.20±0.03E-05	5.40±9.54E-12
4th Quarter	1.48±0.69E-10	-0.42±2.66E-11	1.21±0.59E-10	1.64±0.02E-04	-1.21±7.08E-11
Annual Total	4.00±1.22E-10	0.71±6.29E-11	3.80±1.14E-10	7.65±0.08E-04	0.71±9.46E-11

	Pu-239/240	**Am-241**
1st Quarter	0.53±4.67E-11	2.33±2.70E-11
2nd Quarter	0.00±9.78E-12	1.88±1.64E-11
3rd Quarter	0.00±5.07E-12	1.36±2.18E-11
4th Quarter	0.61±3.22E-11	4.00±4.22E-11
Annual Total	1.14±5.77E-11	9.58±5.70E-11

NA - Not applicable. Ventilation units not in use.

Table D - 16
1999 Airborne Radioactivity Concentrations (µCi/mL) at the Rock Springs Road Air Sampler (AFRSPRD)

Month	Alpha	Beta	H-3
January	4.66±8.20E-16	1.84±0.33E-14	0.10±2.31E-13
February	1.70±1.14E-15	1.61±0.31E-14	-0.44±2.97E-13
March	0.91±1.08E-15	1.41±0.31E-14	3.47±2.55E-13
April	0.47±1.12E-15	1.09±0.29E-14	-0.63±3.74E-13
May	0.65±1.13E-15	1.17±0.30E-14	-2.61±5.99E-13
June	3.99±9.55E-16	1.73±0.32E-14	-1.81±9.47E-13
July	0.62±1.06E-15	2.02±0.34E-14	0.30±1.28E-12
August	0.29±1.03E-15	1.52±0.32E-14	0.41±1.05E-12
September	0.56±1.20E-15	2.24±0.35E-14	-4.81±8.65E-13
October	0.23±1.20E-15	1.98±0.34E-14	-3.05±6.76E-13
November	0.85±1.32E-15	3.20±0.41E-14	6.59±4.97E-13
December	1.02±1.24E-15	1.97±0.35E-14	-1.31±3.75E-13

Quarter	K-40	Co-60	Sr-90	I-129	Cs-137
1st Quarter	2.24±4.73E-15	1.99±2.05E-16	-1.27±1.82E-16	-0.67±2.15E-16	0.60±1.95E-16
2nd Quarter	3.83±2.32E-15	-0.64±1.92E-16	0.65±1.62E-16	1.02±2.42E-16	0.16±1.77E-16
3rd Quarter	5.37±5.41E-15	-1.24±2.63E-16	-0.82±1.50E-16	0.37±3.74E-16	0.28±2.38E-16
4th Quarter	1.71±0.68E-14	-0.30±2.94E-16	-0.48±1.65E-16	-0.09±1.04E-16	-1.14±3.06E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	0.97±2.20E-17	9.71±4.44E-17	0.69±1.37E-17	7.87±3.91E-17	3.52±0.04E-10
2nd Quarter	-0.20±1.38E-17	1.05±0.26E-16	-4.72±5.35E-18	9.73±2.42E-17	3.05±0.04E-10
3rd Quarter	0.47±1.48E-17	1.08±0.28E-16	6.75±8.11E-18	1.08±0.26E-16	3.19±0.03E-10
4th Quarter	0.48±2.49E-17	7.14±2.56E-17	3.63±6.69E-18	7.75±2.49E-17	2.20±0.03E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	2.45±2.76E-17	1.07±9.44E-18	1.13±0.93E-17
2nd Quarter	-0.67±1.96E-17	1.08±0.77E-17	1.58±1.17E-17
3rd Quarter	1.59±7.13E-18	1.59±5.52E-18	3.52±4.99E-18
4th Quarter	-3.40±8.34E-18	5.10±7.62E-18	1.13±1.19E-17

Table D - 17
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Dutch Hill Air Sampler (AFBOEHN)

Month	Alpha	Beta
January	9.86±9.48E-16	2.47±0.36E-14
February	1.04±0.97E-15	2.21±0.34E-14
March	0.83±1.52E-15	1.82±0.43E-14
April	0.15±1.02E-15	1.57±0.32E-14
May	0.41±1.07E-15	1.45±0.31E-14
June	1.07±1.11E-15	1.77±0.33E-14
July	0.94±1.13E-15	2.41±0.36E-14
August	0.73±1.32E-15	1.72±0.37E-14
September	0.46±1.19E-15	2.57±0.37E-14
October	0.85±1.28E-15	2.20±0.34E-14
November	1.70±1.48E-15	3.18±0.40E-14
December	1.23±1.26E-15	2.06±0.35E-14

Quarter	Sr-90	Cs-137
1st Quarter	-0.54±2.43E-16	-1.28±2.00E-16
2nd Quarter	-0.26±1.07E-16	1.33±1.60E-16
3rd Quarter	0.18±1.30E-16	0.62±2.49E-16
4th Quarter	1.07±1.27E-16	0.59±2.95E-16

Table D - 18
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Fox Valley Air Sampler (AFFXVRD)

Month	Alpha	Beta
January	1.30±1.03E-15	2.60±0.37E-14
February	8.19±9.21E-16	1.96±0.33E-14
March	0.93±1.07E-15	1.90±0.34E-14
April	0.22±1.05E-15	1.44±0.31E-14
May	0.84±1.17E-15	1.25±0.31E-14
June	1.07±1.08E-15	1.88±0.32E-14
July	0.91±1.11E-15	2.18±0.34E-14
August	1.08±1.17E-15	1.61±0.31E-14
September	0.75±1.21E-15	2.31±0.34E-14
October	0.42±1.22E-15	2.01±0.33E-14
November	0.80±1.30E-15	3.05±0.40E-14
December	0.47±1.08E-15	2.19±0.35E-14

Quarter	Sr-90	Cs-137
1st Quarter	-0.91±2.45E-16	1.01±1.91E-16
2nd Quarter	-0.11±1.30E-16	0.71±1.58E-16
3rd Quarter	3.72±9.73E-17	-0.19±2.41E-16
4th Quarter	-1.25±1.24E-16	0.00±5.75E-16

Table D - 19
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Bulk Storage Warehouse Air Sampler (AFBLKST)

Month	Alpha	Beta
January	9.98±9.60E-16	1.92±0.33E-14
February	7.66±9.13E-16	1.78±0.32E-14
March	0.78±1.04E-15	1.54±0.32E-14
April	0.33±1.10E-15	1.21±0.30E-14
May	0.63±1.14E-15	1.28±0.31E-14
June	1.13±1.12E-15	1.81±0.33E-14
July	0.81±1.08E-15	2.11±0.34E-14
August	1.20±1.53E-15	2.54±0.45E-14
September	1.07±1.31E-15	2.37±0.35E-14
October	-0.13±1.10E-15	1.94±0.33E-14
November	0.84±1.31E-15	3.18±0.41E-14
December	1.03±1.22E-15	2.04±0.35E-14

Quarter	Sr-90	Cs-137
1st Quarter	-1.36±2.86E-16	-1.27±1.99E-16
2nd Quarter	-0.70±1.47E-16	-0.41±1.69E-16
3rd Quarter	0.93±1.36E-16	0.80±3.15E-16
4th Quarter	0.31±1.34E-16	-0.09±2.70E-16

Table D - 20
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Route 240 Air Sampler (AFRT240)

Month	Alpha	Beta
January	1.28±1.05E-15	2.38±0.36E-14
February	1.13±1.02E-15	2.35±0.36E-14
March	0.67±1.03E-15	1.68±0.33E-14
April	0.45±1.12E-15	1.44±0.32E-14
May	0.41±1.06E-15	1.46±0.31E-14
June	1.14±1.13E-15	1.76±0.33E-14
July	1.15±1.25E-15	2.13±0.36E-14
August	0.55±1.18E-15	1.79±0.35E-14
September	1.06±1.41E-15	2.33±0.37E-14
October	-0.29±1.12E-15	1.99±0.35E-14
November	1.42±1.47E-15	2.94±0.40E-14
December	0.88±1.22E-15	1.91±0.35E-14

Quarter	Sr-90	Cs-137
1st Quarter	-1.37±1.96E-16	0.66±1.76E-16
2nd Quarter	-0.07±1.02E-16	0.71±1.67E-16
3rd Quarter	-0.56±1.63E-16	-1.16±2.69E-16
4th Quarter	0.90±9.90E-17	4.04±4.54E-16

Table D - 21
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Thomas Corners Road Air Sampler (AFTCORD)

Month	Alpha	Beta
January	9.81±9.57E-16	1.94±0.33E-14
February	6.81±8.68E-16	1.84±0.32E-14
March	1.01±1.06E-15	1.42±0.31E-14
April	0.69±1.15E-15	1.23±0.30E-14
May	0.76±1.17E-15	1.35±0.32E-14
June	1.01±1.12E-15	1.87±0.34E-14
July	1.11±1.20E-15	2.32±0.36E-14
August	1.08±1.53E-15	4.08±0.53E-14
September	1.23±1.40E-15	4.22±0.46E-14
October	0.32±1.22E-15	1.89±0.33E-14
November	1.13±1.39E-15	3.02±0.40E-14
December	0.89±1.20E-15	2.21±0.36E-14

Quarter	Sr-90	Cs-137
1st Quarter	-2.95±2.67E-16	-0.43±2.17E-16
2nd Quarter	-0.15±1.13E-16	1.22±1.59E-16
3rd Quarter	0.97±1.88E-16	0.92±2.50E-16
4th Quarter	0.58±1.14E-16	0.00±5.09E-16

Table D - 22
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the West Valley Air Sampler (AFWEVAL)

Month	Alpha	Beta
January	1.19±1.01E-15	2.43±0.36E-14
February	1.02±0.98E-15	1.93±0.33E-14
March	0.69±1.02E-15	1.70±0.33E-14
April	0.65±1.17E-15	1.40±0.31E-14
May	1.41±1.30E-15	1.41±0.32E-14
June	0.82±1.07E-15	1.84±0.34E-14
July	0.82±1.19E-15	2.18±0.36E-14
August	0.76±1.24E-15	1.58±0.34E-14
September	0.79±1.38E-15	2.17±0.37E-14
October	0.43±1.28E-15	1.90±0.34E-14
November	1.19±1.39E-15	3.01±0.40E-14
December	0.86±1.19E-15	1.98±0.34E-14

Quarter	Sr-90	Cs-137
1st Quarter	0.46±1.56E-16	1.03±5.41E-16
2nd Quarter	0.22±1.28E-16	0.99±1.65E-16
3rd Quarter	1.66±1.89E-16	-0.58±2.85E-16
4th Quarter	0.50±1.72E-16	0.70±2.72E-16

Table D - 23
1999 Radioactivity Concentrations (μCi/mL) in Airborne Particulates at the Springville Air Sampler (AFSPRVL)

Month	Alpha	Beta
January	8.76±9.54E-16	2.17±0.35E-14
February	6.62±9.10E-16	2.03±0.34E-14
March	0.65±1.04E-15	1.49±0.33E-14
April	0.34±1.11E-15	1.22±0.31E-14
May	0.56±1.09E-15	1.16±0.29E-14
June	0.79±1.03E-15	1.73±0.32E-14
July	0.86±1.13E-15	2.23±0.35E-14
August	0.48±1.06E-15	1.78±0.33E-14
September	1.15±1.30E-15	2.34±0.35E-14
October	0.67±1.30E-15	2.02±0.34E-14
November	1.40±1.42E-15	2.81±0.39E-14
December	1.09±1.23E-15	2.03±0.34E-14

Quarter	Sr-90	Cs-137
1st Quarter	0.87±1.53E-16	3.95±3.65E-16
2nd Quarter	1.24±1.06E-16	-0.67±1.62E-16
3rd Quarter	1.89±1.68E-16	1.63±2.49E-16
4th Quarter	-0.91±1.23E-16	1.74±8.00E-16

Table D - 24
1999 Airborne Radioactivity Concentrations (µCi/mL)
at the Great Valley Background Air Sampler (AFGRVAL)

Month	Alpha	Beta	H-3
January	7.99±9.13E-16	2.17±0.34E-14	-0.17±2.66E-13
February	9.52±9.63E-16	1.93±0.33E-14	0.37±4.52E-13
March	5.00±9.76E-16	1.59±0.32E-14	4.56±2.58E-13
April	0.49±1.13E-15	1.32±0.31E-14	-1.82±4.29E-13
May	0.34±1.05E-15	1.27±0.30E-14	-3.79±5.84E-13
June	0.80±1.05E-15	1.74±0.32E-14	-2.14±7.90E-13
July	0.59±1.06E-15	2.16±0.34E-14	-0.55±1.15E-12
August	0.70±1.12E-15	1.68±0.33E-14	0.42±1.05E-12
September	1.01±1.31E-15	2.17±0.34E-14	-3.61±9.44E-13
October	1.13±1.37E-15	1.98±0.33E-14	2.16±5.22E-13
November	0.33±1.16E-15	2.49±0.37E-14	2.84±4.29E-13
December	0.98±1.19E-15	1.83±0.33E-14	-1.79±3.46E-13

Quarter	K-40	Co-60	Sr-90	I-129	Cs-137
1st Quarter	4.31±5.15E-15	-0.65±1.84E-16	-1.11±2.38E-16	0.21±2.68E-16	0.00±3.38E-16
2nd Quarter	2.07±3.68E-15	0.01±1.70E-16	0.26±1.30E-16	-0.60±1.20E-16	-0.78±1.50E-16
3rd Quarter	0.53±5.09E-15	-0.80±2.44E-16	1.05±1.35E-16	-2.19±4.31E-16	-1.51±2.34E-16
4th Quarter	2.36±7.60E-15	-1.26±2.90E-16	0.19±1.28E-16	0.98±1.45E-16	-0.41±2.86E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	1.06±1.96E-17	1.62±0.56E-16	1.50±1.69E-17	1.37±0.52E-16	4.04±0.05E-10
2nd Quarter	0.38±2.11E-17	9.96±2.52E-17	5.71±5.60E-18	8.95±2.24E-17	3.28±0.06E-10
3rd Quarter	0.20±1.20E-17	1.03±0.27E-16	0.00±8.83E-18	1.10±0.27E-16	3.25±0.04E-10
4th Quarter	0.41±2.67E-17	8.17±2.71E-17	2.41±9.11E-18	1.14±0.31E-16	1.45±0.02E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	-1.02±6.60E-18	-1.66±3.34E-18	1.34±1.14E-17
2nd Quarter	0.75±1.69E-17	1.25±9.65E-18	1.46±1.09E-17
3rd Quarter	9.43±7.77E-18	1.57±3.14E-18	1.10±0.91E-17
4th Quarter	0.00±5.66E-18	4.23±4.93E-18	3.70±8.05E-18

Table D - 25
1999 Radioactivity Concentrations (µCi/mL) in Airborne Particulates at the Nashville Background Air Sampler (AFNASHV)

Month	Alpha	Beta
January	1.28±1.05E-15	2.62±0.37E-14
February	1.33±1.06E-15	1.97±0.33E-14
March	1.28±1.17E-15	1.81±0.34E-14
April	0.25±1.08E-15	1.34±0.31E-14
May	0.73±1.14E-15	1.30±0.30E-14
June	1.29±1.15E-15	1.56±0.31E-14
July	0.83±1.11E-15	2.13±0.34E-14
August	1.09±9.81E-16	1.67±0.32E-14
September	0.82±1.26E-15	2.20±0.35E-14
October	0.07±1.16E-15	1.94±0.33E-14
November	0.90±1.35E-15	3.31±0.42E-14
December	0.85±1.20E-15	2.11±0.36E-14

Quarter	Sr-90	Cs-137
1st Quarter	-1.24±1.72E-16	2.32±1.85E-16
2nd Quarter	0.95±1.17E-16	0.31±1.54E-16
3rd Quarter	0.09±1.24E-16	-0.17±2.29E-16
4th Quarter	-0.29±1.20E-16	1.28±3.04E-16

Table D - 26
1999 Radioactivity (nCi/m²/month) and pH in Fallout
Dutch Hill (AFDHFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH (standard units)
January	4.56±0.96E-02	8.30±0.50E-01	-1.02±0.75E-07	1.41±1.35E+01	-0.31±1.04E+00	4.18
February	1.95±0.34E-02	1.69±0.11E-01	7.75±7.76E-08	0.52±1.08E+00	0.78±1.37E-01	NA
March	2.02±0.34E-02	2.39±0.13E-01	-1.10±0.82E-07	-7.24±9.80E-01	1.77±9.17E-02	3.66
April	3.21±0.50E-02	4.08±0.17E-01	2.91±8.54E-08	-0.28±8.73E-01	0.71±4.81E-02	3.00
May	2.09±0.60E-02	1.76±0.18E-01	-1.03±0.85E-07	0.69±3.37E+00	0.44±2.20E-01	6.43
June	1.75±0.46E-02	1.56±0.12E-01	-7.79±8.65E-08	0.63±1.31E+00	1.60±7.72E-02	3.80
July	5.35±0.65E-02	5.15±0.19E-01	-3.00±0.91E-07	-3.55±8.69E-01	0.24±5.36E-02	3.45
August	2.78±0.84E-02	6.52±0.40E-01	9.42±8.09E-08	4.44±5.20E+00	-2.19±3.39E-01	4.52
September	3.04±1.13E-02	4.08±0.34E-01	-1.59±0.86E-07	-1.80±6.03E+00	1.15±3.80E-01	4.49
October	2.89±1.00E-02	7.13±0.38E-01	-1.90±0.87E-07	0.42±4.26E+00	-0.64±2.65E-01	3.88
November	5.04±0.97E-02	3.87±0.30E-01	8.20±8.32E-08	0.14±4.71E+00	1.84±3.55E-01	4.13
December	2.69±1.01E-02	5.77±0.48E-01	-1.73±0.81E-07	-4.51±6.79E+00	1.37±5.18E-01	5.19

NA - Not available.

Table D-27
1999 Radioactivity (nCi/m²/month) and pH in Fallout
Rain Gauge (ANRGFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH (standard units)
January	4.90±1.30E-02	7.47±0.64E-01	4.35±5.35E-08	-0.32±1.58E+01	0.19±1.42E+00	4.22
February	2.98±0.45E-02	2.07±0.13E-01	5.39±7.52E-08	1.30±3.00E+00	0.54±1.79E-01	4.52
March	1.79±0.74E-02	1.76±0.26E-01	-8.44±8.13E-08	-0.77±3.36E+00	-2.89±4.07E-01	6.03
April	1.66±0.78E-02	3.91±0.29E-01	-1.02±0.84E-07	-0.11±3.63E+00	-1.16±4.86E-01	7.15
May	2.47±0.69E-02	2.26±0.20E-01	-3.57±1.04E-07	0.64±3.51E+00	-1.14±2.28E-01	5.71
June	4.47±0.67E-02	2.83±0.15E-01	-4.09±8.78E-08	-0.28±1.06E+00	0.91±8.20E-02	3.53
July	6.25±0.72E-02	5.27±0.19E-01	-2.80±0.94E-07	3.26±7.91E-01	0.98±5.46E-02	3.71
August	2.37±0.87E-02	6.16±0.46E-01	7.23±8.09E-08	-1.03±0.61E+01	-0.20±4.28E-01	4.28
September	6.07±9.09E-03	3.33±0.35E-01	-1.69±0.86E-07	-0.49±5.93E+00	0.03±4.14E-01	4.11
October	4.08±1.31E-02	5.25±0.47E-01	-3.84±8.31E-08	-2.29±6.93E+00	-0.20±5.05E-01	4.53
November	6.56±1.48E-02	5.43±0.51E-01	2.31±8.19E-08	7.44±9.19E+00	-0.66±6.38E-01	4.42
December	3.54±1.50E-02	7.09±0.68E-01	-2.06±0.81E-07	-0.24±1.00E+01	2.48±7.06E-01	4.45

Table D-28
1999 Radioactivity (nCi/m²/month) and pH in Fallout
Route 240 (AF24FOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH (standard units)
January	3.25±0.88E-02	4.86±0.43E-01	2.59±7.48E-08	1.39±0.79E+01	2.38±6.51E-01	4.24
February	2.41±0.38E-02	2.46±0.13E-01	1.78±7.54E-08	-8.73±8.48E-01	-3.12±6.09E-02	3.87
March	1.73±0.38E-02	2.36±0.14E-01	-6.56±8.35E-08	-0.49±2.42E+00	0.83±2.26E-01	4.10
April	2.96±0.63E-02	4.05±0.23E-01	-2.72±8.25E-08	-3.04±3.12E+00	-1.26±1.65E-01	3.86
May	2.45±0.68E-02	3.18±0.23E-01	-1.78±0.87E-07	0.01±3.24E+00	-0.20±2.12E-01	4.55
June	3.93±0.64E-02	2.23±0.14E-01	-6.34±8.82E-08	0.94±1.10E+00	-1.99±8.84E-02	3.64
July	1.02±0.42E-02	2.19±0.14E-01	-3.36±0.69E-07	0.84±1.23E+00	1.42±7.90E-02	6.79
August	4.45±1.11E-02	5.41±0.40E-01	6.66±8.07E-08	1.86±5.59E+00	0.52±3.90E-01	4.65
September	9.08±8.16E-03	3.77±0.32E-01	-9.47±8.61E-08	-0.98±1.56E+01	-0.08±1.19E+00	4.07
October	3.57±1.04E-02	3.95±0.35E-01	0.60±8.23E-08	-1.28±6.71E+00	5.61±4.34E-01	4.58
November	3.79±0.98E-02	5.58±0.42E-01	-3.52±8.17E-08	-3.27±4.17E+00	1.56±2.99E-01	3.92
December	4.87±1.54E-02	7.36±0.64E-01	-1.99±0.81E-07	-0.23±1.02E+01	-3.38±8.14E-01	4.79

Table D-29
1999 Radioactivity (nCi/m²/month) and pH in Fallout
Thomas Corners Road (AFTCFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH (standard units)
January	6.94±1.50E-02	6.56±0.60E-01	-2.16±7.57E-08	0.00±1.03E+01	-3.32±9.37E-01	4.37
February	4.55±0.93E-02	1.87±0.13E-01	7.56±7.62E-08	0.39±1.93E+00	0.35±1.31E-01	6.95
March	1.91±0.74E-02	2.14±0.26E-01	1.24±8.28E-08	3.85±6.51E+00	2.63±6.12E-01	6.28
April	2.03±0.68E-02	4.42±0.31E-01	-3.36±8.25E-08	3.20±6.49E+00	2.49±3.95E-01	4.35
May	2.90±0.81E-02	2.31±0.24E-01	-1.05±0.59E-07	3.15±6.38E+00	-0.41±4.95E-01	4.70
June	4.07±0.61E-02	1.63±0.12E-01	-5.14±8.95E-08	-1.06±8.14E-01	-1.72±6.26E-02	3.75
July	2.98±0.67E-02	5.05±0.29E-01	-2.04±0.86E-07	-0.97±4.17E+00	1.21±2.09E-01	3.63
August	2.39±1.07E-02	5.67±0.55E-01	1.24±0.81E-07	-0.74±8.98E+00	0.36±4.87E-01	5.27
September	7.85±9.55E-03	2.61±0.32E-01	-1.53±0.85E-07	-0.56±6.07E+00	-2.44±4.87E-01	4.27
October	4.43±1.21E-02	4.24±0.38E-01	-1.40±0.81E-07	-1.94±4.99E+00	0.93±4.18E-01	5.34
November	4.38±1.23E-02	3.68±0.44E-01	1.11±0.83E-07	3.72±5.71E+00	0.62±4.85E-01	4.57
December	3.32±1.49E-02	6.89±0.67E-01	-1.08±0.82E-07	0.25±8.30E+00	-2.54±7.50E-01	4.62

Table D-30
1999 Radioactivity (nCi/m²/month) and pH in Fallout
Fox Valley Road (AFFXFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH (standard units)
January	5.23±1.22E-02	5.72±0.53E-01	0.64±7.56E-08	0.34±1.27E+01	0.26±1.30E+00	4.39
February	3.37±0.73E-02	1.60±0.12E-01	6.56±7.65E-08	-9.12±9.46E-01	0.16±1.12E-01	6.86
March	1.08±0.65E-02	1.55±0.23E-01	-4.81±8.13E-08	-0.49±5.38E+00	4.32±4.47E-01	5.96
April	2.19±0.54E-02	3.15±0.20E-01	-3.18±8.23E-08	1.61±2.63E+00	-0.67±1.92E-01	5.05
May	7.92±1.22E-02	3.43±0.26E-01	-9.22±8.84E-08	0.98±4.95E+00	-0.57±3.73E-01	4.38
June	6.53±1.01E-02	2.77±0.15E-01	-3.87±6.37E-08	1.06±8.04E-01	-0.59±5.69E-02	4.27
July	2.38±0.57E-02	4.73±0.24E-01	-2.40±0.96E-07	-0.86±2.42E+00	1.28±1.96E-01	3.82
August	3.51±0.92E-02	5.87±0.41E-01	1.08±0.81E-07	0.64±5.18E+00	0.91±4.18E-01	5.29
September	2.48±1.11E-02	2.78±0.32E-01	-8.16±8.65E-08	-1.98±6.26E+00	-2.08±4.01E-01	4.75
October	1.07±0.19E-01	4.45±0.40E-01	-4.96±8.31E-08	-1.42±6.45E+00	0.33±3.91E-01	5.64
November	7.54±1.50E-02	6.42±0.50E-01	7.08±8.27E-08	3.38±5.13E+00	0.54±3.52E-01	4.55
December	6.50±1.70E-02	6.48±0.62E-01	-1.21±0.83E-07	-0.32±1.06E+01	-5.90±6.65E-01	6.50

Appendix E

Summary of Groundwater Monitoring Data

Table E-1
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUS and Constituent SSWMUs	Well ID Number [1]		Additional Analytes Measured in 1999 [2]	Well ID Number [1]		Additional Analytes Measured in 1999 [2]
SSWMU #1 - Low-Level Waste Treatment Facilities:						
	103*	(S:D)	V	110*	(T:D)	V
• Former Lagoon 1	104	(S:U)	SV,V	111*	(S:D)	S, SV, V, M33
• LLWTF Lagoons	105	(S:D)	V	114	(T:D)	*p*
• LLWTF Building	106	(S:D)	V	115	(T:U)	*p*
• Interceptors	107	(T:D)	V	116*	(S:U)	S,V
• Neutralization Pit	108	(T:D)	V	8604	(S:U)	V
	109	(T:D)	*p*	8605*	(S:D)	M33, S, SV, V
SSWMU #2 - Miscellaneous Small Units:						
	201	(S:U)		206	(TS:D)	
• Sludge Ponds	202	(TS:U)	*p*	207	(S:D)	*p*
• Solvent Dike	203	(S:D)	*p*	208	(TS:D)	V
• Equalization Mixing Basin	204*	(TS:U)		8606	(S:D)	*p*
• Paper Incinerator	205	(S:D)				
SSWMU #3 - Liquid Waste Treatment System:						
• Liquid Waste Treatment System	301*	(S:B)		307	(S:D)	*p*
• Cement Solidification System	302	(TS:U)				
• Main Process Building (specific areas)	305	(S:D)	*p*			

[1] Hydrogeologic unit monitored and well position in SSWMU follow the well ID in parentheses. Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S:B) monitors background conditions in the sand and gravel unit.*

[2] See Table 3-1 (p. 3-6) for a description of codes and analytes. The parameters listed in this table, Table E-1, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled at all monitoring locations for 1999. Wells measured for potentiometric (water-level) data only are designated by p.

** Monitoring for certain parameters is required by the RCRA §3008(h) Order on Consent.*

Table E-1 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUS and Constituent SSWMUs	Well ID Number [1]		Additional Analytes Measured in 1999 [2]	Well ID Number [1]		Additional Analytes Measured in 1999 [2]
SSWMU #4 - HLW Storage and Processing Area:						
• Vitrification Facility	401*	(S:B)	R	405	(T:C)	
• Vitrification Test Tanks	402	(TS:U)		406*	(S:D)	R,V
• HLW Tanks	403	(S:U)	V	408*	(S:D)	R,V
• Supernatant Treatment System	404	(TS:U)	*p*	409	(T:D)	
SSWMU #5 - Maintenance Shop Leach Field:						
• Maintenance Shop Leach Field	501*	(S:U)	S, V	502*	(S:D)	S, SM, V
SSWMU #6 - Low-level Waste Storage Area:						
	601	(S:D)	*p*	605	(S:D)	S
• Hardstands (old and new)	602	(S:D)	S	8607*	(S:U)	V
• Lag Storage	602A[3]	(S:D)	S	8608	(S:U)	*p*
• Lag Storage Additions (LSAs 1,2,3,4)	603	(S:U)	*p*	8609*	(S:U)	S, V
	604	(S:D)				
SSWMU #7- Chemical Process Cell (CPC)Waste Storage Area:	701	(TS:U)	*p*	705	(T:C)	*p*
	702	(T:C)	*p*	706*	(S:B)	
	703	(T:D)	*p*	707	(T:D)	
	704	(T:D)	V			
• CPC Waste Storage Area						

[1] Hydrogeologic unit monitored and well position in SSWMU follow the well ID in parentheses. Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S:B) monitors background conditions in the sand and gravel unit.*

[2] See Table 3-1 (p. 3-6) for a description of codes and analytes. The parameters listed in this table, Table E-1, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled at all monitoring locations for 1999. Wells measured for potentiometric (water-level) data only are designated by p.

[3] Well 602 was decommissioned in 1999 and replaced with well 602A.

** Monitoring for certain parameters is required by the RCRA §3008(h) Order on Consent.*

Table E-1 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUS and Constituent SSWMUs	Well ID Number [1]		Additional Analytes Measured in 1999 [2]	Well ID Number [1]		Additional Analytes Measured in 1999 [2]
SSWMU #8 - Construction and Demolition Debris Landfill:						
• Former Construction and Demolition Debris Landfill	801*	(S:U)	S,V	804*	(S:D)	V
	802	(S:D)	V	8603	(S:U)	S
	803*	(S:D)	SV, V	8612*	(S:D)	SV, V
SSWMU #9 - NRC-licensed Disposal Area:						
• NRC-licensed Disposal Area	901*	(K:U)		908*	(WT:U)	
• Container Storage Area	902*	(K:U)		909*	(WT:D)	M33, R, V, SV
• Trench Interceptor Project	903*	(K:D)		910*	(T:D)	
	904	(T:D)	*p*	8610*	(K:D)	
	905	(S:D)	*p*	8611*	(K:D)	
	906*	(WT:D)		NDATR	(Interceptor Trench Manhole Sump: D)	M33, R, V, SV
	907	(WT:D)	*p*			
SSWMU #10 - IRTS Drum Cell:						
• IRTS Drum Cell	1001	(K:U)	*p*	1006*	(WT:D)	
• Background (south plateau)	1002	(K:D)	*p*	1007	(WT:D)	
	1003	(K:D)	*p*	1008B	(K:B)	
	1004	(K:D)	*p*	1008C*	(WT:B)	
	1005*	(WT:U)				

[1] Hydrogeologic unit monitored and well position in SSWMU follow the well ID in parentheses. Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S:B) monitors background conditions in the sand and gravel unit.*

[2] See Table 3-1 (p. 3-6) for a description of codes and analytes. The parameters listed in this table, Table E-1, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled at all monitoring locations for 1999. Wells measured for potentiometric (water-level) data only are designated by p.

** Monitoring for certain parameters is required by the RCRA §3008(h) Order on Consent.*

Table E-1 (concluded)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUS and Constituent SSWMUs	Well ID Number [1]		Additional Analytes Measured in 1999 [2]	Well ID Number [1]		Additional Analytes Measured in 1999 [2]
SSWMU #11 - State-licensed Disposal Area (SDA)	1101A	(WT:U)	See Appendix L	1104C	(K:D)	See Appendix L
	1101B	(T:U)		1105A	(WT:D)	
• State-licensed Disposal Area [NYSERDA]	1101C	(K:U)		1105B	(T:D)	
	1102A	(WT:D)		1106A	(K:U)	
	1102B	(T:D)		1106B	(T:U)	
Note: The SDA is sampled by NYSERDA under an independent monitoring program.	1103A	(WT:D)		1107A	(T:D)	
	1103B	(T:D)		1108A	(WT:U)	
	1103C	(K:D)		1109A	(T:U)	
	1104A	(WT:D)		1109B	(WT:U)	
	1104B	(T:D)		1110A	(WT:D)	
				1111A	(WT:D)	
Main Plant Area Well Points:						
(Monitor groundwater at various locations north and east of the main plant. Not in a SSWMU.)	WP-A	(S)				
	WP-C	(S)				
	WP-H	(S)				
Former Sand and Gravel Background:	NB1S	(S:B)				
(Well originally used for background; replaced by a combination of wells 301, 401, and 706. Not in a SSWMU.)						
North Plateau Groundwater Seeps:						
(Monitor groundwater emanating from seeps along the north pleateau edge. Not in a SSWMU.)	SP02	(S)	RI	SP12*		I, RI,V
	SP04	(S)	RI	SP18		RI
	SP05	(S)	RI	SP23		RI
	SP06	(S)	RI	GSEEP*		I, RI, V
	SP11	(S)	RI			

[1] Hydrogeologic unit monitored and well position in SSWMU follow the well ID in parentheses. Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S:B) monitors background conditions in the sand and gravel unit.*

[2] See Table 3-1 (p. 3-6) for a description of codes and analytes. The parameters listed in this table, Table E-1, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled at all monitoring locations for 1999. Wells measured for potentiometric (water-level) data only are designated by p.

** Monitoring for certain parameters is required by the RCRA §3008(h) Order on Consent.*

Table E-2
1999 Contamination Indicator and Radiological Indicator Results
Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
301	UP(1)	7.15	1050	-0.26±1.61E-09	0.77±2.72E-09	-1.77±0.76E-07
301	UP(2)	7.32	967	0.94±1.94E-09	7.81±2.52E-09	-1.43±7.43E-08
301	UP(3)	6.77	1040	1.70±2.13E-09	5.91±2.67E-09	9.22±7.82E-08
301	UP(4)	6.88	1394	-0.77±3.52E-09	9.33±5.15E-09	-6.32±8.20E-08
401	UP(1)	6.93	1956	0.59±3.32E-09	6.22±4.69E-09	-1.61±0.55E-07
401	UP(2)	6.99	2135	1.99±3.44E-09	0.26±4.43E-09	-6.14±7.35E-08
401	UP(3)	6.80	2305	3.64±4.41E-09	1.84±4.64E-09	0.41±8.15E-08
401	UP(4)	6.71	2570	4.47±3.83E-09	7.23±5.10E-09	-1.07±0.82E-07
403	UP(1)	7.24	1046	0.99±2.33E-09	5.50±3.14E-09	-6.58±7.61E-08
403	UP(2)	6.85	884	-0.25±1.19E-09	6.33±2.22E-09	7.62±7.64E-08
403	UP(3)	7.06	898	2.33±2.08E-09	5.81±2.47E-09	-1.34±0.81E-07
403	UP(4)	7.23	838	-0.35±1.91E-09	1.02±0.39E-08	8.63±8.16E-08
706	UP(1)	6.76	499	3.69±7.78E-10	4.82±2.08E-09	-6.76±5.36E-08
706	UP(2)	6.72	670	-0.12±1.08E-09	1.11±0.21E-08	-9.60±7.42E-08
706	UP(3)	6.72	620	0.13±1.67E-09	1.04±0.20E-08	9.81±7.68E-08
706	UP(4)	6.82	624	-0.84±1.45E-09	1.22±0.24E-08	6.41±5.89E-08
NB1S	UP(1)	6.83	672	0.60±1.18E-09	1.54±0.99E-09	-3.04±7.45E-08
NB1S	UP(2)	7.66	464	-5.78±6.21E-10	2.66±1.36E-09	2.70±7.52E-08
NB1S	UP(3)	7.11	701	-1.01±1.67E-09	2.28±1.58E-09	1.44±0.54E-07
NB1S	UP(4)	6.66	651	-0.84±1.30E-09	3.03±1.89E-09	3.99±8.56E-08
201	DOWN-B(1)	7.14	1598	1.37±3.24E-09	9.40±4.76E-09	-1.62±7.57E-08
201	DOWN-B(2)	6.50	1496	-0.26±2.61E-09	2.96±0.54E-08	3.24±7.89E-08
201	DOWN-B(3)	6.93	1676	3.11±3.45E-09	1.67±0.37E-08	-1.62±0.81E-07
201	DOWN-B(4)	6.81	978	-1.93±2.29E-09	9.96±5.02E-09	2.83±8.20E-08
103	DOWN-C(1)	8.96	1453	3.44±2.34E-09	3.17±0.39E-08	1.02±0.74E-07
103	DOWN-C(2)	10.02	3010	3.68±3.64E-09	5.33±0.61E-08	9.81±7.76E-08
103	DOWN-C(3)	8.87	3555	3.48±3.48E-09	1.12±0.06E-07	-6.04±8.19E-08
103	DOWN-C(4)	9.50	4030	6.70±6.85E-09	9.07±1.15E-08	2.02±0.83E-07
104	DOWN-C(1)	7.19	1135	-1.76±3.46E-09	2.23±0.02E-05	5.53±0.79E-07
104	DOWN-C(2)	7.10	1186	0.00±5.12E-09	2.25±0.01E-05	6.26±0.84E-07
104	DOWN-C(3)	7.18	1274	0.00±8.04E-09	2.64±0.02E-05	5.44±0.90E-07
104	DOWN-C(4)	7.02	1476	4.52±9.95E-09	3.18±0.02E-05	7.09±0.91E-07
111	DOWN-C(1)	6.69	617	5.04±6.06E-09	6.13±0.10E-06	3.81±0.77E-07
111	DOWN-C(2)	6.84	542	2.90±5.67E-09	5.17±0.09E-06	4.18±0.81E-07
111	DOWN-C(3)	6.87	663	2.87±6.89E-09	6.85±0.11E-06	3.85±0.83E-07
111	DOWN-C(4)	6.61	723	7.13±8.06E-09	6.25±0.10E-06	1.19±0.84E-07

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-2 (continued)
1999 Contamination Indicator and Radiological Indicator Results
Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
205	DOWN-C(1)	7.32	1868	1.84±3.66E-09	1.54±0.50E-08	-1.07±0.74E-07
205	DOWN-C(2)	6.86	1961	1.30±3.08E-09	1.01±0.48E-08	7.02±7.72E-08
205	DOWN-C(3)	6.72	2655	1.81±3.68E-09	1.67±0.37E-08	-1.81±0.80E-07
205	DOWN-C(4)	6.83	1408	-1.20±1.86E-09	1.64±0.38E-08	-1.53±0.81E-07
406	DOWN-C(1)	6.98	571	7.59±6.66E-10	7.13±1.56E-09	8.47±8.84E-08
406	DOWN-C(2)	6.77	689	0.44±1.20E-09	8.17±2.01E-09	7.11±8.81E-08
406	DOWN-C(3)	6.78	994	0.98±1.96E-09	1.67±0.27E-08	-3.22±5.81E-08
406	DOWN-C(4)	7.28	748	1.39±1.54E-09	8.81±2.74E-09	1.92±0.85E-07
408	DOWN-C(1)	7.31	1713	0.78±1.86E-09	4.68±0.01E-04	1.23±1.01E-07
408	DOWN-C(2)	7.21	1760	-0.93±1.07E-08	5.04±0.01E-04	-4.48±9.86E-08
408	DOWN-C(3)	7.42	1860	-1.30±3.39E-09	5.43±0.01E-04	1.11±0.94E-07
408	DOWN-C(4)	7.04	1881	0.32±3.78E-08	5.73±0.02E-04	8.75±8.19E-08
501	DOWN-C(1)	7.40	1524	2.21±7.49E-09	1.93±0.01E-04	2.74±0.76E-07
501	DOWN-C(2)	7.30	1404	-1.54±6.76E-09	1.61±0.01E-04	2.32±0.79E-07
501	DOWN-C(3)	7.47	1714	0.00±1.15E-08	2.25±0.01E-04	1.26±0.78E-07
501	DOWN-C(4)	6.95	1809	0.00±1.45E-08	2.18±0.01E-04	2.05±0.85E-07
502	DOWN-C(1)	7.38	1334	2.17±7.37E-09	1.43±0.01E-04	3.57±0.77E-07
502	DOWN-C(2)	7.28	1335	0.00±7.28E-09	1.52±0.01E-04	2.39±0.79E-07
502	DOWN-C(3)	7.53	1390	2.24±9.81E-09	1.66±0.01E-04	1.59±0.79E-07
502	DOWN-C(4)	7.00	1460	-2.18±9.54E-09	1.79±0.01E-04	4.98±0.63E-07
602	DOWN-C(1)	6.73	716	0.53±1.02E-09	2.17±0.16E-08	3.89±0.17E-06
602	DOWN-C(2)	7.18	780	1.73±1.78E-09	3.66±0.38E-08	2.98±0.15E-06
602	DOWN-C(3)	6.55	732	0.72±1.74E-09	2.76±0.32E-08	3.72±0.16E-06
602A	DOWN-C(3)	6.89	608	7.71±8.75E-10	1.25±0.22E-08	0.32±1.10E-07
602A	DOWN-C(4)	6.86	621	0.69±1.77E-09	1.73±0.32E-08	1.48±0.60E-07
604	DOWN-C(1)	6.64	746	0.88±1.04E-09	1.78±1.96E-09	-5.15±7.38E-08
604	DOWN-C(2)	6.63	754	-0.45±1.04E-09	5.46±1.86E-09	-6.83±8.48E-08
604	DOWN-C(3)	6.44	719	0.27±1.17E-09	1.28±0.26E-08	-1.05±0.80E-07
604	DOWN-C(4)	6.29	1024	0.39±1.41E-09	4.23±1.44E-09	8.52±8.63E-08
8605	DOWN-C(1)	6.92	896	1.04±0.82E-08	9.77±0.11E-06	5.58±0.68E-07
8605	DOWN-C(2)	6.81	856	7.46±8.44E-09	1.27±0.01E-05	8.91±0.87E-07
8605	DOWN-C(3)	6.79	1050	1.05±1.15E-08	1.35±0.02E-05	3.48±0.87E-07
8605	DOWN-C(4)	6.80	1150	4.65±9.11E-09	9.48±0.13E-06	3.66±0.86E-07
8607	DOWN-C(1)	6.59	1143	-0.12±1.68E-09	9.44±3.14E-09	-5.45±7.75E-08
8607	DOWN-C(2)	6.74	1532	0.64±2.52E-09	2.08±0.33E-08	2.53±7.51E-08
8607	DOWN-C(3)	6.34	2070	3.55±2.96E-09	1.50±0.32E-08	-0.97±7.83E-08
8607	DOWN-C(4)	6.58	1809	1.44±2.06E-09	1.90±0.39E-08	3.00±8.26E-08

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-2 (continued)
1999 Contamination Indicator and Radiological Indicator Results
Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25⁰C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
8609	DOWN-C(1)	7.04	1063	-0.33±1.77E-09	7.46±0.10E-07	7.25±0.88E-07
8609	DOWN-C(2)	7.19	1054	-0.69±1.85E-09	5.83±0.13E-07	7.88±0.87E-07
8609	DOWN-C(3)	7.06	1084	-0.34±1.95E-09	6.58±0.10E-07	6.87±0.87E-07
8609	DOWN-C(4)	7.01	1113	1.94±2.35E-09	6.98±0.18E-07	6.82±0.91E-07
105	DOWN-D(1)	7.14	1349	0.65±2.26E-09	4.39±0.09E-07	4.96±0.79E-07
105	DOWN-D(2)	7.30	1386	0.17±2.09E-09	6.82±0.11E-07	4.91±0.90E-07
105	DOWN-D(3)	7.11	1366	2.00±1.86E-09	1.05±0.01E-06	4.63±0.89E-07
105	DOWN-D(4)	7.12	1520	0.67±1.30E-08	1.35±0.05E-06	3.43±0.87E-07
106	DOWN-D(1)	6.93	1140	-0.69±1.35E-09	3.89±1.68E-09	1.51±0.08E-06
106	DOWN-D(2)	7.55	1425	0.37±2.20E-09	4.27±2.43E-09	1.32±0.09E-06
106	DOWN-D(3)	6.79	1320	3.62±2.73E-09	6.94±2.79E-09	1.41±0.10E-06
106	DOWN-D(4)	6.79	1388	6.64±3.20E-09	7.57±2.81E-09	1.70±0.12E-06
116	DOWN-D(1)	7.13	631	0.31±1.44E-09	3.88±0.33E-08	-0.33±5.55E-08
116	DOWN-D(2)	7.44	1446	1.87±2.33E-09	6.42±0.40E-08	1.33±0.76E-07
116	DOWN-D(3)	7.19	1384	0.63±1.44E-09	6.50±0.44E-08	2.25±0.55E-07
116	DOWN-D(4)	7.00	1280	1.23±2.35E-09	8.83±0.51E-08	2.87±0.87E-07
605	DOWN-D(1)	6.74	510	-3.50±9.71E-10	6.35±0.30E-08	-5.26±7.63E-08
605	DOWN-D(2)	7.48	877	-0.36±1.32E-09	8.54±0.52E-08	2.14±7.59E-08
605	DOWN-D(3)	6.87	788	0.57±1.30E-09	8.05±0.47E-08	-1.51±0.80E-07
605	DOWN-D(4)	7.12	780	0.13±1.63E-09	6.96±0.44E-08	-4.65±8.49E-08
801	DOWN-D(1)	6.75	960	3.24±6.36E-09	5.91±0.10E-06	2.04±0.78E-07
801	DOWN-D(2)	6.75	1215	-1.45±6.34E-09	7.41±0.11E-06	3.82±0.81E-07
801	DOWN-D(3)	6.71	1414	0.00±8.89E-09	9.48±0.13E-06	1.67±0.82E-07
801	DOWN-D(4)	6.71	1351	0.39±1.09E-08	8.28±0.12E-06	3.60±0.87E-07
802	DOWN-D(1)	7.09	1040	2.38±1.90E-09	2.95±2.16E-09	2.68±0.82E-07
802	DOWN-D(2)	7.42	486	-1.81±8.60E-10	2.16±1.63E-09	4.36±7.45E-08
802	DOWN-D(3)	7.09	454	0.68±1.16E-09	2.79±2.36E-09	5.00±7.84E-08
802	DOWN-D(4)	7.00	1033	0.27±2.39E-09	4.93±2.66E-09	4.20±0.87E-07
803	DOWN-D(1)	6.89	1356	-2.09±2.23E-09	1.04±0.27E-08	2.54±0.82E-07
803	DOWN-D(2)	6.99	1304	0.18±2.29E-09	8.53±2.62E-09	2.97±0.79E-07
803	DOWN-D(3)	6.69	1454	1.25±1.97E-09	1.20±0.20E-08	1.46±0.82E-07
803	DOWN-D(4)	7.11	1461	-0.26±3.34E-09	1.78±0.45E-08	3.42±0.85E-07
804	DOWN-D(1)	6.73	578	0.10±1.02E-09	2.15±0.08E-07	5.77±7.74E-08
804	DOWN-D(2)	6.73	1115	0.32±1.72E-09	3.70±0.09E-07	6.22±7.49E-08
804	DOWN-D(3)	6.44	1274	0.86±1.62E-09	3.98±0.10E-07	2.03±0.57E-07
804	DOWN-D(4)	7.12	921	-1.00±1.73E-09	3.66±0.09E-07	3.61±0.60E-07

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-2 (concluded)
1999 Contamination Indicator and Radiological Indicator Results
Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
8603	DOWN-D(1)	7.23	1454	2.32±7.89E-09	2.03±0.02E-05	5.76±0.79E-07
8603	DOWN-D(2)	6.90	1568	-1.68±7.38E-09	2.40±0.02E-05	5.80±0.84E-07
8603	DOWN-D(3)	7.44	1513	-1.35±6.66E-09	2.69±0.02E-05	3.56±0.82E-07
8603	DOWN-D(4)	7.21	1628	0.66±1.30E-08	2.84±0.02E-05	4.40±0.88E-07
8604	DOWN-D(1)	7.19	1331	4.03±7.90E-09	3.27±0.02E-05	6.41±0.81E-07
8604	DOWN-D(2)	6.99	1431	3.19±8.85E-09	4.12±0.03E-05	5.67±0.84E-07
8604	DOWN-D(3)	7.12	1359	0.00±9.03E-09	4.04±0.03E-05	5.99±0.84E-07
8604	DOWN-D(4)	7.08	1428	0.46±1.28E-08	3.16±0.02E-05	5.99±0.89E-07
8612	DOWN-D(1)	7.15	1159	0.30±2.15E-09	0.09±2.25E-09	5.63±0.87E-07
8612	DOWN-D(2)	7.44	1195	-0.02±1.77E-09	0.50±2.28E-09	4.62±0.80E-07
8612	DOWN-D(3)	7.25	1184	1.00±1.68E-09	2.63±1.79E-09	5.80±0.87E-07
8612	DOWN-D(4)	6.94	1196	0.39±2.76E-09	2.48±2.57E-09	6.26±0.90E-07

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-3
1999 Contamination Indicator and Radiological Indicator Results
Lavery Till-Sand Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
302	UP(1)	7.29	2290	2.90±4.44E-09	0.99±4.58E-09	-8.14±7.61E-08
302	UP(2)	7.03	1168	-2.28±3.15E-09	-0.27±4.46E-09	8.26±7.81E-08
302	UP(3)	7.10	2110	1.49±3.72E-09	4.29±4.70E-09	1.87±0.77E-07
302	UP(4)	7.02	2245	-0.16±3.44E-09	4.16±4.97E-09	0.17±5.71E-08
402	UP(1)	7.34	2255	1.62±3.83E-09	4.41±4.68E-09	-0.74±7.98E-08
402	UP(2)	7.12	1240	3.47±3.97E-09	1.87±4.54E-09	6.77±7.88E-08
402	UP(3)	7.06	2245	1.28±4.19E-09	3.02±3.31E-09	1.94±0.79E-07
402	UP(4)	6.97	2450	-1.68±4.99E-09	6.86±5.23E-09	9.89±8.37E-08
204	DOWN-B(1)	7.71	1022	1.24±1.72E-09	-0.30±2.62E-09	-6.18±8.01E-08
204	DOWN-B(2)	7.53	1042	-0.90±1.20E-09	2.62±1.57E-09	1.10±0.78E-07
204	DOWN-B(3)	7.66	1054	1.77±2.22E-09	1.64±2.43E-09	-2.58±7.85E-08
204	DOWN-B(4)	7.32	1070	3.86±2.36E-09	4.64±2.57E-09	2.28±8.30E-08
206	DOWN-C(1)	7.71	1047	-0.50±1.42E-09	-1.52±2.55E-09	0.22±7.74E-08
206	DOWN-C(2)	7.11	1076	0.00±1.88E-09	2.40±2.21E-09	6.03±7.79E-08
206	DOWN-C(3)	7.37	1084	3.62±2.49E-09	3.93±2.58E-09	-8.02±8.39E-08
206	DOWN-C(4)	7.03	1090	-0.91±2.18E-09	6.11±2.73E-09	9.88±8.19E-08
208	DOWN-C(1)	7.90	309	3.00±4.32E-10	1.49±0.80E-09	-5.70±7.60E-08
208	DOWN-C(2)	7.05	308	9.39±7.01E-10	1.38±0.79E-09	-2.70±7.58E-08
208	DOWN-C(3)	7.77	292	1.52±0.83E-09	1.03±1.31E-09	-2.22±0.79E-07
208	DOWN-C(4)	7.91	314	1.32±0.90E-09	2.20±1.25E-09	-6.21±8.32E-08

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-4
1999 Contamination Indicator and Radiological Indicator Results
Weathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
908	UP(1)	6.92	2800	5.11±4.49E-09	1.18±0.49E-08	1.81±0.78E-07
908	UP(3)	6.89	3100	9.67±6.38E-09	1.79±0.53E-08	1.34±8.06E-08
1005	UP(1)	7.20	708	1.42±1.53E-09	-1.05±2.54E-09	1.70±0.79E-07
1005	UP(3)	7.26	768	3.83±2.02E-09	4.79±2.56E-09	-1.57±8.00E-08
1008C	UP(1)	7.55	611	-0.30±1.09E-09	2.64±1.03E-09	-1.56±0.77E-07
1008C	UP(3)	7.39	619	-1.12±1.60E-09	2.22±1.56E-09	-3.28±7.92E-08
906	DOWN-B(1)	7.50	594	0.95±1.02E-09	2.74±2.00E-09	1.55±0.78E-07
906	DOWN-B(3)	7.24	688	2.20±1.57E-09	3.58±2.14E-09	-2.59±8.10E-08
1006	DOWN-B(1)	6.87	2340	7.15±5.16E-09	1.99±4.61E-09	1.20±0.79E-07
1006	DOWN-B(3)	7.01	2360	5.90±4.69E-09	5.78±4.78E-09	-1.09±0.78E-07
1007	DOWN-B(1)	6.86	1326	1.30±2.97E-09	5.95±2.54E-09	-1.18±7.66E-08
1007	DOWN-B(3)	6.99	1341	0.00±2.50E-09	3.26±2.51E-09	2.58±0.79E-07
NDATR	DOWN-C(1)	7.56	736	0.81±1.41E-09	1.85±0.05E-07	5.44±0.20E-06
NDATR	DOWN-C(2)	7.58	465	0.17±1.02E-09	1.08±0.06E-07	1.64±0.10E-06
NDATR	DOWN-C(3)	7.46	574	2.58±1.94E-09	8.60±0.40E-08	1.13±0.04E-05
NDATR	DOWN-C(4)	7.38	761	2.12±1.80E-09	1.74±0.07E-07	3.45±0.16E-06
909	DOWN-C(1)	6.53	1520	2.70±3.72E-09	4.22±0.10E-07	2.14±0.12E-06
909	DOWN-C(3)	6.72	1298	3.96±4.39E-09	6.44±0.13E-07	3.64±0.15E-06

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-5
1999 Contamination Indicator and Radiological Indicator Results
Unweathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
405	UP(1)	6.92	1083	1.77±2.10E-09	4.48±2.39E-09	9.41±0.89E-07
405	UP(2)	7.02	1324	0.96±1.48E-09	2.79±1.67E-09	9.55±5.45E-08
405	UP(3)	7.49	1221	1.54±2.12E-09	5.05±2.62E-09	9.75±7.59E-08
405	UP(4)	7.33	421	0.52±2.82E-09	5.54±2.76E-09	1.58±0.83E-07
110	DOWN-B(1)	7.22	558	0.81±1.26E-09	7.02±9.64E-10	1.40±0.10E-06
110	DOWN-B(2)	7.68	559	0.75±1.08E-09	2.22±1.38E-09	1.40±0.09E-06
110	DOWN-B(3)	7.20	538	1.22±1.72E-09	1.44±1.48E-09	1.43±0.10E-06
110	DOWN-B(4)	7.25	556	3.93±1.69E-09	5.04±1.98E-09	1.20±0.10E-06
704	DOWN-B(1)	6.87	869	-0.31±1.67E-09	7.15±2.47E-09	-2.84±0.87E-07
704	DOWN-B(2)	6.47	760	-0.27±1.37E-09	7.82±2.47E-09	-7.02±8.44E-08
704	DOWN-B(3)	6.70	823	0.65±1.89E-09	1.22±0.25E-08	-1.84±0.79E-07
704	DOWN-B(4)	6.56	1171	1.16±2.88E-09	1.28±0.32E-08	0.66±8.52E-08
707	DOWN-B(1)	7.21	444	-0.16±7.57E-10	1.74±0.96E-09	-1.26±8.04E-08
707	DOWN-B(2)	6.93	408	-2.12±6.64E-10	5.14±1.50E-09	-5.52±7.53E-08
707	DOWN-B(3)	6.92	598	0.38±1.65E-09	4.06±1.64E-09	7.42±8.25E-08
707	DOWN-B(4)	6.89	556	-1.29±1.07E-09	3.07±1.88E-09	-4.06±5.95E-08
107	DOWN-C(1)	7.31	796	1.10±1.03E-09	1.60±1.89E-09	9.75±0.89E-07
107	DOWN-C(2)	7.32	755	2.24±1.67E-09	3.69±2.24E-09	7.54±0.60E-07
107	DOWN-C(3)	7.17	718	2.58±1.84E-09	1.58±0.28E-08	7.51±0.92E-07
107	DOWN-C(4)	7.16	775	2.93±1.86E-09	5.25±2.04E-09	7.26±0.92E-07
108	DOWN-C(1)	7.62	566	1.62±1.27E-09	2.11±1.01E-09	-6.26±7.50E-08
108	DOWN-C(2)	7.53	562	2.07±0.91E-09	3.03±1.01E-09	6.92±7.55E-08
108	DOWN-C(3)	7.21	563	0.92±1.60E-09	3.89±1.61E-09	2.47±0.78E-07
108	DOWN-C(4)	7.26	556	2.99±1.24E-09	3.18±1.53E-09	5.56±8.40E-08
409	DOWN-C(1)	8.19	335	6.72±6.94E-10	4.38±1.31E-09	0.69±7.52E-08
409	DOWN-C(2)	8.02	348	5.90±7.34E-10	2.62±0.84E-09	-2.02±7.50E-08
409	DOWN-C(3)	8.06	335	1.30±0.78E-09	1.80±1.34E-09	6.83±7.53E-08
409	DOWN-C(4)	7.82	363	8.20±8.64E-10	2.24±1.26E-09	5.02±8.12E-08
910	DOWN-C(1)	7.01	1267	0.87±2.38E-09	3.57±0.34E-08	-1.50±0.75E-07
910	DOWN-C(3)	7.30	939	1.92±2.13E-09	6.69±0.41E-08	-1.94±7.81E-08

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-6
1999 Contamination Indicator and Radiological Indicator Results
Kent Recessional Sequence

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
901	UP(1)	7.55	380	8.46±7.76E-10	3.90±1.29E-09	5.80±5.32E-08
901	UP(3)	7.26	453	9.07±8.70E-10	3.10±1.45E-09	-3.18±7.76E-08
902	UP(1)	7.84	444	1.47±0.95E-09	3.32±1.27E-09	7.00±7.63E-08
902	UP(3)	7.93	440	1.10±0.98E-09	3.73±1.50E-09	6.57±7.69E-08
1008B	UP(1)	8.07	352	-0.57±6.29E-10	2.70±1.21E-09	-1.06±0.75E-07
1008B	UP(3)	7.84	225	6.09±5.84E-10	8.88±1.67E-09	7.80±7.58E-08
903	DOWN-B(1)	7.47	900	-0.27±1.20E-09	2.02±2.05E-09	1.62±0.80E-07
903	DOWN-B(3)	7.45	910	0.71±1.63E-09	0.68±2.06E-09	2.67±7.66E-08
8610	DOWN-B(1)	8.10	925	0.53±1.12E-09	3.22±2.05E-09	-1.46±0.79E-07
8610	DOWN-B(3)	7.91	900	0.45±1.34E-09	6.61±2.31E-09	1.12±0.77E-07
8611	DOWN-B(1)	7.50	957	0.93±1.61E-09	0.68±2.65E-09	-1.30±0.77E-07
8611	DOWN-B(3)	7.50	1085	1.65±1.76E-09	1.59±2.36E-09	8.44±7.60E-08

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-7
1999 Contamination Indicator and Radiological Indicator Results
North Plateau Seep Monitoring Locations

Location Code	Hydraulic Position	pH	Conductivity (μmhos/cm@25^{0}C)	Gross Alpha (μCi/mL)	Gross Beta (μCi/mL)	Tritium (μCi/mL)
GSEEP	DOWN-D(1)	6.83	915	-0.10±1.45E-09	4.35±2.84E-09	6.80±0.87E-07
GSEEP	DOWN-D(2)	7.10	760	-0.59±1.24E-09	5.71±2.35E-09	5.31±0.81E-07
GSEEP	DOWN-D(3)	6.52	978	1.43±1.79E-09	7.70±2.72E-09	6.80±0.87E-07
GSEEP	DOWN-D(4)	6.93	1030	-0.09±1.01E-09	7.64±1.93E-09	8.83±0.65E-07
SP02	DOWN-D(1)	NS	NS	0.18±1.21E-09	1.80±2.58E-09	7.20±0.84E-07
SP02	DOWN-D(3)	NS	NS	-0.13±1.52E-09	6.47±2.65E-09	4.66±0.89E-07
SP04	DOWN-D(1)	NS	NS	-1.17±1.12E-09	6.80±1.74E-09	3.30±0.79E-07
SP04	DOWN-D(3)	NS	NS	0.16±1.72E-09	5.15±2.60E-09	2.28±0.85E-07
SP05	DOWN-D(1)	NS	NS	-0.10±1.11E-09	3.45±2.10E-09	2.92±0.78E-07
SP05	DOWN-D(3)	NS	NS	0.86±1.62E-09	5.62±2.32E-09	1.99±0.84E-07
SP06	DOWN-D(1)	NS	NS	-1.26±1.09E-09	2.94±1.06E-09	1.40±0.76E-07
SP06	DOWN-D(3)	NS	NS	-0.67±1.60E-09	3.71±1.64E-09	-3.10±8.13E-08
SP11	DOWN-D(1)	NS	NS	0.65±1.37E-09	7.18±2.87E-09	1.86±0.77E-07
SP11	DOWN-D(3)	NS	NS	1.62±2.03E-09	1.22±0.30E-08	1.69±0.61E-07
SP12	DOWN-D(1)	7.54	1102	-0.65±1.79E-09	2.53±2.32E-09	5.94±0.87E-07
SP12	DOWN-D(3)	7.35	1019	1.13±2.08E-09	3.08±2.51E-09	5.32±0.86E-07
SP18	DOWN-D(1)	NS	NS	8.47±4.97E-10	6.07±1.36E-09	1.08±7.59E-08

NS - Not sampled.
Sample collection quarter is noted in parentheses next to hydraulic position.

Table E-8
1999 Contamination Indicator and Radiological Indicator Results
North Plateau Well Points

Location Code	Hydraulic Position	pH	Conductivity (µmhos/cm@25^{0}C)	Gross Alpha (µCi/mL)	Gross Beta (µCi/mL)	Tritium (µCi/mL)
WP-A	DOWN-C(4)	9.71	85	2.03±3.13E-10	5.00±0.21E-08	9.71±0.34E-06
WP-C	DOWN-C(4)	7.05	122	-1.64±3.21E-10	1.02±0.11E-08	4.56±0.14E-05
WP-H	DOWN-C(4)	6.64	772	1.88±1.07E-09	4.27±0.02E-06	7.38±0.27E-06

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 9
1999 Detections of Volatile Organic Compounds
at Selected Groundwater Monitoring Locations

Location Code	Sampling Quarter	1,1,1-TCA (µg/L)	1,1-DCA (µg/L)	DCDFMeth (µg/L)	1,2-DCE(total) (µg/L)	TCE (µg/L)
SP12	1	< 5.0	< 5.0	< 5.0	NS	< 5.0
	3	< 5.0	< 5.0	< 5.0	NS	< 5.0
803	1	< 5.0	< 5.0	< 5.0	NS	< 5.0
	2	< 5.0	< 5.0	< 5.0	NS	< 5.0
	3	< 5.0	< 5.0	< 5.0	NS	< 5.0
	4	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
8609	1	< 5.0	< 5.0	< 5.0	NS	< 5.0
8612	1	3.0*	19.5	4.0*	23.0	< 5.0
	2	2.2*	17.1	2.9*	19.1	< 5.0
	2**	2.5*	14.8	4.5*	NS	< 5.0
	3	2.1	16.0	3.8	21.0	< 5.0
	4	< 5.0	17.0	< 5.0	23.7	< 5.0

Note: *Samples are collected according to different schedules (annual, semiannual, or quarterly).*
*** *Compound was detected below the practical quantitation limit (PQL) of 5 µg/L.*
**** *Confirmatory samples for the second-quarter 1999 round were collected at a later date and were not averaged with earlier samples.*
NS - *Not sampled.*

Table E - 10
1999 Tributyl Phosphate Sampling Results at Selected Groundwater Monitoring Locations

Location Code	Sampling Quarter	Tributyl Phosphate (TBP) *(µg/L)*
111	*1*	33.9
	3	10.2
8605	*1*	475
	3	306

Note: Samples are collected according to different schedules (annual, semiannual, or quarterly).

Table E - 11
1999 Metals (µg/L) Sampling Results

Title 6 NYCRR Appendix 33 List

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
111	DOWN-C(1)	<10	<10	75	<1	<5	1	1	<25
502	DOWN-C(1)	NS	<10	315	NS	<5	313	1	<25
502	DOWN-C(3)	NS	<10	312	NS	<5	126	<50	<25
8605	DOWN-C(1)	<10	5	94	<1	<5	1	1	<25
Weathered Till									
NDATR	DOWN-C(1)	<10	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN-C(2)	<10	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN-C(3)	<10	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN-C(4)	<10	<10	<200	<1	<5	<10	<50	<20
909	DOWN-C(1)	<10	10	<200	<1	<5	<10	<50	<25

NS - Not sampled.
Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 11 (concluded)
1999 Metals (µg/L) Sampling Results

Title 6 NYCRR Appendix 33 List

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
111	DOWN-C(1)	<3	0.2	<40	<5	2	<10	<3000	<50	3
502	DOWN-C(1)	<3	<0.2	20	<5	1	NS	NS	1	1
502	DOWN-C(3)	2	<0.2	14	<5	4	NS	NS	<50	3
8605	DOWN-C(1)	2	0.2	<40	3	2	<10	<3000	<25	3
Weathered Till										
NDATR	DOWN-C(1)	<3	<0.2	<40	11	<10	<10	<3000	<50	14
NDATR	DOWN-C(2)	<3	<0.2	<40	<5	<10	<10	<3000	<50	<20
NDATR	DOWN-C(3)	<3	<0.1	<40	<5	<10	<10	<3000	<50	<20
NDATR	DOWN-C(4)	<3	<0.2	<40	<5	<10	<10	<3000	<50	25
909	DOWN-C(1)	5	<0.2	<40	8	<10	<10	<3000	<50	53

NS - Not sampled.

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 12
1999 Sampling Parameters at Early Warning Monitoring Wells (µg/L)

Location Code	Sample Quarter	Aluminum Total	Iron Total	Manganese Total
502	(1)	< 200	2090	10
	(3)	123	947	7.0

Table E - 13
1999 Alpha-, Beta-, and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	C-14	I-129	Cs-137
Sand and Gravel				
401	UP(1)	2.12±5.16E-09	2.91±4.63E-10	1.90±1.13E-08
406	DOWN-C(1)	1.92±5.15E-09	1.72±1.33E-09	0.30±1.48E-08
408	DOWN-C(1)	2.03±5.16E-09	-1.81±2.72E-09	-1.39±5.73E-09
Weathered Till				
NDATR	DOWN-C(1)	6.85±5.24E-09	9.00±9.29E-10	-4.26±9.74E-09
NDATR	DOWN-C(3)	1.17±0.49E-08	2.19±5.93E-10	1.84±7.38E-09
909	DOWN-C(1)	1.43±0.60E-08	9.65±2.29E-09	0.40±1.28E-08

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 13 (continued)
1999 Alpha-, Beta-, and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	Sr-90	Tc-99	Ra-226	Ra-228	U-232
Sand and Gravel						
401	UP(1)	1.83±1.74E-09	-2.87±1.13E-09	8.56±3.36E-10	2.61±8.15E-10	3.78±3.25E-10
111	DOWN-C(1)	3.20±0.03E-06	NS	NS	NS	NS
406	DOWN-C(1)	2.11±1.81E-09	4.03±1.58E-09	3.42±2.34E-10	-6.68±9.03E-10	3.22±3.59E-10
408	DOWN-C(1)	1.07±0.01E-04	1.39±0.20E-08	1.04±0.34E-09	2.58±2.24E-09	1.08±3.16E-10
501	DOWN-C(1)	1.05±0.01E-04	NS	NS	NS	NS
502	DOWN-C(1)	8.11±0.02E-05	NS	NS	NS	NS
602	DOWN-C(1)	9.98±2.70E-09	NS	NS	NS	NS
602	DOWN-C(3)	1.69±0.33E-08	NS	NS	NS	NS
602A	DOWN-C(3)	7.45±2.96E-09	NS	NS	NS	NS
8605	DOWN-C(1)	5.14±0.06E-06	NS	NS	NS	NS
8609	DOWN-C(1)	3.72±0.10E-07	NS	NS	NS	NS
8609	DOWN-C(3)	3.52±0.14E-07	NS	NS	NS	NS
116	DOWN-D(1)	2.14±0.35E-08	NS	NS	NS	NS
116	DOWN-D(3)	2.41±0.26E-08	NS	NS	NS	NS
605	DOWN-D(1)	3.09±0.29E-08	NS	NS	NS	NS
605	DOWN-D(3)	3.74±0.47E-08	NS	NS	NS	NS
801	DOWN-D(1)	3.36±0.05E-06	NS	NS	NS	NS
801	DOWN-D(2)	4.25±0.06E-06	NS	NS	NS	NS
801	DOWN-D(3)	4.57±0.07E-06	NS	NS	NS	NS
801	DOWN-D(4)	4.26±0.05E-06	NS	NS	NS	NS
804	DOWN-D(4)	1.87±0.06E-07	NS	NS	NS	NS
8603	DOWN-D(1)	1.12±0.01E-05	NS	NS	NS	NS
8603	DOWN-D(3)	1.33±0.01E-05	NS	NS	NS	NS
Weathered Till						
NDATR	DOWN-C(1)	9.33±0.46E-08	0.22±1.50E-09	7.78±3.11E-10	9.36±9.01E-10	4.72±4.07E-10
NDATR	DOWN-C(3)	4.58±0.54E-08	0.05±2.17E-09	5.57±2.64E-10	3.11±0.60E-09	-1.14±6.22E-11
909	DOWN-C(1)	2.15±0.10E-07	2.34±1.53E-09	6.71±3.16E-10	3.83±0.85E-09	5.26±3.91E-10

NS - Not sampled.
Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 13 (concluded)
1999 Alpha-, Beta-, and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	U-233/234	U-235/236	U-238	Total U (µg/mL)
Sand and Gravel					
401	UP(1)	2.34±2.42E-10	1.32±1.67E-10	2.02±1.75E-10	8.87±0.22E-05
406	DOWN-C(1)	2.54±1.88E-10	0.47±1.13E-10	1.92±1.82E-10	1.88±0.05E-04
408	DOWN-C(1)	4.94±2.69E-10	0.76±1.05E-10	3.04±2.11E-10	6.09±0.10E-04
Weathered Till					
NDATR	DOWN-C(1)	1.41±0.56E-09	2.40±2.58E-10	1.23±0.51E-09	3.04±0.04E-03
NDATR	DOWN-C(3)	1.92±0.17E-09	4.68±3.42E-11	1.50±0.15E-09	4.40±0.11E-03
909	DOWN-C(1)	1.34±0.52E-09	1.02±1.41E-10	7.29±3.94E-10	1.90±0.06E-03

Sample collection quarter is noted in parentheses next to hydraulic position.

Table E - 14
Practical Quantitation Limits (PQLs) in µg/L

COMPOUND	PQL	COMPOUND	PQL
Title 6 NYCRR Appendix 33 Volatiles		*Title 6 NYCRR Appendix 33 Volatiles*	
Acetone	10	Methacrylonitrile	5
Acetonitrile	100	Methyl ethyl ketone	10
Acrolein	5	Methyl iodide	5
Acrylonitrile	5	Methyl methacrylate	5
Allyl chloride	5	4-Methyl-2-pentanone	10
Benzene	5	Methylene bromide	10
Bromodichloromethane	5	Methylene chloride	5
Bromoform	5	Pentachloroethane	5
Bromomethane	10	Propionitrile	50
Carbon disulfide	10	Styrene	5
Carbon tetrachloride	5	1,1,1,2-Tetrachloroethane	5
Chlorobenzene	5	1,1,2,2,-Tetrachloroethane	5
Chloroethane	10	Tetrachloroethylene	5
Chloroform	5	Toluene	5
Chloromethane	10	1,1,1-Trichloroethane	5
Chloroprene	5	1,1,2-Trichloroethane	5
1,2-Dibromo-3-chloropropane	5	1,2,3-Trichloropropane	5
Dibromochloromethane	5	Vinyl acetate	10
1,2-Dibromoethane	5	Vinyl chloride	10
Dichlorodifluoromethane	5	Xylene (total)	5
1,1-Dichloroethane	5	cis-1,3-Dichloropropene	5
1,2-Dichloroethane	5	trans-1,2-Dichloroethylene	5
1,1-Dichloroethylene	5	trans-1,3-Dichloropropene	5
1,2-Dichloropropane	5	trans-1,4-Dichloro-2-butene	5
Ethyl benzene	5	Trichloroethylene	5
Ethyl methacrylate	5	Trichlorofluoromethane	5
2-Hexanone	10		
Isobutyl alcohol	100		
Title 6 NYCRR Appendix 33 Metals		*Title 6 NYCRR Appendix 33 Metals*	
Aluminum*	200	Lead	3
Antimony	10	Manganese*	15
Arsenic	10	Mercury	0.2
Barium	200	Nickel	40
Beryllium	1	Selenium	5
Cadmium	5	Silver	10
Chromium	10	Thallium	10
Cobalt	50	Tin	3000
Copper	25	Vanadium	50
Iron*	100	Zinc	20

** Aluminum, iron, and manganese are not Appendix 33 parameters; they are sampled for the north plateau early warning program.*

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 14 (continued)
Practical Quantitation Limits (PQLs) in µg/L

COMPOUND	PQL
Title 6 NYCRR Appendix 33 Semivolatiles	
Acenaphthene	10
Acenaphthylene	10
Acetophenone	10
2-Acetylaminofluorene	10
4-Aminobiphenyl	10
Aniline	10
Anthracene	10
Aramite	10
Benzo[a]anthracene	10
Benzo[a]pyrene	10
Benzo[b]fluoranthene	10
Benzo[ghi]perylene	10
Benzo[k]fluoranthene	10
Benzyl alcohol	10
Bis(2-chlorethyl)ether	10
Bis(2-chloroethoxy)methane	10
Bis(2-chloroisopropyl)ether	10
Bis(2-ethylhexyl)phthalate	10
4-Bromophenyl phenyl ether	10
Butyl benzyl phthalate	10
Chlorobenzilate	10
2-Chloronaphthalene	10
2-Chlorophenol	10
4-Chlorophenyl phenyl ether	10
Chrysene	10
Di-n-butyl phthalate	10
Di-n-octyl phthalate	10
Diallate	10
Dibenz[a,h]anthracene	10
Dibenzofuran	10
3,3-Dichlorobenzidine	10
2,4-Dichlorophenol	10
2,6-Dichlorophenol	10
Diethyl phthalate	10
Dimethoate	10
7,12-Dimethylbenz[a]anthracene	10
3,3-Dimethylbenzidine	20
2,4-Dimethylphenol	10
Dimethyl phthalate	10
4,6-Dinitro-o-cresol	25
2,4-Dinitrophenol	25
2,4-Dinitrotoluene	10

COMPOUND	PQL
Title 6 NYCRR Appendix 33 Semivolatiles	
2,6-Dinitrotoluene	10
Diphenylamine	10
Ethyl methanesulfonate	10
Famphur	10
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexchlorobutadiene	10
Hexachlorocyclopentadiene	10
Hexachloroethane	10
Hexachlorophene	500
Hexachloropropene	10
Indeno(1,2,3,-cd)pyrene	10
Isodrin	10
Isophorone	10
Isosafrole	10
Kepone	70
Methapyrilene	10
Methyl methanesulfonate	10
3-Methylcholanthrene	10
2-Methylnaphthalene	10
1,4-Naphthoquinone	10
1-Naphthylamine	10
2-Naphthylamine	10
Nitrobenzene	10
5-Nitro-o-toluidine	10
4-Nitroquinoline 1-oxide	40
N-Nitrosodi-n-butylamine	10
N-Nitrosodiethylamine	10
N-Nitrosodimethylamine	10
N-Nitrosodiphenylamine	10
N-Nitrosodipropylamine	10
N-Nitrosomethylethylamine	10
N-Nitrosomorpholine	10
N-Nitrosopiperidine	10
N-Nitrosopyrrolidine	10
Naphthalene	10
0,0,0-Triethyl phosphorothioate	10
0,0-Diethyl 0-2-pyrazinyl-phosphorothioate	10
p-(Dimethylamino)azobenzene	10

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 14 (concluded)
Practical Quantitation Limits (PQLs) in µg/L

COMPOUND	PQL
Title 6 NYCRR Appendix 33 Semivolatiles	
p-Chloroaniline	10
p-Chloro-m-cresol	10
p-Cresol	10
p-Dichlorobenzene	10
p-Nitroaniline	25
p-Nitrophenol	25
p-Phenylenediamine	20
Parathion	10
Pentachlorobenzene	10
Pentachloronitrobenzene	10
Pentachlorophenol	25
Phenacetin	10
Phenathrene	10
Phenol	10
Pronamide	10
Pyrene	10
Safrole	10
1,2,4,5-Tetrachlorobenzene	10

COMPOUND	PQL
Title 6 NYCRR Appendix 33 Semivolatiles	
2,3,4,6-Tetrachlorophenol	10
Tetraethyl dithiopyrophosphate	10
1,2,4-Trichlorobenzene	10
2,4,5-Trichlorophenol	25
2,4,6-Trichlorophenol	10
alpha,alpha-Dimethylphenethylamine	50
m-Cresol	10
m-Dichlorobenzene	10
m-Dinitrobenzene	10
m-Nitroaniline	25
o-Cresol	10
o-Dichlorobenzene	10
o-Nitroaniline	25
o-Nitrophenol	10
o-Toluidine	10
sym-Trinitrobenzene	10
2-Picoline	10
Pyridine	10
1,4-Dioxane	10

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

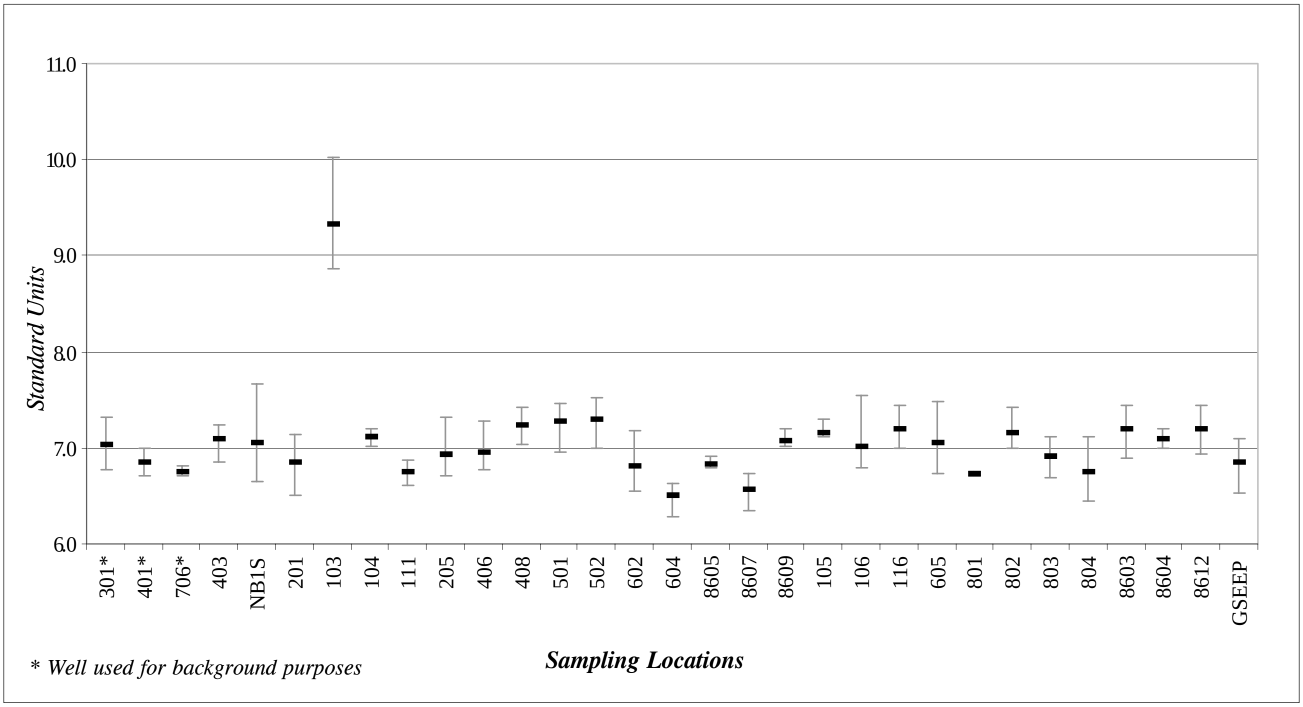

Figure E-1. pH in Groundwater Samples from the Sand and Gravel Unit

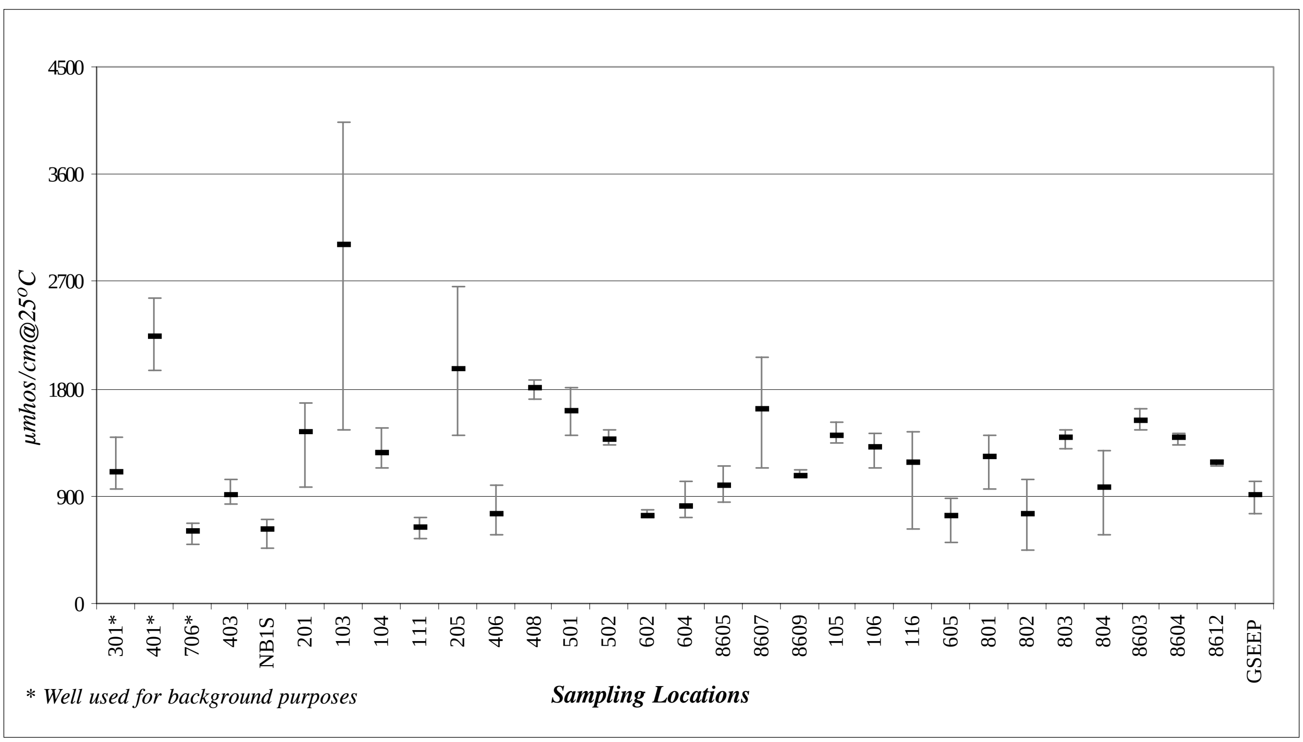

Figure E-2. Conductivity (µmhos/cm@25^{O}C) of Groundwater Samples from the Sand and Gravel Unit

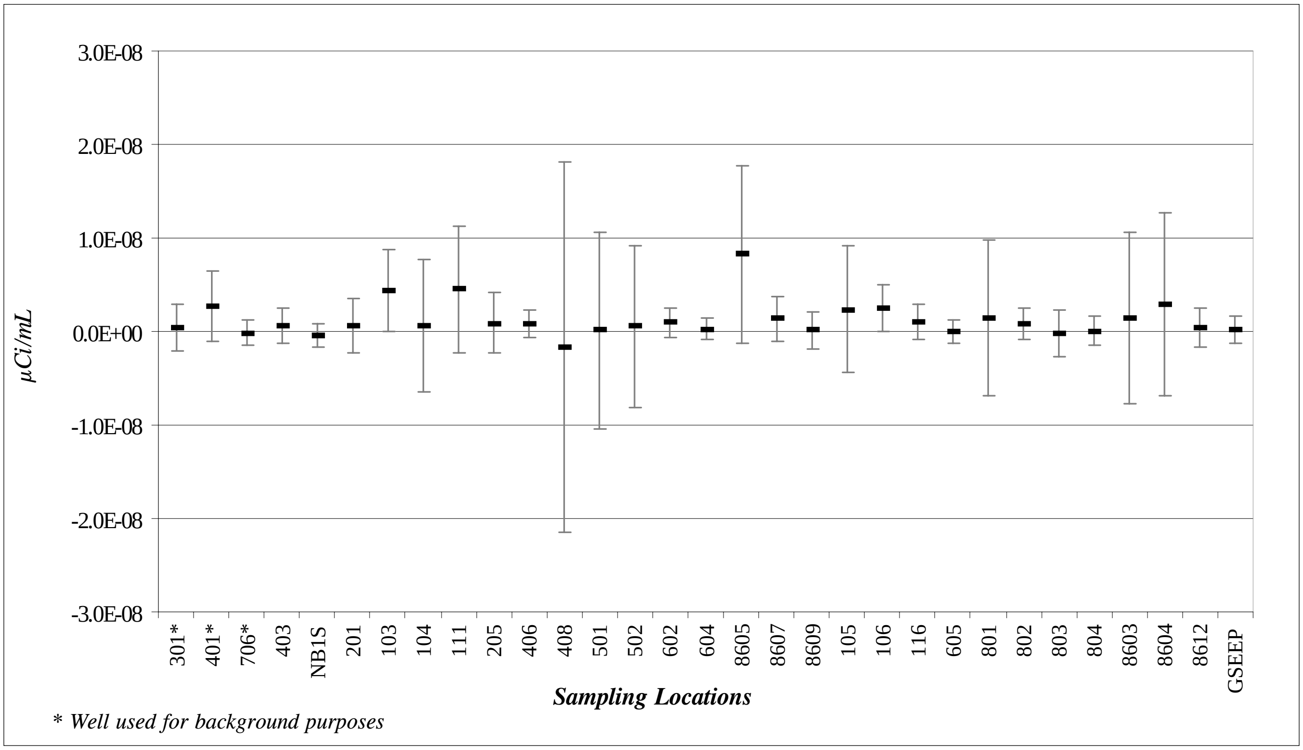

Figure E-3. Gross Alpha (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit

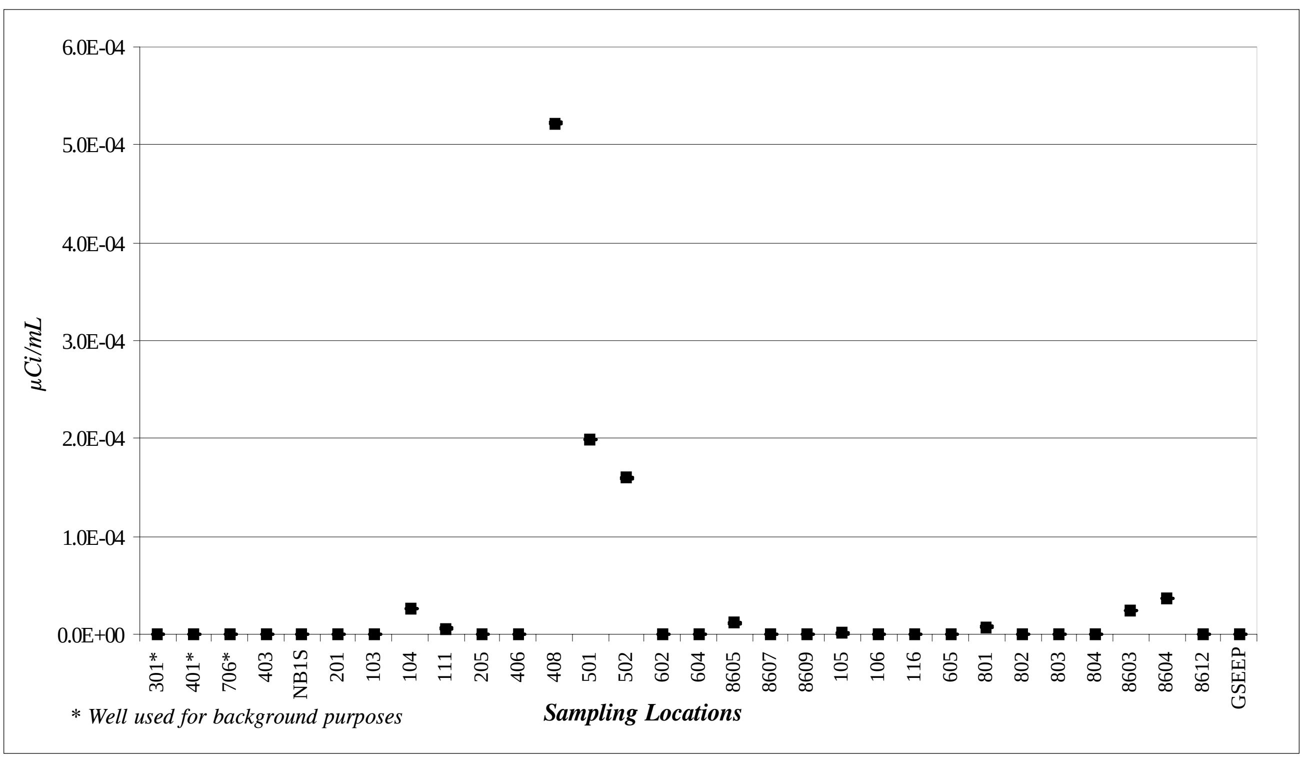

Figure E-4. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit

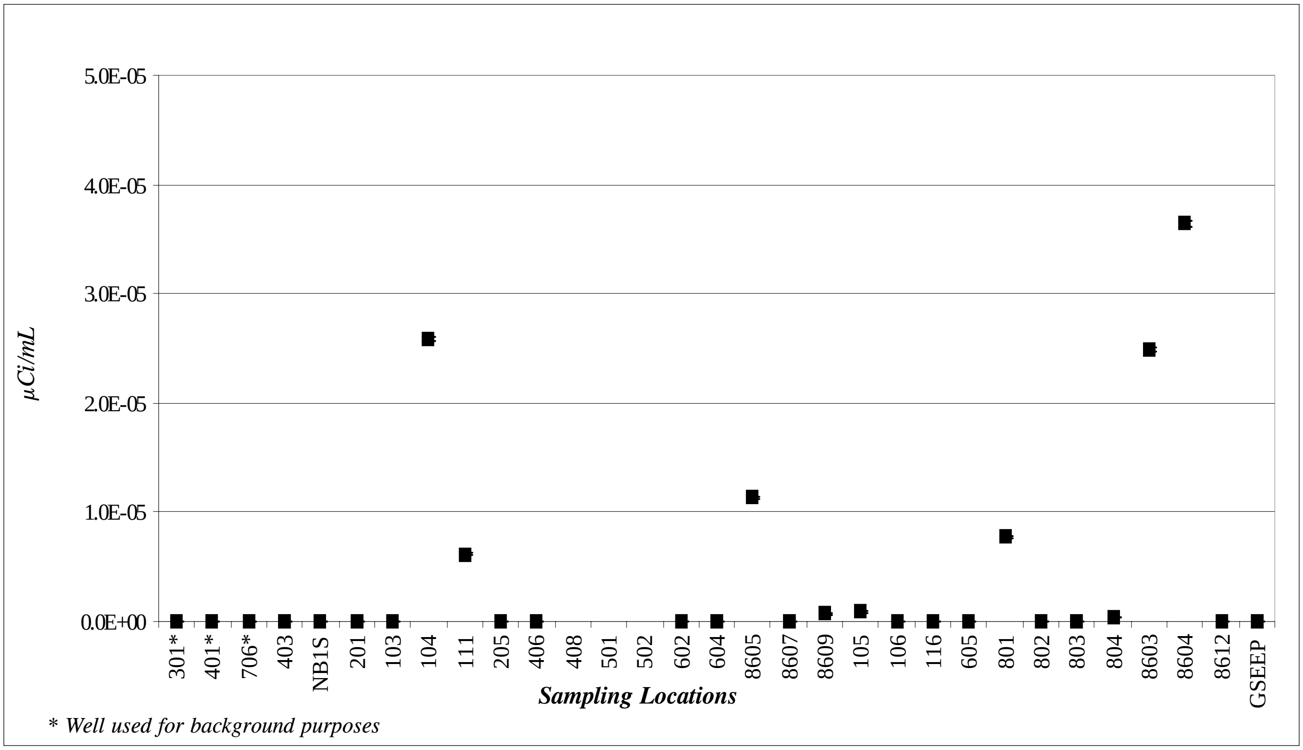

Figure E-4a. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (Magnified scale of Fig. E-4)

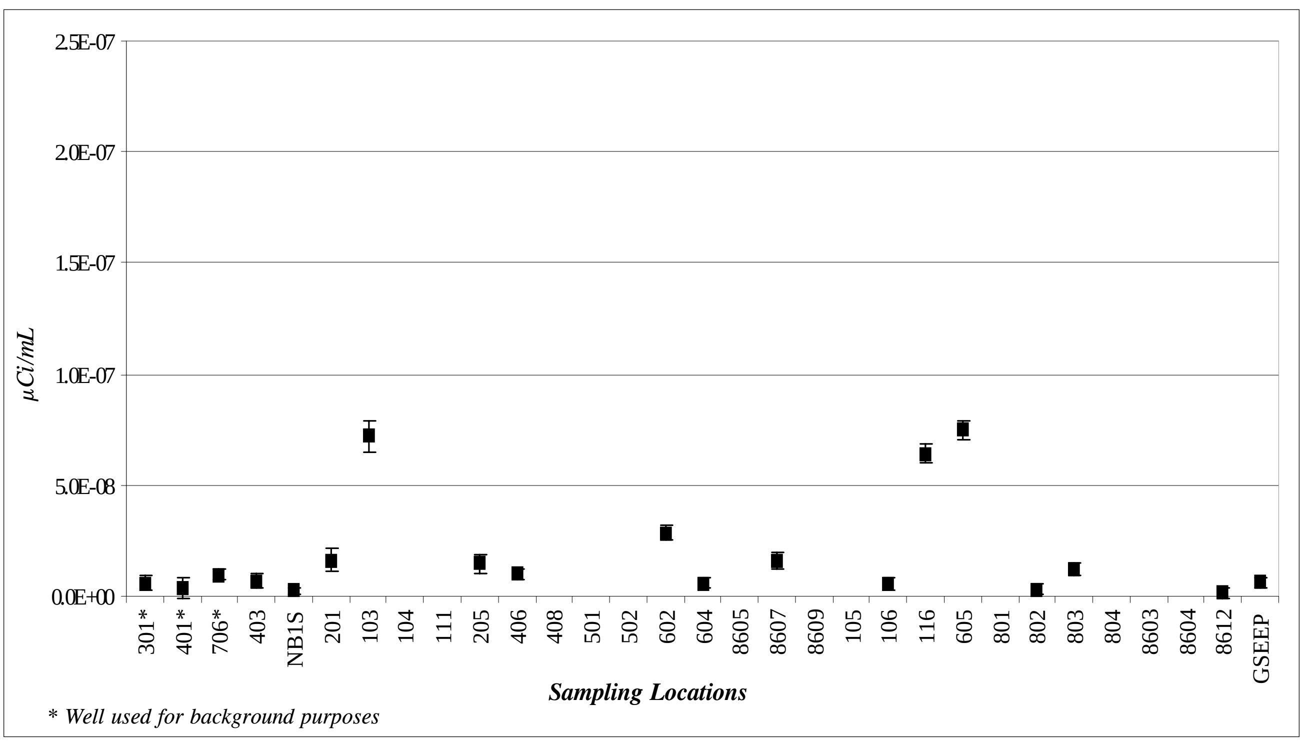

Figure E-4b. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (Magnified scale of Fig. E-4a)

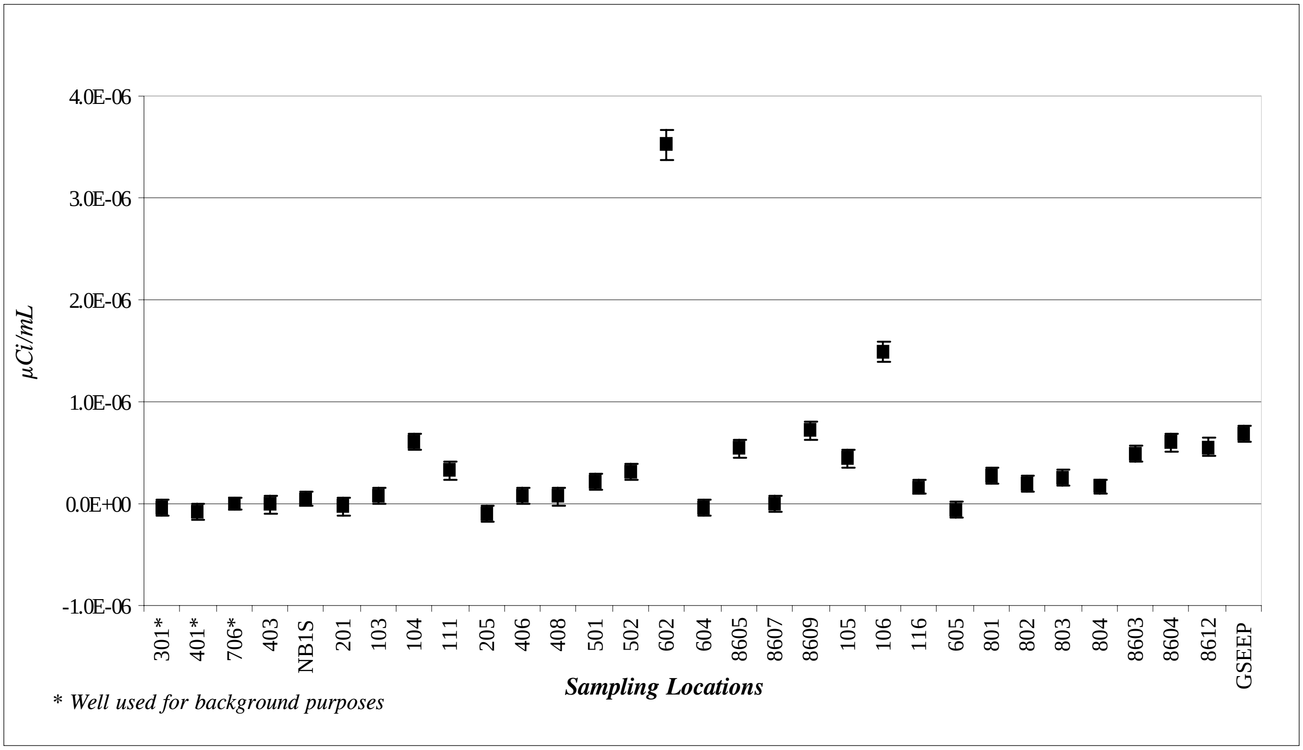

Figure E-5. Tritium Activity (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit

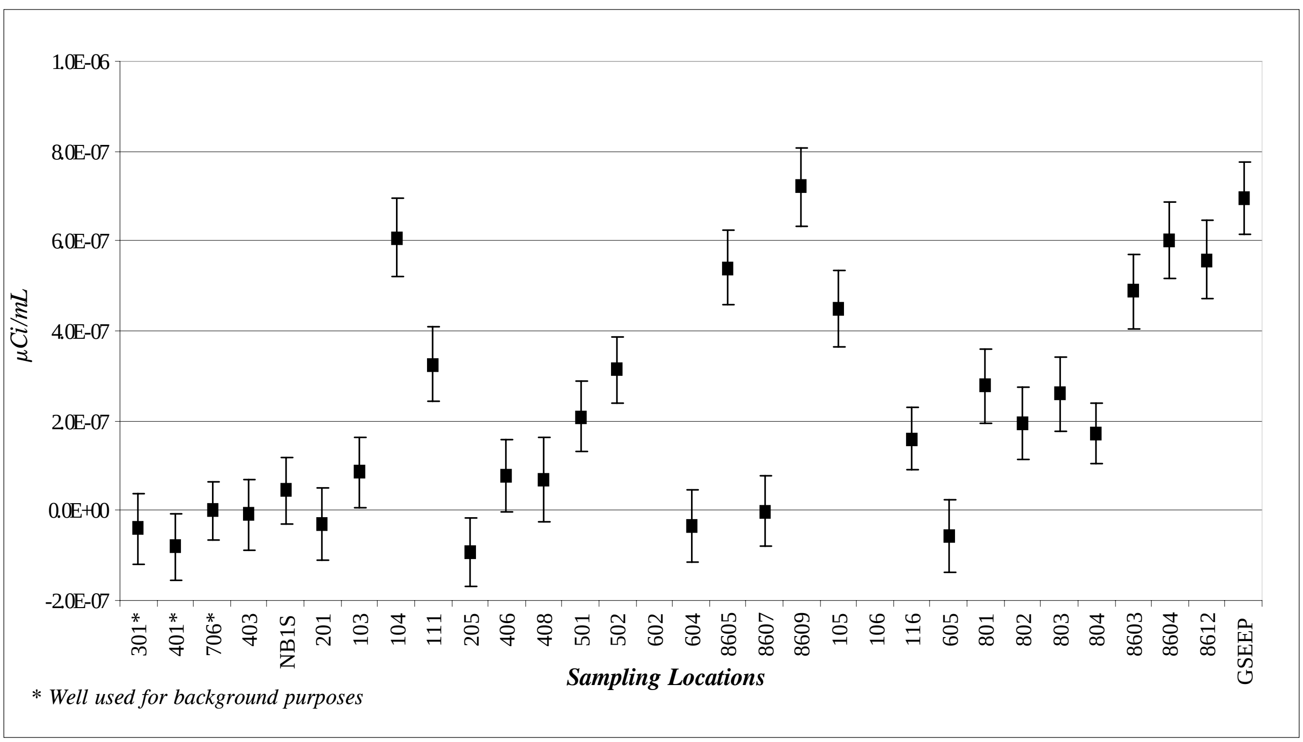

Figure E-5a. Tritium Activity (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (Magnified scale of Fig. E-5)

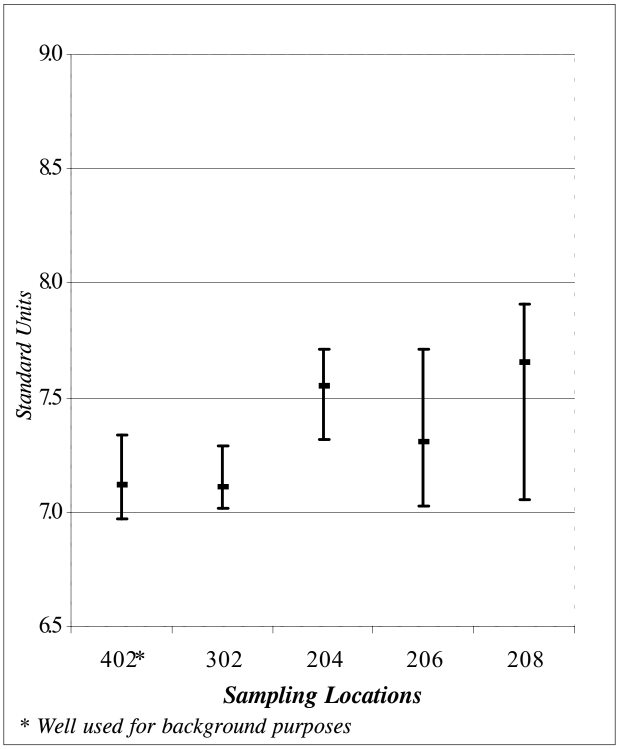

Figure E-6. pH of Groundwater Samples from the Till-Sand Unit

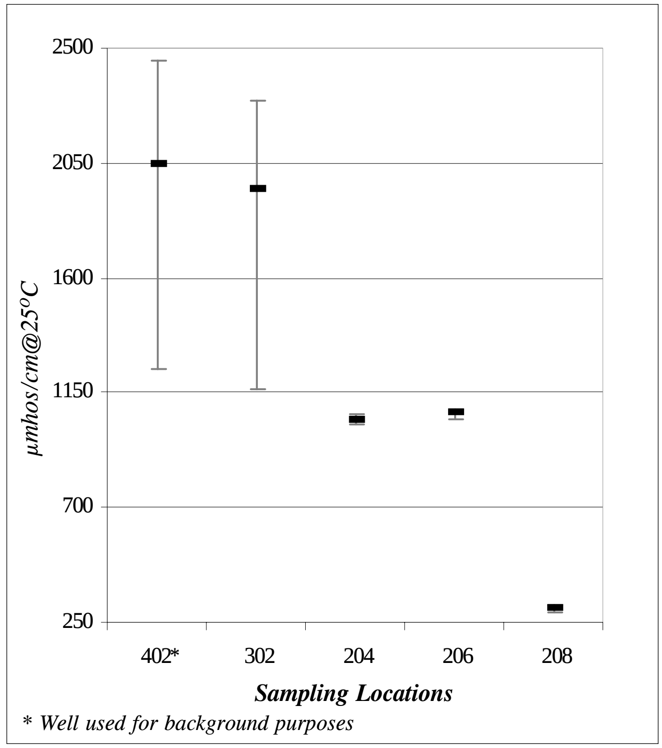

Figure E-7. Conductivity (µmhos/cm@25°C) of Groundwater Samples from the Till-Sand Unit

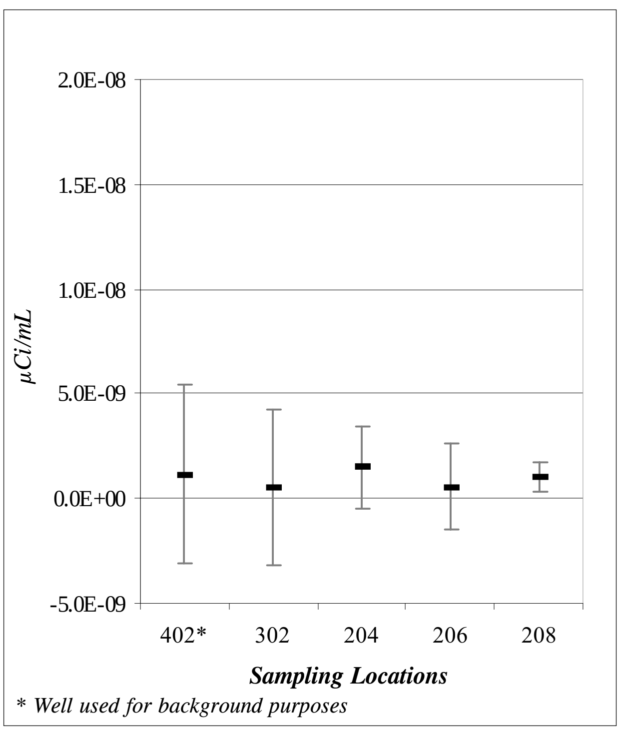

Figure E-8. Gross Alpha (µCi/mL) in Groundwater Samples from the Till-Sand Unit

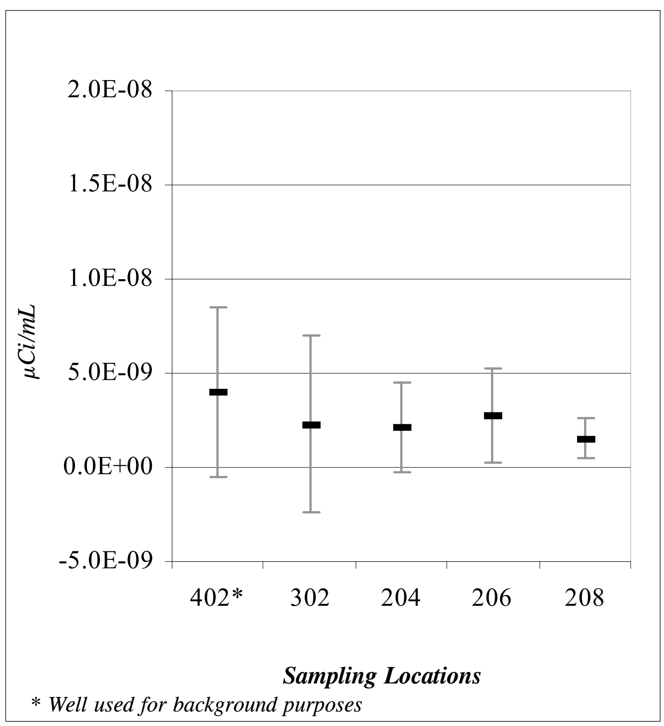

Figure E-9. Gross Beta (µCi/mL) in Groundwater Samples from the Till-Sand Unit

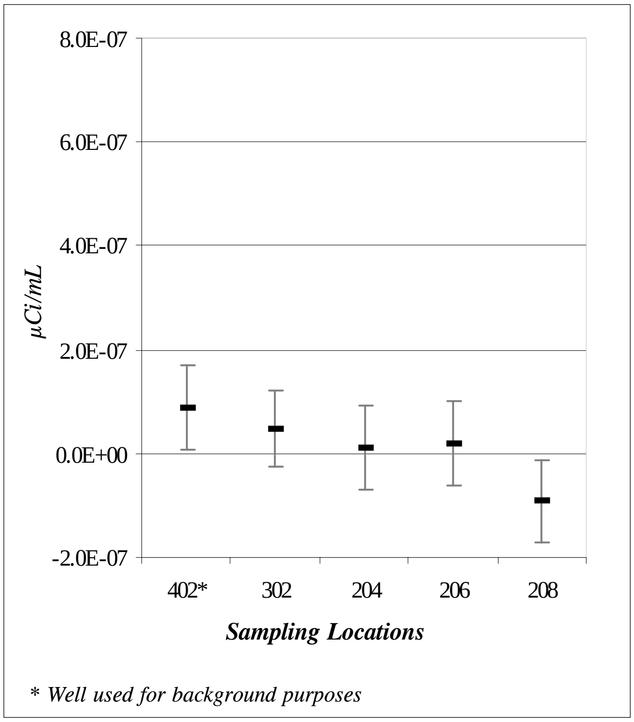

Figure E-10. Tritium Activity (µCi/mL) in Groundwater Samples from the Till-Sand Unit

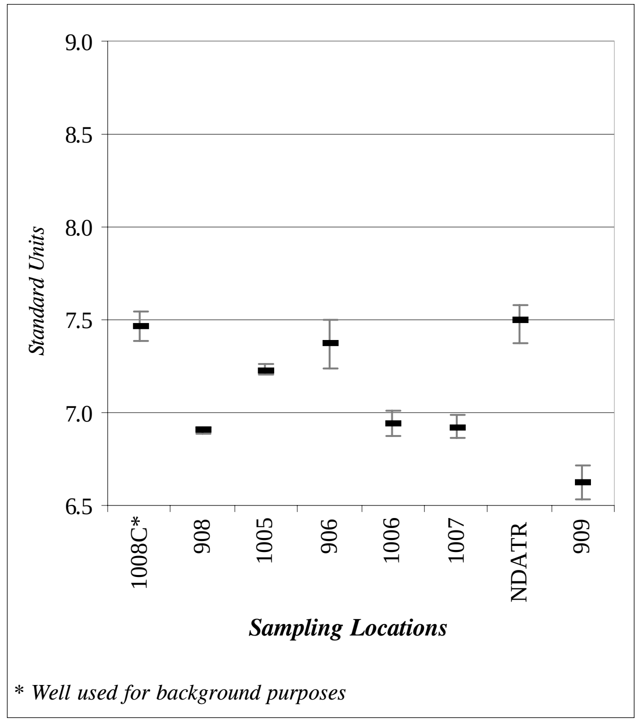

Figure E-11. pH of Groundwater Samples from the Weathered Lavery Till Unit

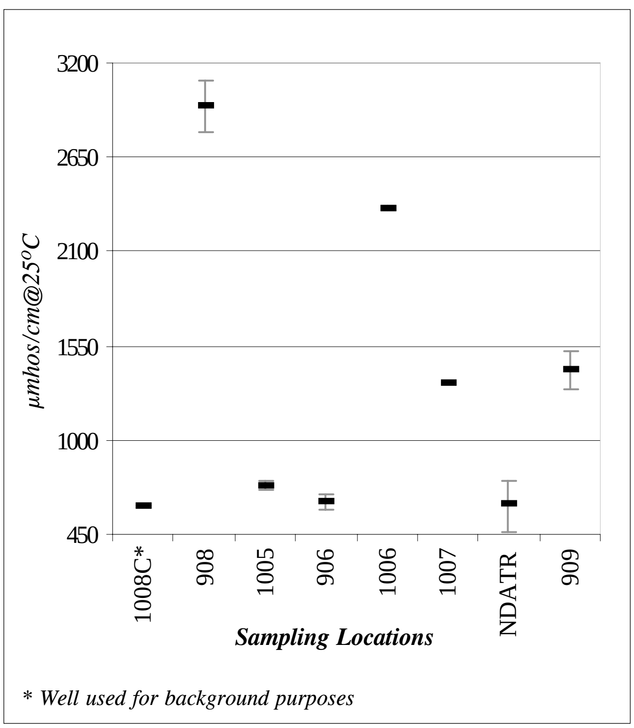

Figure E-12. Conductivity (µmhos/cm@25ºC) of Groundwater Samples from the Weathered Lavery Till Unit

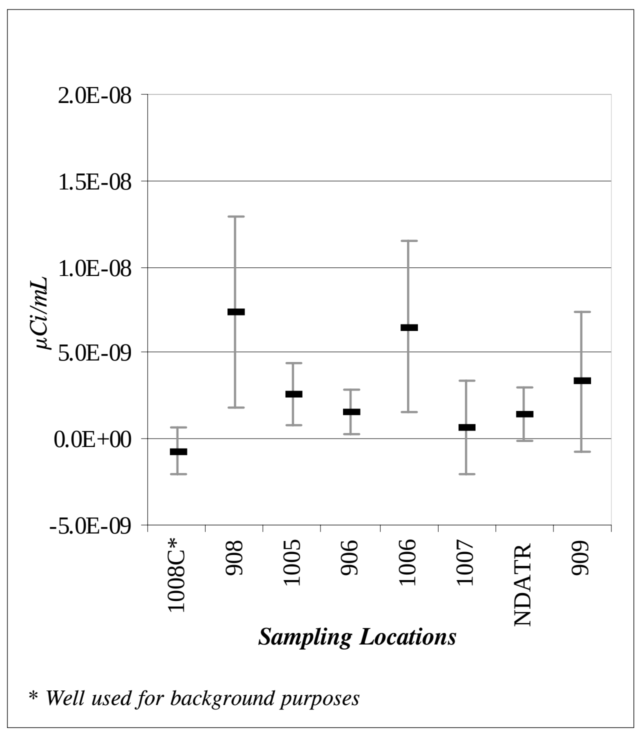

Figure E-13. Gross Alpha (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

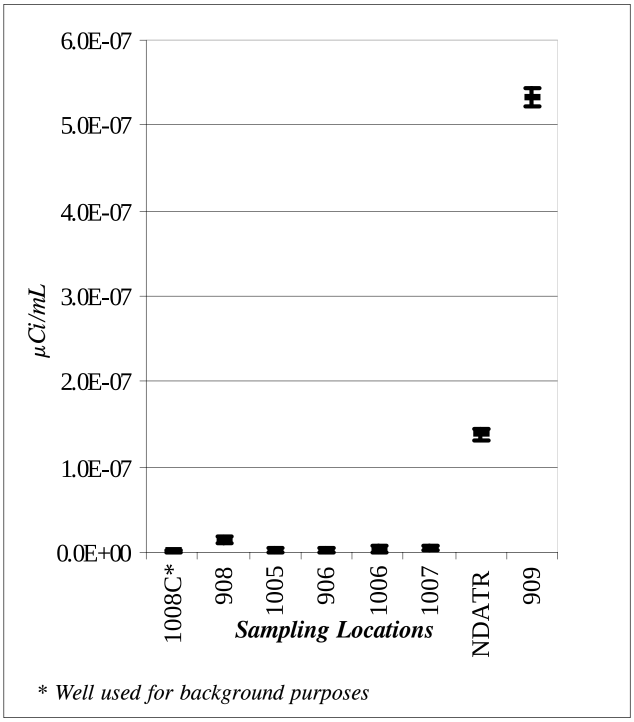

Figure E-14. Gross Beta (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

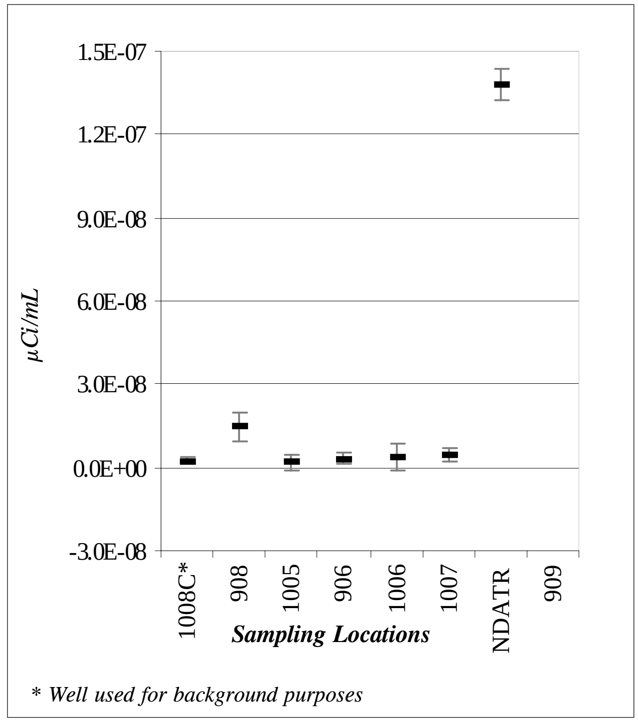

Figure E-14a. Gross Beta (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit (Magnified scale of Fig. E-14)

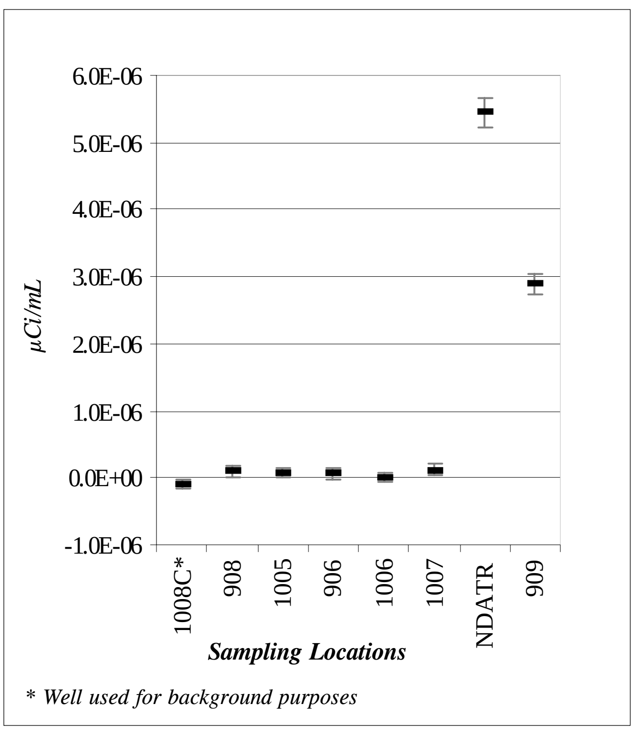

Figure E-15. Tritium Activity (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

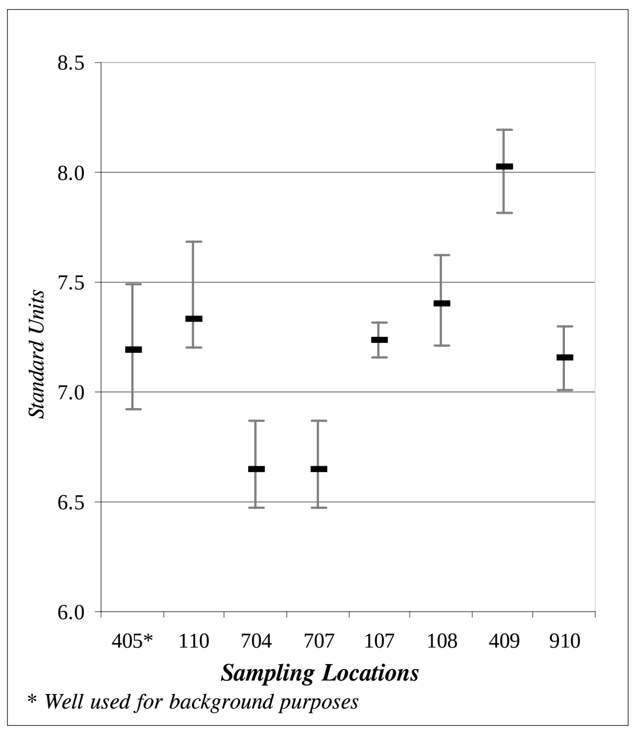

Figure E-16. pH of Groundwater Samples from the Unweathered Lavery Till Unit

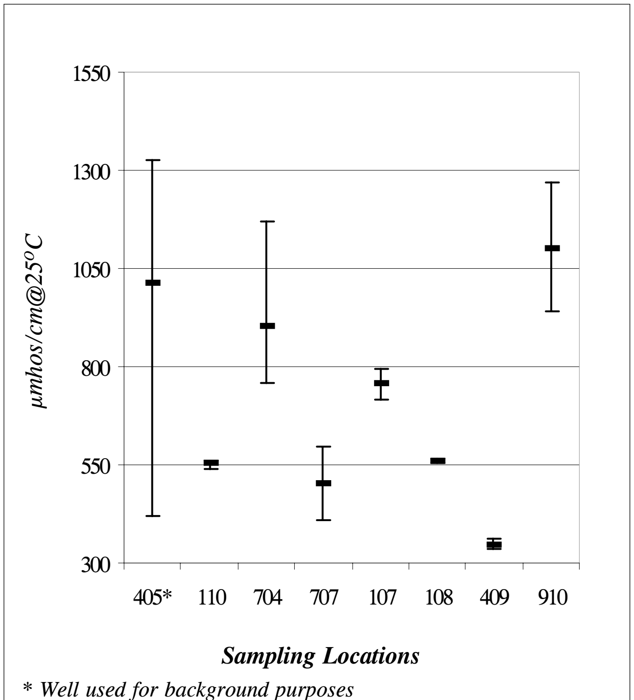

Figure E-17. Conductivity (μmhos/cm@25^{O}C) of Groundwater Samples from the Unweathered Lavery Till Unit

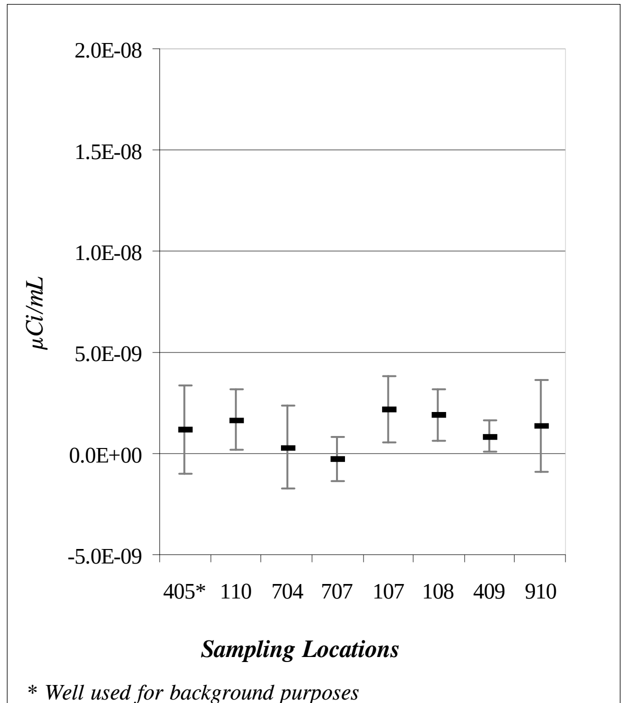

Figure E-18. Gross Alpha (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

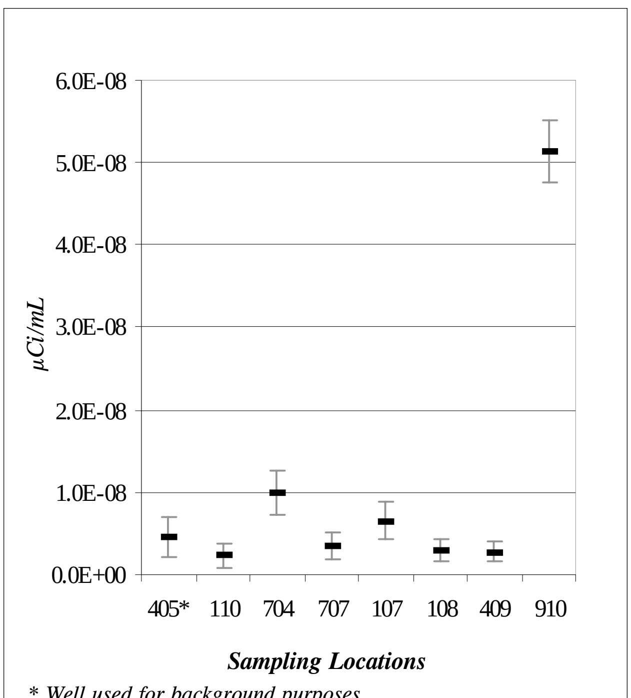

Figure E-19. Gross Beta (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

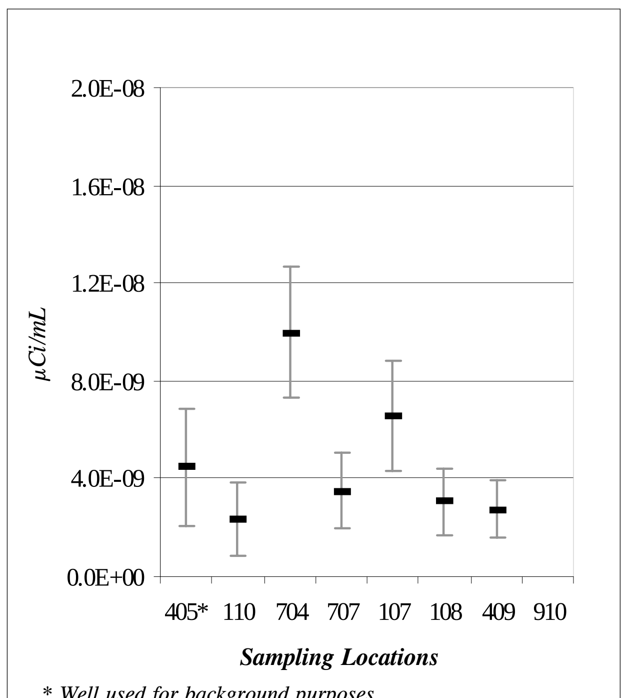

Figure E-19a. Gross Beta (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit (Magnified scale of Fig. E-19)

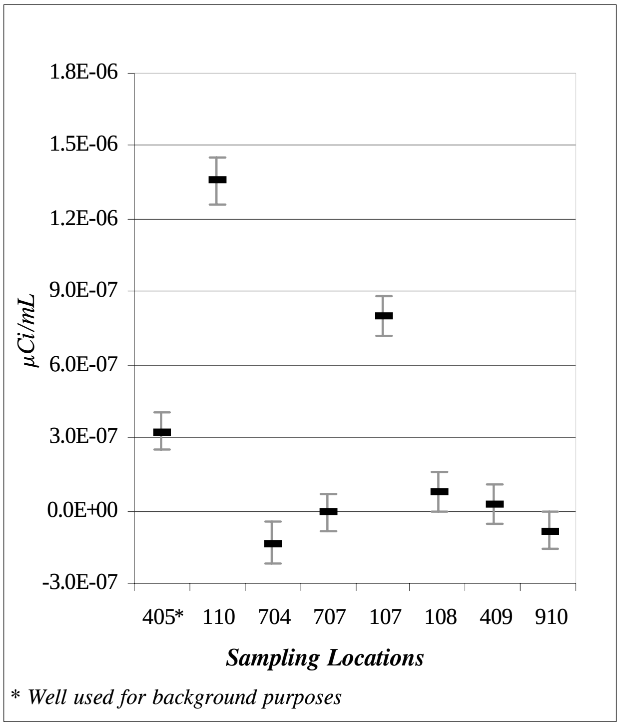

Figure E-20. Tritium Activity (µCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

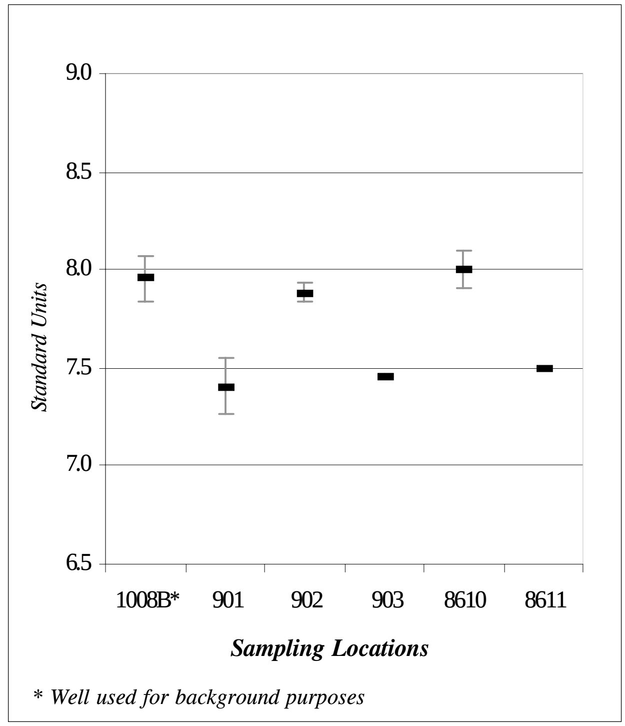

Figure E-21. pH of Groundwater Samples from the Kent Recessional Sequence

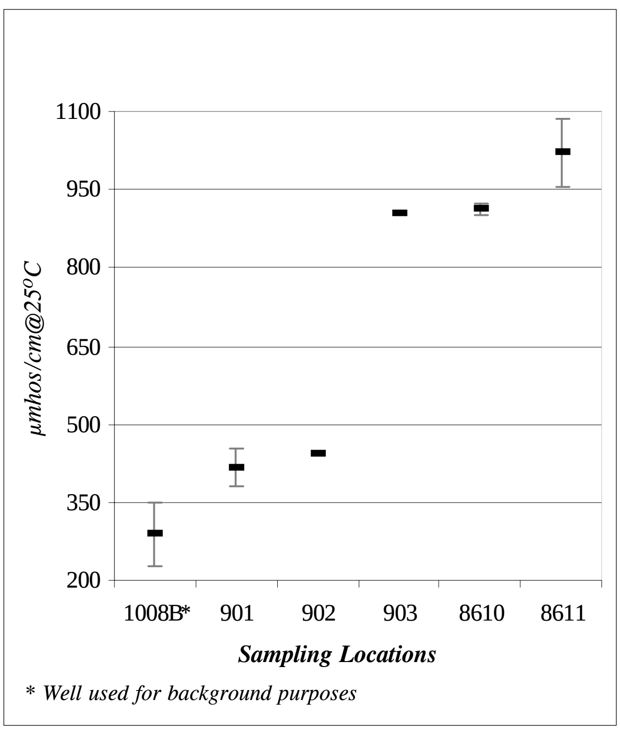

Figure E-22. Conductivity (µmhos/cm@25^{O}C) of Groundwater Samples from the Kent Recessional Sequence

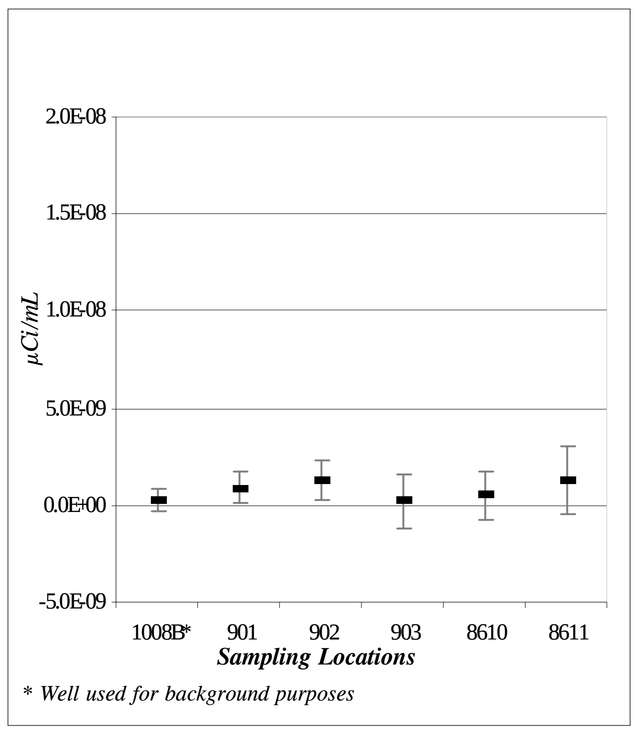

Figure E-23. Gross Alpha (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

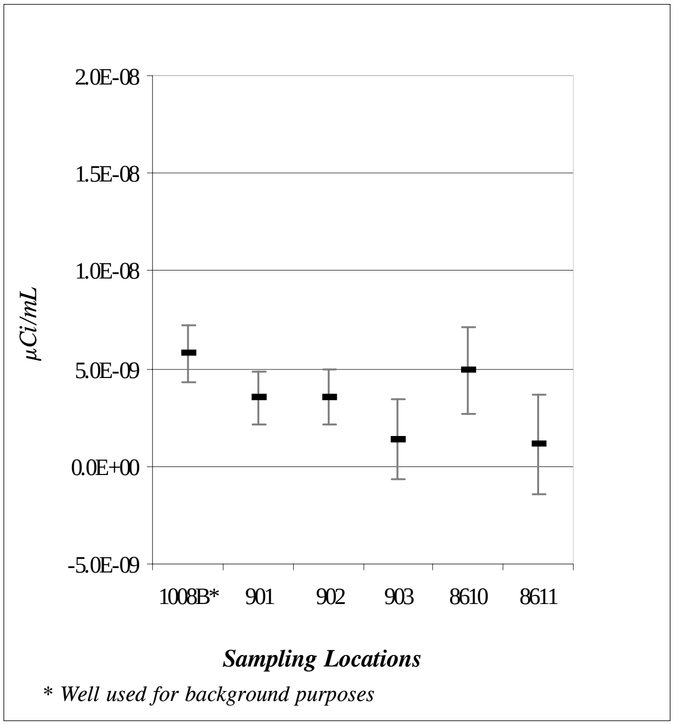

Figure E-24. Gross Beta (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

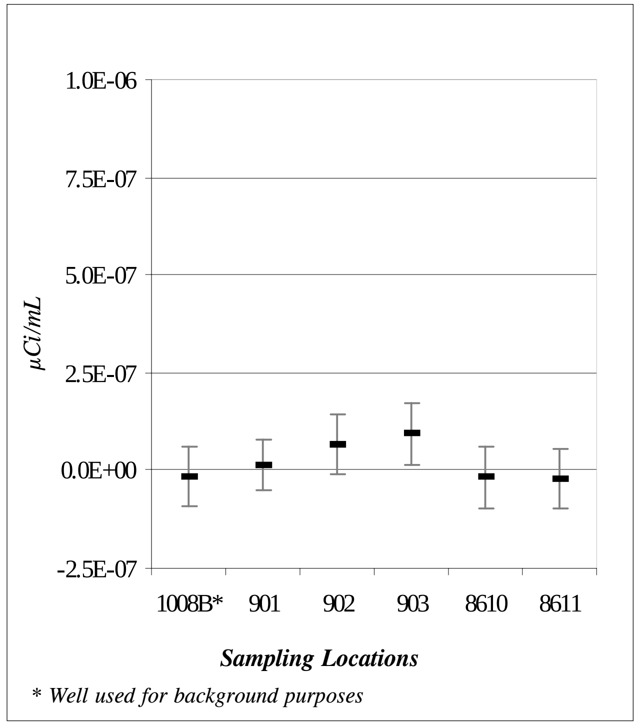

Figure E-25. Tritium Activity (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

Appendix F

Summary of Biological Data

Milk and Meat Samples are Collected from Local Bovine Herds

Table F-1
1999 Radioactivity Concentrations (μCi/mL) in Milk

Location	H-3	K-40	Sr-90	I-129	Cs-137
BFMCOBO (WNW Farm)					
1st Quarter	-1.19±0.92E-07	1.59±0.19E-06	1.73±0.92E-09	1.73±2.57E-10	1.29±1.55E-09
2nd Quarter	-1.16±0.74E-07	1.49±0.18E-06	6.21±1.72E-10	0.94±2.18E-10	0.62±1.67E-09
3rd Quarter	-1.17±0.77E-07	1.44±0.17E-06	1.70±0.78E-09	4.93±4.72E-10	0.77±1.45E-09
4th Quarter	2.83±6.89E-08	1.44±0.18E-06	1.27±0.55E-09	0.64±1.76E-10	0.80±1.67E-09
BFMCTLN (Control)					
1st Quarter	-3.24±1.04E-07	1.18±0.14E-06	3.64±1.18E-09	1.43±2.52E-10	1.12±1.15E-09
2nd Quarter	-5.82±7.66E-08	1.80±0.22E-06	5.89±0.75E-10	4.20±2.98E-10	-0.08±1.53E-09
3rd Quarter	-8.84±7.86E-08	1.48±0.16E-06	1.70±0.80E-09	0.79±2.31E-10	0.00±2.04E-09
4th Quarter	8.48±7.11E-08	1.46±0.17E-06	8.51±5.53E-10	1.89±2.07E-10	1.45±1.58E-09
BFMCTLS (Control)					
1st Quarter	-8.93±9.32E-08	1.36±0.16E-06	3.38±0.85E-09	0.11±1.58E-10	0.88±1.46E-09
2nd Quarter	-1.17±0.75E-07	1.64±0.19E-06	3.82±1.24E-10	-1.98±2.87E-10	0.58±1.42E-09
3rd Quarter	-1.16±0.76E-07	1.44±0.16E-06	-0.14±6.53E-10	-1.20±4.43E-10	-0.06±1.83E-09
4th Quarter	2.83±6.90E-08	1.43±0.17E-06	9.84±4.66E-10	0.34±2.94E-10	-0.57±1.50E-09
BFMREED (NNW Farm)					
1st Quarter	-1.49±0.97E-07	1.18±0.15E-06	7.63±9.91E-10	1.90±2.80E-10	0.87±1.61E-09
2nd Quarter	-1.46±0.82E-07	1.44±0.19E-06	4.29±2.98E-10	2.32±2.33E-10	2.37±2.95E-09
3rd Quarter	-1.48±0.77E-07	1.37±0.17E-06	9.49±7.66E-10	-1.92±3.88E-10	-0.86±2.47E-09
4th Quarter	0.00±6.84E-08	1.43±0.17E-06	1.38±0.52E-09	1.20±0.69E-10	1.59±1.49E-09
BFMSCHT (S Farm)					
Annual	-2.36±0.75E-07	1.36±0.17E-06	1.86±0.82E-09	1.43±2.88E-10	1.05±1.57E-09
BFMWIDR (SE Farm)					
Annual	-2.36±0.75E-07	1.49±0.18E-06	1.48±0.67E-09	0.19±2.82E-10	1.75±1.69E-09

Table F-2
1999 Radioactivity Concentrations (μCi/g Dry) in Meat

1999 Radioactivity Concentrations in Beef

Location	% Moisture	H-3 (μCi/mL)	K-40	Sr-90	Cs-137
Beef Flesh Background (BFBCTRL 06/99)	75.3	-1.76±0.77E-07	1.36±0.17E-05	-0.22±2.15E-09	-0.12±1.63E-08
Beef Flesh Background (BFBCTRL 09/99)	73.0	-2.98±7.74E-08	8.83±1.15E-06	2.92±1.50E-09	2.50±1.65E-08
Beef Flesh Near-Site (BFBNEAR 06/99)	76.5	-1.17±0.79E-07	1.44±0.16E-05	-1.98±2.26E-09	2.10±2.55E-08
Beef Flesh Near-Site (BFBNEAR 09/99)	73.0	-2.98±7.72E-08	1.09±0.13E-05	2.18±1.71E-09	-0.04±1.79E-08

1999 Radioactivity Concentrations in Venison

Location	% Moisture	H-3 (μCi/mL)	K-40	Sr-90	Cs-137
Deer Flesh Background (BFDCTRL 10/99)	65.0	5.80±7.63E-08	7.11±0.98E-06	3.72±0.24E-08	5.86±2.47E-08
Deer Flesh Background (BFDCTRL 11/99)	69.2	2.88±7.47E-08	7.79±1.09E-06	1.73±0.26E-08	1.07±0.34E-07
Deer Flesh Background (BFDCTRL 12/99)	72.3	0.00±7.43E-08	6.63±1.04E-06	6.70±1.50E-09	8.86±2.91E-08
Deer Flesh Near-Site (BFDNEAR 10/99)	72.4	5.79±7.62E-08	9.60±1.26E-06	-0.50±2.00E-09	1.39±0.43E-07
Deer Flesh Near-Site (BFDNEAR 11/99)	50.5	0.00±7.44E-08	6.42±1.10E-06	5.00±9.00E-10	0.00±3.94E-08
Deer Flesh Near-Site (BFDNEAR 11/99)	71.4	1.15±0.78E-07	8.71±1.17E-06	0.30±1.50E-09	3.68±2.12E-08

Table F-3
1999 Radioactivity Concentrations (µCi/g Dry) in Food Crops

Location	% Moisture	H-3 (µCi/mL)	K-40	Co-60	Sr-90	Cs-137
CORN						
Background (BFVCTRC)	74.8	1.21±0.81E-07	1.15±0.15E-05	-0.08±1.53E-08	-0.09±2.54E-09	0.00±2.17E-08
Near-Site (BFVNEAC)	80.6	0.00±7.75E-08	1.41±0.14E-05	1.03±1.47E-08	1.41±0.23E-08	3.58±3.94E-08
BEANS						
Background (BFVCTRB)	91.6	1.51±0.82E-07	3.05±0.34E-05	3.40±3.90E-08	1.71±0.15E-07	3.86±2.87E-08
Near-Site (BFVNEAB)	89.5	2.95±7.65E-08	2.77±0.29E-05	1.23±3.48E-08	8.28±0.70E-08	-0.11±2.81E-08
APPLES						
Background (BFVCTRA)	83.7	-6.01±6.97E-08	5.94±0.99E-06	1.00±2.07E-08	9.94±2.54E-09	-0.20±2.18E-08
Near-Site (BFVNEAAF)	83.8	-2.98±7.03E-08	8.08±1.15E-06	0.06±2.22E-08	1.03±0.30E-08	0.22±1.93E-08
HAY						
Background (BFHCTLS)	NA	NA	2.24±0.28E-05	2.14±4.06E-08	6.11±0.56E-08	1.25±3.53E-08
Near-Site (BFHNEAR)	NA	NA	9.53±1.85E-06	1.98±4.87E-08	1.39±0.06E-07	2.31±4.76E-08

NA - Not applicable.

Table F-4
1999 Radioactivity Concentrations (µCi/g Dry) in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek above the Springville Dam (BFFCATC)

1st Half 1999

Species	% Moisture	Sr-90	Cs-137
White Sucker	80.9	-0.68±1.62E-08	3.75±5.09E-08
Hog-nosed Sucker	81.5	-0.28±1.90E-08	8.05±8.85E-08
Hog-nosed Sucker	80.2	1.56±1.60E-08	0.75±4.34E-08
Hog-nosed Sucker	81.2	1.81±2.08E-08	4.70±3.63E-08
Hog-nosed Sucker	79.5	-0.96±2.57E-08	-0.39±1.13E-07
Hog-nosed Sucker	80.7	0.94±1.18E-08	8.20±7.22E-08
Hog-nosed Sucker	80.6	1.02±1.17E-08	0.00±1.10E-07
Hog-nosed Sucker	83.0	2.51±1.32E-08	0.87±2.03E-07
Brown Trout	78.1	1.80±2.41E-08	-6.49±7.82E-08
Hog-nosed Sucker	80.5	5.71±9.36E-09	2.50±4.61E-08
Average % Moisture	80.6		
Median		<1.76E-08	8.01E-08
Maximum		2.51E-08	8.20E-08
Minimum		<9.36E-09	<4.34E-08

2nd Half 1999

Species	% Moisture	Sr-90	Cs-137
Hog-nosed Sucker	81.0	5.02±9.35E-08	0.65±5.06E-08
Hog-nosed Sucker	80.0	9.58±6.13E-09	8.41±8.20E-08
Hog-nosed Sucker	81.0	4.35±2.24E-08	-0.72±1.40E-07
White Sucker	82.8	1.00±2.87E-08	1.37±1.23E-07
Hog-nosed Sucker	81.0	1.12±1.78E-08	4.99±5.40E-08
Hog-nosed Sucker	77.0	1.33±1.04E-08	-2.54±5.76E-08
Brown Trout	77.4	1.24±2.06E-08	-0.91±5.70E-08
White Sucker	81.0	1.81±2.51E-08	6.89±8.19E-08
Hog-nosed Sucker	79.0	2.59±1.35E-08	4.03±4.64E-08
Brown Trout	78.4	0.10±1.14E-07	1.21±7.47E-08
Average % Moisture	79.9		
Median		2.55E-08	<6.62E-08
Maximum		4.35E-08	1.37E-07
Minimum		9.58E-09	<4.64E-08

Table F-4 (continued)
1999 Radioactivity Concentrations (µCi/g Dry) in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek below the Springville Dam (BFFCATD)

Annual 1999

Species	% Moisture	Sr-90	Cs-137
Steelhead Trout	77.9	5.76±4.59E-09	0.00±1.35E-07
Steelhead Trout	78.7	2.05±1.53E-09	4.49±4.83E-08
Steelhead Trout	79.0	1.79±1.22E-09	3.84±2.00E-08
Steelhead Trout	73.2	3.03±2.31E-09	4.50±2.28E-08
Steelhead Trout	76.7	2.29±1.87E-09	3.46±5.26E-08
Steelhead Trout	71.5	1.76±0.92E-09	2.85±1.44E-08
Steelhead Trout	76.4	4.98±1.40E-09	0.00±1.65E-07
Steelhead Trout	75.2	1.44±0.83E-09	7.68±3.09E-08
Steelhead Trout	73.7	3.41±1.66E-09	2.99±3.06E-08
Steelhead Trout	71.7	2.09±0.99E-09	1.74±3.11E-08
Average % Moisture	75.4		
Median		2.19E-09	<4.66E-08
Maximum		5.76E-09	7.68E-08
Minimum		1.44E-09	2.85E-08

Table F-4 (concluded)
1999 Radioactivity Concentrations (µCi/g Dry) in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek Background (BFFCTRL)

1st Half 1999

Species	% Moisture	Sr-90	Cs-137
Brown Trout	78.3	1.72±1.24E-08	-0.43±3.93E-08
Brown Trout	74.5	1.24±0.22E-07	-2.29±5.61E-08
Brown Trout	74.7	2.08±1.70E-08	-3.03±5.37E-08
White Sucker	78.8	0.18±1.02E-08	0.00±8.74E-08
White Sucker	78.3	-0.30±2.72E-08	-3.52±5.03E-08
Hog-nosed Sucker	81.0	2.04±0.86E-08	-3.20±5.88E-08
White Sucker	78.5	0.28±1.19E-08	3.74±5.87E-08
Hog-nosed Sucker	83.1	0.81±1.18E-08	-1.26±4.92E-08
Brown Trout	74.9	0.59±1.60E-08	-0.75±5.02E-08
Brown Trout	77.5	0.77±1.49E-08	4.11±4.99E-08
Average % Moisture	78.0		
Median		1.66E-08	<5.20E-08
Maximum		1.24E-07	<8.74E-08
Minimum		<1.02E-08	<3.93E-08

2nd Half 1999

Species	% Moisture	Sr-90	Cs-137
White Sucker	80.0	4.91±6.89E-09	6.89±6.06E-08
White Sucker	81.0	0.27±1.35E-08	0.53±4.97E-08
White Sucker	81.4	1.07±2.29E-08	-0.01±5.57E-08
White Sucker	80.4	1.73±0.94E-08	0.73±5.36E-08
Hog-nosed Sucker	79.0	1.16±0.61E-08	-1.40±5.11E-08
Brown Trout	78.0	0.81±2.08E-08	-0.74±5.57E-08
Brown Trout	76.0	-0.02±1.55E-08	-4.97±8.45E-08
Brown Trout	78.0	0.77±1.42E-08	-2.57±7.36E-08
Brown Trout	78.0	2.08±1.34E-08	0.71±1.63E-07
Hog-nosed Sucker	82.0	0.70±1.03E-08	-0.27±4.13E-08
Average % Moisture	79.4		
Median		<1.48E-08	5.57E-08
Maximum		2.08E-08	6.89E-08
Minimum		<6.89E-09	<4.13E-08

Appendix G

Summary of Nonradiological Monitoring Data

Shipping Water Samples to Off-site Laboratories for Analysis

Table G - 1
West Valley Demonstration Project State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall	Parameter	Daily Maximum Limit*	Sample Frequency
001 (Process and Storm Wastewater)	Flow	Monitor	2 per discharge
	Aluminum, total	14.0 mg/L	2 per discharge
	Ammonia (NH_3)	Monitor	2 per discharge
	Arsenic, dissolved	0.15 mg/L	2 per discharge
	BOD_5	10.0 mg/L	2 per discharge
	Iron, total	Monitor	2 per discharge
	Zinc, total recoverable	0.48 mg/L	2 per discharge
	Suspended solids	45.0 mg/L	2 per discharge
	Cyanide, amenable to chlorination	0.022 mg/L	2 per discharge
	Settleable solids	0.30 mL/L	2 per discharge
	pH (range)	6.5 — 8.5	2 per discharge
	Oil and grease	15.0 mg/L	2 per discharge
	Sulfate (as S)	Monitor	2 per discharge
	Sulfide, dissolved	0.4 mg/L	2 per discharge
	Manganese, total	2.0 mg/L	2 per discharge
	Nitrate (as N)	Monitor	2 per discharge
	Nitrite (as N)	0.1 mg/L	2 per discharge
	Chromium, total recoverable	0.3 mg/L	2 per discharge
	Chromium, hexavalent, total recoverable	0.011 mg/L	2 per discharge
	Cadmium, total recoverable	0.002 mg/L	2 per discharge
	Copper, total recoverable	0.030 mg/L	2 per discharge
	Copper, dissolved	Monitor	2 per discharge
	Lead, total recoverable	0.006 mg/L	2 per discharge
	Nickel, total recoverable	0.14 mg/L	2 per discharge
	Dichlorodifluoromethane	0.01 mg/L	2 per discharge
	Trichlorofluoromethane	0.01 mg/L	2 per discharge
	3,3-dichlorobenzidine	0.01 mg/L	2 per discharge
	Tributyl phosphate	32 mg/L	2 per discharge
	Vanadium, total recoverable	0.014 mg/L	2 per discharge
	Cobalt, total recoverable	0.005 mg/L	2 per discharge
	Selenium, total recoverable	0.004 mg/L	2 per discharge
	Hexachlorobenzene	0.02 mg/L	2 per discharge
	Alpha - BHC	0.00001 mg/L	2 per discharge
	Heptachlor	0.00001 mg/L	2 per discharge
	Surfactant (as LAS)	0.4 mg/L	2 per discharge
	Xylene	0.05 mg/L	2 per discharge
	2-butanone	0.5 mg/L	2 per discharge
	Total Dissolved Solids	Monitor	2 per discharge
	Barium	0.5 mg/L	annual
	Antimony	1.0 mg/L	annual
	Chloroform	0.3 mg/L	annual
	Bis(2-ethylhexyl)phthalate	1.6 mg/L	semiannual
	4-Dodecene	0.6 mg/L	semiannual
	Titanium	0.65 mg/L	semiannual

** Daily average limitations are also identified in the permit but require only monitoring for all parameters except total aluminum (daily average limit - 7.0 mg/L); suspended solids (daily average limit - 30.0 mg/L); BOD_5 for the sum of outfalls 001, 007, and 008 (daily average limit - 5.0 mg/L); and ammonia for the sum of outfalls 001 and 007 (daily average limit - 1.49 mg/L).*

Table G - 1 (concluded)
West Valley Demonstration Project State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall	Parameter	Daily Maximum Limit*	Sample Frequency
007 (Sanitary and Utility Wastewater)	Flow	Monitor	3 per month
	Ammonia (as NH_3)	Monitor	3 per month
	BOD_5	10 mg/L	3 per month
	Iron, total	Monitor	3 per month
	Solids, suspended	45.0 mg/L	3 per month
	Solids, settleable	0.3 mL/L	weekly
	pH (range)	6.5 — 8.5	weekly
	Nitrite (as N)	0.1 mg/L	3 per month
	Oil and grease	15 mg/L	3 per month
	Chlorine, total residual	0.1 mg/L	weekly
	Chloroform	0.20 mg/L	annual
008 (French Drain Wastewater)	Flow	Monitor	3 per month
	BOD_5	5.0 mg/L	3 per month
	Iron, total	Monitor	3 per month
	pH (range)	6.5 — 8.5	3 per month
	Cadmium, total recoverable	0.002 mg/L	3 per month
	Lead, total recoverable	0.006 mg/L	3 per month
	Silver, total	0.008 mg/L	annual
	Zinc, total	0.100 mg/L	annual
	Arsenic	0.17 mg/L	annual
	Chromium	0.13 mg/L	annual
Sum of Outfalls 001, 007, and 008	Iron, total	0.30 mg/L	3 per month
	BOD_5	Monitor	3 per month
Sum of Outfalls 001 and 007	Ammonia (as NH_3)	2.1 mg/L	3 per month
Pseudo-monitoring point (116)	Solids, total dissolved	500 mg/L	2 per discharge

** Daily average limitations are also identified in the permit but require only monitoring for all parameters except total aluminum (daily average limit - 7.0 mg/L); suspended solids (daily average limit - 30.0 mg/L); BOD_5 for the sum of outfalls 001, 007, and 008 (daily average limit - 5.0 mg/L); and ammonia for the sum of outfalls 001 and 007 (daily average limit - 1.49 mg/L).*

Table G - 2
West Valley Demonstration Project 1999 SPDES Noncompliance Episodes

Date	Outfall	Parameters	Limit	Value	Comments

There were no episodes of noncompliance in 1999.

Table G-3A
1999 SPDES Results for Outfall 001 (WNSP001)
Water Quality

	Ammonia *(as NH_3)* (mg/L)		**BOD_5** (mg/L)		**Cyanide** *(amenable to chlorination)* (mg/L)		**Discharge Rate** (MGD)	
Permit limit	Monitor		10.0 mg/L daily maximum		0.022 mg/L daily maximum		Monitor	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	0.14	0.21	< 2.0	< 2.0	< 0.01	< 0.01	0.384	0.469
March	NA	NA	NA	NA	NA	NA	NA	NA
April	< 0.05	< 0.05	< 2.0	< 2.0	< 0.01	< 0.01	0.395	0.495
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	0.31	0.35	< 2.0	< 2.0	< 0.01	< 0.01	0.221	0.318
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	0.22	0.27	< 2.4	2.8	< 0.01	< 0.01	0.384	0.531
December	NA	NA	NA	NA	NA	NA	NA	NA

	Nitrate *(as N)* (mg/L)		**Nitrite** *(as N)* (mg/L)		**Oil & Grease** (mg/L)	
Permit limit	Monitor		0.1 mg/L daily maximum		15.0 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA
February	2.60	2.70	0.10	0.10	< 5.0	< 5.0
March	NA	NA	NA	NA	NA	NA
April	2.60	2.70	< 0.06	0.06	< 5.0	< 5.0
May	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA
July	< 0.05	< 0.05	< 0.05	< 0.05	< 5.0	< 5.0
August	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA
November	0.68	0.72	0.05	0.05	6.5	7.9
December	NA	NA	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-3A (concluded)
1999 SPDES Results for Outfall 001 (WNSP001)
Water Quality

	pH (standard units)		**Solids Settleable** (mL/L)		**Solids Total Dissolved** (mg/L)		**Solids Total Suspended** (mg/L)	
Permit limit	6.5 to 8.5		0.30 mL/L daily maximum		Monitor		45.0 mg/L daily maximum; 30.0 daily average	
Month	**Min**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	7.8	7.8	< 0.1	< 0.1	562	566	5.0	5.0
March	NA	NA	NA	NA	NA	NA	NA	NA
April	7.7	8.0	< 0.1	< 0.1	624	640	< 3.0	4.0
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	7.7	7.8	< 0.1	< 0.1	934	940	< 2.0	2.0
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	7.6	8.0	< 0.1	< 0.1	765	774	10.6	14.0
December	NA	NA	NA	NA	NA	NA	NA	NA

	Sulfate *(as S)* (mg/L)		**Sulfide Dissolved** (mg/L)		**Surfactants** *(as LAS)* (mg/L)	
Permit limit	Monitor		0.4 mg/L daily maximum		0.4 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA
February	40	40	< 0.2	< 0.2	< 0.1	< 0.1
March	NA	NA	NA	NA	NA	NA
April	60	67	< 0.3	0.3	< 0.1	< 0.1
May	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA
July	87	87	< 0.2	< 0.2	< 0.1	< 0.1
August	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA
November	70	80	< 0.2	< 0.2	< 0.03	0.04
December	NA	NA	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-3B
1999 SPDES Results for Outfall 001 (WNSP001)
Metals

	Aluminum Total (mg/L)		**Arsenic Dissolved** (mg/L)		**Cadmium Total Recoverable** (mg/L)		**Cobalt Total Recoverable** (mg/L)	
Permit limit	14 mg/L daily maximum 7.0 mg/L daily average		0.15 mg/L daily maximum		0.002 mg/L daily maximum		0.005 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	0.555	0.570	< 0.003	0.0037	< 0.001	< 0.001	< 0.004	< 0.004
March	NA	NA	NA	NA	NA	NA	NA	NA
April	0.405	0.490	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	0.535	0.620	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	0.220	0.240	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
December	NA	NA	NA	NA	NA	NA	NA	NA

	Chromium Total Recoverable (mg/L)		**Chromium VI Total Recoverable** (mg/L)		**Copper Dissolved** (mg/L)	
Permit limit	0.3 mg/L daily maximum		0.011 mg/L daily maximum		Monitor	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA
February	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
March	NA	NA	NA	NA	NA	NA
April	< 0.01	< 0.01	< 0.01	< 0.01	< 0.014	0.017
May	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA
July	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
August	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA
November	< 0.01	< 0.01	< 0.01	< 0.01	< 0.007	< 0.01
December	NA	NA	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-3B (concluded)
1999 SPDES Results for Outfall 001 (WNSP001)
Metals

	Copper Total Recoverable (mg/L)		Iron Total (mg/L)		Lead Total Recoverable (mg/L)		Manganese Total (mg/L)	
Permit limit	0.030 mg/L daily maximum		Monitor		0.006 mg/L daily maximum		2.0 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	< 0.010	< 0.010	0.350	0.360	< 0.002	< 0.002	0.009	0.010
March	NA	NA	NA	NA	NA	NA	NA	NA
April	< 0.012	0.013	0.205	0.250	< 0.002	0.002	0.009	0.009
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	< 0.010	< 0.010	0.275	0.340	< 0.002	< 0.002	0.050	0.065
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	0.019	0.025	0.206	0.241	0.004	0.004	0.019	0.022
December	NA	NA	NA	NA	NA	NA	NA	NA

	Nickel Total Recoverable (mg/L)		Selenium Total Recoverable (mg/L)		Vanadium Total Recoverable (mg/L)		Zinc Total Recoverable (mg/L)	
Permit limit	0.14 mg/L daily maximum		0.004 mg/L daily maximum		0.014 mg/L daily maximum		0.48 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	< 0.010
March	NA	NA	NA	NA	NA	NA	NA	NA
April	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	0.012	0.013
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	0.011
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	< 0.056	0.071	< 0.002	< 0.002	< 0.010	< 0.010	< 0.016	0.021
December	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-3C
1999 SPDES Results for Outfall 001 (WNSP001)
Organics

VOLATILES

	2-Butanone (mg/L)		Dichlorodifluoromethane (mg/L)		Trichlorofluoromethane (mg/L)		Xylene (mg/L)	
Permit limit	0.5 mg/L daily maximum		0.01 mg/L daily maximum		0.01 mg/L daily maximum		0.05 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA	NA	NA
February	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
March	NA	NA	NA	NA	NA	NA	NA	NA
April	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
May	NA	NA	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA	NA	NA
July	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
August	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA	NA	NA
November	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
December	NA	NA	NA	NA	NA	NA	NA	NA

SEMIVOLATILES

	Alpha-BHC (mg/L)		3,3-Dichlorobenzidine (mg/L)		Hexachlorobenzene (mg/L)	
Permit limit	0.00001 mg/L daily maximum		0.01 mg/L daily maximum		0.02 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA	NA	NA
February	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.01	< 0.01
March	NA	NA	NA	NA	NA	NA
April	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.01	< 0.01
May	NA	NA	NA	NA	NA	NA
June	NA	NA	NA	NA	NA	NA
July	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.01	< 0.01
August	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA
October	NA	NA	NA	NA	NA	NA
November	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.01	< 0.01
December	NA	NA	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-3C (concluded)
1999 SPDES Results for Outfall 001 (WNSP001)
Organics

SEMIVOLATILES (concluded)

	Heptachlor (mg/L)		**Tributyl phosphate** (mg/L)	
Permit limit	0.00001 mg/L daily maximum		32 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**
January	NA	NA	NA	NA
February	< 0.000009	< 0.000009	< 0.01	< 0.01
March	NA	NA	NA	NA
April	< 0.000009	< 0.000009	< 0.01	< 0.01
May	NA	NA	NA	NA
June	NA	NA	NA	NA
July	< 0.000009	< 0.000009	< 0.01	< 0.01
August	NA	NA	NA	NA
September	NA	NA	NA	NA
October	NA	NA	NA	NA
November	< 0.000009	< 0.000009	< 0.01	< 0.01
December	NA	NA	NA	NA

NA = Not applicable. No discharge this month.
No results exceeded the permit limits.

Table G-4
1999 SPDES Results for Outfall 007 (WNSP007)
Water Quality and Iron

	Ammonia *(as NH_3)* (mg/L)		**BOD_5** (mg/L)		**Chlorine Total Residual** (mg/L)		**Discharge Rate** (MGD)		**Iron Total** (mg/L)	
Permit limit	Monitor		10.0 mg/L daily maximum		0.1 mg/L daily maximum		Monitor		Monitor	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.05	< 0.05	< 2.6	3.8	0.02	0.03	0.014	0.025	0.062	0.086
February	< 0.08	0.11	< 2.6	3.4	0.02	0.03	0.012	0.019	< 0.053	0.070
March	< 0.07	0.10	< 2.1	2.4	0.02	0.05	0.014	0.023	0.058	0.067
April	< 0.06	0.08	< 2.2	2.5	0.02	0.04	0.011	0.014	0.057	0.076
May	< 0.05	< 0.05	< 2.0	< 2.0	0.02	0.02	0.009	0.014	< 0.127	0.300
June	< 0.08	0.12	< 2.0	< 2.0	0.02	0.04	0.009	0.012	0.059	0.068
July	0.24	0.45	< 2.0	< 2.0	0.02	0.03	0.010	0.017	< 0.030	< 0.030
August	0.19	0.31	< 2.0	< 2.0	0.02	0.02	0.011	0.019	< 0.030	< 0.030
September	< 0.11	0.14	< 2.0	2.0	0.02	0.03	0.010	0.015	< 0.093	0.147
October	0.23	0.32	< 2.0	< 2.0	0.02	0.03	0.012	0.019	< 0.032	0.035
November	0.25	0.35	< 2.0	< 2.0	0.02	0.03	0.012	0.019	< 0.030	0.031
December	< 0.05	0.06	< 2.0	< 2.0	0.03	0.06	0.013	0.016	< 0.034	0.042

	Nitrite *(as N)* (mg/L)		**Oil & Grease** (mg/L)		**pH** (standard units)		**Solids Settleable** (mL/L)		**Solids Total Suspended** (mg/L)	
Permit limit	0.1 mg/L daily maximum		15 mg/L daily maximum		6.5 to 8.5		0.30 mL/L daily maximum		45.0 mg/L daily maximum; 30.0 daily average	
Month	**Avg**	**Max**	**Avg**	**Max**	**Min**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.05	< 0.05	< 5.1	5.4	7.6	8.0	< 0.1	< 0.1	< 3.0	5.0
February	< 0.05	< 0.05	< 5.0	< 5.0	7.6	7.8	< 0.1	< 0.1	< 2.0	< 2.0
March	< 0.05	< 0.05	< 5.0	< 5.0	7.4	7.8	< 0.1	< 0.1	< 2.0	2.0
April	< 0.05	< 0.05	< 5.0	< 5.0	7.5	8.2	< 0.1	< 0.1	< 2.0	2.0
May	< 0.05	< 0.05	< 5.1	5.4	7.6	8.0	< 0.1	< 0.1	< 3.7	7.0
June	< 0.05	< 0.05	< 5.0	< 5.0	7.5	7.8	< 0.1	< 0.1	< 3.0	5.0
July	< 0.05	< 0.05	< 5.2	5.5	7.7	8.0	< 0.1	< 0.1	< 2.0	< 2.0
August	< 0.05	< 0.05	< 5.0	< 5.0	7.7	8.4	< 0.1	< 0.1	< 5.3	12.0
September	< 0.05	< 0.05	< 5.0	< 5.0	7.6	7.8	< 0.1	< 0.1	< 12.0	29.0
October	< 0.05	< 0.05	< 10.0	14.0	8.0	8.1	< 0.1	< 0.1	< 3.3	6.0
November	< 0.05	< 0.05	8.5	9.9	7.9	8.0	< 0.1	< 0.1	5.4	11.0
December	< 0.05	< 0.05	6.3	7.3	7.7	8.0	< 0.1	< 0.1	< 2.0	< 2.0

No results exceeded the permit limits.

Table G-5
1999 SPDES Results for Outfall 008 (WNSP008)
Water Quality

	BOD_5 (mg/L)		Discharge Rate (GPD)		pH (standard units)	
Permit limit	5.0 mg/L daily maximum		Monitor		6.5 to 8.5	
Month	**Avg**	**Max**	**Avg**	**Max**	**Min**	**Max**
January	< 2.0	< 2.0	2520	3810	6.8	7.2
February	< 2.0	< 2.0	2520	3370	7.0	7.4
March	< 2.0	< 2.0	1830	1950	7.0	7.4
April	< 2.0	< 2.0	2070	2130	7.0	7.0
May	< 2.0	< 2.0	1320	1440	7.0	7.0
June	< 2.0	< 2.0	1160	1260	6.7	7.1
July	< 2.0	< 2.0	1030	1190	6.6	7.2
August	< 2.0	< 2.0	1300	1560	6.8	7.3
September	< 2.0	< 2.0	1700	2110	7.1	7.2
October	< 2.0	< 2.0	1500	1720	7.0	7.2
November	< 2.0	< 2.0	2630	3900	7.0	7.1
December	< 2.53	3.6	2320	2930	6.9	7.2

Metals

	Cadmium Total Recoverable (mg/L)		Iron Total (mg/L)		Lead Total Recoverable (mg/L)	
Permit limit	0.002 mg/L daily maximum		Monitor		0.006 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.001	< 0.001	< 0.030	< 0.030	< 0.002	< 0.002
February	< 0.001	< 0.001	< 0.031	0.032	< 0.003	0.004
March	< 0.001	< 0.001	< 0.035	0.043	< 0.002	0.002
April	< 0.001	0.001	< 0.030	< 0.030	< 0.003	0.005
May	< 0.001	< 0.001	< 0.058	0.090	0.004	0.005
June	< 0.001	< 0.001	0.041	0.053	< 0.003	0.004
July	< 0.001	< 0.001	< 0.037	0.050	< 0.002	0.002
August	< 0.001	< 0.001	< 0.030	0.030	< 0.002	0.002
September	< 0.001	< 0.001	< 0.090	0.205	< 0.003	0.004
October	< 0.001	< 0.001	< 0.039	0.057	< 0.002	0.003
November	< 0.001	< 0.001	< 0.124	0.303	<0.003	0.004
December	< 0.001	< 0.001	<0.031	0.032	< 0.002	0.002

No results exceeded the permit limits.

Table G-6
1999 SPDES Results for Sums of Outfalls 001, 007, and 008
Water Quality

	Ammonia *(as NH_3)*** Flow-Weighted Average (mg/L)		BOD_5 (mg/L)		Iron, Total Flow-Weighted Average (mg/L)	
Permit limit	2.1 daily maximum; 1.49 daily average		5.0 mg/L daily average		0.30 mg/L daily average	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.05	< 0.05	< 2.6	< 3.6	0.00	—
February	< 0.11	0.21	< 2.0	< 2.0	0.00	—
March	< 0.07	0.10	< 2.1	2.4	0.00	—
April	< 0.05	< 0.05	< 2.0	< 2.0	0.07	—
May	< 0.05	< 0.05	< 2.0	< 2.0	0.00	—
June	< 0.08	0.12	< 2.0	< 2.0	0.00	—
July	0.28	0.45	< 2.0	< 2.0	0.00	—
August	0.16	0.25	< 2.0	< 2.0	0.00	—
September	< 0.09	0.12	< 2.0	< 2.0	0.00	—
October	0.23	0.32	< 2.0	< 2.0	0.00	—
November	0.19	0.27	< 2.2	< 2.8	0.00	—
December	< 0.05	0.06	< 2.1	< 2.2	0.00	—

1999 SPDES Results for Outfall 116
Water Quality

	Total Dissolved Solids (mg/L)	
Permit limit	500 mg/L daily maximum	
Month	**Avg**	**Max**
January	NA	NA
February	334	356
March	NA	NA
April	390	411
May	NA	NA
June	NA	NA
July	445	487
August	NA	NA
September	NA	NA
October	NA	NA
November	373	405
December	NA	NA

*** = Sum of outfalls 001 and 007 only.* *NA = No discharge.* *No results exceeded the permit limits.*

Table G-7
1999 Annual/Semiannual SPDES Results for Outfall 001

Water Quality (Measured Annually):

	Chloroform (mg/L)
Permit limit	0.3 mg/L daily maximum
Monitoring period	**Maximum measured**
02/01/99 - 01/31/00	< 0.005

Metals (Measured Annually or Semiannually):

	Antimony Total (mg/L)	**Barium Total** (mg/L)	**Titanium Total** (mg/L)
Permit limit	1.0 mg/L daily maximum	0.5 mg/L daily maximum	0.65 mg/L daily maximum
Monitoring period	**Maximum measured**	**Maximum measured**	**Maximum measured**
02/01/99 - 01/31/00	< 0.06	< 0.05	NA
02/01/99 - 07/31/99	NA	NA	< 0.05
08/01/99 - 01/31/00	NA	NA	< 0.05

Organics (Measured Semiannually):

	bis (2-ethylhexyl) phthalate (mg/L)	**4-Dodecene** (mg/L)
Permit limit	1.6 mg/L daily maximum	0.6 mg/L daily maximum
Monitoring period	**Maximum measured**	**Maximum measured**
02/01/99 - 07/31/99	< 0.01	< 0.06
08/01/99 - 01/31/00	< 0.01	< 0.06

NA - Not analyzed during this monitoring period.
No results exceeded the permit limits.

Table G-8
1999 Annual SPDES Results for Outfalls 007 and 008

Outfall 007 Water Quality (Measured Annually):

	Chloroform (mg/L)
Permit limit	0.20 mg/L daily maximum
Monitoring period	**Maximum measured**
02/01/99 - 01/31/00	< 0.005

Outfall 008 Water Quality (Measured Annually):

	Arsenic Total (mg/L)	**Chromium Total** (mg/L)	**Silver Total** (mg/L)	**Zinc Total** (mg/L)
Permit limit	0.17 mg/L daily maximum	0.13 mg/L daily maximum	0.008 mg/L daily maximum	0.100 mg/L daily maximum
Monitoring period	**Max**	**Max**	**Max**	**Max**
02/01/99 - 01/31/00	< 0.003	< 0.010	< 0.003	0.199*

* *Value exceeded the action level for total zinc.*

Appendix H

Summary of Direct Radiation Monitoring Data

An Environmental TLD Package

Table H - 1
Summary of 1999 Quarterly Averages of Off-site TLD Measurements
(mR±SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DFTLD01	17±3.9	24±13.6	24±6.6	34±16.2	25±11.2
DFTLD02	16±2.1	34±22.2	21±1.4	20±11.7	23±12.6
DFTLD03	12±1.9	26±16.5	23±3.2	23±12.6	21±10.5
DFTLD04	13±2.0	30±13.9	25±12.1	17±11.3	21±10.9
DFTLD05	13±1.9	27±11.4	25±1.9	20±12.2	21±8.5
DFTLD06	15±4.0	29±15.7	29±12.4	16±7.2	22±10.8
DFTLD07	13±3.2	28±8.8	25±12.4	16±10.4	21±9.3
DFTLD08	15±6.4	34±15.4	21±4.9	17±4.3	22±9.0
DFTLD09	13±1.8	23±9.1	28±5.4	16±7.3	20±6.5
DFTLD10	13±3.0	32±14.9	26±10.6	16±13.7	22±11.5
DFTLD11	15±4.0	18±6.8	33±9.7	16±4.5	21±6.6
DFTLD12	15±2.5	24±11.1	24±9.2	18±6.6	20±8.0
DFTLD13	13±2.1	23±7.9	32±6.9	15±8.6	21±6.9
DFTLD14	14±2.2	32±17.1	19±3.6	13±3.4	20±9.0
DFTLD15	14±2.9	21±10.0	21±5.8	12±5.4	17±6.5
DFTLD16	15±4.0	28±14.8	18±4.4	13±7.2	19±8.7
DFTLD17**	14±1.9	32±8.6	26±12.2	15±8.3	22±8.6
DFTLD20	14±3.3	18±7.1	25±16.4	18±4.9	19±9.4
DFTLD21	15±4.0	22±8.2	26±13.6	15±5.0	20±8.6
DFTLD22	13±1.0	21±10.3	25±10.2	18±4.4	19±7.6
DFTLD23**	13±2.3	24±7.3	30±11.4	12±5.0	20±7.3
DFTLD37**	17±2.6	24±11.3	21±3.5	15±7.9	19±7.2
DFTLD41**	16±3.0	17±4.9	25±12.1	12±7.5	18±7.7

* *Off-site locations are shown on Figure A-11 (p. A-13) and A-12 (p. A-14).*
** *Background measurements are provided by off-site TLDs 17, 23, 37, and 41.*

Table H - 2
Summary of 1999 Quarterly Averages of On-site TLD Measurements
(mR±SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DNTLD18	26±3.9	44±3.5	33±4.7	25±4.6	32±4.2
DNTLD19	15±1.9	27±6.6	39±16.3	14±6.5	24±9.4
DNTLD24	583±20.6	584±41.7	620±6.2	577±9.4	591±23.9
DNTLD25	19±3.1	31±12.8	23±5.2	13±2.5	22±7.2
DNTLD26	17±2.8	23±6.9	28±9.9	16±7.5	21±7.2
DNTLD27	15±3.1	27±12.8	21±7.6	15±4.1	20±7.9
DNTLD28	17±2.7	21±7.0	26±5.2	21±13.3	21±8.1
DNTLD29	18±3.8	29±12.3	26±4.6	29±14.3	26±9.9
DNTLD30	17±1.5	25±5.3	24±4.6	25±14.8	23±8.2
DNTLD31	16±1.0	24±6.4	20±5.2	17±3.5	19±4.5
DNTLD32	23±1.0	33±6.3	33±7.7	24±11.0	28±7.4
DNTLD33	31±6.2	29±7.9	36±8.4	25±4.3	30±6.9
DNTLD34	44±1.9	49±4.3	56±8.5	45±5.8	49±5.7
DNTLD35	76±1.5	68±12.5	85±8.8	67±4.9	74±8.1
DNTLD36	32±3.8	37±9.6	44±11.5	29±5.4	36±8.2
DNTLD38	28±4.9	34±14.4	48±16.8	29±9.6	35±12.3
DNTLD39	47±3.2	52±6.9	70±9.6	40±7.1	52±7.1
DNTLD40	173±5.6	146±4.7	268±13.9	113±11.4	175±9.7
DNTLD42	84±2.5	75±4.6	99±12.6	81±8.0	85±7.9
DNTLD43	25±2.5	30±10.1	35±6.7	22±9.6	28±7.8

* *On-site locations are shown on Figure A-10 (p. A-12).*

Table H - 3
3rd Quarter 1999 TLD Results and Instantaneous Dose Readings (μR/hr) with a High-pressure Ion Chamber (HPIC) at Each Monitoring Location

Off-site Location Number	3rd Quarter TLD Result	August 1999 HPIC Results
DFTLD01	10.64	10.00
DFTLD02	9.30	9.00
DFTLD03	10.19	8.00
DFTLD04	11.07	8.00
DFTLD05	11.07	9.00
DFTLD06	12.85	9.00
DFTLD07	11.07	9.00
DFTLD08	9.30	9.00
DFTLD09	12.40	9.00
DFTLD10	11.51	9.00
DFTLD11	14.61	8.00
DFTLD12	10.63	9.00
DFTLD13	14.17	9.00
DFTLD14	8.41	9.00
DFTLD15	9.30	9.00
DFTLD16	7.97	9.00
DFTLD17	11.52	9.00
DFTLD20	11.07	8.00
DFTLD21	11.51	9.00
DFTLD22	11.08	10.00
DFTLD23	13.29	9.00
DFTLD37	9.30	10.00
DFTLD41	11.07	9.00

On-site Location Number	3rd Quarter TLD Result	August 1999 HPIC Results
DNTLD18	14.64	17.00
DNTLD19	17.31	11.00
DNTLD24	275.21	316.00
DNTLD25	10.18	12.00
DNTLD26	12.43	11.00
DNTLD27	9.32	10.00
DNTLD28	11.54	10.00
DNTLD29	11.53	11.00
DNTLD30	10.63	12.00
DNTLD31	8.87	10.00
DNTLD32	14.63	12.00
DNTLD33	15.97	15.00
DNTLD34	24.84	26.00
DNTLD35	37.71	37.00
DNTLD36	19.52	17.00
DNTLD38	21.30	18.00
DNTLD39	31.07	22.00
DNTLD40	118.95	60.00
DNTLD42	43.96	29.00
DNTLD43	15.54	13.00

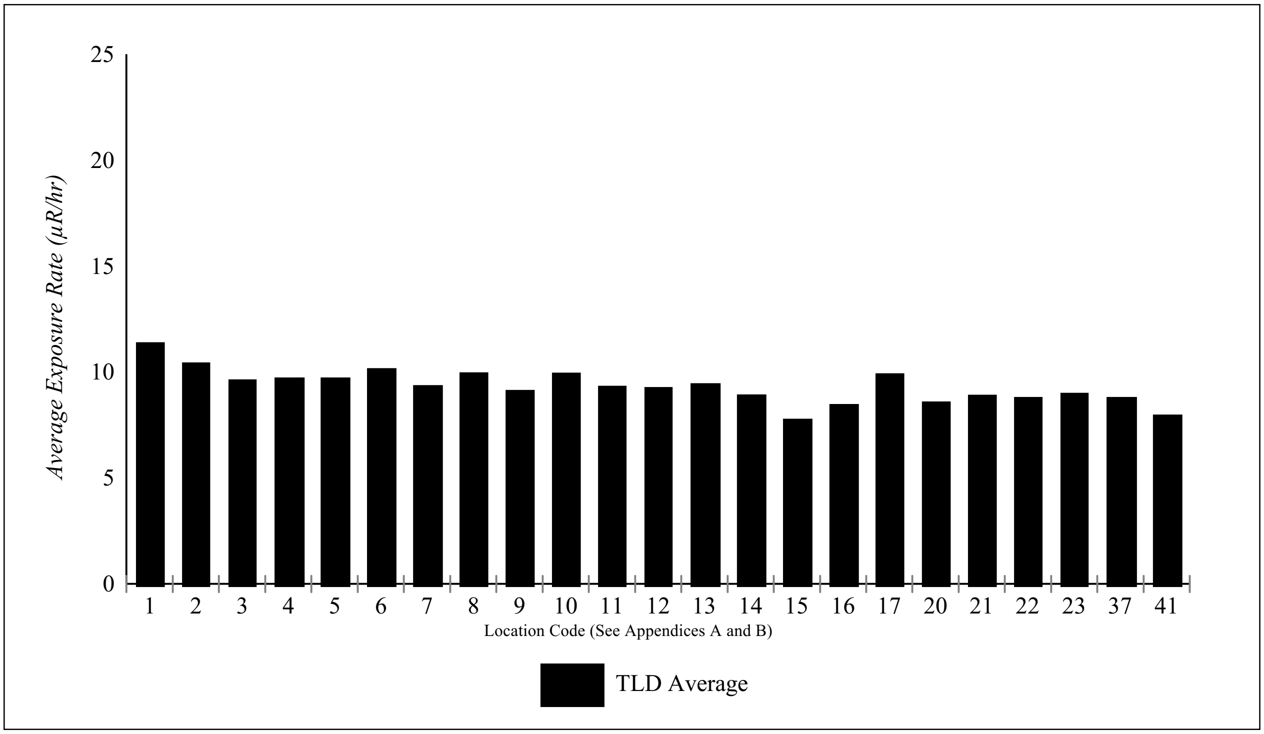

Figure H-1. 1999 Average Yearly Gamma Exposure Rates around the West Valley Demonstration Project Site

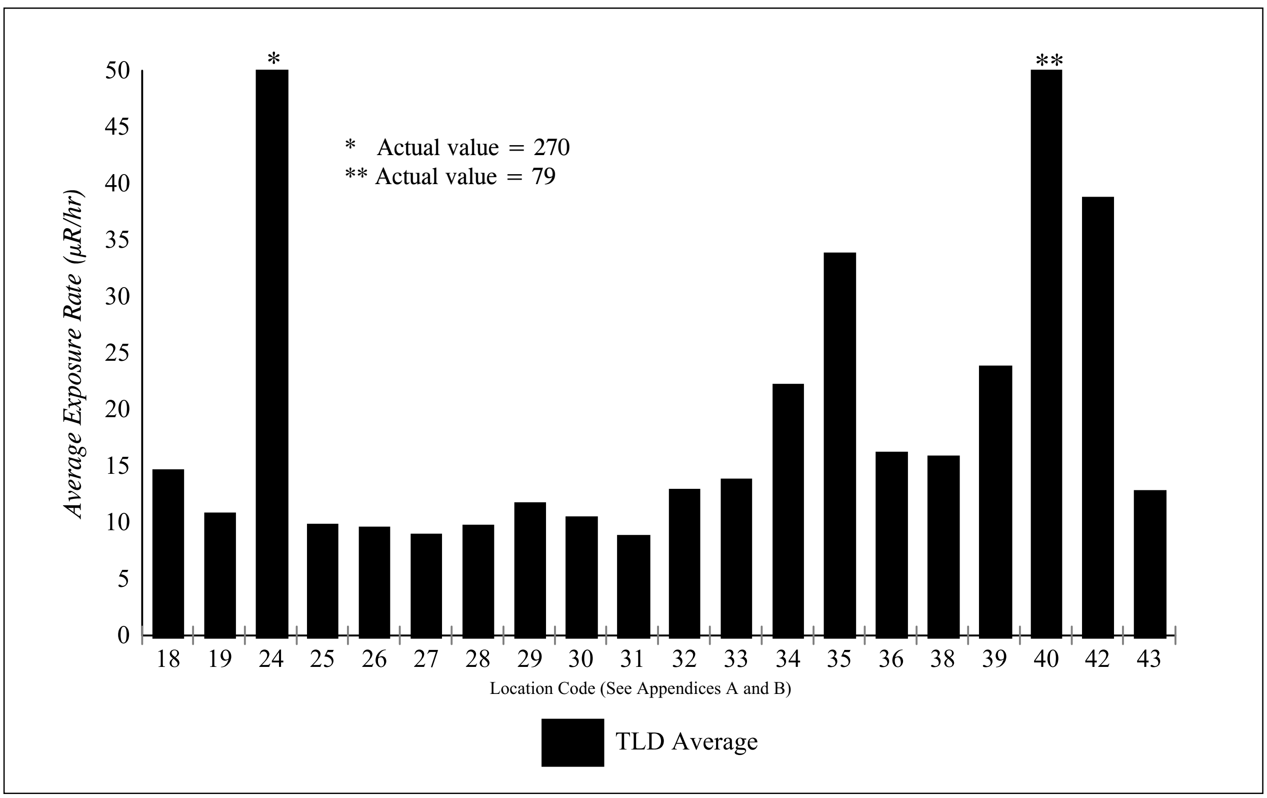

Figure H-2. 1999 Yearly Gamma Exposure Rates on the West Valley Demonstration Project Site

Appendix I

Summary of Meteorological Data

On-site Meteorological Tower and Rain Gauge

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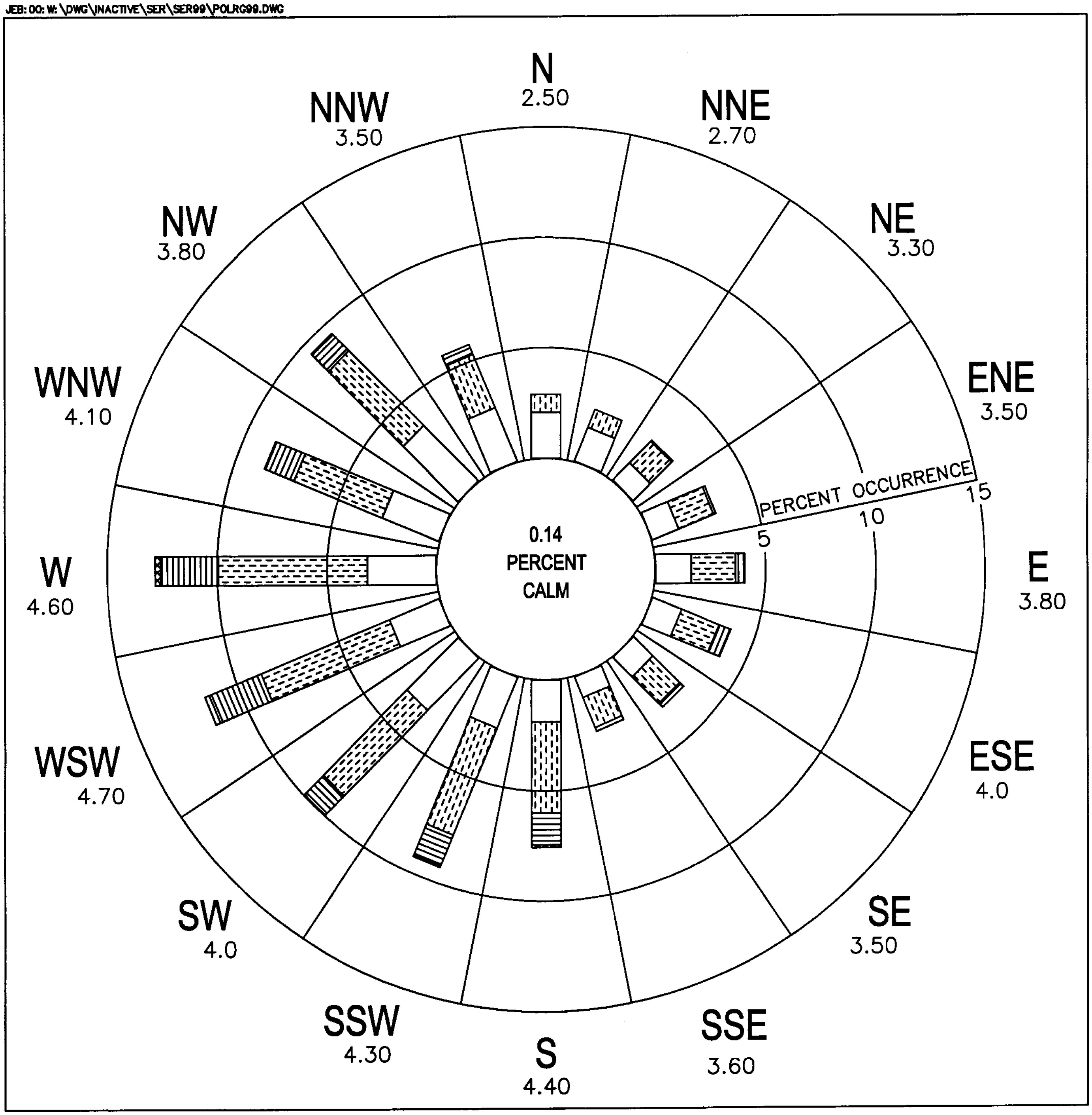


WIND SPEED RANGE

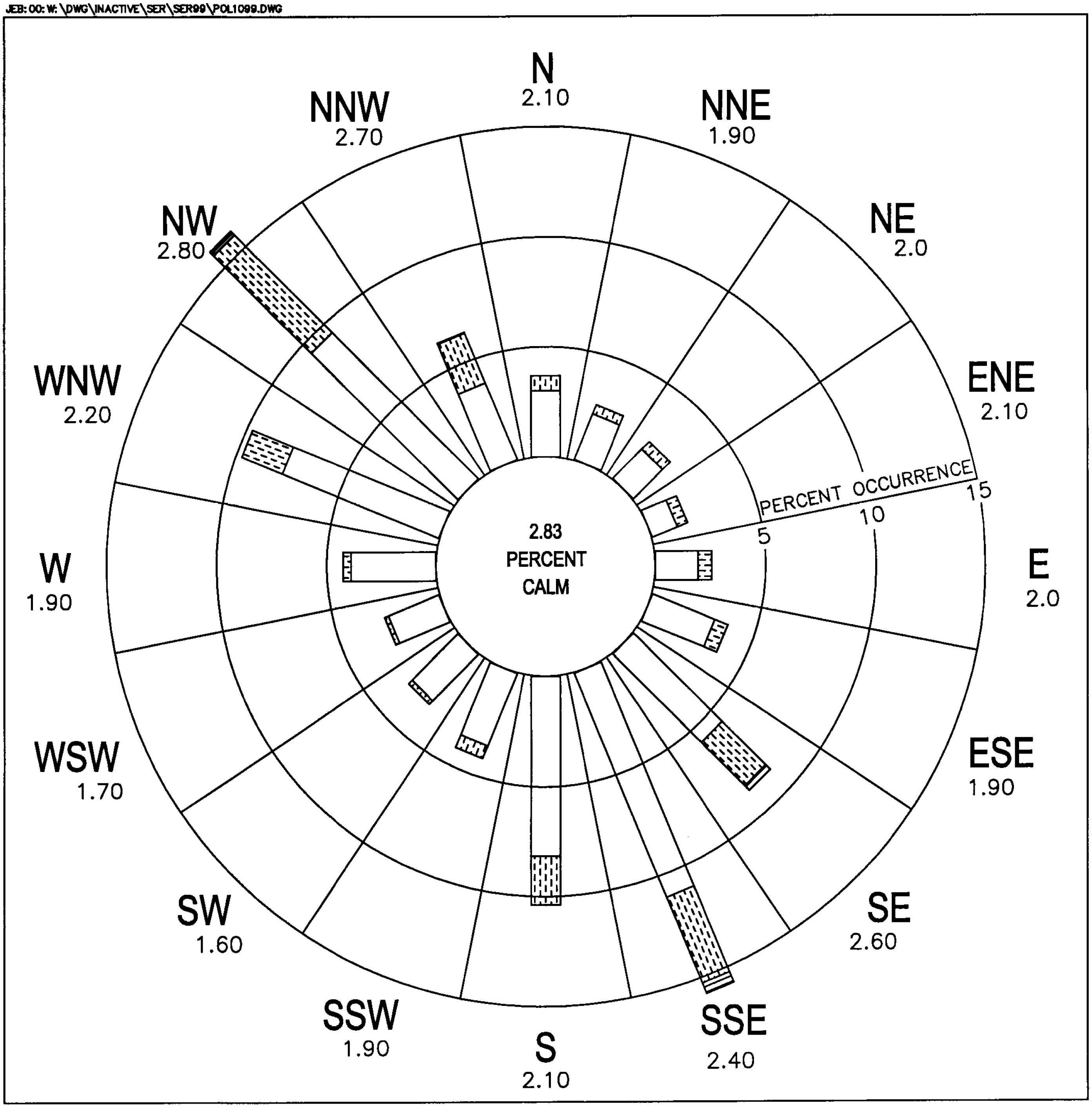
- 0.5 - 3.0 M/SEC
- >3.0 - 6.0
- >6.0 - 9.0
- >9.0 - 12.0
- >12.0

CALM <0.5

NUMBERS INDICATE SECTOR MEAN WIND SPEED
SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

West Valley Nuclear Services Co.
Regional Monitoring Station
West Valley, New York
Figure I-1
10.0-Meter Wind Frequency Rose

JEB: 00: W: \DWG\INACTIVE\SER\SER99\POL1099.DWG



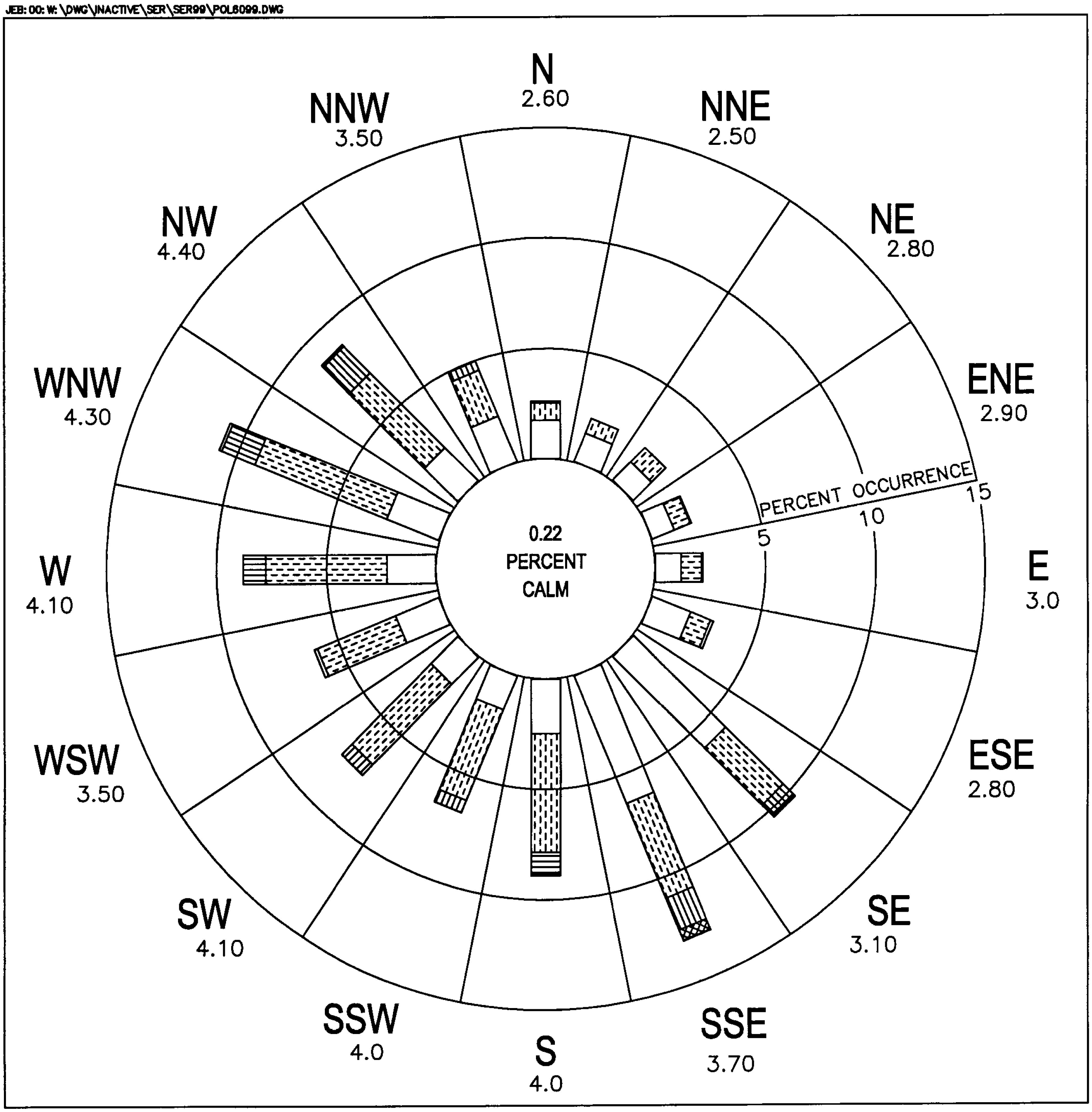
WIND SPEED RANGE

- 0.5 - 3.0 M/SEC
- >3.0 - 6.0
- >6.0 - 9.0
- >9.0 - 12.0
- >12.0

CALM <0.5

NUMBERS INDICATE SECTOR MEAN WIND SPEED
SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

West Valley Nuclear Services Co.
Primary Monitoring Station
West Valley, New York
Figure I-2
10.0-Meter Wind Frequency Rose



WIND SPEED RANGE

- 0.5 - 3.0 M/SEC
- >3.0 - 6.0
- >6.0 - 9.0
- >9.0 - 12.0
- >12.0

CALM <0.5

NUMBERS INDICATE SECTOR MEAN WIND SPEED
SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

West Valley Nuclear Services Co.
Primary Monitoring Station
West Valley, New York
Figure I-3
60.0-Meter Wind Frequency Rose

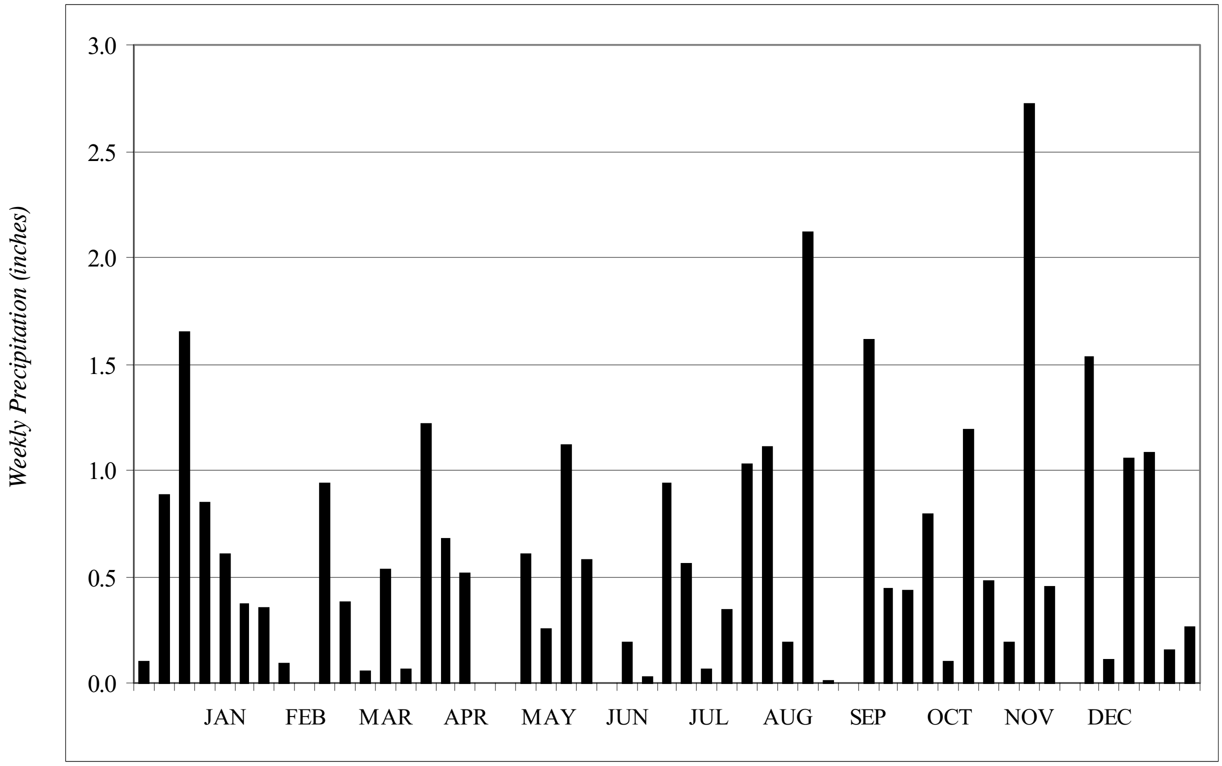


Figure I-4. 1999 Weekly Precipitation

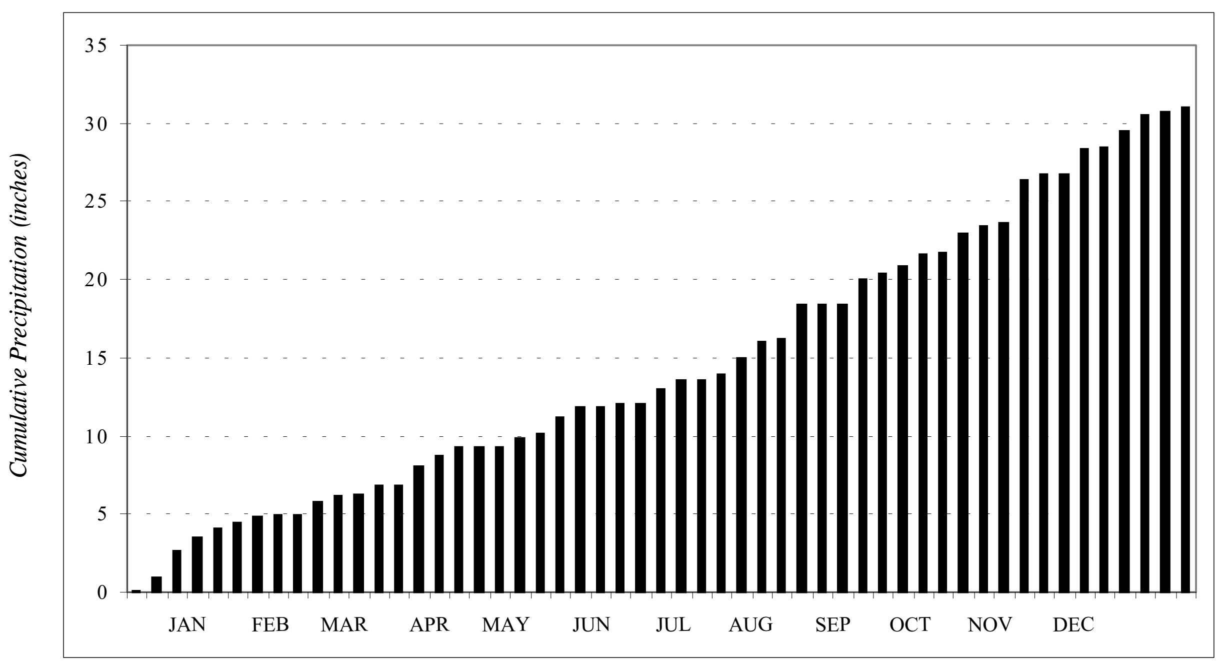


Figure I-5. 1999 Cumulative Precipitation

Table I-1
1999 Site Precipitation Collection Data

Week Ending	*Weekly* (inches)	*Cumulative* (inches)	Week Ending	*Weekly* (inches)	*Cumulative* (inches)
Jan 01	0.10	0.10	Jul 02	0.94	12.97
Jan 08	0.88	0.98	Jul 09	0.56	13.53
Jan 15	1.65	2.63	Jul 16	0.06	13.59
Jan 22	0.85	3.48	Jul 23	0.34	13.93
Jan 29	0.60	4.08	Jul 30	1.03	14.96
Feb 05	0.37	4.45	Aug 06	1.11	16.07
Feb 12	0.35	4.80	Aug 13	0.19	16.26
Feb 19	0.09	4.89	Aug 20	2.12	18.38
Feb 26	0.00	4.89	Aug 27	0.01	18.39
Mar 05	0.94	5.83	Sep 03	0.00	18.39
Mar 12	0.38	6.21	Sep 10	1.61	20.00
Mar 19	0.05	6.26	Sep 17	0.44	20.44
Mar 26	0.53	6.79	Sep 24	0.43	20.87
Apr 02	0.06	6.85	Oct 01	0.79	21.66
Apr 09	1.22	8.07	Oct 08	0.10	21.76
Apr 16	0.68	8.75	Oct 15	1.19	22.95
Apr 23	0.51	9.26	Oct 22	0.48	23.43
Apr 30	0.00	9.26	Oct 29	0.19	23.62
May 07	0.00	9.26	Nov 05	2.72	26.34
May 14	0.60	9.86	Nov 12	0.45	26.79
May 21	0.25	10.11	Nov 19	0.00	26.79
May 28	1.12	11.23	Nov 26	1.53	28.32
Jun 04	0.58	11.81	Dec 03	0.11	28.43
Jun 11	0.00	11.81	Dec 10	1.05	29.48
Jun 18	0.19	12.00	Dec 17	1.08	30.56
Jun 25	0.03	12.03	Dec 24	0.15	30.71
			Dec 31	0.26	30.97

Table I-2
1999 Annual Temperature Summary at the 10-Meter Primary Meteorological Tower

Month	Average Temperature		Maximum Temperature		Minimum Temperature	
	^{0}C	^{0}F	^{0}C	^{0}F	^{0}C	^{0}F
January	-4.7	23.5	13.7	56.7	-23.5	-10.3
February	-1.4	29.5	15.8	60.4	-17.8	-0.04
March	-2.1	28.2	15.9	60.6	-21.9	-7.4
April	9.2	48.6	18.5	65.3	-0.3	31.5
May	14.5	58.1	28.6	83.5	0.8	33.4
June	18.8	65.8	31.3	88.3	2.2	36.0
July	21.8	71.2	32.1	89.8	7.2	45.0
August	18.0	64.4	28.3	82.9	5.9	42.6
September	15.9	60.6	29.0	84.0	0.3	32.5
October	9.2	48.6	23.4	74.1	-3.4	25.9
November	6.0	42.8	20.6	69.1	-12.1	10.2
December	-0.9	30.4	17.9	64.2	-16.2	2.8
Annual Average	8.7	47.6	22.9	73.3	-6.6	20.2

Table I - 3
1999 Annual Barometric Pressure Summary
(station pressure - inches of mercury)

Month	Average Pressure	Maximum Pressure	Minimum Pressure
January	28.54	29.16	28.03
February	28.49	28.90	27.85
March	28.49	29.12	27.80
April	28.45	28.82	27.89
May	28.50	28.77	27.93
June	28.56	28.89	28.03
July	28.50	28.77	28.18
August	28.49	28.82	28.20
September	28.50	28.74	28.08
October	28.56	28.94	27.90
November	28.54	29.06	27.65
December	28.51	29.74	27.92
Annual Average	28.51	28.98	27.96

Appendix J

Summary of Quality Assurance Crosscheck Analyses

Keeping Up With Regulatory Changes

Table J-1

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 50; EML-604 QAP 9903; June 1999

Analyte	Matrix	Units	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Air filter	Bq/filter	1.34E-01	1.77E-01	1.321	Yes	GEL
Co-60	Air filter	Bq/filter	4.96E+00	4.95E+00	0.998	Yes	GEL
Cs-137	Air filter	Bq/filter	6.05E+00	6.06E+00	1.001	Yes	GEL
Gross Alpha	Air filter	Bq/filter	1.61E+00	1.68E+00	1.043	Yes	GEL
Gross Beta	Air filter	Bq/filter	1.56E+00	1.40E+00	0.897	Yes	GEL
Pu-238	Air filter	Bq/filter	2.72E-01	2.90E-01	1.065	Yes	GEL
Pu-239	Air filter	Bq/filter	1.24E-01	1.37E-01	1.100	Yes	GEL
Sb-125	Air filter	Bq/filter	3.59E+00	3.65E+00	1.017	Yes	GEL
Sr-90	Air filter	Bq/filter	6.44E-01	5.53E-01	0.858	Yes	GEL
U-234	Air filter	Bq/filter	6.00E-02	7.00E-02	1.166	Yes	GEL
U-238	Air filter	Bq/filter	6.10E-02	6.80E-02	1.103	Yes	GEL
U (total)	Air filter	μg/filter	4.95E+00	5.49E+00	1.110	Yes	GEL
Co-57	Air filter	Bq/filter	3.01E+00	2.77E+00	0.920	Yes	EL
Co-60	Air filter	Bq/filter	4.96E+00	4.86E+00	0.980	Yes	EL
Cs-137	Air filter	Bq/filter	6.05E+00	5.80E+00	0.959	Yes	EL
Gross Alpha	Air filter	Bq/filter	1.61E+00	1.45E+00	0.901	Yes	EL
Gross Beta	Air filter	Bq/filter	1.56E+00	1.68E+00	1.077	Yes	EL
Sb-125	Air filter	Bq/filter	3.59E+00	3.09E+00	0.861	Yes	EL
Ac-228	Soil	Bq/kg	4.71E+01	4.99E+01	1.058	Yes	GEL
Am-241	Soil	Bq/kg	4.89E+00	4.50E+00	0.919	Yes	GEL
Bi-214	Soil	Bq/kg	6.99E+01	7.41E+01	1.061	Yes	GEL
Cs-137	Soil	Bq/kg	6.60E+02	6.56E+02	0.994	Yes	GEL
K-40	Soil	Bq/kg	3.63E+02	3.58E+02	0.987	Yes	GEL
Pb-212	Soil	Bq/kg	4.79E+01	4.95E+01	1.034	Yes	GEL
Pb-214	Soil	Bq/kg	7.10E+01	8.20E+01	1.155	Yes	GEL
Pu-239	Soil	Bq/kg	8.11E+00	7.62E+00	0.940	Yes	GEL
Sr-90	Soil	Bq/kg	3.24E+01	3.78E+01	1.166	Yes	GEL
Th-234	Soil	Bq/kg	1.38E+02	1.32E+02	0.957	Yes	GEL
U-234	Soil	Bq/kg	1.41E+02	1.36E+02	0.965	Yes	GEL
U-238	Soil	Bq/kg	1.45E+02	1.39E+02	0.957	Yes	GEL
U (total)	Soil	μg/g	1.18E+01	9.77E+00	0.828	Yes	GEL

Acceptance is based on the reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits.* ***Pass*** *indicates a ratio within control limits but outside warning limits.* ***No*** *indicates a ratio outside control limits. Samples were analyzed by either the WVDP Environmental Laboratory (EL) or General Engineering Laboratory (GEL).*

Table J-1 (concluded)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 50; EML-604 QAP 9903; June 1999

Analyte	Matrix	Units	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Veg	Bq/kg	3.52E+00	3.68E+00	1.044	Yes	GEL
Cm-244	Veg	Bq/kg	1.67E+00	2.36E+00	1.410	Pass	GEL
Co-60	Veg	Bq/kg	2.15E+01	2.09E+01	0.975	Yes	GEL
Cs-137	Veg	Bq/kg	4.67E+02	4.63E+02	0.991	Yes	GEL
K-40	Veg	Bq/kg	6.57E+02	6.88E+02	1.047	Yes	GEL
Pu-239	Veg	Bq/kg	5.20E+00	5.40E+00	1.038	Yes	GEL
Sr-90	Veg	Bq/kg	7.36E+02	5.76E+02	0.783	Yes	GEL
Am-241	Water	Bq/L	1.15E+00	1.18E+00	1.028	Yes	GEL
Co-60	Water	Bq/L	5.11E+01	5.63E+01	1.102	Yes	GEL
Cs-137	Water	Bq/L	3.94E+01	4.13E+01	1.048	Yes	GEL
Fe-55	Water	Bq/L	9.74E+01	8.93E+01	0.917	Yes	GEL
Gross Alpha	Water	Bq/L	1.09E+03	1.20E+03	1.100	Yes	GEL
Gross Beta	Water	Bq/L	1.10E+03	1.05E+03	0.953	Yes	GEL
H-3	Water	Bq/L	1.21E+02	1.16E+02	0.961	Yes	GEL
Ni-63	Water	Bq/L	1.14E+02	1.19E+02	1.042	Yes	GEL
Pu-238	Water	Bq/L	7.72E-01	7.52E-01	0.975	Yes	GEL
Pu-239	Water	Bq/L	1.01E+00	9.74E-01	0.965	Yes	GEL
Sr-90	Water	Bq/L	4.10E+00	3.45E+00	0.840	Pass	GEL
U-234	Water	Bq/L	2.69E-01	3.15E-01	1.174	Yes	GEL
U-238	Water	Bq/L	2.62E-01	3.06E-01	1.167	Yes	GEL
U (total)	Water	μg/mL	2.10E-02	2.33E+01	1099	No	GEL
Co-60	Water	Bq/L	5.11E+01	5.39E+01	1.055	Yes	EL
Cs-137	Water	Bq/L	3.94E+01	4.10E+01	1.041	Yes	EL
Gross Alpha	Water	Bq/L	1.09E+03	8.29E+02	0.761	Pass	EL
Gross Beta	Water	Bq/L	1.10E+03	1.03E+03	0.941	Yes	EL
H-3	Water	Bq/L	1.21E+02	1.26E+02	1.041	Yes	EL
Sr-90	Water	Bq/L	4.10E+00	3.81E+00	0.928	Yes	EL

*Acceptance is based on the reported-to-actual ratio, assigned statistically on a case-by-case basis. **Yes** indicates a ratio within warning limits. **Pass** indicates a ratio within control limits but outside warning limits. **No** indicates a ratio outside control limits. Samples were analyzed by either the WVDP Environmental Laboratory (EL) or General Engineering Laboratory (GEL).*

Table J-2

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 51; EML-605 QAP 9909; December 1999

Analyte	Matrix	Units	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Air filter	Bq/filter	1.27E-01	1.05E-01	0.827	Pass	GEL
Co-57	Air filter	Bq/filter	7.73E+00	7.79E+00	1.008	Yes	GEL
Co-60	Air filter	Bq/filter	6.35E+00	6.81E+00	1.072	Yes	GEL
Cs-137	Air filter	Bq/filter	6.43E+00	7.06E+00	1.098	Yes	GEL
Gross Alpha	Air filter	Bq/filter	2.77E+00	2.72E+00	0.982	Yes	GEL
Gross Beta	Air filter	Bq/filter	2.66E+00	2.71E+00	1.019	Yes	GEL
Mn-54	Air filter	Bq/filter	7.91E+00	8.81E+00	1.114	Yes	GEL
Pu-238	Air filter	Bq/filter	9.70E-02	8.20E-02	0.847	Pass	GEL
Pu-239	Air filter	Bq/filter	1.36E-01	1.45E-01	1.066	Yes	GEL
Ru-106	Air filter	Bq/filter	5.50E+00	7.01E+00	1.275	Pass	GEL
Sr-90	Air filter	Bq/filter	3.36E-01	3.38E-01	1.006	Yes	GEL
U-234	Air filter	Bq/filter	6.60E-02	6.90E-02	1.049	Yes	GEL
U-238	Air filter	Bq/filter	6.50E-02	7.50E-02	1.161	Yes	GEL
U (total)	Air filter	μg/filter	5.23E+00	5.84E+00	1.117	Yes	GEL
Co-57	Air filter	Bq/filter	7.73E+00	7.25E+00	0.938	Yes	EL
Co-60	Air filter	Bq/filter	6.35E+00	6.51E+00	1.025	Yes	EL
Cs-137	Air filter	Bq/filter	6.43E+00	6.16E+00	0.958	Yes	EL
Gross Alpha	Air filter	Bq/filter	2.77E+00	2.45E+00	0.884	Yes	EL
Gross Beta	Air filter	Bq/filter	2.66E+00	3.10E+00	1.165	Yes	EL
Mn-54	Air filter	Bq/filter	7.91E+00	8.91E+00	1.126	Yes	EL
Ru-106	Air filter	Bq/filter	5.50E+00	5.30E+00	0.964	Yes	EL
Ac-228	Soil	Bq/kg	1.24E+02	1.31E+02	1.056	Yes	GEL
Am-241	Soil	Bq/kg	1.44E+00	1.69E+00	1.174	Yes	GEL
Bi-212	Soil	Bq/kg	1.40E+02	8.29E+01	0.592	Yes	GEL
Bi-214	Soil	Bq/kg	6.95E+01	8.85E+01	1.273	Pass	GEL
Cs-137	Soil	Bq/kg	2.04E+02	2.17E+02	1.064	Yes	GEL
K-40	Soil	Bq/kg	7.80E+02	9.14E+02	1.172	Yes	GEL
Pb-212	Soil	Bq/kg	1.27E+02	1.42E+02	1.118	Yes	GEL
Pb-214	Soil	Bq/kg	7.20E+01	1.02E+02	1.417	Pass	GEL
Pu-239	Soil	Bq/kg	3.20E+00	2.75E+00	0.859	Pass	GEL
Sr-90	Soil	Bq/kg	1.30E+01	9.80E+00	0.754	Pass	GEL
Th-234	Soil	Bq/kg	1.98E+02	1.88E+02	0.949	Yes	GEL
U-234	Soil	Bq/kg	1.90E+02	1.83E+02	0.963	Yes	GEL
U-238	Soil	Bq/kg	2.02E+02	1.97E+02	0.975	Yes	GEL
U (total)	Soil	μg/g	1.63E+01	1.51E+01	0.926	Yes	GEL

Acceptance is based on the reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits.* ***Pass*** *indicates a ratio within control limits but outside warning limits.* ***No*** *indicates a ratio outside control limits. Samples were analyzed by either the WVDP Environmental Laboratory (EL) or General Engineering Laboratory (GEL).*

Table J-2 (concluded)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 51; EML-605 QAP 9909; December 1999

Analyte	Matrix	Units	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Veg	Bq/kg	2.88E+00	3.13E+00	1.087	Yes	GEL
Cm-244	Veg	Bq/kg	1.61E+00	1.85E+00	1.149	Yes	GEL
Co-60	Veg	Bq/kg	1.76E+01	1.84E+01	1.045	Yes	GEL
Cs-137	Veg	Bq/kg	4.40E+02	4.59E+02	1.043	Yes	GEL
K-40	Veg	Bq/kg	5.13E+02	5.79E+02	1.129	Yes	GEL
Pu-239	Veg	Bq/kg	4.30E+00	4.48E+00	1.042	Yes	GEL
Sr-90	Veg	Bq/kg	5.95E+02	5.86E+02	0.985	Yes	GEL
Am-241	Water	Bq/L	8.50E-01	9.84E-01	1.158	Yes	GEL
Co-60	Water	Bq/L	5.24E+01	5.48E+01	1.046	Yes	GEL
Cs-137	Water	Bq/L	7.60E+01	7.76E+01	1.021	Yes	GEL
Fe-55	Water	Bq/L	5.30E+01	4.58E+01	0.864	Yes	GEL
Gross Alpha	Water	Bq/L	1.58E+03	1.79E+03	1.133	Yes	GEL
Gross Beta	Water	Bq/L	7.40E+02	9.69E+02	1.309	Yes	GEL
H-3	Water	Bq/L	8.07E+01	8.42E+01	1.043	Yes	GEL
Ni-63	Water	Bq/L	1.14E+02	1.15E+02	1.009	Yes	GEL
Pu-238	Water	Bq/L	7.90E-01	8.57E-01	1.085	Yes	GEL
Pu-239	Water	Bq/L	8.70E-01	9.34E-01	1.074	Yes	GEL
Sr-90	Water	Bq/L	1.72E+00	1.77E+00	1.029	Yes	GEL
U-234	Water	Bq/L	3.70E-01	3.86E-01	1.043	Yes	GEL
U-238	Water	Bq/L	3.60E-01	3.90E-01	1.083	Yes	GEL
U (total)	Water	μg/mL	3.00E-02	3.20E-02	1.067	Yes	GEL
Co-60	Water	Bq/L	5.24E+01	5.36E+01	1.023	Yes	EL
Cs-137	Water	Bq/L	7.60E+01	7.66E+01	1.008	Yes	EL
Gross Alpha	Water	Bq/L	1.58E+03	1.53E+03	0.969	Yes	EL
Gross Beta	Water	Bq/L	7.40E+02	1.01E+03	1.365	Pass	EL
H-3	Water	Bq/L	8.07E+01	8.33E+01	1.032	Yes	EL
Sr-90	Water	Bq/L	1.72E+00	1.48E+00	0.860	Pass	EL

Acceptance is based on the reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits.* ***Pass*** *indicates a ratio within control limits but outside warning limits.* ***No*** *indicates a ratio outside control limits. Samples were analyzed by either the WVDP Environmental Laboratory (EL) or General Engineering Laboratory (GEL).*

Appendix K

Environmental Regulations, Orders, Standards, and Permits

Table K-1
Department of Energy Radiation Protection Standards and Derived Concentration Guides [1]

Effective Dose Equivalent Radiation Standard for Protection of the Public

Continuous exposure of any member of the public from routine activities:
All exposure pathways =100 mrem/year (1 mSv/yr) effective dose equivalent

Department of Energy Derived Concentration Guides (DCGs) for Inhaled Air or Ingested Water (µCi/mL)

Radionuclide	Half-life [2] (years)	In Air	In Water	Radionuclide	Half-life [2] (years)	In Air	In Water
H-3*	1.23E+01	1E-07	2E-03	**Eu-152**	1.36E+01	5E-11	2E-05
C-14*	5.73E+03	6E-09	7E-05	**Eu-154***	8.80E+00	5E-11	2E-05
K-40	1.28E+09	9E-10	7E-06	**Eu-155**	4.96E+00	3E-10	1E-04
Fe-55	2.70E+00	5E-09	2E-04	**Th-232**	1.40E+10	7E-15	5E-08
Co-60*	5.27E+00	8E-11	5E-06	**U-232***	7.20E+01	2E-14	1E-07
Ni-59	7.50E+04	4E-09	7E-04	**U-233***	1.59E+05	9E-14	5E-07
Ni-63	1.00E+02	2E-09	3E-04	**U-234***	2.44E+05	9E-14	5E-07
Sr-90*	2.86E+01	9E-12	1E-06	**U-235***	7.04E+08	1E-13	6E-07
Y-90	7.31E-03	1E-09	1E-05	**U-236***	2.34E+07	1E-13	5E-07
Zr-93	1.53E+06	4E-11	9E-05	**U-238***	4.47E+09	1E-13	6E-07
Nb-93m	1.46E+01	4E-10	3E-04	**Np-239**	6.45E-03	5E-09	5E-05
Tc-99*	2.13E+05	2E-09	1E-04	**Pu-238***	8.78E+01	3E-14	4E-08
Ru-106	1.01E+00	3E-11	6E-06	**Pu-239***	2.41E+04	2E-14	3E-08
Cd-113m	1.37E+01	8E-12	9E-07	**Pu-240***	6.57E+03	2E-14	3E-08
Sn-126	1.00E+05	1E-10	8E-06	**Pu-241**	1.44E+01	1E-12	2E-06
Sb-125	2.77E+00	1E-09	5E-05	**Am-241***	4.32E+02	2E-14	3E-08
Te-125m	1.59E-01	2E-09	4E-05	**Am-242m**	1.52E+02	2E-14	3E-08
I-129*	1.57E+07	7E-11	5E-07	**Am-243**	7.38E+03	2E-14	3E-08
Cs-134*	2.06E+00	2E-10	2E-06	**Cm-243**	2.85E+01	3E-14	5E-08
Cs-135	2.30E+06	3E-09	2E-05	**Cm-244**	1.81E+01	4E-14	6E-08
Cs-137*	3.02E+01	4E-10	3E-06	**Gross Alpha (as Am-241)**	NA	2E-14	3E-08
Pm-147	2.62E+00	3E-10	1E-04				
Sm-151	9.00E+01	4E-10	4E-04	**Gross Beta (as Sr-90)**	NA	9E-12	1E-06

[1] DOE Order 5400.5 (February 8, 1990). Effective May 8, 1990. (See Derived Concentration Guides, p. 1-5, in Chapter 1, Environmental Monitoring Program Information.)

[2] U.S. Department of Energy. 1981. Radioactive Decay Tables. Washington, D.C.: Technical Information Center, U.S. Department of Energy.

** Radionuclides measured in WVDP effluent.*

NA - Not applicable.

Table K - 2
Environmental Regulations, Orders, and Standards

The following environmental standards and laws are applicable, in whole or in part, to the West Valley Demonstration Project:

Atomic Energy Act of 1954, 42 USC§ 2011 *et seq.*

DOE Order 231.1, September 30, 1995. *Environment, Safety, and Health Reporting*, including Change 2 (November 7, 1996).

DOE Order 232.1A, August 1, 1997. *Occurrence Reporting and Processing of Operations Information.*

DOE Order 451.1A, June 5, 1997. *National Environmental Policy Act.*

DOE Order 5400.1, November 9, 1988. *General Environmental Protection Program*, including Change 1 (June 29, 1990).

DOE Order 5400.5, February 8, 1990. *Radiation Protection of the Public and the Environment*, including Change 2 (January 7, 1993).

DOE Order 5480.4, May 15, 1984. *Environmental Protection, Safety, and Health Protection Standards*, including Change 4 (June 7, 1993).

DOE Order 5484.1, February 24, 1981. *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*, including Change 7 (October 17, 1990).

DOE Regulatory Guide DOE/EH-0173T, January 1991. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance.*

Clean Air Act (CAA). Pub. L. No. 84-159. 42 USC§ 7401 *et seq.*, as amended, and implementing regulations.

Federal Water Pollution Control Act [Clean Water Act (CWA)]. Pub. L. No. 95-217. 33 USC §1251 *et seq.*, as amended, and implementing regulations.

Resource Conservation and Recovery Act (RCRA). Pub. L. No. 94-580. 42 USC §6901 *et seq.*, as amended, and implementing regulations.

National Environmental Policy Act (NEPA) of 1969. Pub. L. No. 91-190. 42 USC §4321 *et seq.*, as amended, and implementing regulations.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Pub. L. No. 96-510. 42 USC §9601 *et seq.* (including Superfund Amendments and Reauthorization Act of 1986), and implementing regulations.

Toxic Substances Control Act (TSCA). Pub. L. No. 94-469. 15 USC §2601 *et seq.*, as amended, and implementing regulations.

Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. Pub. L. No. 99-499. 42 USC §11001 *et seq.*, and implementing regulations.

Safe Drinking Water Act (SDWA). Pub. L. No. 93-523. 42 USC §300*f* *et seq.*, as amended, and implementing regulations.

Environmental Conservation Law of New York State and implementing regulations (NYCRR).

Water quality standards contained in the State Pollutant Discharge Elimination System (SPDES) permit issued for the facility are listed in Table G-1. Airborne emissions are regulated by the Environmental Protection Agency under the National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR §61 Subpart H (December 15, 1989).

The above list covers the major activities at the West Valley Demonstration Project but does not constitute a comprehensive enumeration.

Table K-3
West Valley Demonstration Project Environmental Permits

Permit Name and Number	Agency/Permit Type	Description	1999 Changes	Status
West Valley Demonstration Project Part A Permit Application	NYSDEC	Provides Interim Status under RCRA for treatment and storage of hazardous waste	None	No expiration date.
Article 19 Air State Facility Permit 90422-00005	NYSDEC	Includes 2 new boilers that began operation in 1998	Sources removed from Modification Application because of exempt status; WVDP awaiting approval	Effective 1/23/98. Modification Application to incorporate remaining COs submitted 12/31/97.
Boilers (042200-0114-00002 and (042200-0114-00003)	NYSDEC/ Certificate to Operate (CO) an Air Emission Source (2 COs)	Old boilers in utility room - backup for new boilers. Existing permit includes two boilers installed in 1997.	Boilers have been removed from service	COs issued 11/30/90. No expiration date. Extended indefinitely in accordance with revised Title 6 NYCRR § 201, which went into effect 7/7/96. Boilers have been removed from the State Facility Permit application.
Cold chemical solids transfer system (042200-0114-CTS02) Cold chemical vessel vent system (042200-0114-CTS03) Cold chemical vessel dust collection hood (042200-0114-CTS04)	NYSDEC/CO (3 COs)	Cold chemical facility. Dry or solid chemical emissions from solids transfer system and dust collection hood and from mix-tank vent for vitrification operations.	None	Solids transfer system CO (-CTS02) and vessel dust collection hood CO (-CTS04) issued 1/8/92. Vessel vent system CO (-CTS03) issued 10/26/95. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201.
Vitrification facility heating, ventilation, and air conditioning (HVAC) system (042200-0114-15F-2)	NYSDEC/CO	Canister-welding emissions vented through vitrification facility HVAC system, i.e., canister-welding ventilation	None	CO issued 10/26/95. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201.
Vitrification off-gas treatment system (04220-0114-15F-1)	NYSDEC/CO	Vitrification facility off-gas treatment system emissions	None	CO issued 5/2/97. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201
Slurry-fed ceramic melter (modification to WVDP-687-01) Process building ventilation	EPA/NESHAP	Slurry-fed ceramic melter radionuclide emissions - main plant stack modified 2/18/97	None	Permit approved February 18, 1997. No expiration date. Request to modify submitted to the EPA 8/99.
Vitrification facility HVAC system	EPA/NESHAP	Vitrification facility HVAC system for radionuclide emissions	None	Permit approved February 18, 1997. No expiration date. Request to modify submitted to the EPA 8/99.

Table K-3 (concluded)
West Valley Demonstration Project Environmental Permits

Permit Name and Number	Agency/Permit Type	Description	1999 Changes	Status
01-14 building ventilation system (WVDP-187-01)	EPA/NESHAP	Liquid waste treatment system ventilation of radionuclide emissions in the 01-14 building	None	Issued 10/5/87. Modified 5/25/89. No expiration date. Request to cancel submitted to the EPA 8/99
Contact size-reduction facility (WVDP-287-01)	EPA/NESHAP	Contact size-reduction and decontamination facility radionuclide emissions	None	Issued 10/5/87. No expiration date. Request to cancel submitted to the EPA 8/99
Supernatant treatment system/Permanent Ventilation System (WVDP-387-01)	EPA/NESHAP	Supernatant treatment system ventilation for radionuclide emissions	Modified to accommodate waste tank ventilation	Revised 1/1/97. No expiration date.
Outdoor ventilated enclosures (WVDP-587-01)	EPA/NESHAP	Ten portable ventilation units for removal of radionuclides	None	Issued 12/22/87. No expiration date. Request to cancel submitted to the EPA 8/99.
State Pollutant Discharge Elimination System (NY-0000973)	NYSDEC/ Water	Covers discharges to surface waters from various sources on-site	Renewed effective 2/1/99. Expires 2/1/04. No other changes.	NYSDEC has prepared a draft permit modification for storm water discharges and for a groundwater recovery system discharge increase. Permit terms for NYSERDA and DOE responsibilities related to storm water discharges are being negotiated with NYSDEC.
Buffalo Pollutant Discharge Elimination System (99-04-TR096)	Buffalo Sewer Authority/ Sanitary sewage and sewage sludge disposal	Permit issued to hauler of waste from the wastewater treatment facility	Renewed 6/29/99	Hauler must renew permit by 6/30/00.
Chemical bulk storage (9-000158)	NYSDEC/ Chemical bulk storage tank	Registration of bulk storage tanks used for listed hazardous chemicals	None	Permit issued 6/25/99; will expire 7/5/01.
Petroleum bulk storage (9-008885)	NYSDEC/ Petroleum bulk storage tank registration	Registration of bulk storage tanks used for petroleum	None	Regsistration expires 9/2/01. Will renew before expiration.
Bird depredation license (DWP99-001)	New York State Division of Fish and Wildlife	State license for the removal of inactive nests of migratory birds	The WVDP is no longer required to file for a U.S.Fish and Wildlife permit for these activities.	CY 1999 license expired 12/31/99. Application for CY2000 renewal submitted to regulators.

Appendix L

Summary of NYSERDA Groundwater Monitoring Data

An Aerial View of the New York State-licensed Disposal Area

Table L-1
1999 Contamination Indicator Results at SDA Monitoring Wells

Sample Location	Date	Conductivity (µmhos/cm@25ºC)	pH (standard units)	Temperature (ºC)	Turbidity (NTU)
WNW1101A	*June*	599	7.85	12.6	1.94
WNW1101A	*December*	602	7.67	10.6	0.20
WNW1101B	*June*	570	7.88	13.5	5.29
WNW1101B	*December*	651	7.64	9.4	0.53
WNW1101C	*June*	NA	NA	NA	NA
WNW1101C	*December*	353	7.66	8.5	295.00
WNW1102A	*June*	687	8.36	12.1	4.86
WNW1102A	*December*	714	7.90	11.7	2.37
WNW1102B	*June*	657	7.51	13.4	56.10
WNW1102B	*December*	670	7.57	10.6	1.49
WNW1103A	*June*	930	7.41	12.5	>1000.00
WNW1103A	*December*	893	7.47	11.6	2.21
WNW1103B	*June*	678	7.60	13.8	11.00
WNW1103B	*December*	676	7.68	9.3	0.34
WNW1104A	*June*	697	7.91	16.5	11.60
WNW1104A	*December*	620	8.04	10.8	0.40
WNW1104B	*June*	598	7.42	14.6	3.53
WNW1104B	*December*	601	7.68	10.0	0.19
WNW1105A	*June*	671	7.77	11.1	>1000.00
WNW1105A	*December*	676	7.63	10.0	356.00
WNW1105B	*June*	710	7.73	12.4	>1000.00
WNW1105B	*December*	710	7.67	9.1	765.00
WNW1106A	*June*	715	7.54	11.7	1.58
WNW1106A	*December*	730	7.64	10.3	2.77
WNW1106A	*December*	730	7.64	10.3	2.77
WNW1106B	*June*	808	7.63	13.5	28.30
WNW1106B	*December*	724	7.62	10.5	9.37
WNW1107A	*June*	2040	7.00	12.7	6.57
WNW1107A	*December*	1517	6.99	12.2	0.27
WNW1108A	*June*	928	7.52	12.3	177.00
WNW1108A	*December*	908	7.04	10.0	169.00
WNW1109A	*June*	505	7.65	17.5	6.89
WNW1109A	*December*	591	7.74	11.1	11.80
WNW1109B	*June*	316	8.00	14.2	30.10
WNW1109B	*December*	467	7.86	10.5	8.94
WNW1111A	*June*	991	7.33	11.5	4.65
WNW1111A	*June*	991	7.33	11.5	4.65
WNW1111A	*December*	985	7.38	10.0	0.92

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-2
1999 Radiological Indicator Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Gross Alpha	Gross Beta	H-3
WNW1101A	*June*	2.68±1.90E-09	2.58±1.10E-09	8.05±6.90E-08
WNW1101A	*December*	3.10±1.60E-09	3.89±1.10E-09	1.02±0.71E-07
WNW1101B	*June*	1.66±1.50E-09	2.77±1.10E-09	-0.91±6.60E-08
WNW1101B	*December*	5.27±2.20E-09	2.87±1.00E-09	1.88±6.70E-08
WNW1101C	*June*	4.90±7.70E-10	1.35±0.72E-09	-2.36±6.50E-08
WNW1101C	*December*	2.42±1.10E-09	2.79±0.91E-09	4.79±6.90E-08
WNW1102A	*June*	3.45±1.60E-09	2.30±1.10E-09	2.47±0.76E-07
WNW1102A	*December*	2.56±1.60E-09	3.03±1.10E-09	3.07±0.79E-07
WNW1102B	*June*	1.06±1.10E-09	1.69±1.00E-09	-4.96±6.40E-08
WNW1102B	*December*	0.89±1.00E-09	3.59±1.10E-09	-1.65±6.60E-08
WNW1103A	*June*	4.92±3.20E-09	5.28±1.90E-09	5.54±0.89E-07
WNW1103A	*December*	6.37±2.80E-09	4.58±1.50E-09	4.28±0.85E-07
WNW1103B	*June*	1.68±1.10E-09	2.63±0.96E-09	-0.08±6.60E-08
WNW1103B	*December*	1.79±1.20E-09	2.95±1.00E-09	5.43±6.90E-08
WNW1103C	*June*	1.62±1.00E-09	NA	4.22±6.70E-08
WNW1103C	*December*	2.14±1.40E-09	1.28±0.42E-08	1.82±6.80E-08
WNW1104A	*June*	2.69±1.50E-09	2.67±1.10E-09	1.73±0.73E-07
WNW1104A	*December*	2.71±1.60E-09	2.44±0.95E-09	1.71±0.74E-07
WNW1104B	*June*	3.38±2.10E-09	2.67±1.00E-09	-3.97±6.40E-08
WNW1104B	*December*	1.67±1.20E-09	3.51±0.95E-09	0.67±6.60E-08
WNW1104C	*June*	4.85±4.40E-09	8.83±3.50E-09	2.74±6.70E-08
WNW1104C	*December*	6.63±5.20E-09	9.13±4.00E-09	3.58±6.80E-08
WNW1105A	*June*	3.62±1.80E-09	1.93±0.98E-09	9.58±7.00E-08
WNW1105A	*December*	4.08±1.50E-09	2.95±0.95E-09	1.84±0.73E-07
WNW1105B	*June*	2.91±1.60E-09	2.26±1.10E-09	-3.06±6.50E-08
WNW1105B	*December*	3.44±1.40E-09	3.66±0.96E-09	2.25±6.60E-08
WNW1106A	*June*	3.96±2.30E-09	2.48±1.10E-09	6.51±0.93E-07
WNW1106A	*December*	3.37±1.40E-09	4.65±1.10E-09	7.09±0.96E-07
WNW1106A	*December*	3.38±1.40E-09	3.58±1.00E-09	6.79±0.95E-07
WNW1106B	*June*	1.15±1.00E-09	1.22±0.80E-09	-1.48±6.50E-08
WNW1106B	*December*	8.02±7.20E-10	2.82±1.00E-09	4.72±6.70E-08
WNW1107A	*June*	5.85±2.90E-09	2.07±0.41E-08	1.50±0.07E-05
WNW1107A	*December*	9.11±3.60E-09	1.17±0.29E-08	1.27±0.06E-05
WNW1108A	*June*	6.68±3.40E-09	5.44±1.60E-09	1.13±0.71E-07
WNW1108A	*December*	5.56±2.00E-09	4.12±1.30E-09	8.65±6.90E-08
WNW1109A	*June*	4.19±2.30E-09	3.13±1.00E-09	2.95±0.79E-07
WNW1109A	*December*	4.11±1.40E-09	3.67±0.95E-09	3.46±0.80E-07
WNW1109B	*June*	6.44±9.00E-10	1.31±0.72E-09	5.91±0.90E-07
WNW1109B	*December*	1.46±0.71E-09	1.85±0.65E-09	4.83±0.86E-07
WNW1110A	*June*	7.72±2.70E-09	8.36±1.90E-09	1.49±0.72E-07
WNW1110A	*December*	1.13±0.37E-08	8.81±2.20E-09	5.80±6.70E-08
WNW1111A	*June*	8.67±4.20E-09	4.24±1.90E-09	2.19±0.75E-07
WNW1111A	*June*	4.98±3.10E-09	4.01±1.90E-09	1.94±0.74E-07
WNW1111A	*December*	4.42±1.80E-09	5.45±1.60E-09	2.14±0.74E-07

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA- Not available.

Table L-3
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Actinium-228	Bismuth-214	Carbon-14	Cesium-134
WNW1101A	*June*	1.59±1.50E-08	0.67±1.00E-08	-0.04±5.30E-09	-3.89±4.30E-09
WNW1101A	*December*	NA	NA	NA	NA
WNW1101B	*June*	-1.46±1.90E-08	0.50±1.00E-08	3.41±5.30E-09	-4.86±4.10E-09
WNW1101B	*December*	NA	NA	NA	NA
WNW1101C	*June*	-0.02±1.70E-08	2.64±8.10E-09	6.28±5.40E-09	-2.75±4.00E-09
WNW1101C	*December*	NA	NA	NA	NA
WNW1102A	*June*	0.23±2.00E-08	-0.02±1.00E-08	1.39±5.30E-09	-1.74±4.50E-09
WNW1102A	*December*	NA	NA	NA	NA
WNW1102B	*June*	0.42±1.60E-08	-0.87±8.80E-09	1.93±5.30E-09	0.56±4.20E-09
WNW1102B	*December*	NA	NA	NA	NA
WNW1103A	*June*	0.57±1.70E-08	-2.43±9.30E-09	6.08±5.40E-09	-1.09±4.20E-09
WNW1103A	*December*	NA	NA	NA	NA
WNW1103B	*June*	-1.12±1.90E-08	-5.21±8.20E-09	5.37±5.40E-09	2.31±4.20E-09
WNW1103B	*December*	NA	NA	NA	NA
WNW1104A	*June*	-2.04±1.70E-08	2.06±7.80E-09	1.46±5.30E-09	-0.47±4.20E-09
WNW1104A	*December*	NA	NA	NA	NA
WNW1104B	*June*	1.95±1.80E-08	0.27±1.10E-08	4.44±5.40E-09	-7.76±5.20E-09
WNW1104B	*December*	NA	NA	NA	NA
WNW1104C	*June*	-5.12±6.80E-08	2.25±3.40E-08	NA	-2.20±1.70E-08
WNW1104C	*December*	NA	NA	NA	NA
WNW1105A	*June*	-0.66±2.00E-08	0.08±1.10E-08	2.73±5.30E-09	-0.65±5.20E-09
WNW1105A	*December*	NA	NA	NA	NA
WNW1105B	*June*	0.90±1.70E-08	8.81±8.70E-09	1.09±5.30E-09	-1.71±4.30E-09
WNW1105B	*December*	NA	NA	NA	NA
WNW1106A	*June*	-1.08±1.90E-08	0.19±1.10E-08	NA	-4.11±4.30E-09
WNW1106A	*December*	NA	NA	-2.17±2.70E-08	NA
WNW1106A	*December*	NA	NA	0.41±1.10E-08	NA
WNW1106B	*June*	1.10±1.90E-08	0.84±1.10E-08	3.55±5.40E-09	-6.82±5.50E-09
WNW1106B	*December*	NA	NA	NA	NA
WNW1107A	*June*	-0.09±1.80E-08	-1.26±8.60E-09	-0.51±5.20E-09	0.60±4.70E-09
WNW1107A	*December*	NA	NA	NA	NA
WNW1108A	*June*	-0.22±2.10E-08	3.23±9.60E-09	1.04±5.30E-09	2.06±4.10E-09
WNW1108A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA- Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Actinium-228	Bismuth-214	Carbon-14	Cesium-134
WNW1109A	*June*	1.73±2.10E-08	-0.28±1.10E-08	3.92±5.30E-09	-0.02±4.80E-09
WNW1109A	*December*	NA	NA	NA	NA
WNW1109B	*June*	0.21±2.20E-08	0.12±1.00E-08	3.84±5.30E-09	-5.13±4.90E-09
WNW1109B	*December*	NA	NA	NA	NA
WNW1110A	*June*	-0.91±1.50E-08	-0.67±1.10E-08	NA	-2.74±4.90E-09
WNW1110A	*December*	NA	NA	-0.42±2.00E-08	NA
WNW1111A	*June*	-0.51±1.70E-08	3.56±9.10E-09	2.95±5.40E-09	-4.56±4.50E-09
WNW1111A	*June*	-1.53±1.60E-08	4.71±9.80E-09	NA	-6.13±4.70E-09
WNW1111A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA- Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Cesium-137	Cobalt-57	Cobalt-60	Iodine-129
WNW1101A	*June*	-2.43±4.80E-09	-1.38±1.90E-08	0.56±4.00E-09	-0.90±1.50E-10
WNW1101A	*December*	NA	NA	NA	NA
WNW1101B	*June*	-1.91±4.40E-09	1.77±1.80E-08	-0.08±4.60E-09	1.05±1.20E-10
WNW1101B	*December*	NA	NA	NA	NA
WNW1101C	*June*	-1.15±3.90E-09	-0.06±1.80E-08	0.03±2.90E-09	-0.18±1.40E-10
WNW1101C	*December*	NA	NA	NA	NA
WNW1102A	*June*	-2.53±4.10E-09	-1.30±1.80E-08	0.86±5.80E-09	-0.68±1.40E-10
WNW1102A	*December*	NA	NA	NA	NA
WNW1102B	*June*	1.71±4.30E-09	-1.41±1.90E-08	-0.88±3.50E-09	-0.87±1.60E-10
WNW1102B	*December*	NA	NA	NA	NA
WNW1103A	*June*	1.14±4.40E-09	-0.27±1.80E-08	3.28±3.50E-09	1.43±1.50E-10
WNW1103A	*December*	NA	NA	NA	NA
WNW1103B	*June*	1.46±4.80E-09	0.06±2.00E-08	1.23±4.90E-09	-0.15±1.30E-10
WNW1103B	*December*	NA	NA	NA	NA
WNW1104A	*June*	1.47±3.80E-09	0.03±2.20E-08	-0.91±6.10E-09	0.34±1.40E-10
WNW1104A	*December*	NA	NA	NA	NA
WNW1104B	*June*	0.46±5.30E-09	0.76±2.30E-08	-2.65±4.70E-09	0.59±1.30E-10
WNW1104B	*December*	NA	NA	NA	NA
WNW1104C	*June*	0.78±1.70E-08	-4.29±8.20E-08	-0.56±2.00E-08	NA
WNW1104C	*December*	NA	NA	NA	NA
WNW1105A	*June*	0.76±4.50E-09	0.00±2.10E-08	-2.61±5.10E-09	0.53±1.40E-10
WNW1105A	*December*	NA	NA	NA	NA
WNW1105B	*June*	-3.46±3.60E-09	0.73±1.80E-08	-0.74±4.30E-09	-0.42±1.40E-10
WNW1105B	*December*	NA	NA	NA	NA
WNW1106A	*June*	-0.56±5.20E-09	-1.74±1.80E-08	-1.34±3.90E-09	0.46±1.70E-10
WNW1106A	*December*	NA	NA	NA	NA
WNW1106B	*June*	-3.33±5.20E-09	-2.10±2.40E-08	-0.53±4.40E-09	-0.54±1.40E-10
WNW1106B	*December*	NA	NA	NA	NA
WNW1107A	*June*	1.74±4.10E-09	0.27±1.90E-08	1.82±5.10E-09	0.21±1.50E-10
WNW1107A	*December*	NA	NA	NA	NA
WNW1108A	*June*	0.61±5.40E-09	-0.97±1.70E-08	1.14±5.20E-09	0.54±1.40E-10
WNW1108A	*December*	NA	NA	NA	NA
WNW1109A	*June*	-2.27±5.10E-09	-0.36±2.40E-08	-0.26±5.00E-09	-0.23±1.30E-10
WNW1109A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Cesium-137	Cobalt-57	Cobalt-60	Iodine-129
WNW1109B	*June*	3.86±4.40E-09	-2.03±2.40E-08	0.49±3.70E-09	-0.99±1.50E-10
WNW1109B	*December*	NA	NA	NA	NA
WNW1110A	*June*	-3.62±4.60E-09	-1.26±2.50E-08	2.13±4.90E-09	NA
WNW1110A	*December*	NA	NA	NA	NA
WNW1111A	*June*	2.83±4.60E-09	0.30±1.60E-08	3.06±4.30E-09	0.59±1.40E-10
WNW1111A	*June*	-0.64±4.30E-09	-0.50±2.30E-08	2.96±4.80E-09	0.28±1.10E-10
WNW1111A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Lead-212	Lead-214	Potassium-40	Radium-224
WNW1101A	*June*	-7.22±6.20E-09	9.87±8.40E-09	-2.11±1.00E-07	-7.43±6.30E-09
WNW1101A	*December*	NA	NA	NA	NA
WNW1101B	*June*	2.31±6.90E-09	-4.97±7.90E-09	-0.94±9.60E-08	2.38±7.10E-09
WNW1101B	*December*	NA	NA	NA	NA
WNW1101C	*June*	-2.66±6.40E-09	7.58±7.80E-09	-4.05±7.80E-08	-2.73±6.60E-09
WNW1101C	*December*	NA	NA	NA	NA
WNW1102A	*June*	-0.32±6.40E-09	-3.15±9.20E-09	-6.57±9.50E-08	-0.33±6.60E-09
WNW1102A	*December*	NA	NA	NA	NA
WNW1102B	*June*	-1.43±6.70E-09	-4.25±7.50E-09	-4.21±7.80E-08	-1.47±6.90E-09
WNW1102B	*December*	NA	NA	NA	NA
WNW1103A	*June*	-3.70±6.10E-09	6.18±8.10E-09	-1.53±1.00E-07	-3.81±6.30E-09
WNW1103A	*December*	NA	NA	NA	NA
WNW1103B	*June*	-3.69±6.30E-09	2.07±9.20E-09	-5.75±6.70E-08	-3.80±6.40E-09
WNW1103B	*December*	NA	NA	NA	NA
WNW1104A	*June*	1.38±6.80E-09	-4.86±9.90E-09	-3.30±6.80E-08	1.42±7.00E-09
WNW1104A	*December*	NA	NA	NA	NA
WNW1104B	*June*	5.75±7.60E-09	2.45±9.80E-09	0.00±1.00E-07	5.92±7.90E-09
WNW1104B	*December*	NA	NA	NA	NA
WNW1104C	*June*	0.23±2.60E-08	1.74±3.20E-08	-0.64±3.20E-07	0.25±2.80E-08
WNW1104C	*December*	NA	NA	NA	NA
WNW1105A	*June*	-1.07±7.10E-09	7.11±9.00E-09	4.93±9.50E-08	-1.10±7.20E-09
WNW1105A	*December*	NA	NA	NA	NA
WNW1105B	*June*	-3.95±6.60E-09	4.46±9.60E-09	-2.44±8.40E-08	-4.06±6.80E-09
WNW1105B	*December*	NA	NA	NA	NA
WNW1106A	*June*	7.46±7.20E-10	-2.14±7.80E-09	5.04±9.60E-08	0.77±7.40E-09
WNW1106A	*December*	NA	NA	NA	NA
WNW1106B	*June*	0.28±7.20E-09	4.47±8.80E-09	0.19±1.00E-07	0.29±7.40E-09
WNW1106B	*December*	NA	NA	NA	NA
WNW1107A	*June*	0.83±6.60E-09	-3.37±9.00E-09	-4.58±5.90E-08	0.85±6.80E-09
WNW1107A	*December*	NA	NA	NA	NA
WNW1108A	*June*	7.58±7.60E-09	-7.23±8.60E-09	-4.24±9.00E-08	7.81±7.80E-09
WNW1108A	*December*	NA	NA	NA	NA
WNW1109A	*June*	-1.39±7.80E-09	5.83±9.80E-09	-8.91±9.70E-08	-1.43±8.00E-09
WNW1109A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Lead-212	Lead-214	Potassium-40	Radium-224
WNW1109B	*June*	-3.07±7.90E-09	-3.41±9.70E-09	2.48±9.40E-08	-3.16±8.20E-09
WNW1109B	*December*	NA	NA	NA	NA
WNW1110A	*June*	-3.22±6.50E-09	-2.33±9.60E-09	0.16±6.10E-08	-3.44±7.00E-09
WNW1110A	*December*	NA	NA	NA	NA
WNW1111A	*June*	-8.65±6.60E-09	5.75±8.80E-09	-5.26±7.80E-08	-8.89±6.70E-09
WNW1111A	*June*	-1.04±0.72E-08	-4.29±8.40E-09	3.09±7.10E-08	-1.07±0.74E-08
WNW1111A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Radium-226	Strontium-90	Technetium-99	Thallium-208
WNW1101A	*June*	0.67±1.00E-08	0.06±1.90E-10	0.88±1.20E-09	-7.04±4.70E-09
WNW1101A	*December*	NA	NA	NA	NA
WNW1101B	*June*	0.50±1.00E-08	-0.40±1.90E-10	0.13±1.30E-09	-0.58±4.80E-09
WNW1101B	*December*	NA	NA	NA	NA
WNW1101C	*June*	2.64±8.10E-09	1.01±2.00E-10	NA	1.99±5.50E-09
WNW1101C	*December*	NA	NA	-2.08±3.50E-09	NA
WNW1102A	*June*	-0.01±1.00E-08	0.81±1.90E-10	0.81±1.30E-09	-2.94±5.40E-09
WNW1102A	*December*	NA	NA	NA	NA
WNW1102B	*June*	-0.87±8.80E-09	-0.69±2.20E-10	-0.09±1.20E-09	5.20±4.30E-09
WNW1102B	*December*	NA	NA	NA	NA
WNW1103A	*June*	-2.46±9.20E-09	0.47±2.10E-10	0.30±1.30E-10	-2.97±5.10E-09
WNW1103A	*December*	NA	NA	NA	NA
WNW1103B	*June*	-5.21±8.20E-09	0.32±2.00E-10	0.66±1.30E-09	4.84±4.70E-09
WNW1103B	*December*	NA	NA	NA	NA
WNW1104A	*June*	2.03±7.80E-09	2.32±2.40E-10	0.58±1.30E-09	0.55±3.40E-09
WNW1104A	*December*	NA	NA	NA	NA
WNW1104B	*June*	0.27±1.10E-08	0.30±2.20E-10	0.36±1.30E-09	8.35±5.80E-09
WNW1104B	*December*	NA	NA	NA	NA
WNW1104C	*June*	2.24±3.40E-08	NA	NA	1.19±1.60E-08
WNW1104C	*December*	NA	NA	NA	NA
WNW1105A	*June*	0.08±1.10E-08	1.34±2.40E-10	1.39±1.30E-09	-2.12±6.30E-09
WNW1105A	*December*	NA	NA	NA	NA
WNW1105B	*June*	8.84±8.70E-09	0.21±2.60E-10	1.80±1.30E-09	0.06±4.70E-09
WNW1105B	*December*	NA	NA	NA	NA
WNW1106A	*June*	0.20±1.10E-08	1.45±2.20E-10	1.17±1.30E-09	-0.21±5.60E-09
WNW1106A	*December*	NA	NA	NA	NA
WNW1106B	*June*	0.84±1.10E-08	0.03±2.00E-10	1.27±1.30E-09	4.33±4.80E-09
WNW1106B	*December*	NA	NA	NA	NA
WNW1107A	*June*	-1.30±8.60E-09	1.27±0.30E-08	0.65±1.20E-09	4.14±4.10E-09
WNW1107A	*December*	NA	NA	NA	NA
WNW1108A	*June*	3.18±9.60E-09	0.81±2.20E-10	1.01±1.30E-09	1.51±5.50E-09
WNW1108A	*December*	NA	NA	NA	NA
WNW1109A	*June*	-0.28±1.10E-08	1.90±2.30E-10	0.23±1.30E-09	6.16±5.30E-09
WNW1109A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Radium-226	Strontium-90	Technetium-99	Thallium-208
WNW1109B	*June*	0.13±1.00E-08	1.69±2.10E-10	-0.16±1.20E-09	-2.96±5.10E-09
WNW1109B	*December*	NA	NA	NA	NA
WNW1110A	*June*	-0.66±1.10E-08	NA	NA	-0.83±4.50E-09
WNW1110A	*December*	NA	NA	NA	NA
WNW1111A	*June*	3.51±9.10E-09	-0.88±1.80E-10	1.16±1.30E-09	4.25±4.70E-09
WNW1111A	*June*	4.69±9.80E-09	0.96±3.30E-10	0.73±1.20E-09	2.14±4.30E-09
WNW1111A	*December*	NA	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA- Not available.

Table L-3 (continued)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Thorium-234	Uranium-235	Uranium-238
WNW1101A	*June*	1.32±6.10E-07	-0.93±1.70E-08	NA
WNW1101A	*December*	NA	NA	NA
WNW1101B	*June*	4.18±7.50E-07	-0.42±1.70E-08	NA
WNW1101B	*December*	NA	NA	NA
WNW1101C	*June*	0.50±6.20E-07	0.24±1.60E-08	NA
WNW1101C	*December*	NA	NA	NA
WNW1102A	*June*	4.36±7.80E-07	0.22±1.80E-08	NA
WNW1102A	*December*	NA	NA	NA
WNW1102B	*June*	2.29±6.60E-07	0.86±1.60E-08	NA
WNW1102B	*December*	NA	NA	NA
WNW1103A	*June*	-5.29±6.30E-07	0.68±1.70E-08	NA
WNW1103A	*December*	NA	NA	NA
WNW1103B	*June*	-0.18±7.50E-07	0.14±2.00E-08	NA
WNW1103B	*December*	NA	NA	NA
WNW1104A	*June*	5.92±6.30E-07	0.33±2.10E-08	NA
WNW1104A	*December*	NA	NA	NA
WNW1104B	*June*	1.48±8.40E-07	0.09±2.30E-08	NA
WNW1104B	*December*	NA	NA	NA
WNW1104C	*June*	0.06±2.70E-06	0.87±7.60E-08	NA
WNW1104C	*December*	NA	NA	NA
WNW1105A	*June*	3.08±7.60E-07	1.19±2.10E-08	NA
WNW1105A	*December*	NA	NA	NA
WNW1105B	*June*	0.06±5.80E-07	2.05±1.60E-08	NA
WNW1105B	*December*	NA	NA	NA
WNW1106A	*June*	9.98±7.30E-07	1.02±1.80E-08	NA
WNW1106A	*December*	NA	NA	NA
WNW1106B	*June*	1.63±8.60E-07	0.93±2.30E-08	NA
WNW1106B	*December*	NA	NA	NA
WNW1107A	*June*	-1.03±6.50E-07	1.26±2.00E-08	NA
WNW1107A	*December*	NA	NA	NA
WNW1108A	*June*	0.66±5.90E-07	0.21±1.90E-08	NA
WNW1108A	*December*	NA	NA	NA
WNW1109A	*June*	3.41±8.30E-07	-1.20±2.30E-08	NA
WNW1109A	*December*	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA - Not available.

Table L-3 (concluded)
1999 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Thorium-234	Uranium-235	Uranium-238
WNW1109B	*June*	7.46±7.70E-07	0.44±1.80E-08	1.06±0.80E-07
WNW1109B	*December*	NA	NA	NA
WNW1110A	*June*	-0.25±6.50E-07	-1.39±2.00E-08	NA
WNW1110A	*December*	NA	NA	NA
WNW1111A	*June*	-1.62±7.30E-07	1.17±1.50E-08	NA
WNW1111A	*June*	2.17±7.50E-07	0.01±2.00E-08	NA
WNW1111A	*December*	NA	NA	NA

All data in Tables L-1 through L-3 have been provided by NYSERDA. Some scheduled analyses could not be performed because of insufficient sample volume. NA- Not available.

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GLOSSARY

Accuracy. The degree of agreement between a measurement and its true value. The accuracy of a data set is assessed by evaluating results from standards or spikes containing known quantities of an analyte.

Action plan. An action plan addresses assessment findings and root causes that have been identified in an audit or an assessment report. It is intended to set forth specific actions that the site will undertake to remedy deficiencies. The plan includes a timetable and funding requirements for implementation of the planned activities.

Alluvial fan. A cone-shaped deposit of alluvium made by a stream where it runs out onto a level plain.

Alluvium. Sedimentary material deposited by flowing water such as a river.

Aquifer. A water-bearing unit of permeable rock or soil that will yield water in usable quantities to wells. *Confined aquifers* are bounded above and below by less permeable layers. Groundwater in a confined aquifer is under a pressure greater than the atmospheric pressure. *Unconfined aquifers* are bounded below by less permeable material but are not bounded above. The pressure on the groundwater at the surface of an unconfined aquifer is equal to that of the atmosphere.

As low as reasonably achievable (ALARA). An approach to radiation protection that advocates controlling or managing exposures (both individual and collective) to the work force and the general public and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. As used in DOE Order 5400.5, ALARA is not a dose limit but, rather, a process that has as its objective the attainment of dose levels as far below the applicable limits of the Order as practicable.

Background radiation. Natural and manmade radiation such as cosmic radiation and radiation from naturally radioactive elements and from commercial sources and medical procedures.

Becquerel (Bq). A unit of radioactivity equal to one nuclear transformation per second.

Categorical exclusion. A proposed action that normally does not require an environmental assessment or an environmental impact statement and that the Department of Energy has determined does not individually or cumulatively have a significant effect on the human environment. See 10 CFR 1021.410.

Class A, B, and C low-level waste. Waste classifications from the Nuclear Regulatory Commission's 10 CFR Part 61 rule. Maximum concentration limits are set for specific isotopes. Class A waste disposal is minimally restricted with respect to the form of the waste. Class B waste must meet more rigorous requirements to ensure physical stability after disposal. Greater concentration limits are set for the same isotopes in Class C waste, which also must meet physical stability requirements. Moreover, special measures must be taken at the disposal facility to protect against inadvertent intrusion.

Compliance findings. Conditions that may not satisfy applicable environmental or safety and health regulations, DOE Orders and memoranda, enforcement actions, agreements with regulatory agencies, or permit conditions.

Confidence coefficient or factor. The chance or probability, usually expressed as a percentage, that a confidence interval includes some defined parameter of a population. The confidence coefficients usually associated with confidence intervals are 90%, 95%, and 99%.

Consistency. The condition of showing steady conformity to practices. In the environmental monitoring program, approved procedures are in place in order to ensure that data collection activities are carried out in a consistent manner so that variability is minimized.

Cosmic radiation. High-energy subatomic particles from outer space that bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

Counting error. The variability caused by the inherent random nature of radioactive disintegration and by the detection process.

Curie (Ci). A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

Data set. A group of data (e.g., factual information such as measurements or statistics) used as a basis for reasoning, discussion, or calculation.

Decay (radioactive). Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons or by spontaneous fission.

Derived concentration guide (DCG). The concentration of a radionuclide in air and water that, under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an effective dose equivalent of 100 mrem (1 mSv). See Table K-1 in Appendix K.

Detection limit or level. The smallest amount of a substance that can be distinguished in a sample by a given measurement procedure at a given confidence level. (See **lower limit of detection**.)

Dispersion (groundwater). The process whereby solutes are spread or mixed as they are transported by groundwater as it moves through sediments.

Dosimeter. A portable device for measuring the total accumulated exposure to ionizing radiation.

Downgradient. The direction of water flow from a reference point to a selected point of interest. (See **gradient.**)

Effective dose. See **effective dose equivalent** under **radiation dose**.

Effluent. Any treated or untreated air emission or liquid discharge, including storm water runoff, at a DOE site or facility.

Effluent monitoring. Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

Enhanced work planning. A process that evaluates and improves the program by which work is identified, planned, approved, controlled, and executed. The key elements are line management ownership, a graded approach to work management based on risk and complexity, worker involvement beginning at the earliest phases of work management, organizationally diverse teams, and organized, institution-wide communication.

Environmental assessment. An evaluation that provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact. See 40 CFR 1508.9.

Environmental impact statement. A detailed statement that includes the environmental impact of the proposed action, any adverse environmental effects that cannot be avoided should the proposal be implemented, and alternatives to the proposed action. See Section 102 (2) (C) of the National Environmental Policy Act.

Environmental management system. The systematic application of business management practices to environmental issues, including defining the organizational structure, planning for activities, identifying responsibilites, and defining practices, procedures, processes, and resources.

Environmental monitoring. The collection and analysis of samples or the direct measurement of environmental media. Environmental monitoring consists of two major activities: effluent monitoring and environmental surveillance.

Environmental surveillance. The collection and analysis of samples or the direct measurement of air, water, soil, foodstuff, and biota in order to determine compliance with applicable standards and permit requirements.

Erg. One-billionth (1E-09) of the energy released by a 100-watt bulb in 1 second.

Evapotranspiration. The combined total precipitation returned to the air through direct evaporation and by transpiration of vegetation.

Exposure. The subjection of a target (usually living tissue) to radiation.

Fallout. Radioactive materials mixed into the earth's atmosphere. Fallout constantly precipitates onto the earth.

Finding. A Department of Energy compliance term. A finding is a statement of fact concerning a condition in the Environmental, Safety, and Health program that was investigated during an appraisal. Findings include best management practice findings, compliance findings, and noteworthy practices. A finding may be a simple statement of proficiency or a description of deficiency (i.e., a variance from procedures or criteria). See also **self-assessment**.

Fission. The act or process of splitting into parts. A nuclear reaction in which an atomic nucleus splits into fragments, i.e., fission products, usually fragments of comparable mass, with the evolution of approximately 100 million to several hundred million electron volts of energy.

Gamma isotopic (also **gamma scan).** An analytical method by which the quantity of several gamma ray-emitting radioactive isotopes may be determined simultaneously. Typical nuclear fuel cycle isotopes determined by this method include but are not limited to Co-60, Zr-95, Ru-106, Ag-110m, Sb-125, Cs-134, Cs-137, and Eu-154. Naturally occurring isotopes for which samples also often are analyzed are Be-7, K-40, Ra-224, and Ra-226.

Gradient. Change in value of one variable with respect to another variable, especially vertical or horizontal distance.

Groundwater. Subsurface water in the pore spaces of soil and geologic units.

Half-life. The time in which half the atoms of a radionuclide disintegrate into another nuclear form. The half-life may vary from a fraction of a second to thousands of years.

Hazardous waste. A waste or combination of wastes that because of quantity, concentration, or physical, chemical, or infectious characteristics may: a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

High-level waste (HLW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations sufficient to require permanent isolation. (See also **transuranic waste**.)

Hydraulic conductivity. The ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium; the ratio describing the rate at which water can move through a permeable medium.

Integrated safety management system (ISMS). The integrated safety management system (ISMS) describes the programs, policies, and procedures used by WVNS and the DOE to ensure that WVNS establishes a safe workplace for the employees, the public, and the environment. The guiding principles of ISMS are line management responsibility for safety; clear roles and responsibilities; competence commensurate with responsibilities; balanced priorities; identification of safety standards and requirements; hazard controls; and operations authorization.

Interim status. The status of any currently existing facility that becomes subject to the requirement to have a RCRA permit because of a new statutory or regulatory amendment to RCRA.

Interstitial. The (annular) space between the inner and outer tank walls in a double-walled storage tank.

Ion. An atom or group of atoms with an electric charge.

Ion exchange. The reversible exchange of ions contained in solution with other ions that are part of the ion-exchange material.

Isotope. Different forms of the same chemical element that are distinguished by having the same number of protons but a different number of neutrons in the nucleus. An element can have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium, with one, two, and three neutrons in the nucleus, respectively.

Kame delta. A conical hill or short irregular ridge of gravel or sand deposited in contact with glacier ice.

Lacustrine sediments. A sedimentary deposit consisting of material pertaining to, produced by, or formed in a lake or lakes.

Land disposal restrictions (LDR). Regulations promulgated by the U.S. EPA (and by NYSDEC in New York State) governing the land disposal of hazardous wastes. The wastes must be treated using the best demonstrated available technology or must meet certain treatment standards before being disposed.

Lower limit of detection (LLD). The lowest limit of a given parameter an instrument is capable of detecting. A measurement of analytical sensitivity.

Low-level waste (LLW). Radioactive waste not classified as high-level waste, transuranic waste, spent fuel, or uranium mill tailings. (See **Class A, B, and C low-level waste**.)

Maximally exposed individual. A hypothetical person who remains in an uncontrolled area who would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

Mean. The average value of a series of measurements.

Millirem (mrem). A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 500 millirems per year according to DOE standards. This limit does not include radiation received for medical treatment or the 100 to 360 mrem that people receive annually from background radiation.

Minimum detectable concentration (MDC). Depending on the sample medium, the smallest amount or concentration of a radioactive or nonradioactive analyte that can be reliably detected using a specific analytical method. Calculations of the minimum detectable concentrations are based on the lower limit of detection.

Mixed waste. A waste that is both radioactive and hazardous. Also referred to as radioactive mixed waste (RMW).

n-Dodecane/tributyl phosphate. An organic solution composed of 30% tributyl phosphate (TBP) dissolved in n-dodecane used to first separate the uranium and plutonium from the fission products in the dissolved fuel and then to separate the uranium from the plutonium.

Neutron. An electrically neutral subatomic particle in the baryon family with a mass 1,839 times that of an electron, stable when bound in an atomic nucleus, and having a mean lifetime of approximately 16.6 minutes as a free particle.

Notice of violation. A letter of notice from a regional water engineer in response to an instance of significant noncompliance with a SPDES permit. Generally, an official notification from a regulatory agency of noncompliance with permit requirements.

Nucleus. The positively charged central region of an atom, made up of protons and neutrons and containing almost all of the mass of the atom.

Outfall. The end of a drain or pipe that carries wastewater or other effluents into a ditch, pond, or river.

Parameter. Any of a set of physical properties whose values determine the characteristics or behavior of something (e.g., temperature, pressure, density of air). In relation to environmental monitoring, a monitoring parameter is a constituent of interest. Statistically, the term "parameter" is a calculated quantity, such as a mean or variance, that describes a statistical population.

Particulates. Solid particles and liquid droplets small enough to become airborne.

Person-rem. The sum of the individual radiation dose equivalents received by members of a certain group or population. It may be calculated by multiplying the average dose per person by the number of persons exposed. For example, a thousand people each exposed to one millirem would have a collective dose of one person-rem.

Plume. The distribution of a pollutant in air or water after being released from a source.

Precision. The degree of reproducibility of a measurement under a given set of conditions. Precision in a data set is assessed by evaluating results from duplicate field or analytical samples.

Proglacial lake. A lake occupying a basin in front of a glacier; generally in direct contact with the ice.

Proton. A stable, positively charged subatomic particle in the baryon family with a mass 1,836 times that of an electron.

Pseudo-monitoring point. A theoretical monitoring location rather than an actual physical location; a calculation based on analytical test results of samples obtained from other associated, tributary, monitored locations. (Point 116 at the WVDP is classified as a "pseudo" monitoring point because samples are not actually physically collected at that location. Rather, using analytical results from samples collected from "real" upstream outfall locations, compliance with the total dissolved solids limit in the WVDP's SPDES permit is calculated for this theoretical point.)

Quality factor. The extent of tissue damage caused by different types of radiation of the same energy. The greater the damage, the higher the quality factor. More specifically, the factor by which absorbed doses are multiplied to obtain a quantity that indicates the degree of biological damage produced by ionizing radiation. (See **radiation dose**.) The factor is dependent upon radiation type (alpha, beta, gamma, or x-ray) and exposure (internal or external).

Rad. Radiation absorbed dose. One hundred ergs of energy absorbed per gram.

Radiation. The process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

> **Alpha radiation**. The least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or the outer dead layer of skin.
>
> **Beta radiation**. Electrons emitted from a nucleus during fission and nuclear decay. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.
>
> **Gamma radiation**. A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding such as lead, concrete, or steel to be stopped.
>
> **Internal radiation**. Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or manmade radionuclides in body tissues.

Radiation dose:

> **Absorbed dose**. The amount of energy absorbed per unit mass in any kind of matter from any kind of ionizing radiation. Absorbed dose is measured in rads or grays.

Collective dose equivalent. The sum of the dose equivalents for all the individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population. The unit of collective dose equivalent is person-rem or person-sievert.

Collective effective dose equivalent. The sum of the effective dose equivalents for the individuals comprising a defined population. Units of measurement are person-rems or person-sieverts. The per capita effective dose equivalent is obtained by dividing the collective dose equivalent by the population. Units of measurement are rems or sieverts.

Committed dose equivalent. A measure of internal radiation. The predicted total dose equivalent to a tissue or organ over a fifty-year period after a known intake of a radionuclide into the body. It does not include contributions from sources of external penetrating radiation. Committed dose equivalent is measured in rems or sieverts.

Committed effective dose equivalent. The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is measured in rems or sieverts.

Radioactivity. A property possessed by some elements (such as uranium) whereby alpha, beta, or gamma rays are spontaneously emitted.

Radioisotope. A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen. (See **isotope**.)

Radionuclide. A radioactive nuclide. Radionuclides are variations (isotopes) of elements. They have the same number of protons and electrons but different numbers of neutrons, resulting in different atomic masses. There are several hundred known nuclides, both manmade and naturally occurring.

Rem. An acronym for Roentgen Equivalent Man. A unit of radiation exposure that indicates the potential effect of radiation on human cells.

Remote-handled waste. At the WVDP, waste that has an external surface dose rate that exceeds 100 millirem per hour or a high level of alpha and/or beta surface contamination.

Self-assessment. Self-assessments are appraisals conducted by the WVDP to identify and correct any existing deficiencies in the environmental monitoring program. Under the WVDP environmental monitoring procedure *Self-Assessments for Environmental Programs*, information obtained from an appraisal is categorized as follows:

Key finding. A direct and significant violation of a Department of Energy regulatory or other applicable guidance or procedural requirement, or a recurring pattern of observed deficiencies that could result in such a violation. A finding is a deficiency that requires corrective action.

Observation. A weakness that, if not corrected, could result in a deficiency. An observation may result if an explicit procedural nonconformance is noted but the nonconformance is an isolated incident or of minor significance. An observation requires corrective action.

Comment or concern. A comment is a subjective opinion of the assessment team that may be used to improve any of the specific environmental monitoring program activities, noted in *Self-Assessments for Environmental Programs,* such as sample collection, preparation, logging, storage, and shipping; instrument and equipment calibration; data receipt and data entry; training requirements and records; and compliance with discharge permit requirements. Corrective action in response to a comment or concern is at the discretion of the cognizant staff.

Commendable practice. A significant strength noted during the course of a self-assessment.

Deficiency. A condition that does not meet or cannot be documented to meet applicable requirements.

Sievert. A unit of dose equivalent from the International System of Units (Systeme Internationale). Equal to one joule per kilogram.

Solid waste management unit (SWMU). Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

Spent fuel. Nuclear fuel that has been used in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

Spill. A spill or release is defined as "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances from the ordinary containers employed in the normal course of storage, transfer, processing, or use."

Standard deviation. An indication of the dispersion of a set of results around their average.

Super solid waste management unit (SSWMU). Individual solid waste management units that have been grouped and ranked into larger units — super solid waste management units — because some individual units are contiguous or so close together as to make monitoring of separate units impractical.

Surface water. Water that is exposed to the atmospheric conditions of temperature, pressure, and chemical composition at the surface of the earth.

Surveillance. The act of monitoring or observing a process or activity to verify conformance with specified requirements.

Thermoluminescent dosimeter (TLD). A device that luminesces upon heating after being exposed to radiation. The amount of light emitted is proportional to the amount of radiation to which the luminescent material has been exposed.

Transuranic waste. Waste containing transuranic elements, i.e., those elements with an atomic number greater than 92, including neptunium, plutonium, americium, and curium.

Upgradient. Referring to the flow of water or air, "upgradient" is analogous to upstream. Upgradient is a point that is "before" an area of study that is used as a baseline for comparison with downstream data. See **gradient** and **downgradient**.

Watershed. The area contained within a drainage divide above a specified point on a stream.

Water table. The upper surface in a body of groundwater; the surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric pressure.

X-ray. Penetrating electromagnetic radiations having wave lengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays and those originating in the extranuclear part of the atom as x-rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.

ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-containing material
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
BEIR	Committee on Biological Effects of Ionizing Radiation
BOD_5	Biochemical Oxygen Demand (5-day)
CAA	Clean Air Act
CDDL	Construction and Demolition Debris Landfill
CEDE	Committed Effective Dose Equivalent
CEMP	Code of Environmental Management Principles for Federal Agencies
CEQ	(President's) Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	Certificate-to-Operate
CPC	Chemical Process Cell
CPC-WSA	Chemical Process Cell Waste Storage Area
CSPF	Container Sorting and Packaging Facility
CSRF	Contact Size-reduction Facility
CSS	Cement Solidification System
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CX	Categorical Exclusion
CY	Calendar Year
DCG	Derived Concentration Guide
DMR	Discharge Monitoring Report
DOE	(U.S.) Department of Energy
DOE-EM	Department of Energy, Office of Environmental Restoration and Waste Management
DOE-HQ	Department of Energy, Headquarters Office
DOE-OH	Department of Energy, Ohio Field Office
DOT	(U.S.) Department of Transportation
EA	Environmental Assessment

EDE	Effective Dose Equivalent
EHS	Extremely Hazardous Substance
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EMS	Environmental Management System
EPA	(U.S.) Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ES&H	Environmental Safety and Health
ESR	(WVDP) Effluent Summary Report
EWP	Enhanced Work Planning
FFC Act	Federal Facility Compliance Act
FONSI	Finding of No Significant Impact
FRS	Fuel Receiving and Storage
FSFCA	Federal and State Facility Compliance Agreement
FY	Fiscal Year
GEL	General Engineering Laboratory
HEPA	High-efficiency Particulate Air (filter)
HLW	High-level (radioactive) Waste
HPIC	High-pressure Ion Chamber
HTO	Hydrogen Tritium Oxide
HVAC	Heating, Ventilation, and Air Conditioning
ICRP	International Commission on Radiological Protection
IRTS	Integrated Radwaste Treatment System
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
LAS	Linear Alkylate Sulfonate
LDR	Land Disposal Restriction
LIMS	Laboratory Information Management System
LLD	Lower Limit of Detection
LLW	Low-level (radioactive) Waste
LLWTF	Low-level (Liquid) Waste Treatment Facility
LPS	Liquid Pretreatment System
LSA	Lag Storage Area
LTR	License Termination Rule
LWTS	Liquid Waste Treatment System
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MSDS	Material Safety Data Sheet
MTAR	Monthly Trend Analysis Report
NCRP	National Council on Radiation Protection and Measurements
NDA	Nuclear Regulatory Commission-licensed Disposal Area
NEPA	National Environmental Policy Act
NERL ESD	National Exposure Research Laboratory, Environmental Sciences Division

NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services, Inc.
NIST	National Institute of Standards and Technology
NOI	Notice of Intent
NO_x	Nitrogen Oxides
NPOC	Nonpurgeable Organic Carbon
NPGRS	North Plateau Groundwater Recovery System
NPDES	National Pollutant Discharge Elimination System
NRC	(U.S.) Nuclear Regulatory Commission
NYCRR	New York Official Compilation of Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOL	New York State Department of Labor
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey
OH/WVDP	Department of Energy, West Valley Demonstration Project
OSHA	Occupational Safety and Health Act
OSR	Operational Safety Requirement
OVE	Outdoor Ventilated Enclosure
PC	Permit-to-Construct
PCB	Polychlorinated Biphenyl
PQL	Practical Quantitation Limit
PTW	Permeable Treatment Wall
PVS	Permanent Ventilation System
PVU	Portable Ventilation Unit
QA	Quality Assurance
QAP	Quality Assessment Program (also Quality Assurance Program)
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RMW	Radioactive Mixed Waste
SAR	Safety Analysis Report
SARA	Superfund Amendments and Reauthorization Act
SD	Standard Deviation
SDA	(New York) State-licensed Disposal Area
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SI	Systeme Internationale (International System of Units)
SO_2	Sulfur Dioxide
SPDES	State Pollutant Discharge Elimination System
STS	Supernatant Treatment System
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit

SSWMU	Super Solid Waste Management Unit
TBP	Tributyl Phosphate
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimetry
TOC	Total Organic Carbon
TOX	Total Organic Halogens
TRI	Toxic Release Inventory
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WNYNSC	Western New York Nuclear Service Center
WRG	Work Review Group
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services Company
WWTF	Wastewater Treatment Facility

Units of Measure

Radioactivity

Symbol	*Name*
Ci	curie
mCi	millicurie (1E-03 Ci)
μCi	microcurie (1E-06 Ci)
nCi	nanocurie (1E-09 Ci)
pCi	picocurie (1E-12 Ci)
Bq	becquerel (27 pCi)

Volume

Symbol	*Name*
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
gal	gallon
ft^3	cubic feet
ppm	parts per million
ppb	parts per billion

Dose

Symbol	*Name*
Sv	sievert (100 rems)
mSv	millisievert (1E-03 Sv)
Gy	gray (100 rads)
mrem	millirem

Area

Symbol	*Name*
ha	hectare (10,000 m^2)

Concentration

Symbol	*Name*
μCi/mL	microcuries per milliliter
mL/L	milliliters per liter
μCi/g	microcuries per gram
mg/L	milligrams per liter
μg/mL	micrograms per milliliter
pCi/L	picocuries per liter

Length

Symbol	*Name*
m	meter
km	kilometer (1E+03 m)
cm	centimeter (1E-02 m)
mm	millimeter (1E-03 m)
μm	micrometer (1E-06 m)

Mass

Symbol	*Name*
g	gram
kg	kilogram (1E+03 g)
mg	milligram (1E-03 g)
μg	microgram (1E-06 g)
ng	nanogram (1E-09 g)
t	metric ton (1E+06 g)

Flow Rate

Symbol	*Name*
mgd	million gallons per day
cfm	cubic feet per minute
Lpm	liters per minute
gpd	gallons per day

Unit Prefixes

centi	1/100 = 1 x 10^{-2} = 0.01 = E-02
milli	1/1,000 = 1 x 10^{-3} = 0.001 = E-03
micro	1/1,000,000 = 1 x 10^{-6} = 0.000001 = E-06
nano	1/1,000,000,000 = 1 x 10^{-9} = 0.000000001 = E-09
pico	1/1,000,000,000,000 = 1 x 10^{-12} = 0.000000000001 = E-12

Scientific Notation

Scientific notation may be used to express very large or very small numbers. A number smaller than 1 is expressed with a negative exponent, e.g., 1.3×10^{-6}. To convert this number to decimal form, the decimal point is moved left by the number of places equal to the exponent. Thus, 1.3×10^{-6} becomes 0.0000013.

A number larger than 10 is expressed with a positive exponent, e.g., 1.3×10^{6}. To convert this number to decimal form, the decimal point is moved right by the number of places equal to the exponent. Thus, 1.3×10^{6} becomes 1,300,000.

The power of 10 also is expressed as E. For example, 1.3×10^{-6} also can be written as 1.3E-06. The chart below shows equivalent exponential and decimal values.

1.0×10^{2}	=	1E+02	=	100	
1.0×10^{1}	=	1E+01	=	10	
1.0×10^{0}	=	1E+00	=	1	
1.0×10^{-1}	=	1E-01	=	0.1	
1.0×10^{-2}	=	1E-02	=	0.01	
1.0×10^{-3}	=	1E-03	=	0.001	
1.0×10^{-4}	=	1E-04	=	0.0001	
1.0×10^{-5}	=	1E-05	=	0.00001	
1.0×10^{-6}	=	1E-06	=	0.000001	One Millionth
1.0×10^{-7}	=	1E-07	=	0.0000001	
1.0×10^{-8}	=	1E-08	=	0.00000001	

Conversion Chart

Both traditional radiological units (curie, roentgen, rad, rem) and the Systeme Internationale (S.I.) units (becquerel, gray, sievert) are used in this report. Nonradiological measurements are presented in metric units with the English equivalent noted in parentheses.

1 centimeter (cm)	=	0.3937 inches (in)
1 meter (m)	=	39.37 inches (in) = 3.28 feet (ft)
1 kilometer (km)	=	0.62 miles (mi)
1 milliliter (mL)	=	0.0338 ounces (oz)
	=	0.061 cubic inches (in^3)
	=	1 cubic centimeter (cm^3)
1 liter (L)	=	1.057 quarts (qt)
	=	61.02 cubic inches (in^3)
1 gram (g)	=	0.0353 ounces (oz)
	=	0.0022 pounds (lbs)
1 kilogram (kg)	=	2.2 pounds (lbs)
1 curie (Ci)	=	3.7×10^{10} disintegrations per second (d/s)
1 becquerel (Bq)	=	1 disintegration per second (d/s)
	=	27 picocuries (pCi)
1 roentgen (R)	=	2.58×10^{-4} coulombs per kilogram of air (C/kg)
1 rad	=	0.01 gray (Gy)
1 rem	=	0.01 sievert (Sv)
1 millirem (mrem)	=	0.001 rem

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