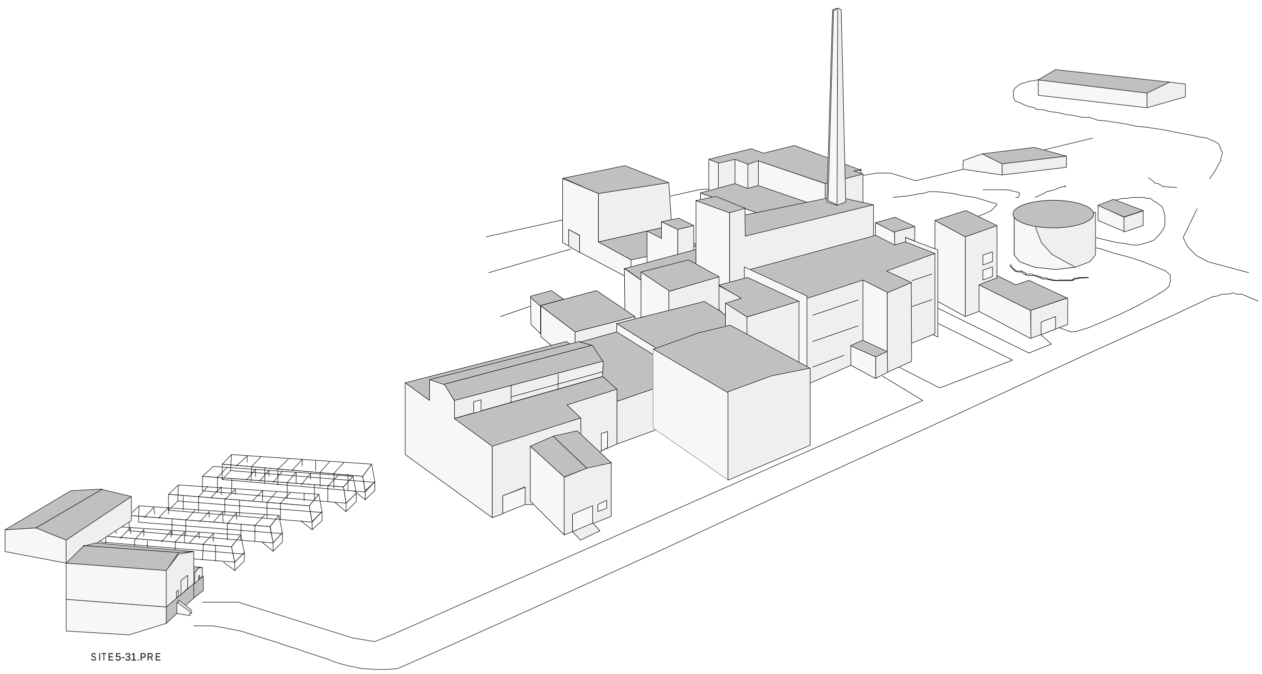
WEST VALLEY DEMONSTRATION PROJECT
SITE ENVIRONMENTAL REPORT
CALENDAR YEAR 1997



West Valley Nuclear Services Company, Inc.
and
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Prepared for:
U.S. Department of Energy
Ohio Field Office
West Valley Demonstration Project
Under Contract DE-AC24-81NE44139

June 1998
P.O. Box 191
10282 Rock Springs Road
West Valley, New York 14171-0191

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for

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Preface

Environmental monitoring at the West Valley Demonstration Project (WVDP) is conducted by the West Valley Nuclear Services Company, Inc. (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 1997 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 is a summary of the site environmental monitoring schedule. Appendix B lists the environmental permits and regulations pertaining to the WVDP. Appendices C through F contain summaries of data obtained during 1997 and are intended for those readers interested in more detail than is provided in the main body of the report.

Requests for additional copies of the 1997 Site Environmental Report and questions regarding the report should be referred to the WVDP Community Relations Department, P.O. Box 191, 10282 Rock Springs Road, West Valley, New York 14171-0191 (telephone: 716-942-4610).

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CHAPTER 2. ENVIRONMENTAL MONITORING

The West Valley Demonstration Project's environmental monitoring program includes monitoring and sampling of liquid and air effluents both on- and off-site. Deer, fish, milk, hay, and various fruits and vegetables also are sampled.

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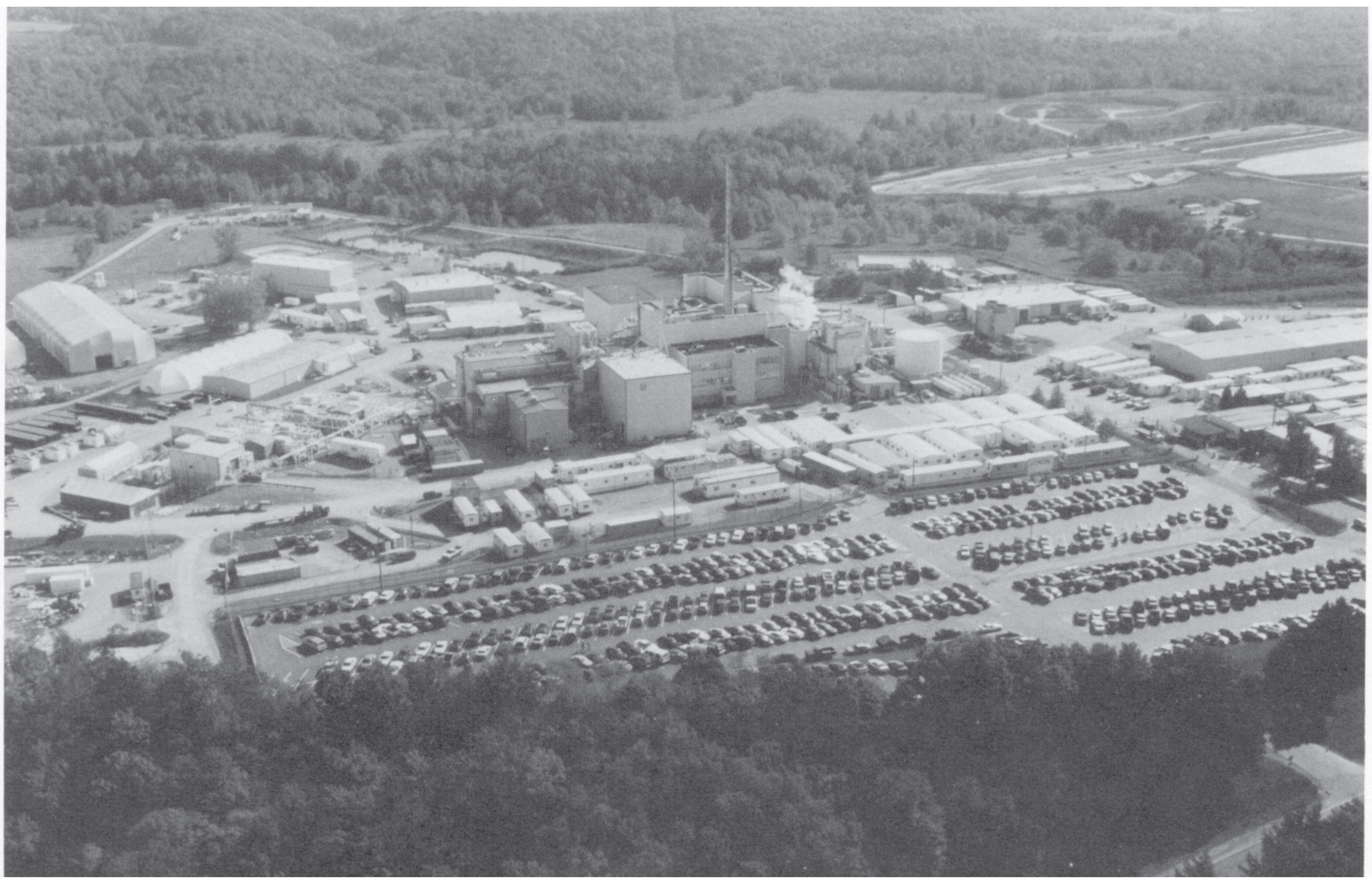

The West Valley Demonstration Project

EXECUTIVE SUMMARY

Project Description

The West Valley Demonstration Project (WVDP), the site of a U.S. Department of Energy environmental cleanup activity operated by West Valley Nuclear Services Co., Inc. (WVNS), is in the process of stabilizing liquid high-level radioactive waste remaining 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's central mission is to stabilize the liquid high-level waste, now stored in underground tanks, in containers suitable for temporary storage on-site and for eventual transport to a federal repository. In 1997 the Project successfully continued vitrification of high-level radioactive waste into a durable, solid glass form.

Compliance

Management at the WVDP continued to provide strong support for environmental compliance issues in 1997. DOE Orders and applicable state and federal statutes and regulations are integrated into the Project's compliance program. Highlights of the 1997 compliance program were as follows:

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

- The Project continued to identify and evaluate 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 and making available to the local community information about hazardous materials used at the Project. All EPCRA reporting deadlines were met ahead of schedule in 1997.

- The State Pollutant Discharge Elimination System (SPDES) permit currently identifies four permitted liquid outfalls at the Project. A draft

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

SPDES permit to monitor eleven identified storm water outfalls was issued for public comment in June 1997.

• In 1997 SPDES permit limits were exceeded three times during temporary process upsets. Natural variations in a nonprocess groundwater outfall caused two additional exceedances.

• No notices of violation from any environmental regulatory agencies were received in 1997, although a warning letter was received from NYSDEC regarding the five SPDES exceedances.

• Among other pollution prevention accomplishments, waste minimization goals for 1997 were exceeded in all of the waste categories set in the goals statement.

• In accordance with the Site Treatment Plan developed under the Federal Facility Compliance Act, all calendar year 1997 milestones for the characterization, treatment, and disposition of radioactive mixed waste at the WVDP were completed.

• Although two minor liquid spills occurred onsite inside a previously contaminated facility area, there were no accidental off-site releases of radiological material in 1997.

Environmental Monitoring Program

Throughout the first year of vitrification, specific, sustained attention was given to environmental monitoring and assessment of effluents from site facilities. During 1997 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 11,000 samples were collected in order to assess the effect of site activities on public health, safety, and the environment.

The Project environmental monitoring network is continually being evaluated and updated to ensure that all locations and sample types that would be sensitive to process-related changes are monitored. Once samples are collected, they are tested for radioactivity 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 monitoring results are kept up-to-date in a controlled computer database available to WVDP scientists, who assess the data and evaluate trends at key locations.

Air Monitoring

WVDP airborne radiological emissions in 1997 included six routinely operated permitted exhaust stacks and five exhausts excluded from permitting because of their low emission potential. As anticipated, radioactive releases from the Project in 1997 were far below the most restrictive limits that ensure public health and safety. Operation of the vitrification process resulted in radiological air releases similar to those noted in the last few months of 1996. The dose from 1997 air emissions was about 0.5% of the most restrictive limit. In 1996 the dose from these emissions was about 0.09%.

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 1997 levels of gaseous iodine-129 emissions increased approximately six times from 1996 levels but, in perspective, total radionuclide emissions remained less than 1% of the EPA radionuclide emissions standard of 10 millirem (mrem) per year effective dose equivalent to the maximally exposed off-site individual. Approximately 99% of the 1997 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 test samples are collected for analysis of tritium and iodine-129. Gross radioactivity (airborne particulate) in air samples from around the perimeter was no different than radioactivity measured in remote background locations or nearby communities. Gross radioactivity at the nearest perimeter sampler remained the same in 1997 as in 1996. Concentrations in samples from two on-site ambient air samplers located near waste storage facilities operated during 1997 also were indistinguishable from background levels.

Nonradiological air emission monitoring of nitrogen oxides, a byproduct of the vitrification process, is conducted as part of the emission-control process. 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.

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. Six treated batches totaling 11.6 million gallons were released over a combined thirty-nine day period in 1997. In 1996, 13.4 million gallons had been released.

The combined average concentration of all radionuclides in liquid releases in 1997 was approximately 22% of the DOE derived concentration guide (DCG) used to evaluate liquid process discharges. (See ***Chapter 1***, ***Environmental Monitoring Program Information*** [p.1-5] for an explanation of derived concentration guides.) The average radioactivity concentrations from 1994 to 1996 were 44%, 43%, and 35% of the DCG, respectively. The reduction from 44% to 22% over this period is mostly attributable to steadily decreasing strontium-90 concentrations. The other major contributor to the total combined DCG is uranium-232, which averaged 11.9% of its DCG in 1997, 9% lower than the average concentration in 1996.

Surface water is continually sampled on the Project premises by four automatic samplers. Time-composite samples are collected at Frank's Creek where it exits the Project and at two other on-site points where drainage flows off-site. Another automatic sampler is located at a 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 1996, the most notable source of gross beta and strontium-90 radioactivity in surface water in 1997 was from groundwater flowing beneath the north plateau and emerging in a seep to join the surface water drainage from the north plateau into Frank's Creek and then off-site. In 1997 the strontium-90 concentration, which originates from pre-Project operations, was about 1.1 times the DCG for liquid discharges. The 1996 strontium-90 concentration at this point was 1.3 times the DCG.

This drainage point has been carefully monitored since the contaminated seep was identified in 1993. Currently, a groundwater recovery and treatment system is being used to reduce the seepage of strontium-90 to surface water on the north plateau. The decrease in the 1997 strontium-90 concentration at the northeast swamp drainage, relative to the 1996 concentration, indicates that the system has favorably influenced a downward trend.

Soil and Stream Sediments

Surface soil is collected annually at the ten air sampler locations 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 to track waterborne movement of contaminants.

Surface soil samples in 1997 showed little change from previous years. For the most part, except for one area that historically shows average cesium-137 concentrations above background values, the concentrations of radionuclides normally present in both worldwide fallout and in 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 radioactivity in downstream creek sediments historically are above concentrations in the upstream sediments. However, the twelve-year graphs indicate no upward trends at either upstream or downstream points. No changes were noted in on-site soil/sediment samples between 1997 and previous years.

Groundwater Monitoring

Scheduled groundwater samples were collected from sixty-five on-site locations in 1997. Based on an evaluation of results from the 1996 program, the location, frequency of sampling, types of testing, and method of sample collection were adjusted for the 1997 monitoring program. Computerized screening of 1997 data speeded identification and evaluation of changes. Monitoring activities in 1997 included gathering more detailed information about the north plateau strontium-90 contamination. The 1997 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 side of the bank above Frank's Creek. Results were similar to 1996 results.

As in previous years, near-site residential water supply wells sampled during 1997 indicated no radioactive contamination.

Vegetation, Meat, and Milk

Test results from beans and sweet corn showed no difference between annual samples collected near the site and samples taken from remote locations. A single hay sample showed a strontium-90 result nine times higher than its control location, but this increase was not corroborated by other sample types collected nearby. Apples collected from a near-site tree showed strontium-90 at levels statistically above 1997 background values. Strontium-90 values slightly above background were reported in most of the near-site fruit and vegetables, but corresponding above-background levels of other radionuclides were not found. In 1997, as in previous years, very little differences in radioactivity concentrations were observed between samples of beef and milk from near-site and remote locations.

Game Animals

Fifty fish specimens from Cattaraugus Creek were collected in 1997 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 levels very similar to those in 1996 samples. Concentrations in downstream and upstream specimens of the same species were similar. One of the ten below-dam fish, a migrating steelhead, did have detectable strontium-90 above background levels.

Three samples of whitetail deer venison from an on-site (WNYNSC) herd were tested for gamma-emitting isotopes and strontium-90. Two of three on-site venison samples contained tritium and cesium-137 concentrations above background concentrations. One person eating 100 pounds of meat from on-site deer would receive 0.46 millirem (mrem), which is 200 times less than the DOE 100 mrem dose standard. In comparison to an equal number of samples from deer taken in areas remote from the Project, the values for strontium-90 and other gamma-emitting isotopes were similar. Special samples were collected from an on-site herd of deer that was moved from inside the facility fence. Calculation of cesium-137 concentrations indicated that there will be no detectable differences from background concentrations in this herd in the fall of 1998, during deer hunting season.

In 1997, the fourth year of public access to portions of the WNYNSC for deer hunting, 113 deer were taken by hunters during the hunting season.

Program Quality

The WVDP environmental 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. In addition to a formal self-assessment review just before vitrification start-up, the WVDP environmental laboratory also continued the practice of analyzing radiological crosscheck samples sent from a national laboratory. Of 169 radiological analyses performed at both the on-site Project laboratory and off-site commercial service laboratories, 98.8% were within the control limits. Of the forty-seven samples tested on-site at the Project environmental laboratory, 100% were within acceptable limits, and twenty-two of the twenty-three nonradiological check samples tested at an off-site laboratory were within acceptable limits.

Although no formal external audits of the environmental program were conducted in 1997, test results from the crosscheck program and from co-located sample measurements taken by independent agencies such as the Nuclear Regulatory Commission (NRC) and the New York State Department of Health (NYSDOH) indicate that high quality standards are being met. The WVNS Environmental Affairs and the WVNS Quality Assurance departments periodically conducted and documented informal reviews of program activities in 1997.

Notable 1997 Events

The central event during 1997 was continued successful operation of the WVDP vitrification facility. Operational tracking of various effluents occupied most of the year. Removal of the resident deer herd from inside the security-fenced area was successfully planned and carried out.

Dose Assessment

There were no events affecting public health and safety or the environment associated with Project operations in 1997. 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 0.05 millirem (mrem). The limit is 10 mrem. Doses from the liquid pathway to the maximally exposed person were estimated to be 0.012 mrem from Project effluents (excluding north plateau drainage). The north plateau drainage contribution to the total liquid dose was estimated to be an additional 0.012 mrem. The predicted dose from all pathways was less than 0.075 mrem, or 0.075% 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 1997 indicates that Project activities pose no threat to public health, 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 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), undertook construction and operation of 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 Western New York Nuclear Service Center 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, federal and state safety regulations, which were more rigorous than those previously in existence, 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 NFS 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., Inc. (WVNS), a subsidiary of Westinghouse Electric Corporation, 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 for the completion of 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 settled into two layers, a liquid supernatant and a precipitate sludge. Various subsystems were constructed that permitted the successful start-up in May 1988 of the integrated radwaste treatment system (IRTS). The system stripped 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 ***Chapter 1, Environmental Monitoring Program Information*** [p. 1-7], 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. The last step, vitrification of the high-level waste residues, began in July 1996 and continued through 1997.

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, economy, 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.

Location of the West Valley Demonstration Project

The WVDP is located about 50 kilometers (30 mi) south of Buffalo, New York (Fig. 1 [p.xxv]). The WVDP facilities occupy a security-fenced area of about 80 hectares (200 acres) within the 1,332-hectare (3,340-acre) Western New York Nuclear Service Center. 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 plant. Several roads and a railway pass through the WNYNSC, but the public does not have access to the WNYNSC. Generally, hunting, fishing, and human habitation on the WNYNSC are prohibited. A NYSERDA-sponsored pilot program to control the deer population — initiated in 1994 — continued in 1997.

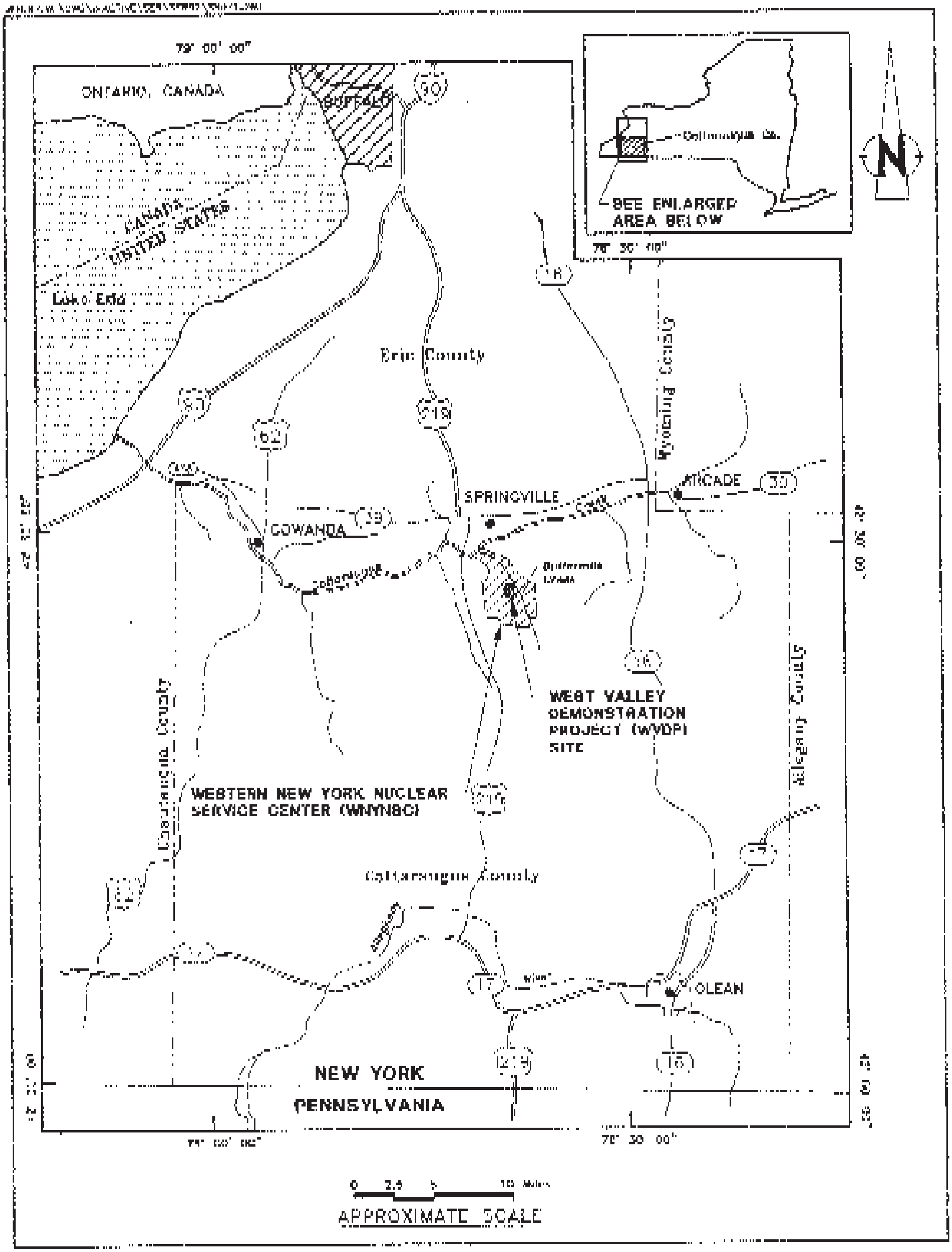

Figure 1. Location of the Western New York Nuclear Service Center.

Limited hunting permits were issued 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. Waters from Lake Erie are used as a public water supply.

Climate

Although there are recorded extremes of 37^{0}C (98.6^{0}F) and -42^{0}C (-43.6^{0}F) in Western New York, the climate is moderate, with an average annual temperature of 7.2^{0}C (45.0^{0}F). Rainfall is relatively high, averaging about 104 centimeters (41 in) per year. Precipitation in 1997 totaled 110 centimeters (43 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, 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 thick sequence of glacial sediments. (See Figs. 3-2 and 3-3 [pp. 3-4 and 3-5] 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 Fig. 3-1 [p. 3-3] in ***Chapter 3, Groundwater Monitoring***.)

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 soils. 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 vertical in a downward direction.

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. (See *Glossary,* p. 3.)

Within the Lavery till on the north plateau is a silty, sandy unit of limited extent, the Lavery till-sand. The flow of groundwater within the till-sand appears to be very limited. Surface discharge points have not been observed, but gradients indicate flow to the southeast.

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 towards the northeast and discharges ultimately to Buttermilk Creek.

The uppermost few feet of shale bedrock below the sedimentary sequence have demonstrated the ability to transmit groundwater flow via fractures.

Information in this Report

Format and Content

Individual chapters in this report include information on compliance with regulations, general information about the monitoring program and significant activities in 1997, summaries of the results of radiological and nonradiological monitoring, and calculations of radiation doses to the population within 80 kilometers of the site. Where appropriate, graphs and tables are included to illustrate important trends and concepts. The bulk of the supporting data is furnished separately in the appendices following the text.

Appendix A (pp. A-i through A-53) summarizes the 1997 environmental monitoring program at both 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 A* [pp. A-v through A-vii].) *Appendix A* lists the kinds of samples taken, the frequency of collection, the parameters analyzed, the location of the sample points, and a brief rationale for the monitoring activities conducted at each location.

Appendix B (pp. B-1 through B-7) 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 1997.

Appendix C (pp. C1-1 through C6-9) summarizes radiochemical and chemical analytical data from air, surface water, off-site groundwater, sediment, soils, and biological samples (meat, milk, food crops, and fish) as well as direct radiation measurements and meteorological monitoring.

Appendix D (pp. D-1 through D-11) 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 D* also lists the comparisons of direct radiation measurements from thermoluminescent dosimeters (TLDs) monitored by the WVDP and measurements from dosimeters placed in the same locations by the U.S. Nuclear Regulatory Commission (NRC).

Appendix E (pp. E-1 through E-38) summarizes the data collected from on-site groundwater monitoring locations. The tables in *Appendix E* report concentrations for parameters such as gross alpha and gross beta, tritium, gamma-emitting radionuclides, organic compounds, and metals.

Appendix F (pp. F-1 through F-10) contains groundwater monitoring data for the New York State-licensed disposal area (SDA), provided by NYSERDA.

Acronyms

Acronyms often are used in technical reports to speed up the reading process. Although using acronyms can be a practical way of referring to agencies or systems with long, 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, common acronyms that the reader is apt to be familiar with (e.g., DOE, EPA, NRC, NYSDEC, 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 found at the end 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 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.

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 on-site radioactive waste processing. Monitoring generally is a continuous process of measurement that allows rapid detection of any changes in the levels of the constituents measured 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 collected must be analyzed in a laboratory to obtain data. However, sample analysis allows much smaller quantities of radioactivity 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, 5400.5, 231.1, and DOE Regulatory Guide DOE/EH-0173T.

The West Valley Demonstration Project also 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.

In addition, the site operates under state-issued air discharge permits for nonradiological plant emissions. 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).

For more information about air and SPDES permits see the ***Environmental Compliance Summary: Calendar Year 1997*** (pp. xlix and lii). Environmental permits are listed in *Appendix B* (pp. B-5 through B-7).

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 as well as 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 many subsurface pathway concerns.

Water and Sediment Pathways

Process waters are treated in a series of on-site lagoons before being discharged through a single outfall. (The locations of the lagoons are noted on Fig. 2-3 [p. 2-6] in ***Chapter 2, Environmental Monitoring***.) 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 isotopic radioactivity.

In general, on-site groundwater and 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-1* [pp. C1-3 through C1-24] for water and sediment data summaries.)

Groundwater Pathways

Groundwater discharge at the WVDP site occurs as springs, seeps along stream channels, direct discharge to streams, evapotranspiration, vertical groundwater outflow, 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 and specific analytes of interest such as volatiles, semivolatiles, metals, and radionuclides at particular monitoring locations. (See Table E-1 [pp. E-3 through E-6] 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 silica gel column 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-9 [p. A-53] in *Appendix A* for these four off-site air sampling locations.) Six samplers are located on the perimeter of the WNYNSC. (See Fig. 2-2 [p. 2-5] in ***Chapter 2, Environmental Monitoring***.) These samples are analyzed for parameters similar to the effluent air samples. (See *Appendix C-2* [pp. C2-3 through C2-26] 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 occurred at Chernobyl. 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 C-2* [pp. C2-24 through C2-26] for fallout data summaries and *Appendix C-1* [pp. C1-22 and C1-23] for soil data summaries.)

Food Pathways

A potentially significant pathway for radioactivity to reach humans is through eating produce and domesticated farm animals raised near the WVDP and game animals and fish that include the WVDP in their range. 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 and its tributaries at various distances downstream from the WVDP. Venison is sampled from the deer herd 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 C-3* [pp. C3-3 through C3-8] 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. The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure.

Forty-three measurement points were used in 1997. (See *Appendix C-4* [pp. C4-3 through C4-6] for a summary of the direct radiation data. See also *Appendix D* [p. D-10] for a comparison of WVDP subcontractor and independent co-located NRC results.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded on-site. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are all measured. Such data are valuable for evaluating long-term geohydrological 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 C-6* [pp. C6-3 through C6-9] 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 D* [pp. D-3 through D-11] for a summary of crosscheck performance.) Outside laboratories contracted to perform analyses for the WVDP also are regularly subjected to performance assessments.

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 planned for implementation.

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ENVIRONMENTAL COMPLIANCE SUMMARY

CALENDAR YEAR 1997

Introduction: Compliance Program

The primary mission of the West Valley Demonstration Project (WVDP) is to develop and demonstrate a safe method of solidifying high-level radioactive mixed waste. Vitrification, the selected method, incorporates radioactive and hazardous materials into a glass-like substance. The treatment process is regulated by various federal and state laws in order to 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 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 confirm 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 performing audits.

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 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 of water and air. These concentrations have been determined to be safe for humans and the environment. In general, the permits describe the discharge points, 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 1997 confirmed that site activities were conducted well within state and federal regulatory limits. On-site nonradiological effluent monitoring, with only a few exceptions, also confirmed that site effluents remained within permitted limits. These exceptions of nonradiological limits, also commonly called exceedances, are described in more detail under the *Clean Air Act* section (p.xlix) and the *Clean Water Act* section (p.lii). Although the exceedances did not have any significant adverse environmental effects, the WVDP continues to make efforts to eliminate the potential for these exceedances to recur.

Management at the WVDP continued to provide strong support for environmental compliance issues in 1997. DOE Orders and applicable state and federal statutes and regulations are integrated into the compliance program at the Project, demonstrating a commitment to protecting the public and the environment while working towards the WVDP goal of high-level radioactive mixed waste vitrification.

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 in 1997.

Compliance Status

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) 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. Under RCRA, generators are responsible 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. In New York, the EPA has delegated the authority to enforce these regulations to NYSDEC. In addition, in May 1990 the state of New York was authorized by the EPA to administer a radioactive and hazardous mixed waste program. The U.S. Department of Transportation (DOT) is responsible for issuing guidelines and regulations for the labeling, packaging, and spill-reporting provisions for hazardous wastes in transit.

Each facility that treats, stores (large quantities 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, identifying the WVDP as a generator of hazardous waste. In June 1990 the WVDP filed a Part A Hazardous Waste Permit Application with NYSDEC for storage and treatment of hazardous wastes. Based on that application, the WVDP was granted interim status. 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 needed in 1997.

Hazardous Waste Management Program

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 8.6 metric tons (9.5 tons) of nonradioactive, hazardous waste off-site in 1997. Of this amount, 1.5 metric tons (1.6 tons) were recycled by the treatment, storage, and disposal facilities (TSDFs).

Off-site hazardous waste shipments and their receipt at designated TSDFs are documented by signed manifests that accompany the shipment. If the signed manifest is not returned to the generator of the waste within the NYSDEC 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 were required to be filed in 1997.

Hazardous waste activities must be reported to NYSDEC every year through the submittal of an annual Hazardous Waste Generator's Report. This report summarizes the hazardous waste activities for the previous year, specifies the quantities of hazardous waste generated, treated, and/or disposed of and identifies the TSDFs used. 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 Hazardous Waste Reduction Plan was submitted in July 1997. The next revision is due July 1998 and the next update is due July 1999.

An annual inspection to assess compliance with hazardous waste regulations was conducted by NYSDEC on March 21, 1997. The most recent EPA inspection occurred on July 24, 1996. No deficiencies were noted by either agency during the inspections.

Nonhazardous, Regulated Waste Management Program

The WVDP transported approximately 128.4 metric tons (141.6 tons) of nonradioactive, nonhazardous material off-site to solid waste management facilities in 1997. Of this amount, 0.7 metric tons (0.8 tons) were recycled or reclaimed. The industrial waste materials included items such as monitoring-well purge water and neutralized acids and bases from laboratory and chemical mixing operations. Some of the regulated materials were managed as recyclable materials. These included lead acid batteries from which the lead was reclaimed and nonhazardous oils, which were recycled at off-site authorized reclamation and recycling facilities. The WVDP also shipped approximately 2,305 metric tons (2,541 tons) of digested sludge and untreated wastewater from the site sanitary and industrial wastewater treatment facility to the Buffalo Sewer Authority for treatment in 1997.

Radioactive Mixed Waste (RMW) Management Program

Radioactive mixed waste (RMW) contains both a radioactive component, regulated under the Atomic Energy Act (AEA), and a hazardous component, regulated under RCRA. Both the EPA and NYSDEC oversee RMW management at the WVDP. To address the management of the hazardous component of RMW, 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, Inc. (WVNS), the primary contractor for the DOE at the WVDP. The FSFCA addresses requirements for managing the hazardous component of the RMW, e.g., regulatory compliance with the Land Disposal Restrictions (LDR) of RCRA for RMW specifies particular storage requirements for RMW and requires the 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 RMW stored in the chemical process cell waste storage area (CPC-WSA).

In November 1997 NYSDEC granted a one-year extension exclusively for section 7.2, Waste Analysis, to complete the final characterization of containers that could store RMW. Characterization of historical wastes continued during 1997. The remainder of the FSFCA agreement expired on March 22, 1998.

The Federal Facility Compliance Act (FFCAct) of 1992, an amendment to RCRA, was signed into law on October 6, 1992. The FFCAct requires DOE facilities to develop treatment plans for RMW inventories and to enter into agreements with 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 and the draft plan in August 1994. The WVDP submitted the proposed site treatment plan to NYSDEC in March 1995. The proposed plan is comprised of two volumes: the Background Volume and the Plan Volume. The Background Volume provides information on each RMW stream as well as information on the preferred treatment method for the waste. The Plan Volume contains proposed schedules for treating the RMW to meet the 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. The WVDP updated the Site Treatment Plan in 1997 to bring waste stream and inventory and treatment information current to the end of fiscal year 1996. An update of fiscal year 1997 activities will be prepared in 1998. All Plan Volume milestones for calendar year 1997 were met.

RCRA Facility Investigation (RFI) Program

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 requires NYSERDA and the DOE's West Valley Demonstration Project Office (DOE-WV) to conduct RCRA facility investigations 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 waste or hazardous constituents from SWMUs.

Because of the proximity of some of the units to each other, twenty-five SWMUs were grouped into twelve super solid waste management units (SSWMUs) to facilitate investigative efforts under the RCRA facility investigation (RFI) program.

In general, the purpose of a RCRA facility investigation is to collect and evaluate information to determine which of the following actions are appropriate for each SWMU or SSWMU in accordance with the Consent Order: no further action; a corrective measures study; or additional investigations to support either no further action or a corrective measures study. The RFI addresses RCRA-regulated hazardous wastes or hazardous constituents. To define and assess the environmental settings, unit and waste characteristics, and the potential sources and extent of nonradiological contamination, the WVDP has reviewed existing information and collected and analyzed samples of surface soil, subsurface soil, sediment, and groundwater.

In 1997 the WVDP continued to monitor and evaluate SWMUs to ensure compliance with the requirements of the RCRA 3008(h) Administrative Order on Consent. The last six draft RFI reports that were reviewed by the EPA and NYSDEC were made final in 1997. (See *Current Issues and Actions* [p.lix]). Of the twelve SSWMUs, five have been identified to date as requiring no further action: #2, miscellaneous small units; #6, the low-level waste storage area; #7, the chemical process cell waste storage area; #10, the radwaste treatment system drum cell; and #12, the hazardous waste storage lockers.

Similarly, the seven remaining SSWMUs have been identified as requiring no immediate action other than continued groundwater monitoring: #1, the low-level waste treatment facility; #3, the liquid waste treatment system; #4, the high-level waste storage and processing area; #5, the maintenance shop leach field; #8, the construction and demolition debris landfill; #9, the Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA); and #11, the New York State-licensed disposal area (SDA).

In addition to the twelve SSWMUs, sixteen rooms previously used during nuclear fuel reprocessing operations were evaluated in May 1994 under the RFI program, as required by the Consent Order. In December 1994 NYSDEC and the EPA reviewed the evaluation and issued a determination of no further action for eight of the rooms. At the same time, NYSDEC and the EPA requested additional information on the remaining eight rooms. In February 1995 the WVDP provided NYSDEC and the EPA with the information requested. On January 28, 1998 the EPA and NYSDEC completed their evaluation and concluded that the remaining rooms do not pose a significant threat for release of hazardous waste or hazardous constituents.

With the submittal of the final RFI reports in 1997 and the determination for the sealed rooms, the site has completed the investigation activities associated with the Consent Order, and groundwater monitoring will continue.

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 as directed by Executive Order 12856, Federal Compliance with Right-to-Know and Pollution Prevention Requirements. Waste streams on-site also are separated into either waste from sources directly associated with the vitrification process or other nonvitrification sources.

Using 1993 waste-generation rates as a baseline for comparison, the WVDP plans to reduce the generation of low-level radioactive waste, radioactive mixed waste, and nonvitrification hazardous waste by 50% by December 31, 1999. The WVDP plans to reduce the generation of sanitary waste and nonvitrification industrial waste by 30% by the same date.

Toward that end, the WVDP set the following cumulative waste-reduction goals for 1997: a 34% reduction in the generation of low-level radioactive waste, radioactive mixed waste, and hazardous waste; a 22% reduction in nonvitrification industrial waste; and a 14% reduction in sanitary waste.

The waste reduction goals for wastes associated with vitrification operations were a 9% reduction in vitrification hazardous waste and a 6% reduction in vitrification industrial waste, compared to an annualized 1996 total of waste generated.

The WVDP greatly exceeded the 1997 reduction goals for all five waste categories. Low-level radioactive waste generation was reduced by 79%, radioactive mixed waste generation by 38%, and nonvitrification and vitrification hazardous waste generation by 61% and 93% respectively. In a similar manner, nonvitrification industrial waste generation was reduced by 64% and sanitary waste generation by 47%.

The amount of vitrification-related acidic/caustic hazardous waste generated in 1997 was reduced by the use of elementary neutralization. This was offset by a 5% increase in the amount of industrial waste generated.

Specific accomplishments in waste minimization and pollution prevention during 1997 included the following:

- 7.3 metric tons (8.0 tons) of radioactively contaminated lead were decontaminated and free-released for reuse or recycling

- 105.0 metric tons (115.7 tons) of paper were recycled

- 97.0 metric tons (106.9 tons) of galvanized steel, carbon steel, and stainless steel were recycled

- 0.9 metric tons (1.0 ton) of hazardous materials were recycled

- 1.6 metric tons (1.7 tons) of nonhazardous, regulated materials were recycled.

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, presented in Title 40, Code of Federal Regulations (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. Facilities with tanks in service on December 22, 1988, were allowed a ten-year grace period to achieve compliance by completing the upgrades.

New York State also regulates underground storage tanks through two programs, petroleum bulk storage (Title 6, New York Official Compilation of Rules and Regulations [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. The WVDP does not use underground chemical bulk storage tanks.

The WVDP previously stored petroleum products in three regulated, 2,000-gallon underground storage tanks. Two of the tanks contained unleaded gasoline. The third tank contained low-sulfur diesel fuel. These three tanks were decommissioned in 1997. (Two aboveground storage tanks encased in concrete are now used in lieu of the former underground storage tanks. One of the aboveground tanks has a capacity of 1,000 gallons and contains low-sulfur diesel fuel. The second tank has a capacity of 2,000 gallons and contains unleaded gasoline. See *New York State-regulated Aboveground Storage Tanks* [p.xlix] for more detail.)

The three former petroleum-storage tanks were decommissioned by excavation and removal in accordance with state and federal regulations. Soil samples were collected from the tank excavations and analyzed according to regulatory guidelines. No petroleum compounds were detected in the tank excavation soil samples. (A fourth tank closed in place before this program was implemented was also removed. The removal is discussed under

Petroleum and Chemical-Product Spill Reporting [p. lvi] and under *Current Issues and Actions, Petroleum-Spill Reporting/Underground Storage Tanks Program* [p. lx]).

A 550-gallon underground storage tank is used to store diesel fuel for the standby power supply for the supernatant treatment ventilation blower system. This tank, a double-walled steel tank with an interstitial leak detection system, is filled by a metered delivery system and is monitored through daily gauging and monthly reconciliations. This tank does not require tightness or integrity testing because of its integral leak detection system. In 1997 the underground piping associated with this tank was removed and replaced with aboveground piping, and an overflow catch basin was installed at the fill port. System improvements planned for 1998 include a new leak detection system and a high-level warning device. The 1997 improvements and planned 1998 upgrades will bring the 550-gallon tank into compliance with the most recent EPA requirements, which become effective December 22, 1998.

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. Aboveground hazardous bulk chemical storage is regulated by New York State 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. Furthermore, petroleum tank fill ports must be color-coded, and chemical tanks labeled to indicate the product stored.

WVDP registration at the end of 1997 included nine aboveground petroleum tanks and fourteen aboveground chemical storage tanks. Three of the petroleum tanks contain No. 2 fuel oil, one contains unleaded gasoline, and the remainder contain diesel fuel. Eleven of the chemical storage tanks contain nitric acid or nitric acid mixtures. Sulfuric acid, sodium hydroxide, and anhydrous ammonia are stored in the remaining three tanks. All of the tanks are equipped with gauges and secondary containment systems.

The Quality Assurance department inspects the aboveground petroleum tanks every month. In December 1997, all aboveground chemical storage tanks were inspected to fulfill the requirements for annual inspection (6 NYCRR Part 598.7(c)). No violations were noted during the inspection. Documentation relating to these periodic inspections is maintained by the WVDP and is available for review by regulatory agencies.

Medical Waste Tracking

Medical waste poses a potential for exposure 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 the medical wastes generated. Medical wastes are sterilized with an autoclave by the disposal firm to remove the associated hazard and then disposed. Sixteen kilograms (35 lbs) of medical waste were generated and disposed in 1997, with approximately 4 kilograms (9 lbs) consisting of needles, syringes, and other sharps, and 12 kilograms (26 lbs) consisting of dressing and protective clothing such as rubber gloves.

Clean Air Act (CAA)

The Clean Air Act (CAA), as amended in 1990, including Titles I through VI, establishes a frame-work for the EPA to regulate air emissions from both stationary and mobile sources. These amendments mandated that each state establish an operating permit program for sources of air pollution. In 1996 NYSDEC amended 6 NYCRR Parts 200, 201, 231, and 621 to implement the new EPA Clean Air Act Title V permitting processes requirements. In New York State, either the EPA or NYSDEC issues permits for stationary sources emitting regulated pollutants, including hazardous air pollutants. Sources requiring permits are those that emit regulated pollutants in quantities above a predetermined threshold that are from a particular source such as a stack, duct, vent, or other similar opening. WVDP radiological emissions are regulated by the EPA, and all other air pollutants are regulated by NYSDEC.

Emissions of radionuclides from 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 seven 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 and soil piles also do not require permits. Emissions from all these sources are quantified for reporting purposes 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 1997 doses to be less than 0.5% of the 10 millirem standard.

Nonradiological point sources of air emissions are regulated by NYSDEC. In 1996 NYSDEC amended 6 NYCRR Part 201 to implement the new EPA Clean Air Act Title V permitting requirements. These regulations require that major source facilities must 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, which relieves the WVDP from filing a Title V permit.

In lieu of a Title V permit application, 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. Under the new State Facility Permit, compliance will be based on site-wide limits for all regulated constituents, and the totals for all will be recorded annually in an air emissions inventory.

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 fourteen COs for nonradiological point sources. On May 2, 1997 NYSDEC issued the certificate-to-operate for the vitrification facility off-gas system as requested by the WVDP in a letter submitted to NYSDEC on June 14, 1996 after the first Relative Accuracy Test Audit (RATA) of the NO_x abatement and monitoring system of the vitrification facility off-gas system. On April 22, 1997, a second RATA was conducted. Representatives from NYSDEC Region 9, Division of Air Resources, visited the site to observe the 1997 NO_x RATA. (The WVDP submits quarterly reports to NYSDEC that contain NO_x and SO_2 total emissions data. These totals were well below the 100-ton cap for each category.)

One reportable toxic air emission exceedance occurred in 1997, during which an estimated 7.41

lbs of ammonia were released from the main plant ventilation stack over a period of seventy-five minutes, exceeding the permitted limit for ammonia. This release was not considered a threat to human health or the environment and no emergency response actions were required. Upon review of the existing permitted limit for ammonia it was determined by NYSDEC and the WVDP that the original limit of 1.845 lbs/hr had been derived using incorrect values. The limit was corrected to 10 lbs/hr as of January 5, 1998. This new limit is still significantly less than the amount considered a threat to human health or the environment. Under this revised permissible limit, the 7.4-lb release would not have been an exceedance.

The air permits that were in effect at the WVDP in 1997 are listed in *Appendix B*, Table B-3 (pp. B-5 through B-7).

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 1997 as indicated on the table below.

- WVDP representatives attended and participated in semiannual 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 involving hazardous-substance management at the WVDP.

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.

- 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 EPCRA Section 304.

- 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 is submitted to the state and local emergency response groups. This supplemental reporting continues to ensure 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 1997, 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 1996 and 1997: sixteen reportable chemicals above threshold planning quantities were stored at the WVDP in 1997.

- Under EPCRA Section 313 requirements, the WVDP submitted a toxic release inventory (TRI) report to the EPA in 1997 for three chemicals — nitric acid, ammonia, and nitrate compounds.

- All notifications required under SARA regulations were submitted ahead of schedule.

Clean Water Act (CWA)

Section 402 of the Clean Water Act (CWA) of 1972, as amended, authorizes the EPA to regulate discharges of pollutants to surface water and groundwater 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 and groundwater.

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. (Article 24 of the New York State Environmental Conservation Law also contains requirements for the protection of freshwater wetlands.) While Section 402 generally regulates disposal of liquids, Section 404 provides regulatory controls for 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.

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.

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 outfalls, which discharge 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 *Groundwater Treatment* below [p.lv] 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 1997 the treated wastewater from the LLWTF was discharged at WNSP001 in six batches that totaled 44.0 million liters (11.6 million gal) for the year. The annual average concentration of radioactivity at the point of release was 22% of the DOE derived concentration guides (DCGs). None of the individual releases exceeded the DCGs.

- 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 1997 was 68,100 liters (18,000 gal).

- Outfall 008 (WNSP008) discharges groundwater and storm water flow directed from the northeast side of the site's LLWTF lagoon system through a french drain. The average daily flow at WNSP008 in 1997 was 7,400 liters (2,000 gal).

- Outfall 116 is a sampling location in Frank's Creek that represents the confluence of outfalls 001, 007, and 008, base flow, wet weather flows (e.g., storm water runoff), groundwater surface seepage, and augmentation water (i.e., untreated water from the site reservoirs). This is not a physical outfall but a location identified in order to demonstrate compliance 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 limits.

During 1997 effluent monitoring indicated that SPDES permit limits were exceeded twice at outfall 001, twice at outfall 008, and once at outfall 116. Although these exceedances did not have any

Month (No. of Exceedances)	**Parameter (Outfall)**	**Cause(s) / Corrective Action**
April (1)	TDS (116)	Changes in Frank's Creek background concentrations during 001 discharge./Use conductivity measurements for interim TDS measurements and analyze TDS in-house, thus allowing faster discharge and/or augmentation flow rate adjustments. Implemented as of October 6, 1997.
September (1)	BOD-5 (008)	Algae dislodged from outfall pipe and/or nonhomogenous seed and sample in dilution bottle./Increased number of sample dilutions from 3 to 5 for better confirmation of results. Implemented as of November 1, 1997.
December (2)	Nitrite (001)	Backflushing anthracite filter with nitric acid wash resulted in excessive levels of nitrate (at 4 ppm) that disrupted the natural nitrification cycle. Natural conversion also slowed by cold weather./Replace anthracite filter with sand filter that does not need nitric acid wash. Implemented as of April 1, 1998.
December (1)	BOD-5 (008)	Algae dislodged from outfall pipe and/or nonhomogenous seed and sample in dilution bottle./Clean discharge pipe and use 300 mL-sample dilution bottles to increase seed and sample homogeneity. Targeted for implementation by July 1998.

significant adverse effect on the environment, the WVDP is continuing to work with NYSDEC to prevent the recurrence of these events. These exceedances are discussed in the following text.

- On April 24, 1997 the calculated TDS at outfall 116 was reported as 551 mg/L, which was above the daily maximum limit of 500 mg/L. This exceedance was attributed to the TDS value of the sample at WNSP006, obtained before the discharge, being reported as 234 mg/L. The predischarge calculation, which is in accordance with the SPDES permit and is based on then-available results, indicated that a calculated TDS value at outfall 116 would be 382 mg/L during discharge of lagoon 3. However, after the start of the discharge, a new sample result from WNSP006 with a TDS concentration of 620 mg/L became available. Because of the different sample results that had been obtained, an insufficient amount of augmentation water had been added at the beginning of the discharge.

- On September 26, 1997 BOD-5 was reported as 9.3 mg/L at outfall WNSP008, exceeding the daily maximum limit of 5.0 mg/L. On December 9, 1997 BOD-5 was reported as 5.9 mg/L at outfall WNSP008, which again exceeded the daily maximum limit. The suspected causes are algae dislodged from the outfall pipe and/or analytical anomalies inherent in the test and calculation methods. The outfall pipe has been replaced and the effect of seeding on the samples, especially the exertion of a false oxygen demand during sample incubation, is being examined.

- On both December 5 and December 9, 1997 nitrite as N at outfall 001 was reported as 0.2 mg/L, exceeding the daily maximum limit of 0.1 mg/L for this parameter. These exceedances were attributed to backflushing the anthracite filter with nitric acid solution, thus resulting in excessive amounts of nitrites being sent to lagoon 3 and subsequent disruption of the natural nitrification cycle. The nitrification cycle was further affected by cold weather. Both of these conditions slowed the natural conversion of nitrite to nitrate before the start of the discharge. Although results indicated elevated nitrite at outfall 001, monitoring data for the receiving stream, Frank's Creek, indicated that nitrite concentrations were within the water quality standard. The existing anthracite filter is scheduled to be replaced in May 1998 by a sand filter, which will not require a nitric acid wash.

The permit exceedances reported during calendar year 1997 resulted in NYSDEC issuing a warning letter on December 31, 1997. The letter indicated that continued violations could result in the initiation of enforcement actions.

On March 24, 1997 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.

The WVDP obtained storm water characterization data through sampling and analysis in 1991 and submitted a storm water discharge permit application to NYSDEC on September 30, 1992. In early 1994, NYSDEC indicated that any future storm water discharge requirements would be incorporated into the WVDP's existing SPDES permit. In response to NYSDEC comments on the permit application, the WVDP monitored the discharge at eleven storm water outfalls in 1995. In April 1996 the WVDP submitted a SPDES permit application for storm water outfalls.

In March 1996 the WVDP submitted an application for a SPDES permit modification 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 *Groundwater Treatment* [p.lv].) NYSDEC issued the draft SPDES permit in June 1997 for public comment. The final permit is expected to be issued to the WVDP during the first half of 1998.

Wetlands

In 1993 a wetlands investigation was conducted within a portion of the WNYNSC, including the WVDP, to identify and delineate jurisdictional wetlands as defined under the Clean Water Act, Section 404, and/or those wetlands potentially subject to regulation as freshwater wetlands by the state of New York.

The investigation identified fifty-one wetland units on a 550-acre area that includes the 200-acre WVDP site and adjacent parcels north, south, and east of the site. A report documenting the wetlands investigation and delineation was submitted to the U.S. Army Corps of Engineers and NYSDEC in June 1994.

NYSDEC reviewed the report and inspected the site, determining that a group of eight contiguous wetlands met the criteria for regulation as a single unit. The group of eight contiguous wetland units, delineated by NYSDEC as a linked unit, will be included on the next available proposed amendment to the official New York State Freshwater Wetlands Map for Cattaraugus County.

Any work conducted within 100 feet of a New York State freshwater wetland requires NYSDEC approval. The WVDP notifies the U.S. Army Corps of Engineers and NYSDEC of those proposed actions that have the potential to affect any of the fifty-one wetland units and that are not specifically exempted from regulation or notification. One notification for minor maintenance and repair of a 5-foot section of rail bed was required in 1997. The work involved clearing accumulated sediment and debris from the drainage approach to and exit from the culvert underlying the rail bed section.

Groundwater Treatment

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. Two 15-foot deep recovery wells, installed near the leading edge of the groundwater plume, were designed to collect contaminated groundwater from the underlying sand and gravel unit. The treatment system uses an ion-exchange column to remove strontium-90 from the groundwater and is operated in conjunction with the LLWTF. After the groundwater is treated, it is discharged to lagoon 2, 4, or 5 at the LLWTF.

In March 1996 the WVDP submitted to NYSDEC an application for a SPDES permit modification to increase the average flow of effluent from the 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. In September 1996 a third recovery well was installed to improve groundwater capture and system performance. Approximately 20.8 million liters (5.5 million gal) were processed through the system in 1997.

The Project evaluated other technologies in 1996 to determine if there were more effective methods for treating the groundwater. Laboratory benchscale tests were conducted from July 1996 to December 1996 to determine the effectiveness of using phosphate-based materials to immobilize strontium-90 in soil and groundwater samples. In 1997 a report was issued on the laboratory benchscale test results, and it was decided that field testing of phosphate-related technologies would not be conducted at this time.

Petroleum- and Chemical-Product Spill Reporting

The WVDP has a Spill Notification and Reporting Policy to ensure that all spills are properly managed, documented, and remediated in accordance with applicable regulations. This policy identifies the departmental responsibilities for spill management and presents 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 June 1996 agreement with NYSDEC regarding the agency's 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. Spills onto the ground of petroleum products of 5 gallons or less are entered in a monthly petroleum spill log. Spills 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. Spills of petroleum products that enter any navigable waters of New York State are reported to the National Response Center within two hours of discovery. Each monthly petroleum spill log is submitted to NYSDEC on the fifteenth day of the following month. In addition to the NYSDEC spill- and release-reporting regulations, the WVDP also reports spills of hazardous substances in accordance with reporting requirements under RCRA, the CAA, EPCRA, the CWA, and the Toxic Substances Control Act (TSCA).

Petroleum- and chemical-product spills were logged and evaluated throughout the year. Petroleum-contaminated soils encountered in 1997 during the excavation and removal of a previously decommissioned underground storage tank required that NYSDEC be notified immediately. This tank had been decommissioned in 1985 by filling it with concrete in accordance with then-current regulations. (See p. lx under *Current Issues and Actions* below.) No other immediate notifications relating to petroleum spills were required during 1997. No chemical spills exceeded the reportable quantities and, therefore, no spills required immediate reporting. All spills that occurred during 1997 were cleaned up in a timely fashion in accordance with the WVDP Spill Notification and Reporting Policy, thereby minimizing any effects on the environment. Debris generated during clean-up activities was characterized and dispositioned appropriately.

Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act (SDWA) as amended in 1996, 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 Western New York Nuclear Service Center (WNYNSC) site 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 collects routine drinking water samples to monitor organic and inorganic water quality. The results of these analyses are reported to the Cattaraugus County Health Department. The Cattaraugus County Health

Department also independently collects a sample of WVDP drinking water every month to determine bacterial and residual chlorine content. Analysis of the microbiological samples collected in 1997 produced satisfactory results and the free chlorine residual measurements in the distribution system were positive on all occasions, indicating proper disinfection.

From 1993 to 1997 the WVDP conducted sampling and testing for lead and copper in the site's drinking water in accordance with EPA and NYSDOH regulations. Previous analytical results had shown lead levels to be above the action level of 15μg/L at several locations in the distribution system. NYSDOH regulations require an evaluation of potential water treatment actions and the preparation of a corrosion control plan for water systems that do not meet the lead and copper action levels. Because two consecutive lead and copper sample rounds were below the EPA action levels in 1996, the site was not required to implement the state-designated corrosion control program. In addition, the WVDP was allowed to reduce the sampling frequency and number of sampling sites.

During 1996 and through 1997, the WVDP replaced existing water faucets with lead-free faucets and completed weekly water-system line flushes in an effort to lower the lead levels. Lead and copper sampling in 1997 indicated that all results were below the action levels for these metals. Sampling for lead and copper will be continued in the summer of 1998 and again in 1999. If these sampling rounds produce results below the action levels for lead and copper, regulations will allow the WVDP to reduce sampling to every three years.

The Cattaraugus County Health Department conducted its annual inspection of the WVDP water supply system on October 21, 1997. 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 (ACMs) and polychlorinated biphenyls (PCBs). Because PCBs are a listed hazardous waste in New York State, the WVDP continued in 1997 to manage radioactively contaminated PCB wastes as radioactive mixed wastes. These wastes originated from a dismantled hydraulic power unit inside the former reprocessing facility, from two radiologically contaminated capacitors that contained PCB fluids, and from the cleanup of a transformer leak. 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 1997 Update (West Valley Nuclear Services Co., Inc. February 1998).

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. February 1, 1996). The WVDP also maintains an annual document log that details PCB use and appropriate PCB waste storage on-site and any changes in storage or disposal status. In August 1996 the DOE and the EPA entered into a Federal Facility Compliance Agreement on Storage of Polychlorinated Biphenyls allowing the storage of PCB wastes for more than the one-year statutory limit for storage under TSCA.

In 1997 the WVDP also continued to maintain compliance with all TSCA requirements for asbestos by managing asbestos-containing materials (ACMs) at the site in accordance with the Asbestos Management Plan (West Valley Nuclear Services Co., Inc. May 1, 1996). The plan includes requirements for limiting worker exposure to ACMs, requirements 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 1997 included the repair or abatement of damaged/friable ACM, removal of roofing materials containing asbestos, and the maintenance of signs and labels to warn workers of ACM. (See also p. lxi under *Current Issues and Actions*.)

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 Title II of NEPA, sets the policy for fulfilling these goals. The CEQ regulations for implementing NEPA are promulgated at 40 CFR Parts 1500 — 1508.

The DOE began revising its NEPA-compliance procedures and guidelines in 1990. On May 26, 1992 the President's Council on Environmental Quality approved the DOE's NEPA procedures, which are promulgated at 10 CFR Part 1021. In July 1996 the DOE amended the NEPA procedures.

NEPA requires that all federal agencies proposing actions that have 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 (10 CFR Part 1021). The DOE's NEPA procedures embody a hierarchical system of assessment for reviewing and documenting proposed actions commensurate with the action's potential for affecting the environment. Reflecting least to greatest significance, the levels of review and documentation are: no impact and categorical exclusion; potential impact and an environmental assessment; and significant impact and an environmental impact statement. (See pp. 1 and 3 in the *Glossary*.)

Several proposed actions at the WVDP were reviewed in 1997 under the Department of Energy's NEPA-implementing regulations:

- sorting of radioactively contaminated soil
- modification of the WVDP wastewater treatment facility equalization basin
- replacement of the low-level liquid waste treatment facility building
- construction of a site emergency vehicle shelter
- improvements to the WVDP's north parking lot
- construction of a site vehicle-maintenance support structure
- extension through 1997 of NEPA coverage of the 1996 routine maintenance activities list of proposed actions
- an applicability determination for replacement of four on-site fire hydrants
- an applicability determination for maintenance activities at off-site environmental monitoring stations
- removal of the nitric acid/caustic tank pad.

The first six proposed actions were categorically excluded under the NEPA-implementation rules and regulations. NEPA coverage for routine maintenance activities was extended for one year, and neither the routine maintenance at the five off-site environmental monitoring stations or at the Buttermilk Creek/Thomas Corners station required NEPA review. (In the latter instance a New York State permit was issued and no environmental review was required under the New York State Environmental Quality Review Act.) The removal of the nitric acid/caustic tank pad also was categorically excluded from additional NEPA review.

On January 7, 1997 the DOE Ohio Field Office Manager delegated approval authority for categorically excluded actions to the West Valley Demonstration Project (DOE-WV) NEPA compliance officer. This authority was granted to the DOE-WV based upon a proven history of the proper implementation of NEPA as well as on the Department of Energy's policy for improving the NEPA process.

Activities continued in 1997 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.

Comments from the public on the draft EIS that were received during the six-month comment period are currently being evaluated. Having met throughout 1997 to review alternatives in the EIS, the Citizen Task Force will be preparing recommendations in 1998 to aid the WVDP in the selection of a preferred alternative. A supplement to the draft EIS that will identify a preferred alternative is being prepared. The supplement is scheduled to be issued in August 1999, and the final EIS is scheduled to be issued in April 2000. The Record of Decision is scheduled to be issued in May 2000.

In May 1997 the Department of Energy issued the Final Waste Management Programmatic Environmental Impact Statement to evaluate management and siting alternatives for the treatment, storage, and disposal of five types of radioactive and hazardous waste. The alternatives are for waste generated from operations over the next twenty years at fifty-four sites in the DOE complex. The preferred alternatives for WVDP waste include:

- off-site treatment of low-level mixed waste and disposal at one of two or three regional disposal sites

- on-site treatment of low-level waste and shipment for disposal to one of two or three regional disposal sites

- on-site treatment and storage of WVDP transuranic waste

- on-site storage of WVDP vitrified high-level waste pending disposal in an off-site geologic repository.

WVDP hazardous and solid waste will continue to be shipped off-site for treatment and disposal.

Summary of Permits

The environmental permits that were in effect at the WVDP in 1997 are listed in *Appendix B*, Table B-3 (pp. B-5 through B-7).

Current Issues and Actions

Resource Conservation and Recovery Act (RCRA)

RCRA Facility Investigation

In 1997 the WVDP continued to monitor and evaluate SWMUs to ensure compliance with the requirements of the RCRA 3008(h) Administrative Order on Consent. Six of the previously submitted draft RFI reports that were reviewed by the EPA and NYSDEC were made final. Based on the results of the RFI for the maintenance shop leach field, two septic tanks that previously had received sanitary waste from the WVDP maintenance shop were cleaned and closed in 1997.

Clean Water Act (CWA)

Storm Water Discharge Permit Application

Precipitation can become contaminated with pollutants from industrial process facilities, stored industrial materials, material 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 significance of releases of pollutants from storm water collection and discharge systems and to determine appropriate permitting requirements.

In 1992 the WVDP submitted an application for an individual permit for storm water discharges associated with industrial activity. The application included characteristic analytical results from sampling conducted at three locations in 1991. These monitoring locations not only comprised all storm water discharged from the WVDP but also included base flow for the receiving water at the sample points. NYSDEC requested that the sampling points be moved to locations with no base flow to differentiate the quality of the storm water discharges from the receiving water. In response to the request, thirty-two on-site monitoring points were identified in 1994. As CWA regulations allow petitioning to group identical discharges for monitoring and reporting, NYSDEC accepted the WVDP's petition to group several of the discharge points and eleven storm water outfalls were monitored in 1995.

Two samples were collected from each outfall, a first-flush sample collected within roughly the first half-hour of the storm event and a flow-weighted composite collected during the first three hours of the storm event. The storm water samples were analyzed for parameters identified in the existing SPDES permit. In April 1996, the WVDP submitted a SPDES discharge permit application that identified these outfalls. In June 1997 NYSDEC issued for public comment the draft SPDES permit that incorporated storm water outfalls. The WVDP submitted comments and is expecting a final permit in the first half of 1998 that encompasses the current outfalls, the storm water monitoring points, and the north plateau groundwater recovery system.

Petroleum-Spill Reporting/Underground Storage Tanks Program

An underground storage tank that had been used previously to store gasoline was excavated and removed in 1997. The tank had been located near the southwest corner of the main warehouse, and it was decommissioned in 1985 by filling it with concrete, in accordance with then-current regulations.

Petroleum-contaminated soils were encountered at the bottom of the excavation during the 1997 tank-removal project. Appropriate regulatory agencies were notified upon discovery of the contaminated soils. It was presumed that the leak had occurred before the tank had been decommissioned in 1985.

At the request of NYSDEC, a sampling and analysis plan was prepared to determine the affected media and to define the lateral and vertical extent of petroleum-contaminated soils. The field effort for the sampling and analysis plan, including soil and groundwater sampling, was completed during December 1997, and the results are now being evaluated. Preliminary results indicate that the petroleum contamination is limited to the immediate vicinity of the former tank. A final report presenting the results of the sampling and analysis plan and remedial alternatives, if warranted, will be completed during early 1998.

Emergency Planning and Community Right-to-Know Act (EPCRA)

In the unlikely event of a radiological emergency requiring off-site response support, the WVDP maintains arrangements with local emergency response agencies. An agreement with Mercy Flight to provide helicopter transport from the site for worker medical emergencies was completed in 1997. An agreement also was negotiated with the Erie County Medical Center, the regional trauma center. Erie County Medical Center now participates with Bertrand Chaffee Hospital in training activities for the treatment of radiologically contaminated patients.

Toxic Substances and Control Act (TSCA)

In December 1997 a site-wide inspection was initiated to visually reinspect and reassess the condition of all confirmed and assumed asbestos-containing materials (ACM), to identify any suspected materials not previously addressed, to collect samples, and to record any changes in conditions or quantities of ACM in the inspection report. The inspection will be completed in 1998. If required, based on the conditions found during this inspection and on laboratory analysis results of the samples collected, specific asbestos-remediation response actions will be identified. The Asbestos Management Plan inventory and status tables also will be updated in 1998.

Project Assessment Activities in 1997

As the primary contractor for the DOE at the WVDP, WVNS conducted more than 164 reviews of environmentally related activities in 1997. These included one audit of environmental aspects of the vitrification process, two self-assessments of the environmental monitoring program, and 161 interdepartmental surveillances of environmental protection activities. The local DOE Project office also conducted a number of independent reviews of various aspects of the environmental program in 1997. Overall results of the reviews reflect continuing, well-managed environmental programs at the WVDP.

Significant external environmental overview activities in 1997 included an inspection by NYSDEC for compliance with RCRA; an inspection by NYSDEC for compliance with SPDES requirements; and an annual 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.

ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the West Valley Demonstration Project (the WVDP or Project) is the byproduct of the reprocessing of spent nuclear fuel conducted during the late 1960s and early 1970s by Nuclear Fuel Services, Inc. (NFS).

Since the Western New York Nuclear Service Center (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 p. 5 in the *Glossary*.) The nuclei continue to 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). At the WVDP, uranium-232 is in the high-level waste mixture and can be detected

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.

in liquid waste streams as a result of a thorium-based nuclear fuel reprocessing campaign conducted by NFS.

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 decontaminated 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 Ra-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7×10^{10} d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second.

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-

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.

trillionth (10^{-12}) of a curie, equal to 3.7 x 10^{-2} 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 amount of energy necessary to lift a mosquito about 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 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 (kinds and structures of rock and soil), the hydrology (location and flow of surface and underground water), 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 are normally present in WVDP waste streams. 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 A* [pp.A-i through A-53] for the schedule of samples and radionuclides measured and *Appendix B*, Table B-1 [p. B-3] for related Department of Energy

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 B-1, Appendix B, p. B-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. 4-6] 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 Emissions Standards for Hazardous Air Pollutants (NESHAP) apply to Project airborne effluents. As a convenient reference point, comparisons with DCGs are made throughout this report for both air and water samples.

[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" 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 average value that would be obtained if many measurements were taken). 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 ($\pm$) value following the result, e.g., 5.30 $\pm$ 3.6E-09μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be 0.0000000053 ± 0.0000000036μCi/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 "<" if that analyte was not measurable. (See also *Data Reporting* [p. 5-7] in ***Chapter 5, Quality Assurance***.)

1997 Changes in the Environmental Monitoring Program

Changes in the 1997 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

- The vitrification heating, ventilation, and air conditioning (HVAC) stack monitoring and sampling systems were brought on-line in November 1995. The actual volumetric discharge rate was verified in February 1996. Final isokinetic sampling system specifications were prepared in February also, and the equipment was installed in March 1996. The vitrification system began radioactive operations with the first transfer of high-level waste in June 1996, followed by the start of vitrification in July 1996. In 1997 stack monitoring was improved by installing a heat trace along the monitoring line to prevent ice build-up.

- With the new meteorological tower fully operational, the previous tower was dismantled in July 1997.

- Stack monitoring at the CO_2 decontamination facility was discontinued after the facility was decontaminated and released.

- The groundwater monitoring program was reviewed, and in July three wells monitoring the underground fuel storage tank area were decommissioned. The sampling frequency and the analytes measured were further tailored to address site-wide monitoring parameters as well as constituents of concern specific to super solid waste management units (SSWMUs).

Appendix A (pp. A-i through A-53) summarizes the program changes and lists the sample points and parameters measured in 1997.

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. A four-part process, 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. This cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

Finally, 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 salts 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. This waste 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 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. In addition, 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. A number of 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.

1997 Activities at the WVDP

Vitrification

Solidification of the high-level waste in glass continued in 1997. 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^{o}F and poured into stainless steel canisters. Approximately 300 stainless steel canisters 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.

In 1997 a total of 119 high-level waste canisters were produced and more than 5.5 million curies of radioactivity were transferred to the vitrification facility. Since the beginning of vitrification in 1996, 178 high-level waste canisters have been filled. Based on analysis of the first forty-five batches, the total number of cesium/strontium curies transferred to the vitrification facility by the end of 1997 was more than 7.8 million.

Environmental Management

Aqueous Radioactive Waste

Water containing radioactive material from site process operations is collected and treated in the low-level liquid waste treatment facility (LLWTF). (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 1997, 44.0 million liters (11.6 million gal) of water were treated in the LLWTF and discharged through outfall 001, the lagoon 3 weir.

The discharge waters contained an estimated 12 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous twelve years averaged about 41 millicuries per year. The 1997 release was about 29% of this average. (See *Radiological Monitoring, Low-level Waste Treatment Facility Sampling Location* [p. 2-2] in ***Chapter 2, Environmental Monitoring***.)

Approximately 0.45 curies of tritium were released in WVDP liquid effluents in 1997. This is 27% of the twelve-year average of 1.66 curies.

Unplanned Radiological Releases

A spill of radioactive material at the WVDP occurred on December 15, 1997 in the site's waste storage tank area. A 50-foot long pump in the main radioactive waste storage tank (tank 8D-2) was being remotely flushed and sparged with water and air by Project employees in order to wash contamination off the pump shaft and back into the waste tank in preparation for pump-removal and replacement.

As the flushing and sparging process was completed, a small amount of liquid began to drip from the valve handle area of an air regulator. Two employees' hands were contaminated when they closed the shutoff valve on the line and wiped some of the liquid from the control board. About 100 mL (one-half cup) of the liquid dripped onto the ground. The employees' hands were cleaned and decontaminated, and contaminated soil was dug up. The contaminated soil, control board, and other materials were packaged and placed in storage. The quantity of liquid released was very small and was limited to the immediate area of the waste tank farm, a controlled radiological buffer facility area.

This event was categorized as an off-normal occurrence and an Occurrence Report was prepared. A regulatory compliance evaluation determined that no radioactivity above reportable quantity thresholds was released to the environment.

One other spill in 1997 was observed in the waste tank farm when a pipe containing liquid from the pan under tank 8D-1 was found to be dripping. Pumping was immediately stopped and the leak investigated. A sample of the water was collected and analyzed for gross alpha and beta concentrations; no radioactivity was detected. The spill was not reportable, no cleanup was warranted, and no waste was generated.

There were no unplanned releases in 1997 from the Project to the off-site environment.

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 preset 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 1997 included approximately 140 millicuries of tritium (as hydrogen tritium oxide [HTO] and 7.43 millicuries of iodine-129. (See ***Chapter 2,*** p. 2-31, for further discussion of iodine-129 emissions from the main plant stack.) In 1996, a year in which the vitrification system was in operation for half of the year, tritium and iodine-129 emissions were 53 millicuries and 1.2 millicuries respectively.

Particulate matter radioactivity emissions from the main plant in 1997 included approximately 0.4 millicuries of beta-emitting radioactivity and 0.001 millicuries of alpha-emitting radioactivity. In 1996, beta-emitting and alpha-emitting radioactivity emissions were 0.1 millicuries and 0.0004 millicuries respectively.

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 Department of Energy 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-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 1997.

Results of surface and groundwater monitoring in the vicinity of the trench are discussed under *NDA Sampling Locations*, p. 2-10, and *Results of Monitoring at the NDA*, p. 3-14, respectively.

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. Industrial waste and sanitary waste reduction goals were added in 1994. By using source reduction, recycling, and other techniques, waste in all of these categories has been greatly reduced. In 1997, the seventh year of the program, reductions in all categories exceeded the 1997 reduction goals. (For more details see the ***Environmental Compliance Summary: Calendar Year 1997*** [p.xlvii].)

Pollution Prevention Awareness Program

The WVDP's pollution prevention awareness program is a significant part of the Project's overall waste minimization program. The program includes hazard communication training and new-employee orientation that provides information about the WVDP's Industrial Hygiene and Safety Manual, environmental pollution control procedures, and the Hazardous Waste Management Plan. The WVDP also has expanded its recycling program to include glass and plastic food containers, scrap wood, and scrap metal. The WVDP's goal is to make all employees aware of the importance of pollution prevention both at work and at home.

In conjunction with Earth Day, employees made presentations to more than 1,200 students at eleven local schools about the benefits of reducing, recycling, and reusing.

Waste Management

Significant achievements in 1997 included overall strategy and long-range waste management program planning; waste storage, processing, and off-site disposal; compliance with regulatory requirements; waste volume reduction; and waste minimization and pollution prevention:

- The WVDP Site Technology Coordination group continued to help identify and implement new waste management technologies for WVDP wastes. This group is charged with identifying technology required to meet existing and future waste management goals, evaluating emerging technologies, and promoting technology transfer between DOE facilities, federal agencies, and private industry.

- 712 drums (55-gal) of low-level waste were repackaged for off-site shipment and volume reduction. Approximately 5,000 ft^3 of low-level waste was shipped off-site for commercial treatment and disposal. The volume of low-level waste was reduced by about 20,000 ft^3 through restructuring storage facilities, sorting, soil sorting, and consolidating existing low-level waste inventories.

- Spent synthetic ion-exchange resins were determined to be Class A radioactive waste and were dewatered. Resins will be stored and shipped in 122 ft^3 B-25 overpack steel boxes.

- The CO_2 decontamination demonstration was successfully completed, achieving free release criteria for 16,000 pounds of decontaminated lead. Further decontamination of scrap metal using CO_2 blasting was deemed uneconomical.

- Soil sorting using a mechanical sorting unit as a demonstration project processed more than 19,000 ft^3 of contaminated soils and successfully released more than 9,900 ft^3 of soil with radiological concentrations lower than the criteria limit of 25 pCi/g. This resulted in an overall volume reduction of 51.3%.

- Several low-dose containers were inspected and radiologically screened for possible removal of nonradiologically contaminated materials. Non-radiological materials were removed, shredded, and disposed of as industrial waste, resulting in a net volume reduction of 170 ft^3.

- In accordance with the Site Treatment Plan developed under the Federal Facility Compliance Act, which describes treatment capacities and technologies, all calendar year 1997 milestones for the characterization, treatment, and disposition of radioactive mixed waste at the WVDP were completed.

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.

NEPA activities at the WVDP involve facility maintenance and minor projects that support high-level waste vitrification. These projects are documented and submitted for approval as categorical exclusions, although environmental assessments are occasionally necessary.

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. Comments currently are being evaluated. Having met throughout 1997 to review alternatives presented in the environmental impact statement, the Citizen Task Force will prepare recommendations during 1998 to aid the WVDP in selecting a preferred alternative. (See the ***Environmental Compliance Summary: Calendar Year 1997*** [p.lviii] for a more detailed discussion of specific NEPA activities in 1997.)

A supplement to the draft environmental impact statement is scheduled for release in August 1999, with a final version of the EIS expected in April 2000. The Record of Decision is scheduled for May 2000.

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.

Self-Assessments

Self-assessments continued to be conducted in 1997 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 1997*** [p. lxi] and ***Chapter 5, Quality Assurance*** [p. 5-6].)

Occupational Safety and Environmental Training

The occupational safety of personnel who are involved in industrial operations is protected by standards promulgated under the Occupational Safety and Health Act (OSHA). 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 affected 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.

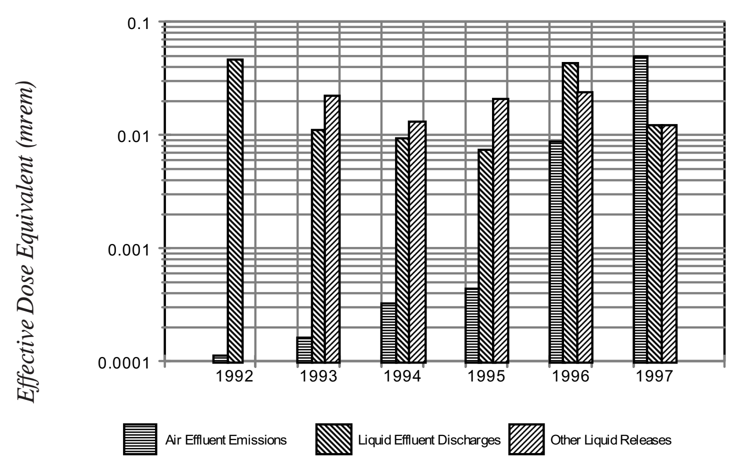

Figure 1-1. Annual Effective Dose Equivalent to the Maximally Exposed Off-site Individual

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 also receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Performance Measures

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

Several performance measures applicable to operations conducted at the WVDP are discussed below. These measures reflect process performance related to wastewater treatment in the low-level liquid 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

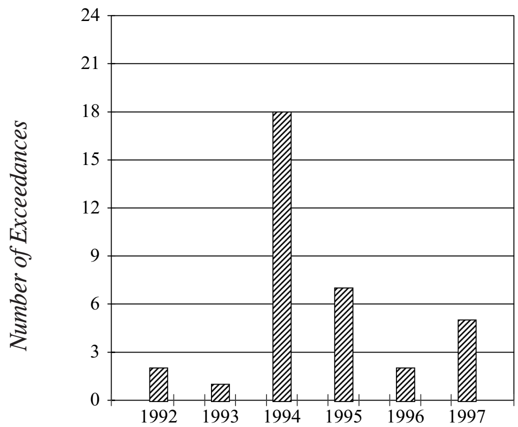

Figure 1-2. SPDES Permit Exceedances by Year

of the as-low-as-reasonably achievable (ALARA) concept, the effective radiological dose to the maximally exposed off-site individual provides an indicator of well-managed radiological operations. The effective dose equivalent for air effluent emissions, liquid effluent discharges, and other liquid releases (such as swamp drainage) from 1992 through 1997 are graphed in Figure 1-1 (p. 1-13). 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 Assessments***.)

SPDES Permit Limit Exceedances

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 the state via Discharge Monitoring Reports required under the SPDES program. The goal of LLWTF and wastewater treatment facility (WWTF) operations is to operate those facilities such that effluent water quality is consistently within the permit requirements.

SPDES permit limit exceedances do occur periodically. A graph of the number of SPDES permit limit exceedances occurring in each calendar year from 1992 through 1997 is shown in Figure 1-2 (this page). Although exceedances are not always related to operating deficiencies, they still can indicate the need to institute changes. All SPDES permit limit exceedances are evaluated to determine their cause and to identify potential corrective measures, including improved operation or treatment techniques.

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 1-3 (p.1-15) for calendar years 1992 through 1997. 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 1-3 include only the nonvitrification portions of these two waste streams.

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. Petroleum spills greater than 5 gallons must be reported within two hours to NYSDEC. Spills 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 spills of diesel fuel immediately reportable to NYSDEC in 1997. However, petroleum-contaminated soils were discovered during excavation of an underground tank that had been used to store gasoline. It is presumed that the leak occurred before the tank was decommissioned in 1985. (See the ***Environmental Compliance Summary: Calendar Year 1997***, p. lvi). Figure 1-4 (this page) is a bar graph of immediately reportable spills from 1992 to 1997.

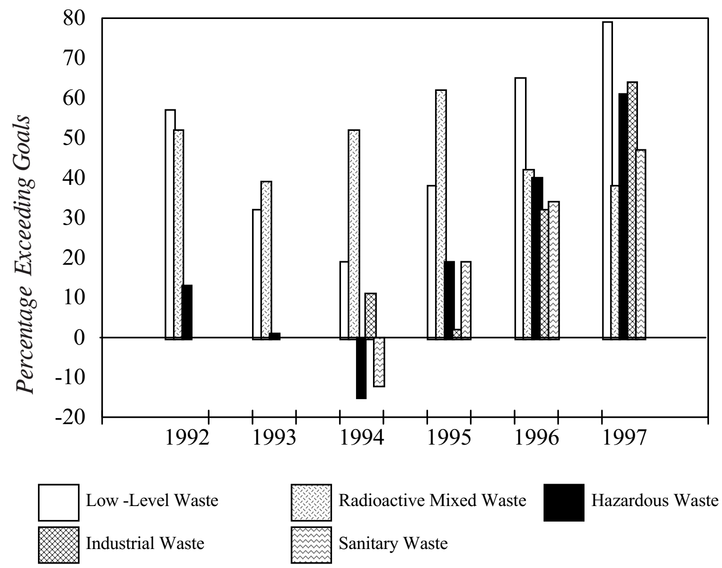

Figure 1-3. Waste Reduction Percentage Exceeding Goals

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 present measures to 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

The primary objective of the West Valley Demonstration Project is to safely solidify the high-level radioactive waste at the site in borosilicate glass. To do this, 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 reposi-

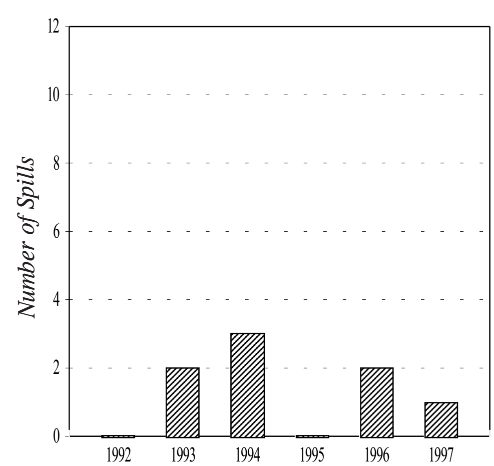

Figure 1-4. Number of Immediately Reportable Spills and Releases

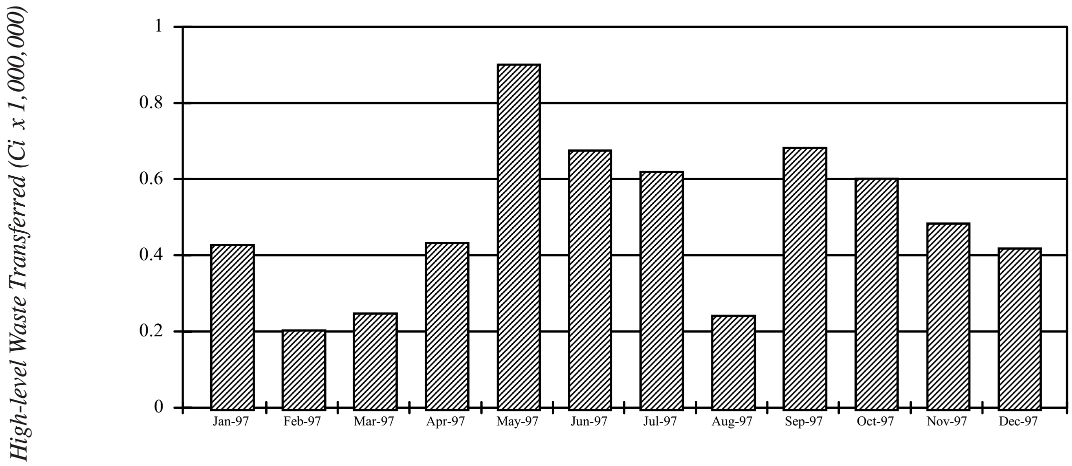

Figure 1-5. Number of Curies Transferred per Month to the Vitrification Facility

tory. It is estimated that 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 1-5 (above) shows the number of curies transferred per month to the vitrification facility in 1997.

ENVIRONMENTAL MONITORING

Pathway Monitoring

The effluent and environmental monitoring program provides data on surface waters, soils, sediments, food and produce, and on the effluent air and liquids that could provide pathways for the movement of radionuclides or hazardous substances from the West Valley Demonstration Project (WVDP) to the public. Both radiological and nonradiological parameters are monitored in order to ascertain the effect of Project activities.

Stream sediments are sampled upstream and downstream of the WVDP. The food pathway is monitored by collecting samples of beef, hay, milk, and produce at both near-site and remote locations, samples of fish upstream and downstream of the site, and venison samples from the near-site deer herd and from background locations. Direct radiation on-site, at the perimeter of the site, in communities near the site, and at background locations is also monitored to provide additional data.

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. (See Chapter 4, Table 4-2 [p.4-7].)

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

Air and Water Pathways

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

Surface water samples are collected from the tributaries of Cattaraugus Creek that flow through the Western New York Nuclear Service Center (WNYNSC) and from drainage channels within the Project site.

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

Sampling Codes

The complete environmental monitoring schedule and maps are located in *Appendix A* (pp. A-i through A-53). 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 A* (p. A-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.

Air Sampler Location and Operation

Air samplers are located at points remote from the WVDP, at the perimeter of the site, and on the site itself. Figure 2-1 (p. 2-4) shows the locations of the on-site air effluent monitors and samplers and the on-site ambient air samplers; Figure 2-2 (p. 2-5) and Figure A-9 in *Appendix A* (p. A-53) show the locations of the perimeter and remote air samplers, respectively.

Air samples are collected by drawing air through a very fine filter with a vacuum pump. The total volume of air drawn through the filter is measured and recorded. The filter traps particles of dust that are then tested in the laboratory for radioactivity. At the Rock Springs Road, Great Valley, and New York State-licensed disposal area (SDA) ambient air sampling locations, samples also are collected for iodine-129 and tritium analyses. (A more detailed description of the air sampling program follows below.)

Water Sampler Location and Operation

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 and at a background station upstream of the site. (Grab samples are collected at several other surface water locations both on- and off-site.) Figure 2-3 (p. 2-6) shows the locations of the on-site surface water monitoring points. (On-site automatic samplers operate at locations WNSP006, WNNDADR,WNSW74A, and WNSWAMP.) Figure 2-4 (p. 2-7) shows the location of the off-site surface water monitoring points. (Off-site automatic samplers are at WFBCTCB, WFFELBR, and the background location, WFBCBKG.)

Radiological Monitoring

Surface Water and Sediment Monitoring

On-site Surface Water Sampling

A map of on-site surface water sampling locations is found on Figure 2-3 (p. 2-6).

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. 2-3 [p. 2-6]) into Erdman Brook, a tributary of Frank's Creek. There were six batch releases totaling about 44.0 million liters (11.6 million gal) in 1997. In addition to composite samples collected near the beginning and end of each discharge, a total of thirty-nine effluent grab samples, one for each day of discharge, was collected and analyzed.

The total amounts of radioactivity from specific radionuclides in the lagoon 3 effluent are listed in *Appendix C-1*, Table C-1.1 (p.C1-3). The observed annual average concentration of each radionuclide released is divided by its corresponding Department of Energy 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 B* [p. B-3].) As a DOE policy, the sum of the percentages calculated for all radionuclides released should not exceed 100%. In 1997 the annual average isotopic concentrations from the lagoon 3 effluent discharge weir combined to be approximately 22% of the DCGs. (See *Appendix C-1*, Table C-1.2 [p. C1-4].)

The average radioactivity concentrations from 1994 to 1996 were 44%, 43%, and 35% of the DCG, respectively. The reduction from 44% to 22% over this period is mostly attributable to improved removal of strontium-90. The low-level waste treatment facility (LLWTF) is designed to most efficiently remove strontium-90 and cesium-137, the more prevalent of the long-lived fission products in WVDP waste waters. To a much lesser extent, other radionuclides are also removed by the LLWTF. For example, the other major contributor to the total combined DCG is uranium-232, which averaged 11.9% of its DCG in 1997, or about 9% lower than its average concentration in 1996. Uranium-232 and other uranium isotopes are common in WVDP liquid waste because they were present in the nuclear fuel that was once reprocessed at the site.

Variations in liquid effluent isotopic ratios continued to reflect the dynamic nature of the waste streams being processed through the low-level waste treatment facility (LLWTF) and of the process itself.

Frank's Creek Sampling Location

A water sampling station (WNSP006) is located on Frank's Creek where Project site drainage leaves the security-fenced area, more than 4.0 kilometers (2.5 mi.) from the nearest public access point. (See Fig. 2-3 [p. 2-6].) This sampler collects a 50-mL aliquot (a small volume of water) every half-hour. Samples are retrieved weekly and composited both monthly and quarterly. (Data are found in Table C-1.4 [p. C1-6].) Weekly samples are analyzed for tritium and gross alpha and beta radioactivity as well as pH and conductivity. The monthly composite is analyzed for strontium-90 and gamma-emitting isotopes. (See *Glossary*, "gamma isotopic.") A quarterly composite is analyzed for carbon-14, iodine-129, technetium-99, alpha-emitting radionuclides, and total uranium.

The highest monthly concentration of a beta-emitting radionuclide at WNSP006 was strontium-90 at 1.93E-08μCi/mL (0.71 Bq/L).This corresponds to 1.9% of the DCG for strontium-90. There was only one positive detection of cesium-137 (1.05E-08μCi/mL [0.39 Bq/L]) in 1997, and this value was very close to the analytical detection limit. The annual average concentration of cesium-137 at WNSP006 was less than 0.6% of the DCG, and the average strontium-90 concentration was 1.3% of the strontium-90 DCG. Tritium, at an annual average of 3.98E-07 μCi/mL (1.47E+01Bq/L), was 0.02% of the DCG value. The annual gross alpha average was less than 1.21E-09μCi/mL (4.47E-02 Bq/L), or less than 4.0% of the DCG for americium-241. The 1997 data are comparable to 1996 data.

The eleven-year trends of gross alpha, gross beta, and tritium concentrations at location WNSP006 are shown on Figure 2-5 (p.2-8).The long-term trend plot for WNSP006 is dominated by fluctuations related to treated WVDP liquid effluent

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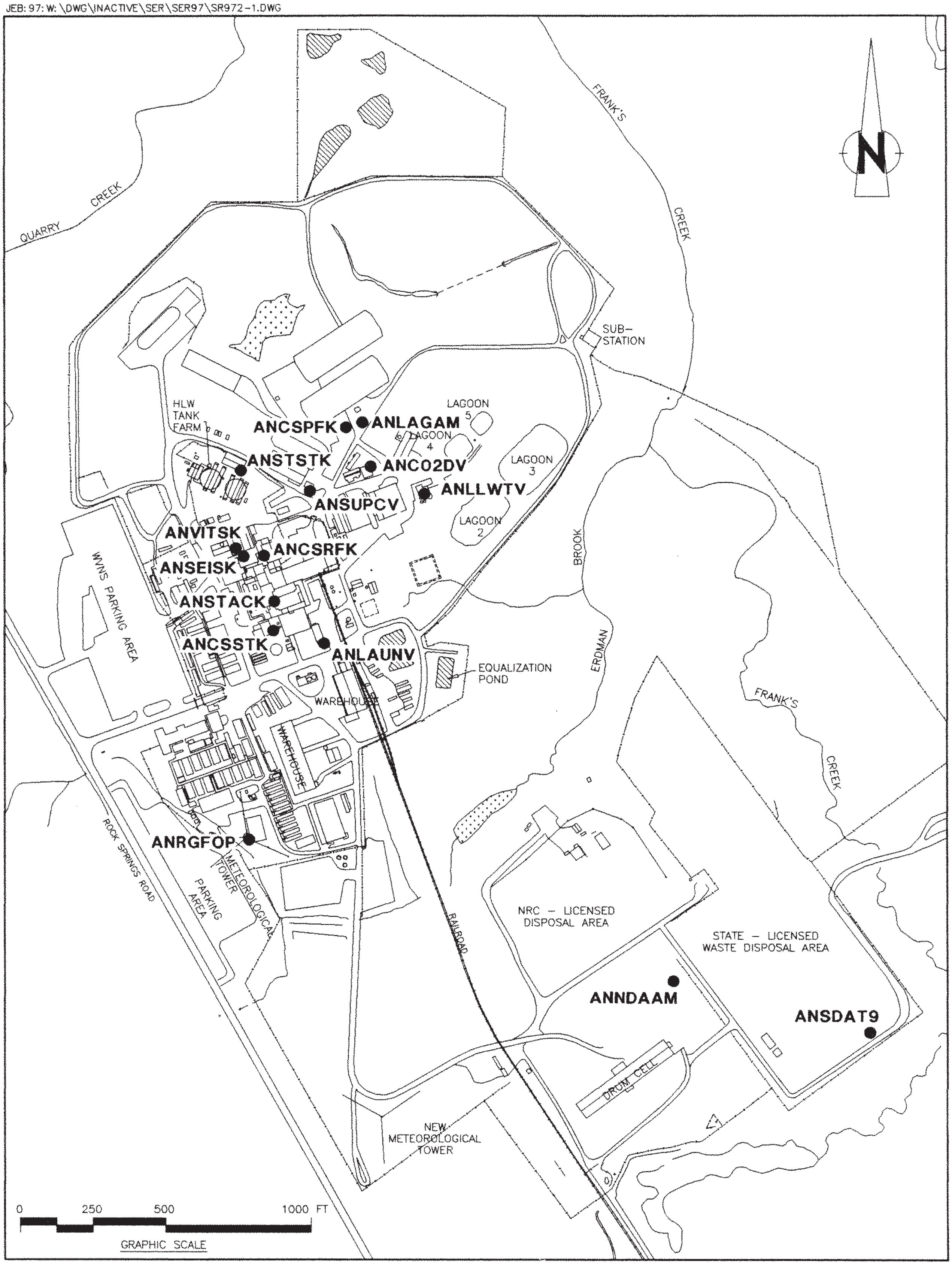

Figure 2-1. On-site Air Monitoring and Sampling Points.

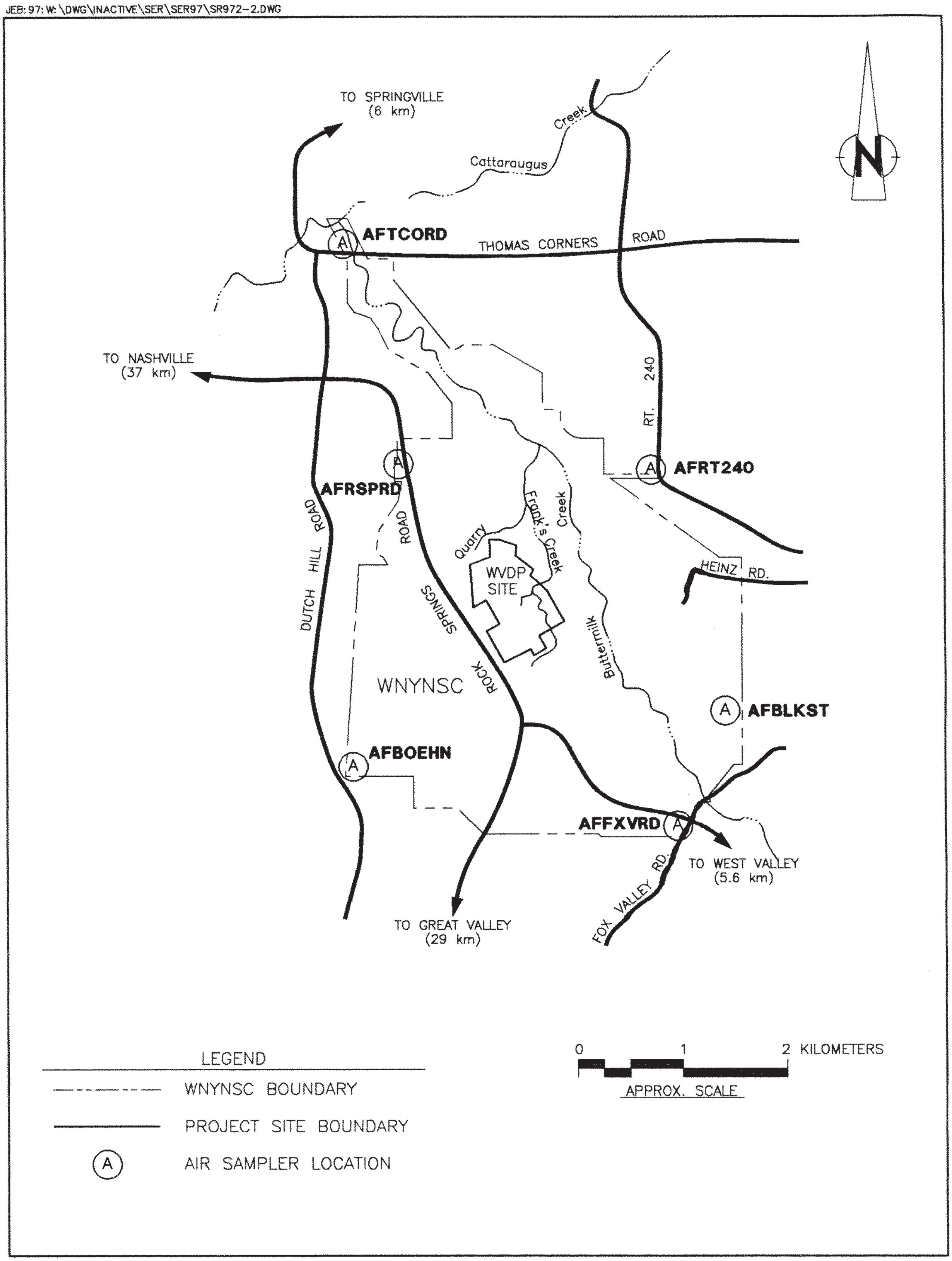

Figure 2-2. Location of Perimeter Air Samplers.

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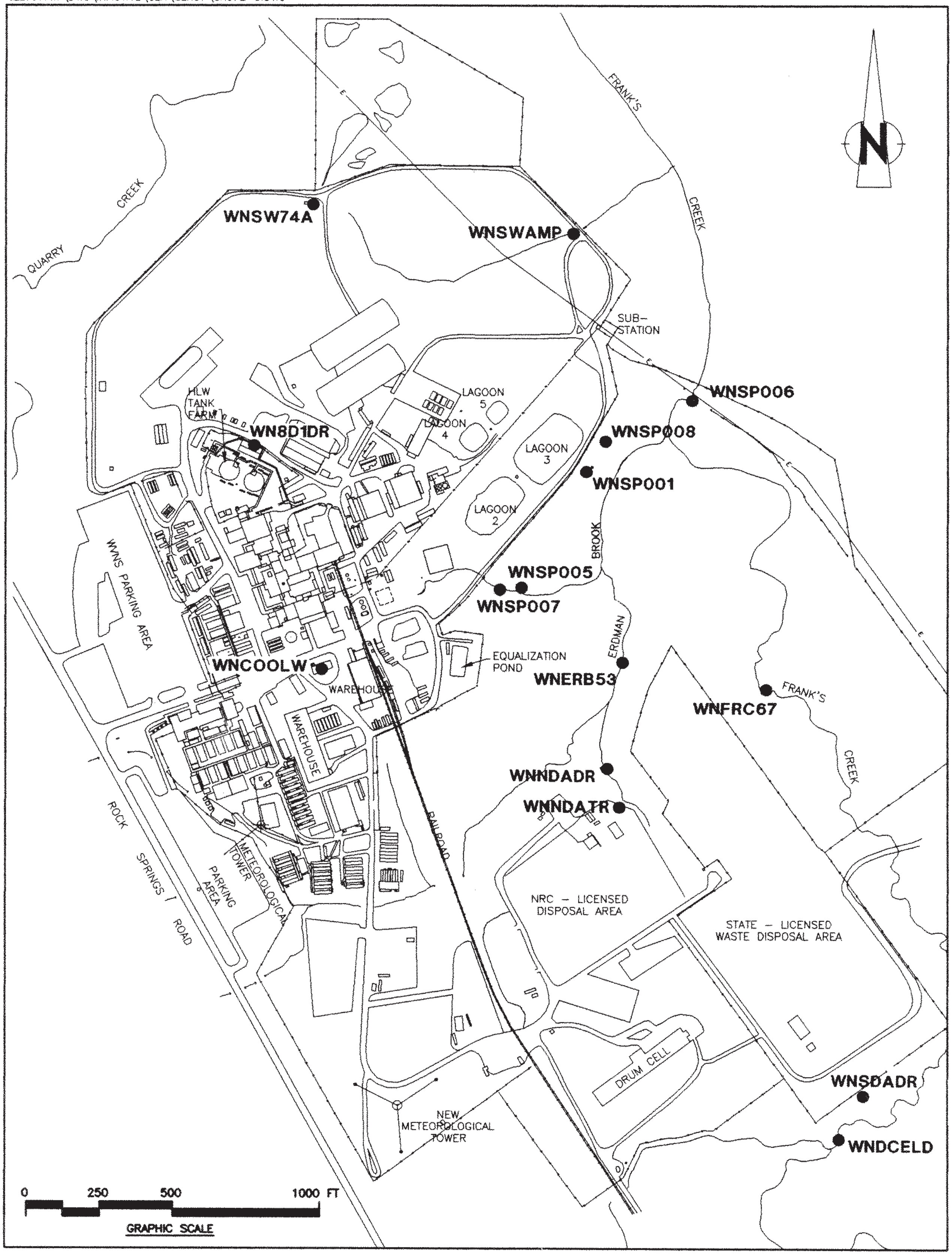

Figure 2–3. On–site Surface Water Sampling Locations.

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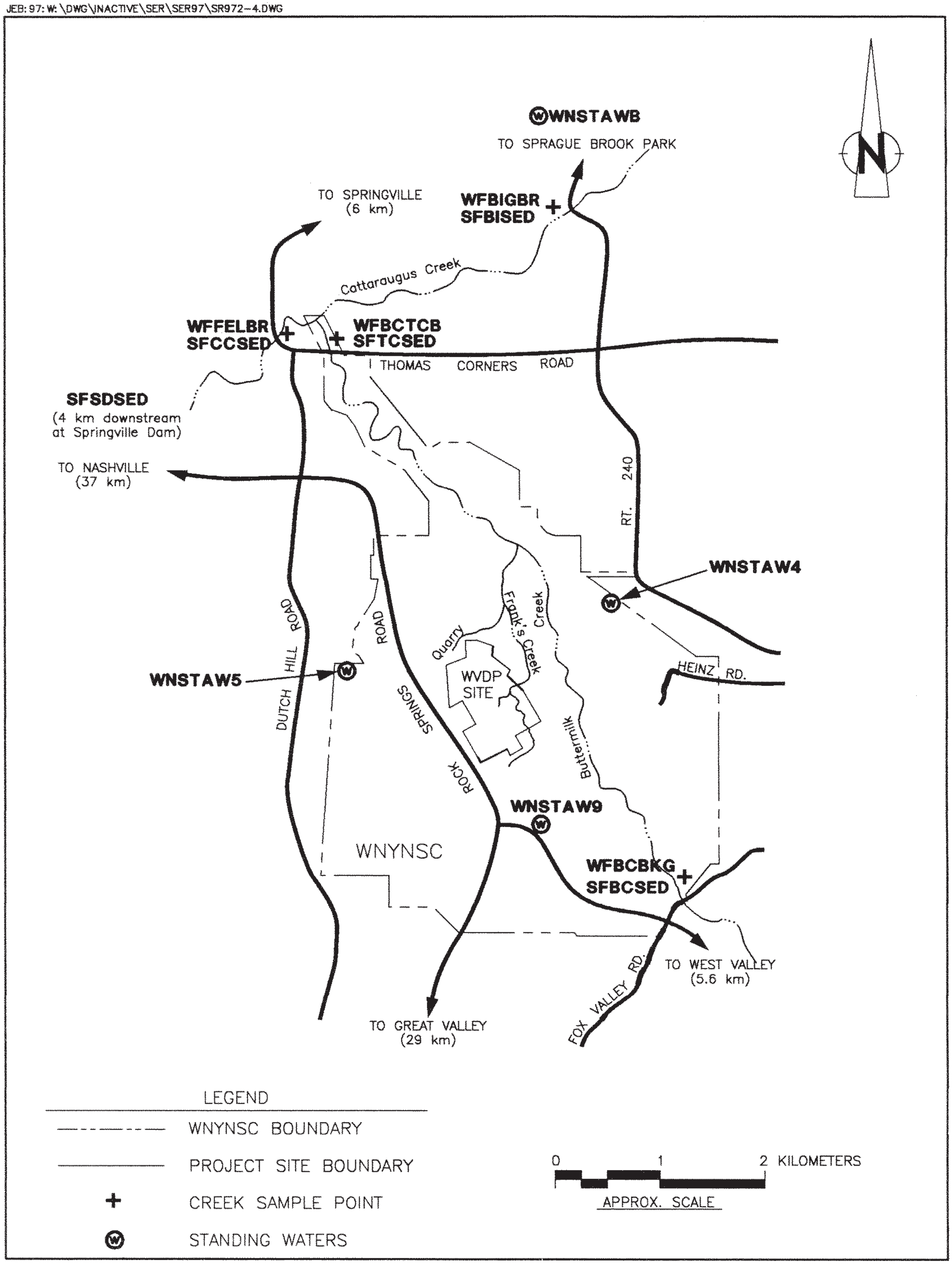

Figure 2-4. Off-site Surface Water and Sediment Sampling Locations.

discharged into the creek. 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 nearly indistinguishable from background.

North Swamp and Northeast Swamp Sampling Locations

The north and northeast swamp drainages on the site's north plateau are two major channels that conduct surface water and emergent groundwater off-site. Samples from the north swamp drainage at location WNSW74A and from the northeast swamp drainage at sampling point WNSWAMP are collected from the automated samplers every week. (See Fig. 2-3 [p. 2-6].) Samples from both locations are analyzed weekly for gross alpha, gross beta, tritium, pH, and conductivity. Composites of weekly samples are also analyzed for a full range of specific radionuclides. Semiannual grab samples from these locations are analyzed for additional chemical parameters.

Results for samples collected at location WNSW74A, which monitors drainage to Quarry Creek from the northern end of the Project premises, are summarized in *Appendix C-1*, Table C-1.8 (p. C1-9). The highest monthly strontium-90 result at WNSW74A was less than 0.7% of its DCG. The highest weekly tritium result at WNSW74A was only 0.008% of its DCG. Tritium at this location typically is below the detection limit.

Sampling point WNSWAMP also monitors surface water drainage from the site's north plateau. (See Tables 2-1 and 2-2 (p. 2-9) and *Appendix C-1*, Table C-1.7 [p.C1-8].) Waters from this drainage run into Frank's Creek downstream of location WNSP006. An upward trend in gross beta concentration from 1993 through 1997 at location WNSWAMP is discussed in ***Chapter 3, Groundwater Monitoring***, under *Special Monitoring, Northeast Swamp Drainage Monitoring* (p.3-17). The highest weekly tritium concentration at this location in 1997 was 2.86E-07μCi/mL, which is above that observed at the background

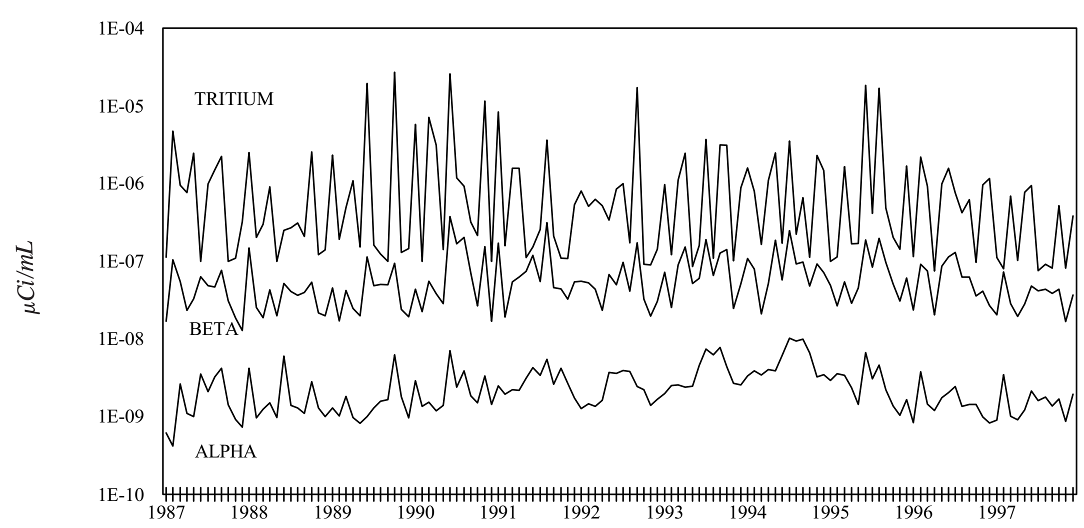

Figure 2-5. Eleven-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNSP006

Table 2-1
1997 Gross Alpha Concentrations at Surface Water Sampling Locations

Location	Number of Samples	Range (μCi/mL)	Range (Bq/L)	Annual Average (μCi/mL)	Annual Average (Bq/L)
OFF-SITE					
WFBIGBR	12	<5.55E-10 — 1.52E-09	<2.05E-02 — 5.64E-02	5.10±7.85E-10	1.89±2.91E-02
WFBCBKG	12	<4.68E-10 — 1.64E-09	<1.73E-02 — 6.08E-02	6.97±6.19E-10	2.58±2.29E-02
WFBCTCB	12	<5.32E-10 — 2.07E-09	<1.97E-02 — 7.67E-02	1.13±0.74E-09	4.19±2.76E-02
WFFELBR	52	<1.28E-09 — 1.05E-08	<4.74E-02 — 3.87E-01	1.12±0.86E-09	4.15±3.19E-02
ON-SITE					
WNNDADR	12	<9.77E-10 — 2.11E-09	<3.62E-02 — 7.82E-02	0.95±1.31E-09	3.50±4.86E-02
WNSWAMP	52	<9.66E-10 — 4.81E-09	<3.58E-02 — 1.78E-01	0.73±1.37E-09	2.70±5.07E-02
WNSW74A	52	<7.71E-10 — 3.10E-09	<2.85E-02 — 1.15E-01	0.42±1.25E-09	1.55±4.63E-02
WNSP006	52	<7.48E-10 — 5.86E-09	<2.77E-02 — 2.17E-01	0.96±1.21E-09	3.55±4.48E-02

Table 2-2
1997 Gross Beta Concentrations at Surface Water Sampling Locations

Location	Number of Samples	Range (μCi/mL)	Range (Bq/L)	Annual Average (μCi/mL)	Annual Average (Bq/L)
OFF-SITE					
WFBIGBR	12	<1.00E-09 — 3.22E-09	<3.71E-02 — 1.19E-01	1.74±1.01E-09	6.43±3.74E-02
WFBCBKG	12	<1.26E-09 — 2.32E-09	<4.67E-02 — 8.57E-02	1.50±1.25E-09	5.54±4.62E-02
WFBCTCB	12	3.52E-09 — 8.05E-09	1.30E-01 — 2.98E-01	5.61±1.47E-09	2.08±0.55E-01
WFFELBR	52	<5.82E-10 — 2.26E-08	<2.16E-02 — 8.37E-01	3.11±1.34E-09	1.15±0.50E-01
ON-SITE					
WNNDADR	12	1.18E-07 — 1.68E-07	4.35E+00 — 6.23E+00	1.45±0.06E-07	5.38±0.21E+00
WNSWAMP	52	8.86E-07 — 4.03E-06	3.28E+01 — 1.49E+02	2.21±0.03E-06	8.18±0.09E+01
WNSW74A	52	3.85E-09 — 1.85E-08	1.42E-01 — 6.84E-01	9.83±2.39E-09	3.64±0.88E-01
WNSP006	52	1.11E-08 — 1.15E-07	4.12E-01 — 4.27E+00	3.37±0.39E-08	1.25±0.14E+00

location WFBCBKG but below the 2E-03 μCi/mL DCG for tritium. The 1997 WNSWAMP average monthly tritium concentration was slightly less than the 1996 concentration.

Other Surface Water Sampling Locations

Sampling point WNSP005, which monitors drainage from the east side of the main plant, and WNFRC67, which monitors surface waters draining from the east side of the SDA, are both grab-sampled on a monthly basis. Samples are analyzed for pH, gross alpha, gross beta, and tritium.

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 the 1993 and 1994 annual site environmental reports. Since July 1993 the access has been valved off from the original high-level waste tank farm drainage area to prevent collected waters from draining freely to the surface. A sample continues to be taken from the access point and is analyzed weekly for gross alpha and beta, tritium, and pH. A monthly composite is analyzed for gamma radionuclides and strontium-90. However, samples collected from this location are not thought to be indicative of either local groundwater or surface water conditions.

NDA Sampling Locations

The surface water drainage path downstream of the Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA) is monitored at location WNNDADR using an automated sampler. (See Fig. 2-3 [p. 2-6].) Weekly samples are analyzed for pH and tritium. Samples also are analyzed for nonpurgeable organic carbon (NPOC) and total organic halogens (TOX). Samples are composited and analyzed on a monthly basis for gross alpha, gross beta, tritium, and gamma-emitting radionuclides. Quarterly composites are analyzed for strontium-90 and iodine-129.

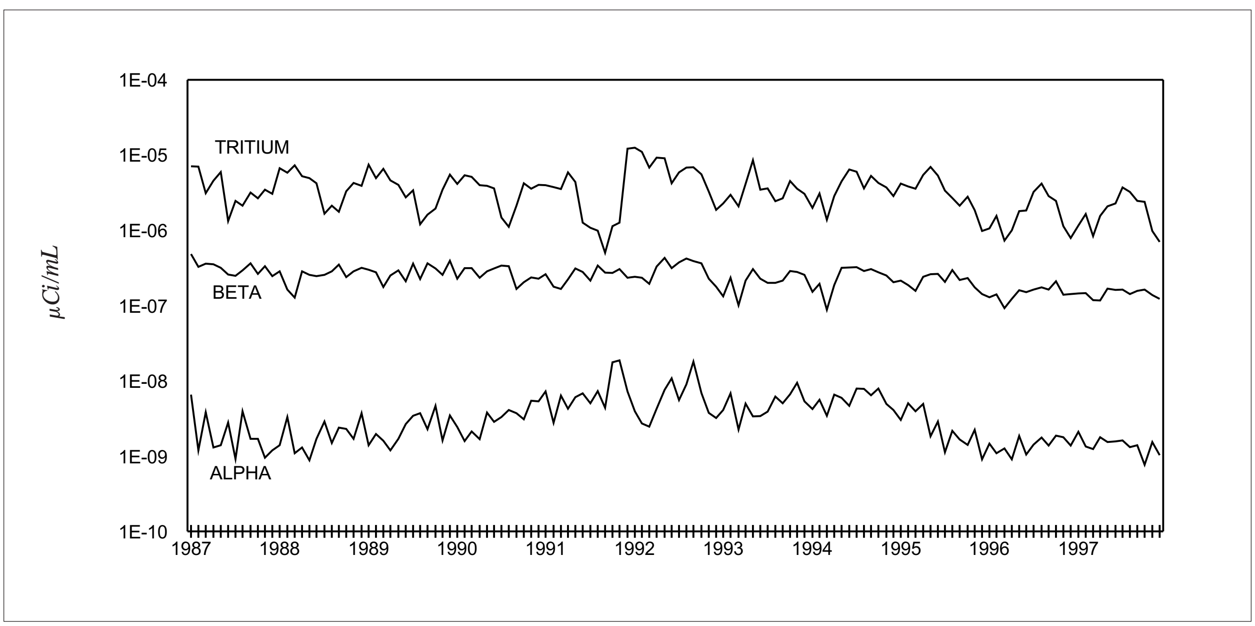

Figure 2-6. Eleven-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNNDADR

Gross beta concentrations at location WNNDADR averaged 1.45E-07 μCi/mL in 1997. (See Table 2-2 [p. 2-9] and Table C-1.19 [p. C1-15] in *Appendix C-1*.) Concentrations at this location were above the average measured at background location WFBCBKG but are all well below the DCG for strontium-90 in water (1E-06 μCi/mL). In fact, the highest quarterly composite isotopic strontium-90 result was only 6.40% of its DCG. Although gross beta activity is higher downstream of the NDA at WNNDADR than in waters from the interceptor trench, which is closer to the NDA, the overall trend for gross beta concentrations at this location has remained relatively constant or shown a slight decrease (Fig. 2-6 [p.2-10]). Except for seasonal variations, the same is true of tritium. Residual contamination from past waste burial activities in soils outside the NDA is the likely source of gross beta activity in samples from WNNDADR. A discussion of tritium concentrations is provided at the end of this chapter under *Special Monitoring*.

A key indicator of any possible migration of nonradiological organic contaminants from the NDA would be the presence of significant iodine-129 in samples from WNNDADR. Iodine-129 is known to travel with the organic contaminants present in the NDA, but it is typically more soluble in water. In 1997 there were no positive detections of iodine-129 in water samples collected at this location. In addition, although NPOC and TOX values are elevated slightly above background surface water (WFBCBKG) values, it is believed that NPOC and TOX values observed at WNNDADR reflect only seasonal variations.

Iodine-129 values obtained from waters collected from the NDA interceptor trench (WNNDATR), which is closer to the NDA than WNNDADR, were all either below or statistically the same as the analytical detection limit. (See *Appendix C-1*, Table C-1.20 [p. C1-16].)

Tritium activity in trench waters is generally higher than that measured at WNNDADR.

Every month, weekly samples from WNNDADR are composited and analyzed for cesium-137. During the entire year only one such composite displayed a positive detection. The February 1997 cesium-137 concentration, at 1.78E-08 μCi/mL, was marginally above the detection limit.

Downstream of WNNDADR, on Erdman Brook and to the northwest of the SDA, is sampling point WNERB53. Weekly samples collected from this point are analyzed for pH, gross alpha, gross beta, and tritium. In addition to samples collected by the WVDP, independent samples are collected and analyzed by the New York State Department of Health (NYSDOH) at this location and at WNFRC67, which monitors waters draining from the east side of the SDA. Although radiological samples collected at WNERB53 do reflect, in some cases, historical waste disposal activities, none of the observed concentrations exceed or even approach the most conservative DCG.

Standing Pond Water

In addition to sampling water from flowing streams, samples from ponds and lakes within the retained premises (WNYNSC) also are collected. Tests for various radiological and water quality parameters are performed annually to verify that no major changes in standing water within the Project facility environs are occurring.

Four ponds near the site were tested in 1997; values for gross alpha, gross beta, and tritium were not significantly different from historical background values. The background samples are collected from a pond 14 kilometers (8.7 mi) north of the Project (WNSTAWB, Fig. 2-4 [p. 2-7]. See Table C-1.21 [p. C1-17].)

Off-site Surface Water Sampling

A map showing off-site surface water and sediment sample locations is found on Figure 2-4 (p. 2-7). Data from off-site sample points show that average gross beta radioactivity concentrations in Buttermilk Creek downstream of the WVDP site generally tend to be higher than concentrations upstream of the site because small amounts of radioactivity from the site enter Buttermilk Creek via Frank's Creek. This is particularly observable during periods of lagoon 3 discharge. Tables 2-1 and 2-2 (p.2-9) list the ranges and annual averages for gross alpha and gross beta activity at surface water locations. Additional information is available in the *Appendix C-1* tables for all off-site surface water monitoring locations.

Cattaraugus Creek at the Felton Bridge Sampling Location

A sampler is located off-site on Cattaraugus Creek at Felton Bridge (WFFELBR) just downstream of Cattaraugus Creek's confluence with Buttermilk Creek, which is the major surface drainage from the WNYNSC. (See Fig. 2-4 [p. 2-7].) The sampler collects a 50-mL aliquot from the creek every half-hour. 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. The weekly samples are analyzed for gross alpha, gross beta, tritium, and pH, and the sample composite is analyzed for gross alpha, gross beta, tritium, strontium-90, and gamma-emitting radionuclides.

The highest concentrations in monthly composite water samples from this Cattaraugus Creek sampler during 1997 show strontium-90 to be only 0.4% of the DCG for strontium-90 in water. As in 1996, there were no positive detections of cesium-137 in Cattaraugus Creek during 1997. (See Table C-1.24 [p. C1-19].) Although gross beta levels at the Felton Bridge sampling location sometimes are elevated slightly during months of lagoon 3 discharge, overall, the yearly average gross beta activity for Cattaraugus Creek at Felton Bridge is nearly indistinguishable from background. Figure 2-7 (below) shows the eleven-year trends for Cattaraugus Creek samples

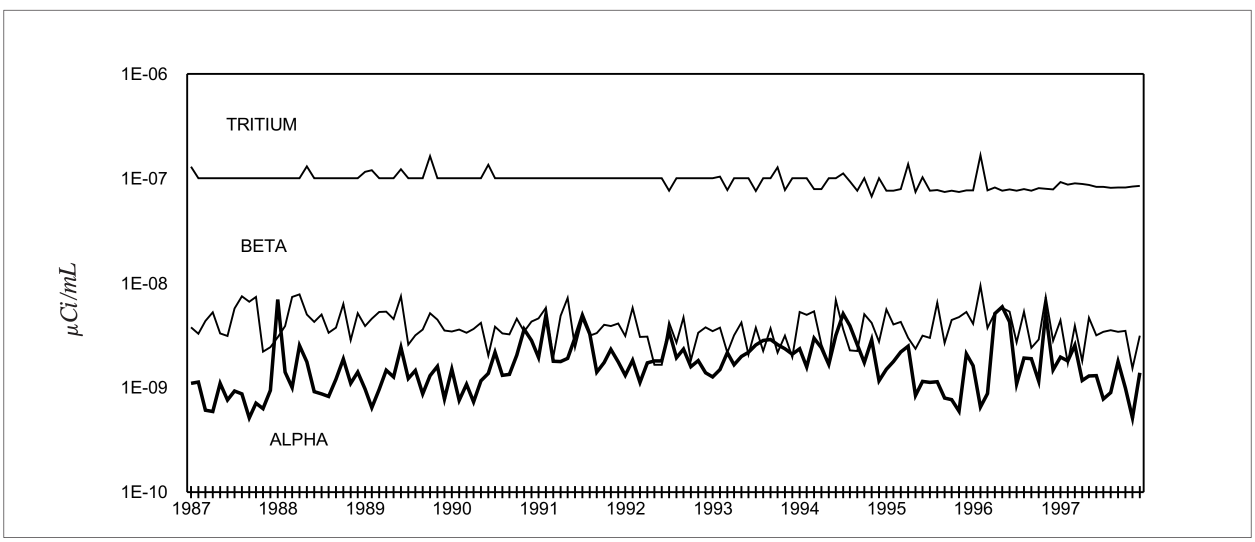

Figure 2-7. Eleven-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WFFELBR

analyzed for gross alpha, gross beta, and tritium. For the most part, tritium concentrations represent method detection limits and not detected radioactivity. Gross beta activity appears to have remained constant at this location since 1987.

Fox Valley Road and Thomas Corners Bridge Sampling Locations

In addition to the Cattaraugus Creek sampler, two surface water monitoring stations are located on Buttermilk Creek, one upstream of the WVDP and one downstream. (See Fig. 2-4 [p. 2-7].) Samplers collect water from a background location upstream of the Project at Fox Valley Road (WFBCBKG) and from a location at Thomas Corners Road that is downstream of the Project and upstream of Buttermilk Creek's confluence with Cattaraugus Creek (WFBCTCB).

These samplers collect a 50-mL aliquot every half-hour. Samples are retrieved weekly and analyzed for pH and conductivity. Samples 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 composite samples from the Fox Valley Road background location also are analyzed for carbon-14, iodine-129, technetium-99, alpha-emitting radionuclides, and total uranium. (Table C-1.22 [p. C1-18] shows monthly and quarterly radioactivity concentrations upstream of the site at Fox Valley Road; Table C-1.23 [p. C1-19] shows monthly and quarterly radioactivity concentrations downstream of the site at Thomas Corners.)

The 1997 data from these locations show that gross beta concentrations downstream of the site at Thomas Corners Bridge are only marginally higher than background concentrations upstream of the site and tritium concentrations are no different from background. The Thomas Corners Bridge sampling point represents an important link in the pathway to humans because dairy cattle have access to waters here. Naturally occurring sources as well as manmade sources contribute to the gross beta radioactivity. However, if the maximum beta concentration in Buttermilk Creek downstream of the Project at Thomas Corners Bridge were entirely attributable to strontium-90, then the radioactivity would represent only 0.80% of the DCG, down from 1.4% in 1996.

In the spring of 1997 severe stream bank erosion became evident at this location. The embankment was reconstructed and stabilized in the fall. A new water sampler weather enclosure was installed and the drainage was improved. While this work was being completed a portable water sampler was operated about 70 yards upstream in Buttermilk Creek. The routine sampling schedule was not interrupted during the upgrade.

Sediment Sampling

Figure 2-4 (p. 2-7) shows the sediment sampling locations. Sediments are grab-sampled annually at or near three of the automatic water sampling locations and at two additional points. Downstream locations are Buttermilk Creek at Thomas Corners Road (SFTCSED), Cattaraugus Creek at Felton Bridge (SFCCSED), and Cattaraugus Creek at the Springville dam (SFSDSED). Upstream background locations are Buttermilk Creek at Fox Valley Road (SFBCSED) and Cattaraugus Creek at Bigelow Bridge (SFBISED).

A comparison of annual averaged cesium-137 concentrations from 1986 through 1997 for these five sampling locations is illustrated in

Figure 2-8 (below). As reported in previous years, cesium-137 concentrations in sediments collected downstream of the WVDP are higher than those observed in samples collected from background locations (SFBCSED or SFBISED). As the figure indicates, concentrations appear to be staying constant with time at the downstream locations. While the cesium-137 activity in downstream Cattaraugus Creek sediments (at locations SFCCSED and SFSDSED) is elevated relative to upstream values (see *Appendix C-1*, Table C-1.30 [p.C1-24]), in perspective, it is within the range of historical background concentrations (as measured at SFGRVAL and SFNASHV) in surface soil in Western New York. (See *Appendix C-1*, Table C-1.29 [p.C1-23].)

A comparison of cesium-137 to the naturally occurring gamma-emitter potassium-40 (Fig. 2-9 [p.2-15]) for the downstream location nearest the Project (Buttermilk Creek at Thomas Corners Road — SFTCSED) indicates that cesium-137 is present at levels lower than naturally occurring gamma emitters. The 1997 concentration was about one-half of the concentration observed in 1996. In addition, when alpha isotopic results for background location SFBCSED, upstream of the site, are compared to those for SFTCSED, downstream of the site, no significant differences are observed.

Air Monitoring

On-site Ventilation Systems

Permits obtained from the U.S. Environmental Protection Agency (EPA) allow air with small amounts of radioactivity to be released from plant ventilation stacks during normal operations. The air released must meet criteria specified in the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations to ensure that the environment and the public's health and safety are not adversely affected. Dose-based comparisons of WVDP emissions against NESHAP criteria are presented in ***Chapter 4, Radiological Dose Assessment***. Although generally less stringent than NESHAP criteria, DOE DCGs are more conducive to concentration-based compari-

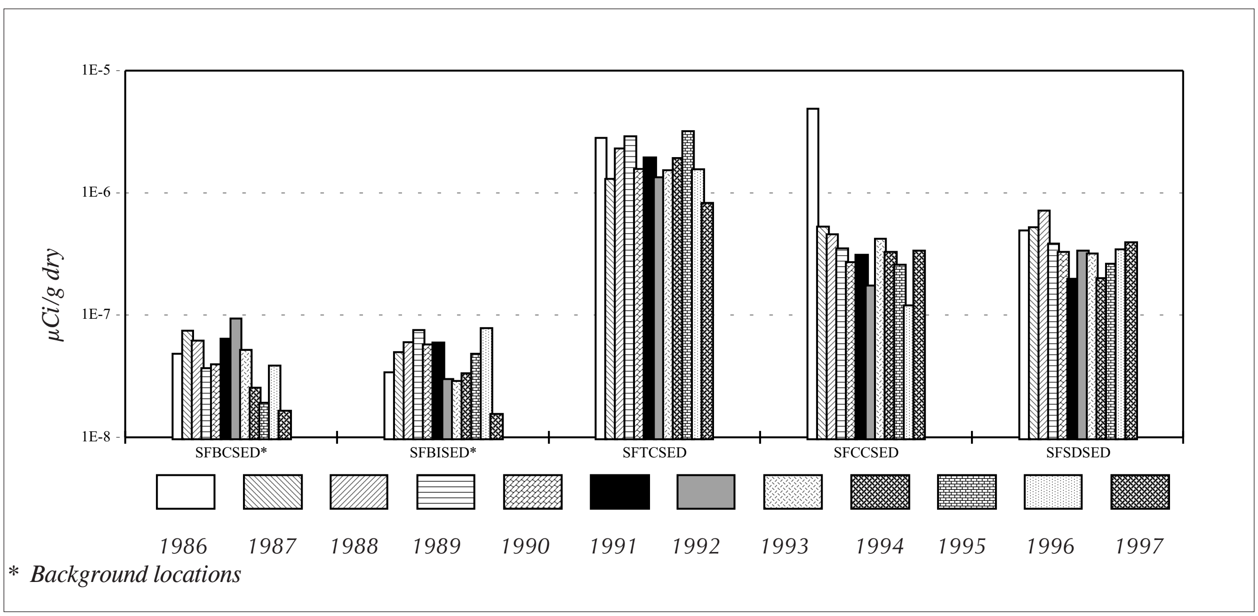

Figure 2-8. Twelve-Year Trends of Cesium-137 in Stream Sediment at Two Locations Upstream and Three Locations Downstream of the WVDP

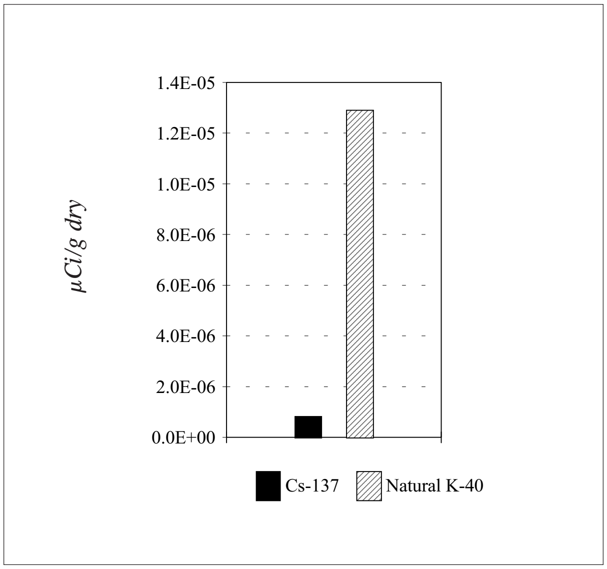

Figure 2-9. Comparison of Cesium-137 with Naturally Occurring Potassium-40 Concentrations in 1997 at Downstream Sampling Location SFTCSED

sons and are used in this chapter for evaluating concentrations of radionuclides in WVDP emissions. Parameters measured include gross alpha and gross beta, tritium, and various radionuclides such as cesium-137 and strontium-90. 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. (DOE standards and DCGs for radionuclides of interest at the WVDP are found in *Appendix B* [p.B-3].)

The exhaust from each permitted fixed ventilation system on-site is continuously filtered, monitored, and sampled as it is released to the atmosphere. Specially designed isokinetic sampling nozzles continuously remove a representative portion of the exhaust air, which is then drawn through very fine glass fiber filters to trap any particles. Sensitive detectors continuously monitor the radioactivity on 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. Six of these sampling systems also contain an activated carbon cartridge used to collect gaseous iodine-129.

In addition to these samples, water vapor from the main plant ventilation stack (ANSTACK) and the supernatant treatment system (ANSTSTK) is collected by trapping moisture in silica gel desiccant columns. The trapped water is distilled from the silica gel desiccant and analyzed for tritium.

Because tritium, iodine, and other isotopic concentrations are quite low, the large-volume samples collected weekly from the main plant stack and from other emission-point samplers provide the only practical means of determining the amount of specific radionuclides released from the facility. In addition to scheduled sampling and analysis of ANSTACK filters for those parameters defined in *Appendix A* of this report, filters are routinely analyzed for strontium-89 and cesium-137 as part of operational-safety monitoring.

The Main Plant Ventilation Stack

Figure 2-1 (p. 2-4) shows the locations of on-site air monitoring and sampling points.

The main ventilation stack is potentially the greatest contributor to airborne releases. The main stack sampling system collects a continuous air sample from this emission point. A high sample-collection flow rate through multiple intake nozzles ensures a representative sample for both the weekly sample and the on-line monitoring system. The total quantity of gross alpha, gross beta, and tritium released each

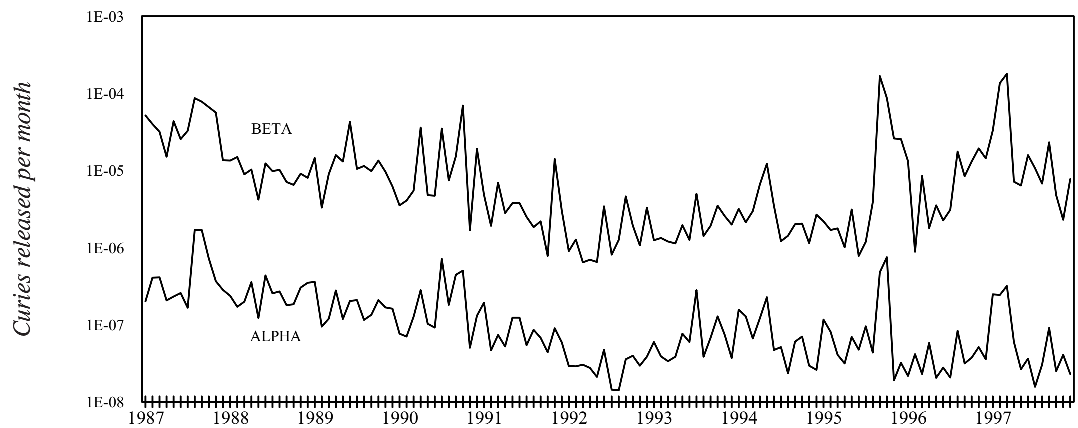

Figure 2-10. Eleven-Year Trends of Gross Alpha and Gross Beta Activity at the Main Stack Sampling Location (ANSTACK)

month from the main stack, based on weekly measurements, is shown in *Appendix C-2*, Table C-2.1 (p. C2-3). Figure 2-10 (above) shows the eleven-year trends in main stack samples analyzed for gross alpha and gross beta activity. The figure indicates a steady five-year downward trend in activity observed for both gross alpha and gross beta from 1987 to mid-1992. From mid-1992 throughout mid-1995 both gross alpha and beta activities rose slightly and then leveled off. During the third and fourth quarters of 1995, concentrations of gross alpha, gross beta, and gamma-emitting radionuclides in ventilated air increased because of transfers of cesium-loaded zeolite from waste tank 8D-1 to 8D-2.

During the first two quarters of 1996 the concentrations returned to levels observed before the zeolite transfer period. As expected, increases were observed during the third and fourth quarters of 1996, coinciding with the start-up of high-level waste vitrification. The levels fluctuated with vitrification operations in 1997 while remaining at generally higher levels than those observed in mid-1992.

A comparison of airborne radioactivity concentrations released from the main plant ventilation in 1997 with the DOE DCGs in Table C-2.2 (p. C2-4) indicates that at the point of stack discharge, average radioactivity levels were already below concentration guidelines for airborne radioactivity in an unrestricted environment. Airborne concentrations from the stack to the site boundary are further reduced by dilution by an average factor of about 200,000. Samples from ambient air perimeter monitors at the site boundary confirm that site operations had no discernible effect on air quality at these perimeter locations.

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 ventilation stack (Tables C-2.3 and C-2.4 [pp. C2-5 and C2-6]). The vitrification off-gas ventilation is emitted through the main plant stack. Air exhausted to the environment from both locations is monitored for radioactivity. Results gathered before July 1996 represent initial pre-vitrification baseline or background levels. Data obtained from July 1996 through the end of 1997 were collected during actual operation of the vitrification facility. A comparison of data collected before and after vitrification startup from the vitrification system (HVAC) ventilation stack shows almost no discernible difference in concentrations in emissions from this facility.

Other On-site Sampling Systems

Sampling systems similar to those of the main stack monitor airborne effluents from the 01-14 building (formerly housing the cement solidification system) ventilation stack (ANCSSTK), the contact size-reduction facility ventilation stack (ANCSRFK), and the supernatant treatment system ventilation stack (ANSTSTK).

A temporary monitoring system was brought on-line at the container sorting and packaging facility ventilation stack (ANCSPFK) in March 1996. The container sorting and packaging facility (CSPF) is a self-contained room within lag storage area #4. Containers of radioactively contaminated materials are opened and hand-sorted in the CSPF before compaction and storage or decontamination. (Durable items such as metal piping can be reused after decontamination.) The CSPF is constantly ventilated during use. The temporary stack monitoring system operated from March 1996 to March 1997 while a permanent system was being designed and installed. The permanent system was brought on-line in March 1997.

The 1997 samples from ANCSSTK, ANCSRFK, ANSTSTK, and ANCSPFK showed detectable gross radioactivity in some cases as well as specific beta- and alpha-emitting radionuclides but did not approach any Department of Energy effluent limitations. Tables C-2.5 through C-2.8 (pp. C2-7 through C2-10) show monthly totals of gross alpha and beta radioactivity and quarterly total radioactivity released for specific radionuclides for each of these sampling locations.

In addition, a temporary demonstration decontamination facility using carbon dioxide (CO_2) cleaning technology was brought on-site in late 1996 and operated into the summer of 1997. Results of sampling from that facility in 1997 are included in Table C-2.15 (p. C2-16).

Three other operations are routinely monitored for airborne radioactive releases: the supercompactor volume-reduction ventilation system (ANSUPCV), the low-level waste treatment facility ventilation system (ANLLWTVH), and the contaminated clothing laundry ventilation system (ANLAUNV).

The supercompactor ventilation (ANSUPCV) has not operated since August 1995. The unit will be removed from the WVDP in 1998.

The low-level waste treatment facility ventilation system and the contaminated clothing laundry ventilation system are sampled for gross alpha and gross beta radioactivity. Data for these two facilities are presented in Tables C-2.9 and C-2.10 (p. C2-11). 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, both ventilations are sampled continuously while discharging to the environment. The low-level waste treatment facility is scheduled to be replaced by a new facility in the spring of 1998.

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.

In 1997 average discharges at the point of release from portable outdoor ventilation units were well below DOE guidelines for alpha and beta radioactivity in an unrestricted environment. Dilution from the point of release to the site boundary would further reduce these concentrations.

In February 1995 ambient air monitors were installed near the lag storage area (ANLAGAM) and near the NDA (ANNDAAM). The 1997 monitoring data are presented in *Appendix C-2*, Tables C-2.11 and C-2.12 (pp. C2-12 and C2-13).

An ambient air sampler (ANSDAT9) monitors potential diffuse releases of radioactivity associated with the SDA, which is managed by the New York State Energy and Research Development Authority (NYSERDA). The ANSDAT9 sampler could also detect site-wide releases to ambient air. With the exception of marginally elevated tritium, radiological results for this location are all either below analytical detection limits or are no different statistically than those observed at the background air monitoring location AFGRVAL. Even the highest positive tritium result observed (3.76E-12 μCi/mL) is only 0.004% of the DOE DCG for this radionuclide. Results of this monitoring are presented in *Appendix C-2*, Table C-2.13 (p.C2-14).

Perimeter and Remote Air Sampling

Maps of perimeter and remote air sampling locations may be found on Figure 2-2 (p. 2-5) and Figure A-9 (p. A-53).

As in previous years, airborne particulate samples for radiological analysis were collected continuously at six locations around the perimeter of the site and at four remote locations at Great Valley, West Valley, Springville, and Nashville, New York. Perimeter locations — on Fox Valley Road, Rock Springs Road, Route 240, Thomas Corners Road, Dutch Hill Road, and at the site's bulk storage warehouse — were chosen to provide historical continuity or because the location would best represent the highest potential off-site airborne concentration of radioactivity. The eleven-year trends of gross alpha and gross beta concentrations at the Rock Springs Road location are shown in Figure 2-11 (below). The remote locations provide

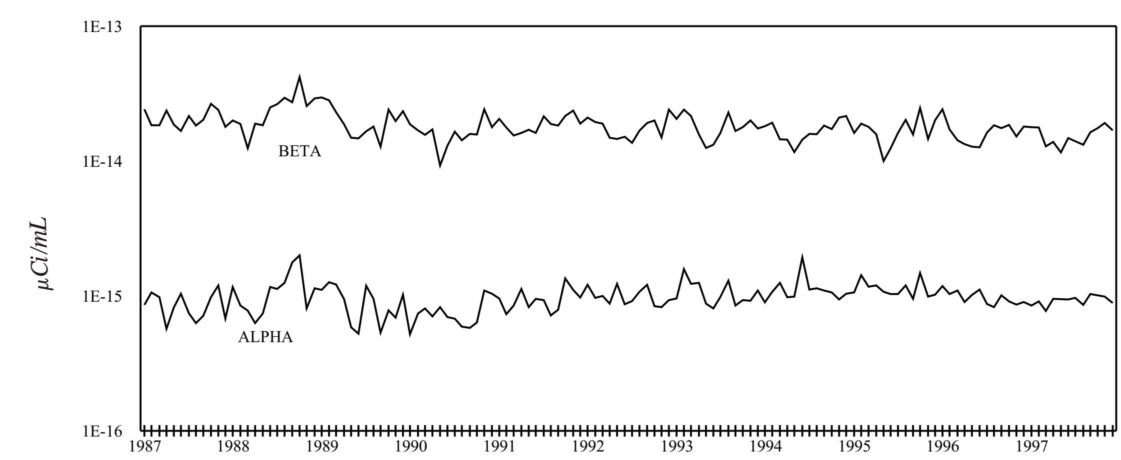

Figure 2-11. Eleven-Year Trends of Gross Alpha and Gross Beta Concentrations at the Rock Springs Road Sampling Location (AFRSPRD)

> ***Global Fallout Sampling***
>
> *Global fallout is sampled at four of the perimeter air sampler locations and at the base of the original on-site meteorological tower. Precipitation from all of the locations is collected and analyzed every month. Monthly gross alpha and gross beta results from these measurements are reported in nCi/m² and tritium results are reported in µCi/mL. (The 1997 data from these analyses and precipitation pH measurement data are found in Appendix C-2, Tables C-2.26 through C-2.30 [pp. C2-24 through C2-26].)*
>
> *Fallout pot data indicate short-term effects. Long-term deposition is measured by surface soil samples collected annually near each air sampling station. Soil sample data are found in Table C-1.29 [p. C1-23] of Appendix C-1.*

data from nearby communities — West Valley and Springville — and from more distant background areas. Concentrations measured at Great Valley (AFGRVAL, 29 km south of the site) and Nashville (AFNASHV, 37 km west of the site in the town of Hanover) are considered representative of regional natural background radiation. During the final week of December 1997 the Springville air sampler was relocated about 1 kilometer from its original position. Trees growing nearby had begun to encroach upon the sampler, making relocation prudent. Great care was taken to ensure that the new location met the technical requirements of a well-placed air sampler.

The air sampler tower supports that had been installed by NFS at three perimeter locations were replaced with smaller weather enclosures in order to standardize air sampling equipment. Access was improved to make it easier to maintain the sampling equipment.

All ten off-site air samplers maintain an average flow of about 40 L/min (1.4 ft³min) through a 47-millimeter glass fiber filter. The sampler heads for each of the locations are set at 1.7 meters above the ground, the height of the average human breathing zone. Filters from off-site and perimeter samplers are collected weekly and analyzed after a seven-day "decay" period to remove interference from short-lived naturally occurring radionuclides.

Gross alpha and gross beta measurements of each filter are made weekly using a low-background gas proportional counter. The gross alpha and gross beta ranges and annual averages for each of the ambient sampling points are provided in Tables 2-3 and 2-4 (p. 2-20). The 1997 concentration ranges are similar to those measured in 1996. Near-site sample concentrations are indistinguishable from background, and all reflect normal seasonal variations.

In addition, quarterly composites, which consist of filters collected each week for thirteen weeks from each sample station, are analyzed. Data from these samplers are provided in *Appendix C-2*, Tables C-2.16 through C-2.25 (pp. C2-17 to C2-23). Although tritium (as hydrogen-tritium oxide [HTO]) was positively detected on three occasions at the Rock Springs Road location near the site, those concentrations were the same as positive concentrations observed at the Great Valley background location. Three strontium-90 values marginally above the detection limit were observed at the Rock Springs Road location during 1997, but all three values overlap background concentrations. Cesium-137, cobalt-60, and, most importantly, iodine-129 remained undetected in 1997.

The gross beta concentrations in air data for the three samplers that have been in operation since before 1982 — Fox Valley, Thomas Corners, and Route 240 — averaged about 1.79E-14µCi/mL (6.62E-04 Bq/m³) in 1996 and 1.72E-14 µCi/mL

Table 2-3

1997 Gross Alpha Concentrations at Off-Site, Perimeter, and On-site Ambient Air Sampling Locations

Location	Number of Samples	Range (μCi/mL)	Range (Bq/m³)	Annual Average (μCi/mL)	Annual Average (Bq/m³)
AFFXVRD	52	<6.46E-16 — 2.42E-15	<2.39E-05 — 8.94E-05	6.92±9.33E-16	2.56±3.45E-05
AFRSPRD	52	<5.67E-16 — 1.81E-15	<2.10E-05 — 6.70E-05	5.92±9.26E-16	2.19±3.42E-05
AFRT240	52	<6.42E-16 — 2.00E-15	<2.38E-05 — 7.40E-05	6.78±9.58E-16	2.51±3.54E-05
AFSPRVL	52	5.13E-16 — 1.91E-15	1.90E-05 — 7.08E-05	4.64±8.87E-16	1.72±3.28E-05
AFTCORD	52	<4.23E-16 — 1.77E-15	<1.57E-05 — 6.53E-05	6.77±9.58E-16	2.51±3.54E-05
AFWEVAL	52	5.76E-16 — 2.06E-15	2.13E-05 — 7.61E-05	6.31±9.08E-16	2.33±3.36E-05
AFGRVAL	52	<5.66E-16 — 1.75E-15	<2.10E-05 — 6.47E-05	6.53±9.39E-16	2.42±3.48E-05
AFBOEHN	52	6.43E-16 — 2.83E-15	2.38E-05 — 1.05E-04	7.51±9.69E-16	2.78±3.58E-05
AFNASHV	52	<6.39E-16 — 2.13E-15	<2.36E-05 — 7.88E-05	7.21±9.70E-16	2.67±3.59E-05
AFBLKST	52	<4.49E-16 — 1.98E-15	<1.66E-05 — 7.32E-05	5.24±8.78E-16	1.94±3.25E-05
ANLAGAM	52	<3.46E-16 — 2.83E-15	<1.28E-05 — 1.05E-04	6.35±6.63E-16	2.35±2.45E-05
ANNDAAM	52	<4.91E-16 — 2.32E-15	<1.82E-05 — 8.58E-05	7.78±7.21E-16	2.88±2.67E-05

Table 2-4

1997 Gross Beta Concentrations at Off-Site, Perimeter, and On-Site Ambient Air Sampling Locations

Location	Number of Samples	Range (μCi/mL)	Range (Bq/m³)	Annual Average (μCi/mL)	Annual Average (Bq/m³)
AFFXVRD	52	8.31E-15 — 3.82E-14	3.07E-04 — 1.41E-03	1.79±0.33E-14	6.63±1.24E-04
AFRSPRD	52	4.81E-15 — 3.04E-14	1.78E-04 — 1.13E-03	1.54±0.33E-14	5.72±1.21E-04
AFRT240	52	7.72E-15 — 3.35E-14	2.86E-04 — 1.24E-03	1.78±0.34E-14	6.57±1.27E-04
AFSPRVL	52	6.16E-15 — 3.05E-14	2.28E-04 — 1.13E-03	1.47±0.32E-14	5.45±1.18E-04
AFTCORD	52	7.30E-15 — 3.02E-14	2.70E-04 — 1.12E-03	1.62±0.33E-14	6.00±1.23E-04
AFWEVAL	52	5.98E-15 — 3.79E-14	2.21E-04 — 1.40E-03	1.84±0.33E-14	6.82±1.24E-04
AFGRVAL	52	4.66E-15 — 3.10E-14	1.73E-04 — 1.15E-03	1.64±0.33E-14	6.05±1.22E-04
AFBOEHN	52	6.18E-15 — 3.82E-14	2.29E-04 — 1.42E-03	1.96±0.35E-14	7.27±1.30E-04
AFNASHV	52	<5.06E-15 — 3.64E-14	<1.87E-04 — 1.35E-03	1.72±0.34E-14	6.35±1.24E-04
AFBLKST	52	7.32E-15 — 3.00E-14	2.71E-04 — 1.11E-03	1.56±0.32E-14	5.76±1.18E-04
ANLAGAM	52	<1.37E-15 — 2.65E-14	<5.07E-05 — 9.79E-04	1.29±0.23E-14	4.78±0.85E-04
ANNDAAM	52	6.66E-15 — 3.46E-14	2.46E-04 — 1.28E-03	1.72±0.26E-14	6.36±0.96E-04

(6.37E-04 Bq/m^3) in 1997. The average gross beta concentration at the two background sampling locations — Great Valley and Nashville — was 1.67E-14 μCi/mL (6.19E-04 Bq/m^3) in 1997.

Off-site Surface Soil Sampling

Maps of off-site surface soil sampling locations may be found on Figures A-6 and A-9 (pp.A-50 and A-53).

Soil from the upper two inches of the ground near the perimeter air samplers is collected annually to measure the radioactivity deposited by worldwide fallout. Samples were collected in 1997 from ten locations: six near-site points on the perimeter of the retained premises (WNYNSC), two in nearby communities, and two in locations 20 to 40 kilometers distant from the Project. Analyses for gross alpha and beta, cesium-137, strontium-90, plutonium-239/240, and americium-241 at all ten locations and analyses for uranium radionuclides and total uranium at three points were compared among the sample locations.

The measured concentrations (Table C-1.29 [p.C1-23]) are typical of normal background concentrations in the region, with two exceptions: Soil from the Rock Springs Road air sampler location has consistently shown a higher-than-background cesium-137 concentration. This sampler is known to be within an extended area of elevated cesium activity that was identified by a 1979 survey, well before the Project was initiated. The 1997 strontium-90 concentrations at the Rock Springs Road and Route 240 locations decreased from 1996 levels to that observed in previous years. This decrease supports the statement in last year's report that the 1996 levels were probably the result of analytical uncertainties rather than Project releases to the environment. At the Thomas Corners Road location the 1997 strontium-90 concentration increased from the 1996 level but remained close to the range of historical background variation.

A single elevated americium-241 value observed at the Boehn Road location, although greater than results from the background locations, is most likely due to analytical uncertainty, given no concurrent rise in any other alpha-emitting radionuclides or cesium-137 in the same sample.

The 1997 results show that detectable concentrations of strontium-90 and cesium-137 (both of which are present in worldwide fallout), and man-made alpha-emitting radionuclides were generally within the same range of uncertainty as background samples.

Radioactivity in the Food Chain

Maps showing biological sampling points are found on Figures 2-12 (p. 2-22) and A-9 (p.A-53).

Each year food samples are collected from locations near the site (Fig. 2-12 [p. 2-22] and from remote locations (Fig. A-9 [p. A-53]). Fish and deer are collected during periods when they would normally be taken by sportsmen for consumption. In addition, milk is collected monthly and beef semiannually from cows that graze near the site and at remote locations. 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. Compared to sport fishing, this method allows a more species-selective control, with unwanted fish being returned to the creek essentially unharmed. Twenty fish samples are collected every year (ten semiannually) above the

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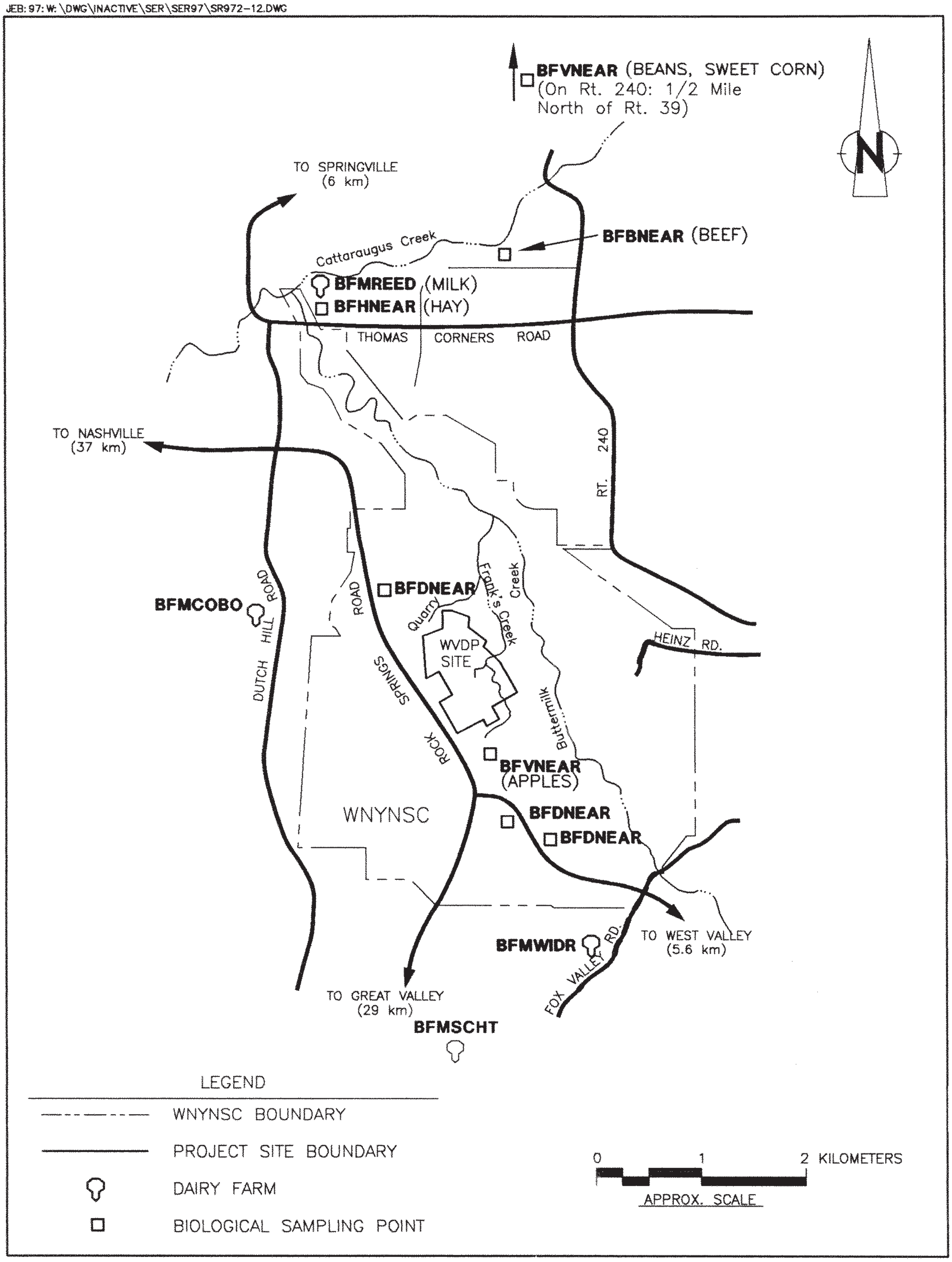

Figure 2-12. Near-site Biological Sampling Points.

Electrofishing in Cattaraugus Creek

Springville dam from the portion of Cattaraugus Creek that is downstream of WNYNSC drainage (BFFCATC). Ten fish samples also are collected annually from Cattaraugus Creek below the dam (BFFCATD), including species that migrate nearly forty miles upstream from Lake Erie. These specimens are representative of sport fishing catches in the creek downstream of the Springville dam.

Twenty control fish are taken every year (ten semiannually) from waters that are not influenced by site runoff (BFFCTRL). These control samples, containing no radioactivity from WVDP effluents, allow comparisons with the concentrations found in fish taken from site-influenced waters. The control species are representative of the several fish species collected in Cattaraugus Creek downstream from the WVDP. A combined total of fifty fish were collected from these locations.

The edible portion of each individual fish was analyzed for strontium-90 content and the gamma-emitting radionuclides cesium-134 and cesium-137. (See Table C-3.4 [p.C3-6 through C3-8] in *Appendix C-3* for a summary of the results.) Throughout the year concentrations of strontium-90 ranged from below the minimum detectable concentration (see *Glossary*) to a maximum of 9.23E-08μCi/g at BFFCATC and from below the minimum detectable concentration to 4.83E-08μCi/g at the control location (BFFCTRL). These levels are very similar to the levels observed in fish collected during 1996. One sport fish caught below the Springville Dam, a steelhead trout, contained 1.28E-07μCi/g of strontium-90. Although this fish contained the highest concentration of strontium-90 among the fish collected from this location in 1997, this value is well within the range of strontium-90 concentrations measured in fish collected from this location before 1997.

Ten fish collected downstream of the site showed marginally positive detections for cesium-137. No cesium-137 concentrations in these fish were statistically different than concentrations measured at the background location.

Venison

Specimens from a near-site deer herd also are analyzed for radioactive components. Historically, concentrations of radioactivity in deer flesh have been very low and Project activities have been shown to have little to no effect on the local herd.

Venison from three deer salvaged from vehicle-deer accidents around the WNYNSC was analyzed and the data compared to that from deer collected far from the site in the towns of Franklinville, Olean, and Burns, New York. Low levels of radioactivity from cesium-137 and naturally occurring potassium-40 were detected in both near-site and control samples.

Concentrations in near-site deer were the same as background levels for these radionuclides in 1997, with the exception of one cesium-137 value, which was within the range of historical control values. The range in concentrations observed was similar to previous years. The shorter-lived cesium-134 isotope was not detected in any near-site or control deer during 1997. Results for these samples are shown in Table C-3.2 (p.C3-4) in *Appendix C-3.* Tritium concentrations in near-site deer were indistinguishable from background. Overall, tritium levels detected in near-site deer and control deer were lower than the 1996 levels.

For the fourth 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. A total of 113 deer were collected. Although hunters were given the option of submitting portions of their takes for testing, none of the deer were analyzed for radioactivity.

Springville Dam on Cattaraugus Creek

A special study of the on-site (WVDP premises) deer population was conducted in 1997 in advance of measures taken to reduce the number of deer inside the security-fenced area. The results of the study are discussed in ***Chapter 4*** under *Environmental Media Concentrations*. (See p. 4-10.)

Beef

In 1997, as in previous years, radiological concentrations in samples of beef from near-site herds were similar to those from control herds.

Beef samples taken semiannually from near-site and remote locations were analyzed for tritium, strontium-90, and gamma-emitting radionuclides such as cesium-134 and cesium-137. Tritium was detected in both near-site and background samples in the second half of 1997, with the near-site result being marginally higher than the background result. During 1997 low positive strontium-90 results were noted in both near-site and background samples. However, near-site and control results were not significantly different. No cesium-134 or cesium-137 was detected at either location in 1997. Results are presented in Table C-3.2 (p.C3-4) in *Appendix C-3*.

Milk

Monthly milk samples were taken in 1997 from dairy farms near the site and from control farms at some distance from the site. (See Fig. 2-12 [p. 2-22].) Quarterly composites of monthly samples from the maximally exposed herd to the north (BFMREED) and from a nearby herd to the northwest (BFMCOBO) were prepared. Single annual samples were taken from herds near the WVDP to the southeast (BFMWIDR) and the south (BFMSCHT). Monthly samples from control herds (BFMCTLN and BFMCTLS) were also prepared as quarterly composites. (See Fig.A-9 in *Appendix A* [p. A-53] for control sample locations.)

Each milk sample was analyzed for strontium-90, iodine-129, gamma-emitting radionuclides (naturally occurring potassium-40, cesium-134, and cesium-137), and tritium. In all cases, radioisotopic concentrations, even when positive, were either within the range of historical background values or statistically overlapped with results from control locations. See Table C-3.1 (p. C3-3).

Fruit, Vegetables, and Forage

Results from the analysis of beans, apples, sweet corn, and hay collected during 1997 are presented in Table C-3.3 (p. C3-5) in *Appendix C-3*. Tritium was not detected in near-site corn and bean samples at levels above background. Although near-site apple samples did show positive tritium results above the control values, results were within the range of control values for other biological matrices.

In 1997 positive strontium-90 results were obtained in all samples. Of these positive results, one near-site apple sample, collected from fruit available to humans but not consumed, indicated strontium-90 at a concentration statistically above the 1997 control value. For a discussion of the dose significance of this elevated value see *Environmental Media Concentrations* in ***Chapter 4***, p. 4-10. The strontium-90 value in near-site corn was statistically higher than the control sample but below other matrix control sample concentrations (e.g., beans and apples). The concentration of strontium-90 in near-site hay in 1997 was statistically higher than the control value but below the value reported for the near-site hay sample in 1996. Cesium-137 was not detected in any fruits, vegetables, or hay.

Direct Environmental Radiation Monitoring

The current monitoring year, 1997, was the fourteenth full year in which direct penetrating radia-

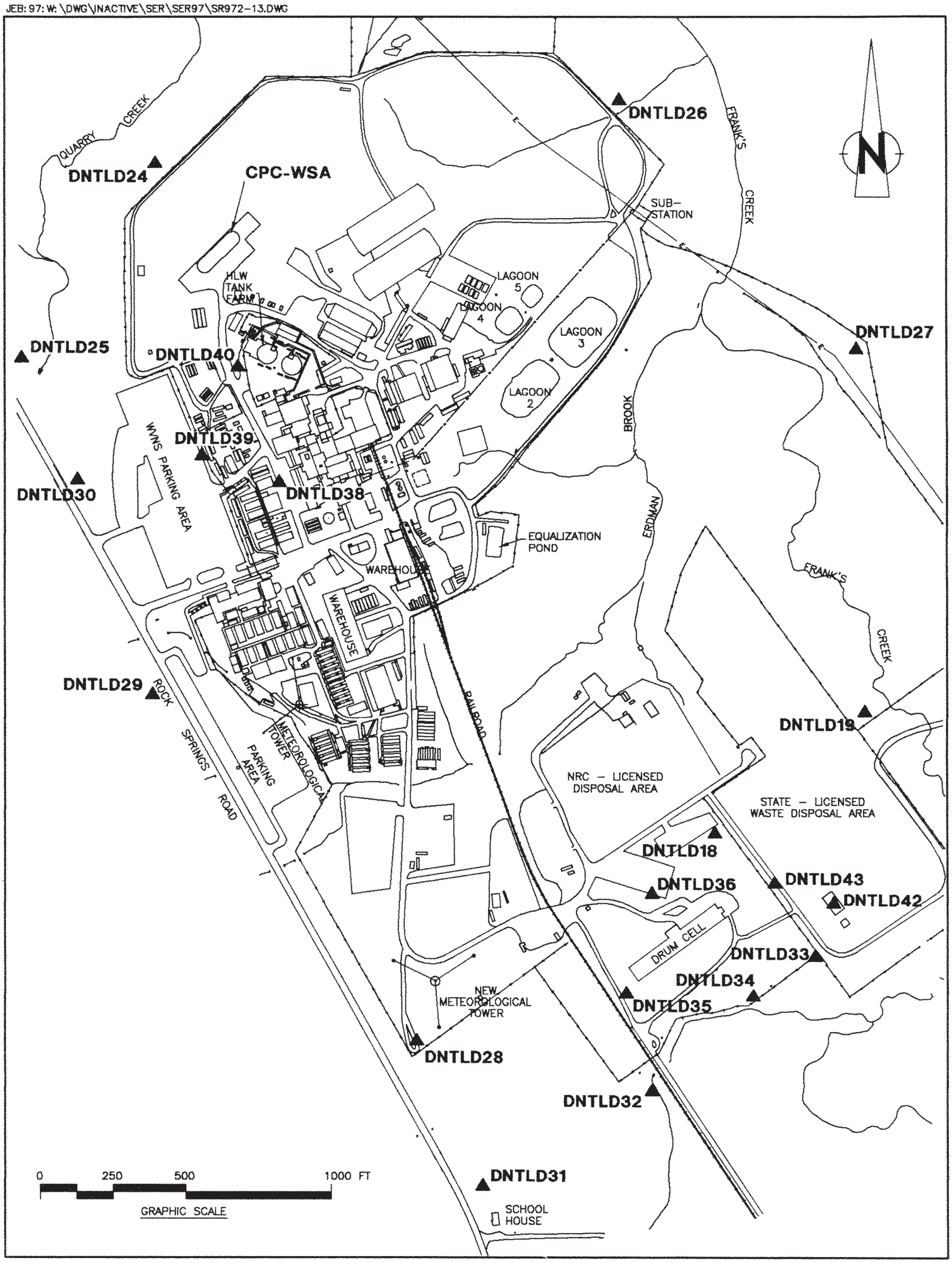

Figure 2–13. Location of On–site Thermoluminescent Dosimeters (TLDs).

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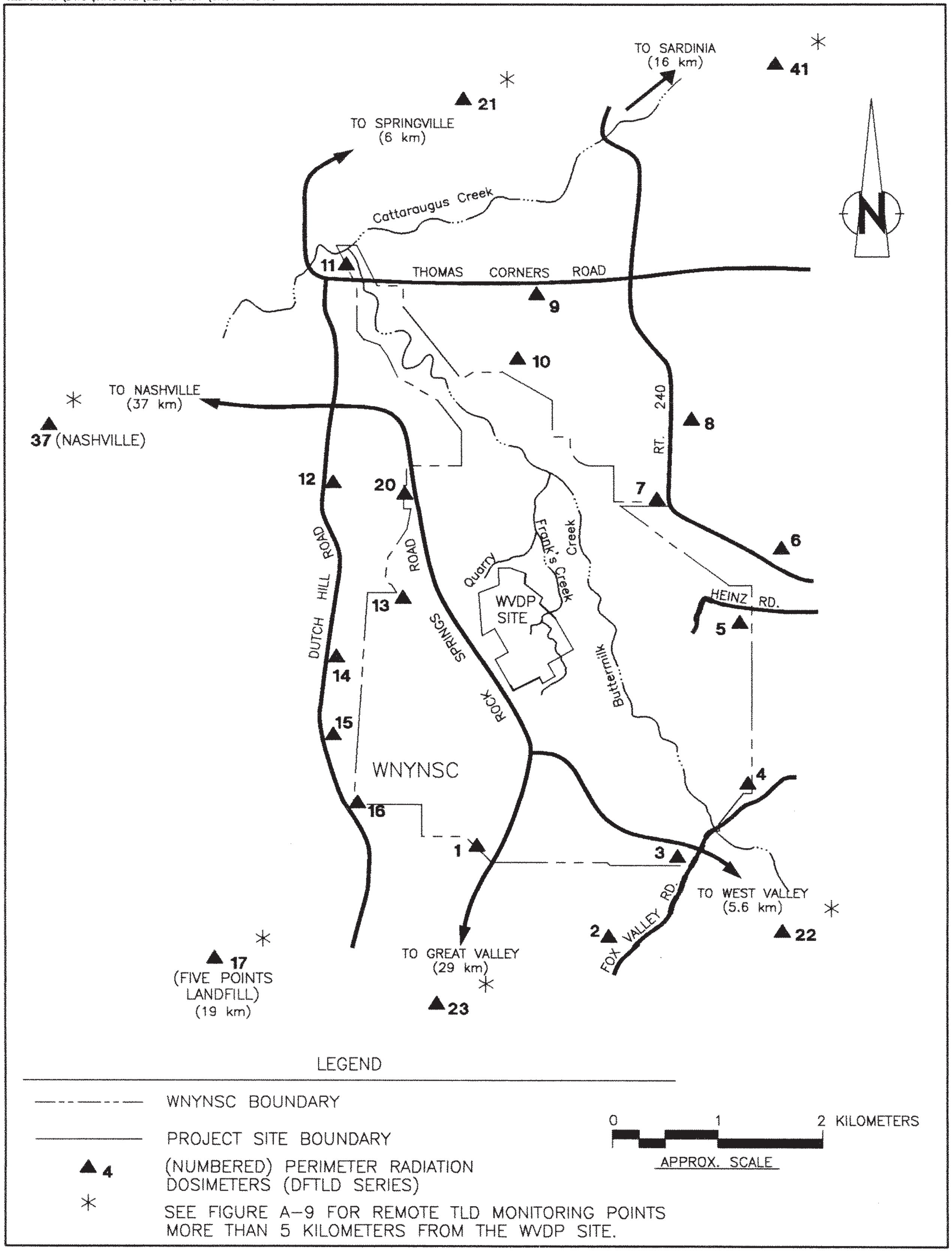

Figure 2-14. Location of Off-site Thermoluminescent Dosimeters (TLDs).

tion was monitored at the WVDP using TLD-700 lithium fluoride thermoluminescent dosimeters (TLDs). These dosimeters, used solely for environmental monitoring, consist of five TLD chips laminated on a card bearing the location identification and other information. The cards are placed at each monitoring location for one calendar quarter (three months) and are then processed to obtain the integrated gamma radiation exposure.

During the third and fourth quarters of 1997 two sets of TLD chips were placed at each monitoring location. The original TLD-700 dosimeters were accompanied by new, copper-activated lithium fluoride dosimeters, and studies are being conducted at the WVDP and the Idaho National Environmental Engineering Laboratory to determine the suitability of the new matrix. The new chips are reportedly more sensitive to environmental radiation. When a sufficient evaluation has been completed the new chips will replace the TLD-700 dosimeters entirely.

This was the second full year in which TLD packages were processed by an independent off-site contractor. (See *Appendix C-4*, Tables C-4.1 and C-4.2 [pp. C4-3 and C4-4]). Calendar year 1997 was the final year in which the NRC co-located environmental TLDs at the WVDP. The three on-site NRC monitoring locations were removed in January 1998.

Monitoring points are located around the WNYNSC perimeter and the access road, at the waste management units, at the site security fence, and at background locations remote from the WVDP site (Figs. 2-13 and 2-14 [pp. 2-26 and 2-27] and Fig. A-9 [p. A-53]). The identification numbers of the TLDs were assigned in the chronological order of TLD installation. The monitoring locations are as follows:

THE PERIMETER OF THE WNYNSC: TLDs #1-16, #20

THE PERIMETER OF THE SITE SECURITY FENCE: TLDs #24, #26-34

ON-SITE SOURCES OR SOLID WASTE MANAGEMENT UNITS: TLDs #18, #32-36, and #43 (RTS drum cell); #18, #19, #33, #42, and #43 (SDA); #24 (component storage, near the WVDP site security fence); #25 (the maximum measured exposure rate at the closest point of public access); #38 (main plant and the previous cement solidification system); #39 (parking lot security fence closest to the vitrification facility); #40 (high-level waste tank farm)

NEAR-SITE COMMUNITIES: TLDs #21 (Springville); #22 (West Valley)

BACKGROUND: TLDs #17 (Five Points Landfill in Mansfield); #23 (Great Valley); #37 (Nashville); #41 (Sardinia).

Measured exposure rates were comparable to those of 1996. There was no significant difference between the pooled quarterly average background TLDs (#17, #23, #37, and #41) and the pooled average for the WNYNSC perimeter locations for the 1997 reporting period.

Tables C-4.1 and C-4.2 (pp. C4-3 through C4-4) provide a summary of the results by calendar quarter for each of the environmental monitoring locations along with averages for comparison. The individual location results show different quarterly results because of seasonal variations. The data obtained for all four calendar quarters compared favorably to the respective quarterly data in 1996. The quarterly average of the seventeen WNYNSC perimeter TLDs was 18.5 milliroentgen (mR) per quarter (17.7 mrem per quarter) in 1997.

The perimeter TLD quarterly averages since 1985, expressed in microroentgen per hour (μR/hr), are shown in Figure 2-15 below.

On-Site Radiation Monitoring

Location #24 on the north inner facility fence was a co-location site in 1997 for one NRC TLD. (See *Appendix D*, Table D-4 [p. D-10].) Valid WVDP data from the fourth quarter of 1997 for location #24 are not available because of a problem with the chip analysis instrument. The average exposure rate at location #24 for the first three quarters, however, was about 0.31 milliroentgens (mR) per hour during 1997, as opposed to 0.38 mR/hr in 1996, 0.39 mR/hr in 1995, 0.47 mR/hr in 1994, 0.48 mR/hr in 1993, and 0.52 mR/hr in 1992. Sealed containers of radioactive components and debris from the plant decontamination work are stored nearby. The decline in exposure rate over time is due to radioactive decay of the materials stored within. The storage area is well within the WNYNSC boundary, just outside of the WVDP fenced area, and is not accessible by the public.

Locations around the integrated radwaste treatment storage building — the drum cell — for the most part stayed the same or decreased slightly during the 1997 calendar year. The average dose rate at TLDs #18, #32, #33, #34, #35, #36, and #43 was 0.019 mR/hr in 1997, slightly lower than the level observed in 1996. These exposure rates, which are above background levels, reflect the placement in the building of drums containing decontaminated supernatant mixed with cement. The drum cell and the surrounding TLD locations are well within the WNYNSC boundary and are not accessible by the public.

Results from locations #27, #28, and #31 at the security fence are near background. These locations are more distant from on-site radioactive waste storage areas. The TLD measurements at the Rock Springs Road location (TLDs #28 and #31) are presented in *Appendix C-4*, Table C-4.2 (p. C4-4). The most recent data show that expo-

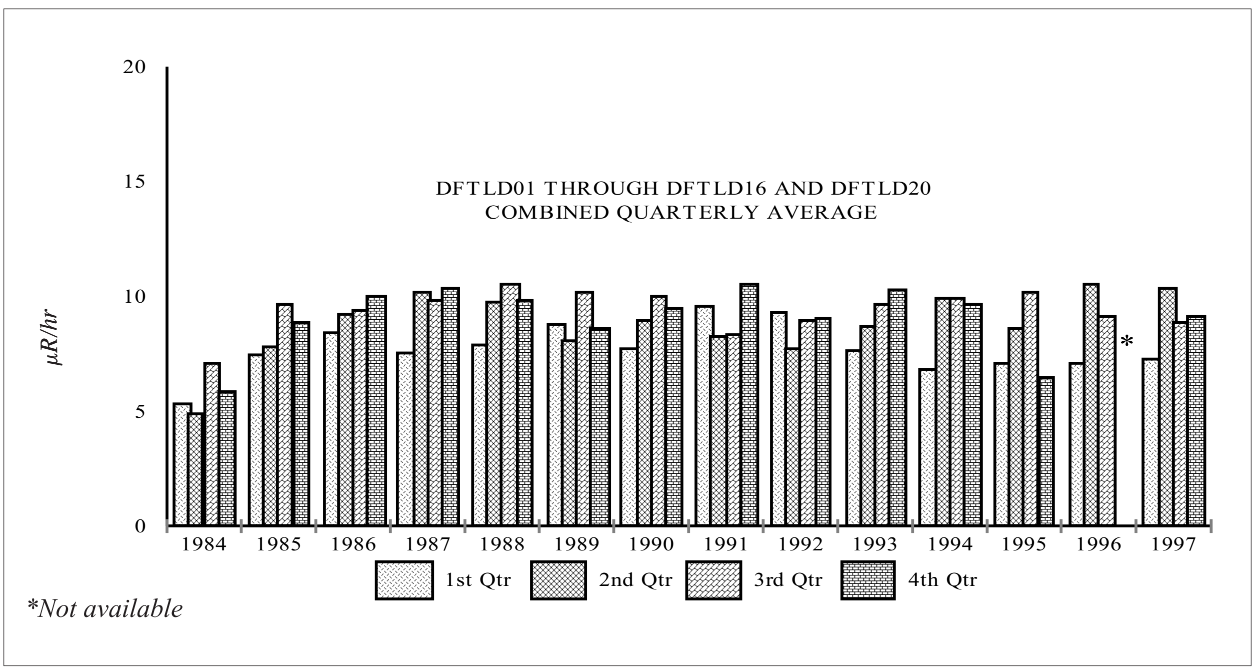

Figure 2-15. Fourteen-Year Trend of Environmental Radiation Levels

Checking Data from the Meteorological Tower

sure rates at Rock Springs Road are the same as or only slightly greater than those seen before any drums were placed in the drum cell.

Results for TLD #42 are above background, reflecting its location close to a waste tank that stores SDA leachate.

Perimeter and Off-site Radiation Monitoring

The perimeter TLDs (TLDs #1-16 and #20) are located in the sixteen compass sectors around the facility near the WNYNSC boundary. The quarterly values for these TLDs (Fig. 2-15 [p. 2-29]) indicate no trends other than normal seasonal fluctuations. TLDs #17, #21-23, #37, and #41 monitor near-site community and background locations. The results from these monitoring points are essentially the same as the perimeter TLDs. Figure C-4.1 in *Appendix C-4* (p. C4-6) shows the average quarterly exposure rate at each off-site TLD location. Figure C-4.2 (p. C4-6) shows the average quarterly exposure rate at each on-site TLD.

Note: In addition to location #24, WVDP fourth-quarter 1997 data are unavailable for locations #17 through #23. All eight of the affected TLD chips were being read by the same analyzer when the instrument problem was encountered. Consequently, fourth-quarter 1997 data for these locations are not presented.

Confirmation of Results

The performance of the environmental TLDs is confirmed periodically using a portable high-pressure ion chamber (HPIC) detection system. In August 1997 the HPIC was transported to each of the forty-three environmental TLD locations and ten instantaneous dose readings were obtained. The ten readings were averaged to determine the dose rate (in μR/hr) at each location. The TLD results and HPIC readings showed very good correlations at forty-one of the forty-three locations. Two locations showing greater variability (locations #24 and #40) are near active waste management areas and would be expected to change during the study period. Results of this study are provided in *Appendix C-4*, Table C-4.3 (p.C4-5).

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 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 indicated by the difference in temperature between the 10-meter and 60-meter 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. 2-1 [p. 2-4]) 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-9 [p. A-53].) Dewpoint, precipitation, and barometric pressure are also monitored at the on-site meteorological tower.

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 1997 the on-site system data recovery rate (time valid data were logged versus total elapsed time) was approximately 96.3%. Figures C-6.1 and C-6.2 in *Appendix C-6* (pp. C6-3 and C6-4) illustrate 1997 mean wind speed and wind direction at the 10-meter and 60-meter elevations. Regional data at the 10-meter elevation are shown in Figure C-6.3 (p.C6-5).

Weekly and cumulative total precipitation data are illustrated in Figures C-6.4 and C-6.5 in *Appendix C-6* (p. C6-6). Precipitation in 1997 was approximately 109.8 centimeters (43.2 in), 5.6% above the annual average of 104 centimeters (41 in). Information 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.

Special Monitoring

Investigation of Increased Iodine Emissions from the Main Stack

The start of radioactive vitrification operations resulted in an increase in the emission rate of radioactive isotopes of iodine from the main plant stack. The reason for the increase is that gaseous iodine is not as efficiently removed by the vitrification process off-gas treatment system as are most of the other radionuclides. (For more information on the off-site effective dose from airborne emissions see ***Chapter 4, Radiological Dose Assessment***, p. 4-10.)

Iodine-129 emissions from the main stack increased in 1996 and continued at elevated levels in 1997. Iodine-129 is a long-lived radionuclide that has always been present in main stack emissions. In addition, iodine-131 was detected in 1996. Iodine-131, an isotope with a half-life of eight days, originates from the decay of curium-244. Curium-244 is present in the high-level waste. Iodine-131 was not detectable until vitrification processing began because the pre-vitrification storage and management of the high-level waste had prevented detectable levels of iodine-131 from reaching the air effluent. The process of preparing the high-level waste for vitrification increased quantities of iodine-129 and allowed a very small yet detectable quantity of iodine-131 to be released to the main plant stack air effluent through the vitrification process off-gas treatment system.

Iodine-129 was closely monitored throughout 1997 and the results compared to process operations in the vitrification facility. Fluctuations in iodine-129 concentrations were too small to determine which specific process was the primary transport mechanism, although the release levels were within the anticipated range. The relevant data are shown in Table C-2.1, *Appendix C-2*, p. C2-3.

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 the New York State Department of Environmental Conservation (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 1997 and was found to be in generally good condition. Routine minor repairs are made to maintain an adequate grass cover, and the grass planted on the clay and soil cap is cut. Adequate drainage is maintained to ensure that no obvious ponding or soil erosion occurs. Results of groundwater monitoring in the general area of the closed landfill, i.e., wells 803 and 8612, are presented in ***Chapter 3, Groundwater Monitoring***, p. 3-15.

WNNDADR Tritium Sampling

As noted in previous reports, tritium has been detected at this location at various concentrations. To understand whether these concentrations are affected solely by seasonal variations or by some other influence, water samples were collected and analyzed weekly during 1997. The average monthly tritium concentration at this location was determined to be 1.93E-06μCi/mL. The highest weekly concentration was recorded in late July at 5.07E-06μCi/mL (0.25% of the DCG). In general, the tritium concentration is more evident during periods of low surface and groundwater flow such as during the summer months.

Low-level Waste Treatment Facility Investigation

The WVDP treats low-level radioactive wastewater at the low-level waste treatment facility (LLWTF) before it is discharged via the lagoon system and SPDES-permitted outfall WNSP001. Sources of wastewater treated by this system include drains in the main plant, process wastewater, groundwater from the NDA interceptor trench, and wastewater from the high-level waste tank farm vault.

A sampling and analysis plan was prepared to evaluate whether certain site-specific metals and other pollutants existed in the wastewater and to determine the removal efficiency of the various wastewater treatment systems in use at the LLWTF. The selected pollutants are listed in the EPA Form 2C table. Although the LLWTF was not designed to specifically remove these constituents from the wastewater, it was expected that some removal would occur. The sampling plan addressed both the untreated wastewater influent and the treated LLWTF effluent.

Sampling of the LLWTF effluent indicated that the highest removal was observed for strontium-90 (99.7%) and cesium-137 (96.4%). Seven metals — aluminum, barium, iron, magnesium, manganese, mercury, and titanium — were regularly detected above their respective method detection limits (MDLs). The remaining metals were either not detected or were sporadically detected above their respective MDLs. Removal of barium, iron, magnesium, manganese, mercury, and titanium ranged from 41% to 80%.

Nonradiological Monitoring

Air Monitoring

Nonradiological air emissions and plant effluents are permitted under NYSDEC and EPA regulations. The regulations that apply to the WVDP are listed in Table B-2 (p. B-4) in *Appendix B*. The individual air permits (certificates to operate) held by the WVDP are identified and described in Table B-3 (pp. B-5 through B-7).

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 1997 were approximately 14 tons; sulfur dioxide emissions were approximately 0.66 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.

The vitrification off-gas treatment system is equipped with a nitrogen oxides abatement and monitoring system. A relative accuracy test audit performed by the WVDP and witnessed by NYSDEC on April 22, 1997, measured a 5.2% accuracy, well within the 20% standard.

Surface Water Monitoring

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. 2-16 [p. 2-34]) and specifies the sampling and analytical requirements for each outfall. This permit was modified in 1990 to include additional monitoring requirements at outfall WNSP001. The WVDP applied for a renewed SPDES permit in 1991. It was received in early January 1994 and went into effect on February 1, 1994 with the expanded monitoring requirements and, in some cases, more stringent discharge limitations. The permit was modified in April, November, and December 1994 and in June 1995. Four outfalls are identified in the 1995 permit:

- 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 001, 007, and 008 as well as storm water runoff, groundwater surface seepage, and augmentation water. Samples from upstream sources (outfalls 001, 007, and 008) are used to calculate total dissolved solids at this location and 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 *Glossary,* p. 6.)

The conditions and requirements of the current SPDES permit are summarized in Table C-5.1 (pp. C5-3 through C5-4) in *Appendix C-5*.

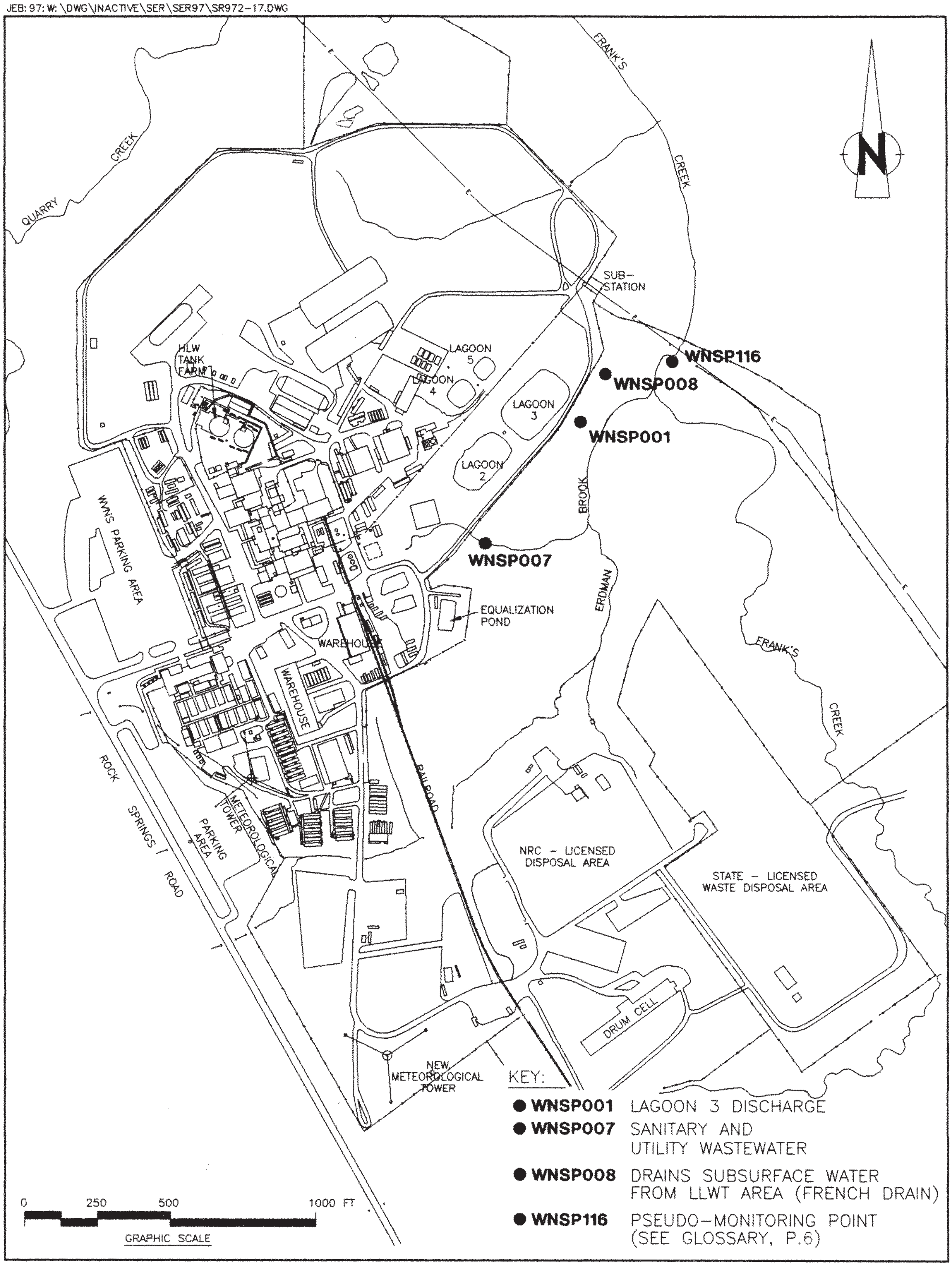

Figure 2–16. SPDES Monitoring Points.

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 amounts of iron that are 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 1997 are displayed in Tables C-5.3A through C-5.8 in *Appendix C-5* (pp. C5-6 through C5-16). The WVDP reported five permit exceedances in 1997 (Table C-5.2 [p. C5-5]). See the ***Environmental Compliance Summary: Calendar Year 1997*** (pp.liii through liv).

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 1997. 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-1.27 (p. C1-21) in *Appendix C-1*.

Results of sampling for nonpurgeable organic carbon (NPOC) and total organic halogens (TOX) at two locations that help monitor the NDA, WNNDADR and WNNDATR, are found in Tables C-1.19 and C-1.20 (pp. C1-15 and C1-16). (See Fig. 2-3 [p. 2-6].) Although values from both locations are routinely higher than those from the background location WFBCBKG and have, on occasion, fluctuated upward, there are no data to suggest that these higher levels are the result of releases from the surrounding waste management units.

Drinking Water Monitoring

The site's drinking water is monitored to verify compliance with EPA and NYSDOH regulations. (See *Safe Drinking Water Act* in the ***Environmental Compliance Summary: Calendar Year 1997*** [p. lvi].)

Samples are collected annually for nitrate, fluoride, and metals concentrations analyses. Sampling and analysis for copper and lead are conducted according to Cattaraugus County Health Department guidance. In 1997 monitoring results indicated that the Project's drinking water met NYSDOH, EPA, and Cattaraugus County Health Department drinking water quality standards.

GROUNDWATER MONITORING

Geological History of the West Valley Site

The West Valley Demonstration Project (WVDP) is located on the dissected and glaciated Allegheny Plateau near the northern border of Cattaraugus County in Western New York. The site is underlain by a thick sequence of Holocene (recent) and Pleistocene (ice age) sediments contained in a steep-sided bedrock valley. From youngest to oldest, these unconsolidated deposits consist of alluvial and glaciofluvial silty coarse-grained deposits, which are found almost exclusively in the northern part of the site, and a sequence of up to three fine-grained glacial tills of Lavery, Kent, and possible Olean age, which are separated by stratified fluvio-lacustrine deposits. These glacial sediments are underlain by bedrock composed of shales and interbedded siltstones of the upper Devonian Canadaway and Conneaut Groups, which dip southward at about 5 m/km (Rickard 1975).

The most widespread glacial unit in the site area is the Kent till, deposited between 18,000 and 24,000 years ago toward the end of the Wisconsin glaciation (Albanese et al. 1984). At that time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier receded, debris trapped in the ice was left behind in the vicinity of West Valley. Meltwater, confined to the valley by the debris dam at West Valley and the ice front, formed a glacial lake that persisted until the glacier receded far enough northward to uncover older drainageways. As the ice continued to melt (between 15,500 and 18,000 years ago), more material was released and deposited to form the recessional sequence (lacustrine and kame delta deposits) that presently overlies the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur 1979).

Between 15,000 and 15,500 years ago the ice began its last advance (Albanese et al. 1984). Material from this advance covered the recessional deposits with as much as 40 meters (130 ft) of glacial till. This unit, the Lavery till, is the uppermost unit throughout much of the site.

The retreat of the Lavery ice left behind another proglacial lake that ultimately drained, allowing the modern Buttermilk Creek to flow northward to Cattaraugus Creek. Post-Lavery outwash and alluvial fans, including the fan that overlies the northern part of the WVDP, were deposited on the Lavery till between 14,200 and 15,000 years ago (LaFleur 1979). The modern Buttermilk Creek has cut the present valley since the final retreat of the Wisconsin glacier.

Surface Water Hydrology of the West Valley Site

The Western New York Nuclear Service Center (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 facilities.

The 80-hectare (200-acre) WVDP site, located on the WNYNSC, is contained within the smaller Frank's Creek watershed. Frank's Creek is a tributary of Buttermilk Creek.

The WVDP is bounded by Frank's Creek to the east and south and by Quarry Creek (a tributary of Frank's Creek) to the north. Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau (Fig. 3-1 [p. 3-3]). 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 on the south plateau.

Hydrogeology of the West Valley Site

The WVDP site area is underlain by glacial tills comprised primarily of clays and silts separated by coarser-grained interstadial layers. The sediments above the second (Kent) till (the Kent recessional sequence, the Lavery till, the 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 Figures 3-2 and 3-3 [pp. 3-4 and 3-5], which show the relative locations of these sediments on the north and south plateaus.)

The Lavery till and the Kent recessional sequence underlie both the north and south plateaus. 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 to 4.9 meters (3 to 16 ft). This layer is referred to as the weathered Lavery till.

The remaining thickness of the Lavery till is unweathered. This unweathered Lavery till is predominantly an olive gray, silty clay glacial till with scattered lenses of silt and sand. The till ranges up to 40 meters (130 ft) in thickness beneath the active areas of the site, generally increasing towards Buttermilk Creek and the center of the bedrock valley.

Hydraulic head distributions in the Lavery till indicate that groundwater flow in the unweathered till is predominantly vertically downward at a relatively slow rate, towards the underlying Kent recessional sequence. The mean hydraulic conductivity of the unweathered till, as determined from the most recent testing of sixteen wells in 1996, was 4.2×10^{-8} cm/sec (1.2×10^{-4} ft/day).

The underlying Kent recessional sequence consists of a lower lacustrine unit of interbedded clay and silty clay layers locally overlain by coarse-grained kame delta and outwash sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern corner where the shoulder of the bedrock valley intersects the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, towards Buttermilk Creek. The hydraulic conductivity, as determined from thirteen wells tested in 1996 and four wells tested in 1997, ranges from approximately 8.4×10^{-9} cm/sec (0.000024 ft/day) to 1.5×10^{-4} cm/sec (0.44 ft/day), with a geometric mean of 4.0×10^{-6} cm/sec (0.01 ft/day). Recharge comes from the overlying till and the

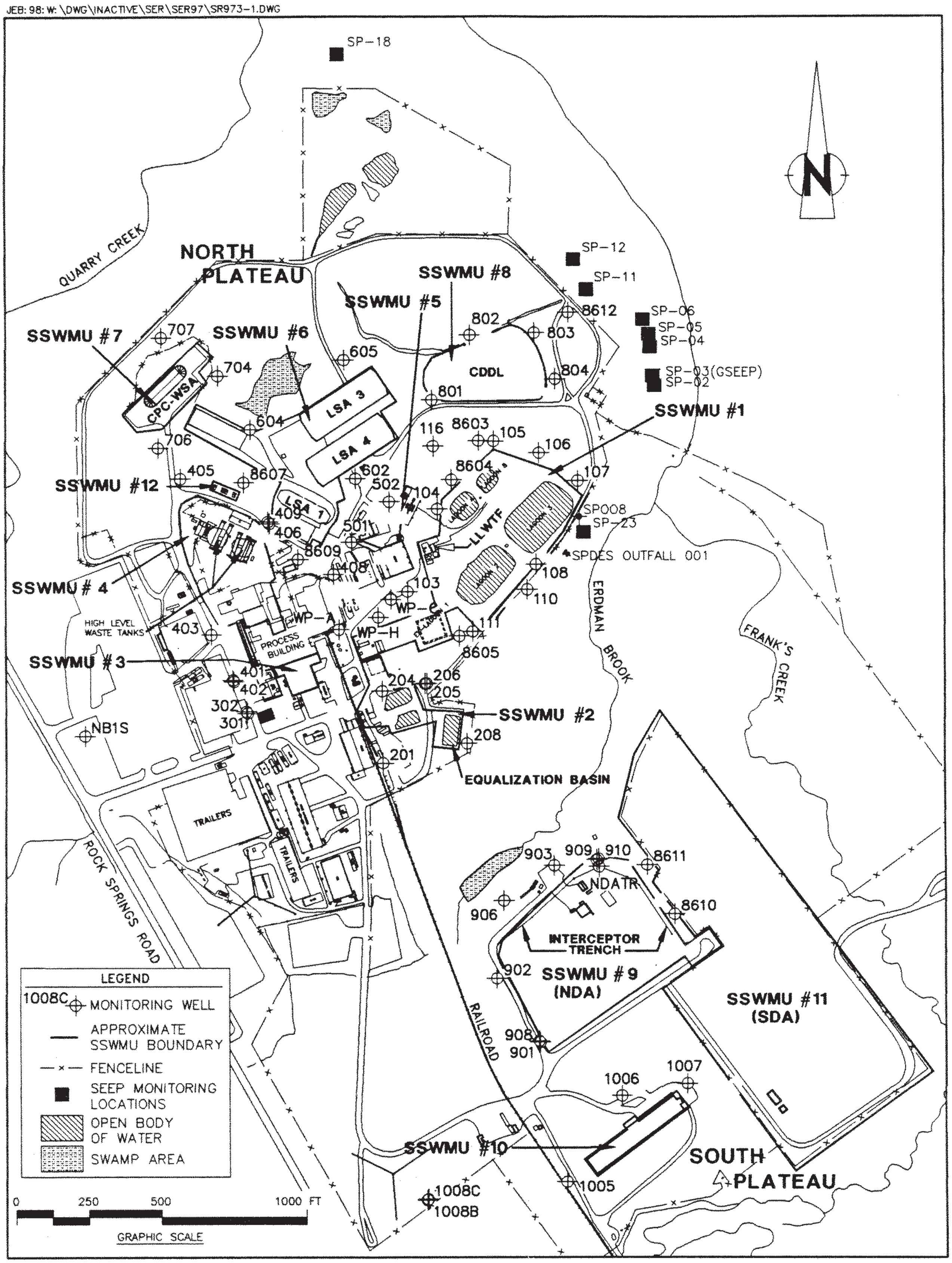

Figure 3-1. WVDP Groundwater Monitoring Program Locations Sampled in 1997.

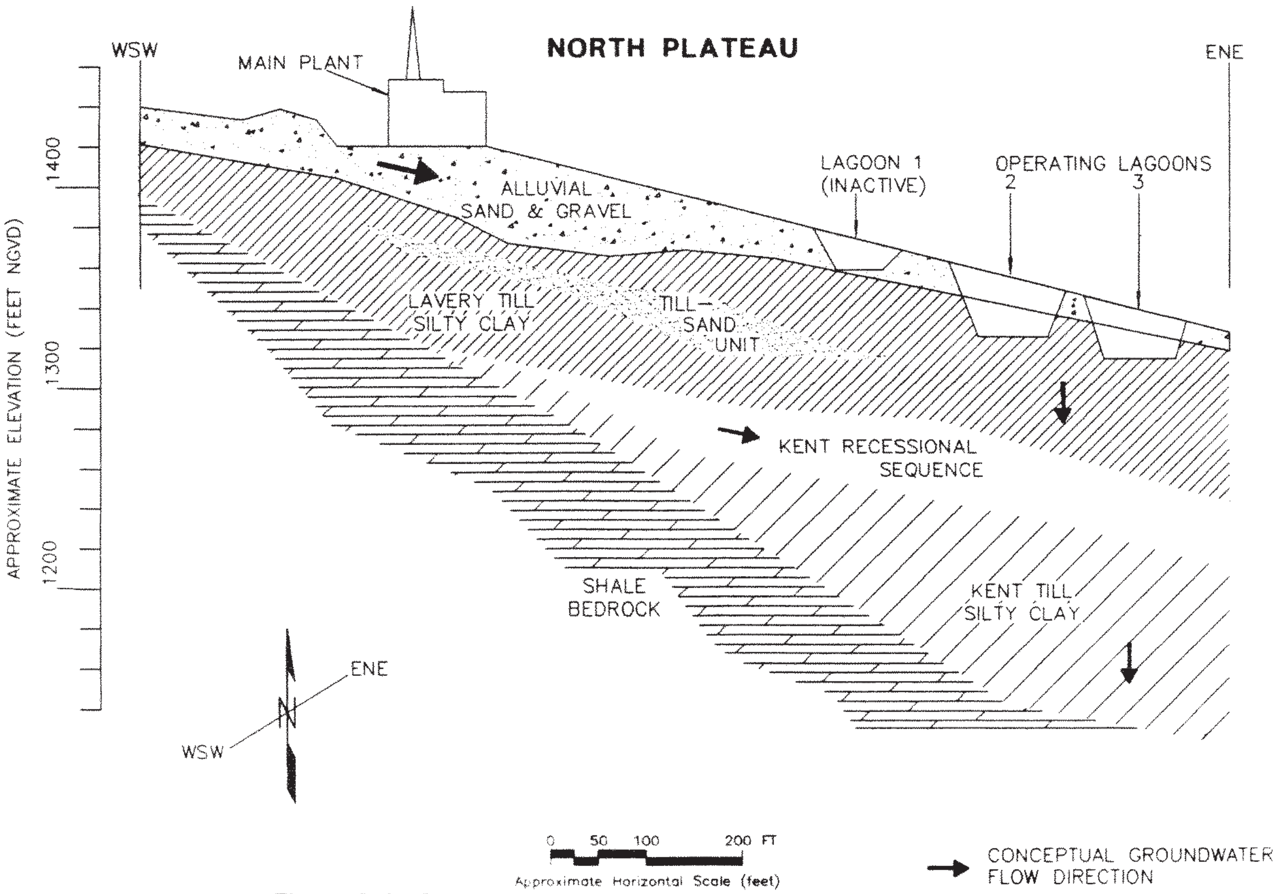

Figure 3-2. Geologic Cross Section through the North Plateau

bedrock in the southwest, and discharge is to Buttermilk Creek.

Underneath the Kent recessional sequence is the less permeable Kent till, which does not provide a pathway for contaminant movement from the WVDP and so is not discussed here.

North Plateau

On the north plateau, where the main plant, waste tanks, and lagoons are located, the unweathered Lavery till is immediately overlain by the surficial sand and gravel layer. Within the Lavery till on the north plateau is another unit, the till-sand. A geologic cross section of the north plateau is shown on Figure 3-2 (above).

Surficial Sand and Gravel Layer

The surficial sand and gravel 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 this layer 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 surface farther north towards the security fence. Groundwater in this layer generally flows across the north plateau from the southwest (near Rock Springs

Road) to the northeast (towards Frank's Creek). Calculations based on the testing of twenty wells and five well points in 1997 indicate that hydraulic conductivity ranged from 6.4 x 10^{-6} cm/sec (0.2 ft/day) to 3.1 x 10^{-3} cm/sec (8.8 ft/day), with a geometric mean hydraulic conductivity of 2.8 x 10^{-4} cm/sec (0.79 ft/day). These new data show higher velocities than noted in earlier site reports, which used a smaller data set of twenty-one wells. Groundwater near the northwestern and southeastern margins of the sand and gravel layer flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till.

Lavery Till-sand

On-site investigations from 1989 through 1990 identified a lenticular sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the north plateau. Groundwater flow through this unit apparently is limited by the cross sectional area of the unit's erosional exposure, and surface discharge locations have not been observed. Results of the most recent hydraulic testing in 1996 of seven wells screened in this unit indicated that hydraulic conductivity ranged from 4.8 x 10^{-8} (0.00014 ft/day) to 2.5 x 10^{-3} cm/sec (7.1 ft/day), with a mean conductivity of 1.1 x 10^{-3} cm/sec (3.1 ft/day).

South Plateau

A geological cross section of the south plateau is shown on Figure 3-3 (below). The uppermost geologic unit, the weathered Lavery till, is discussed below. The other units (the unweathered Lavery till, the Kent recessional sequence, and the Kent till) were discussed above.

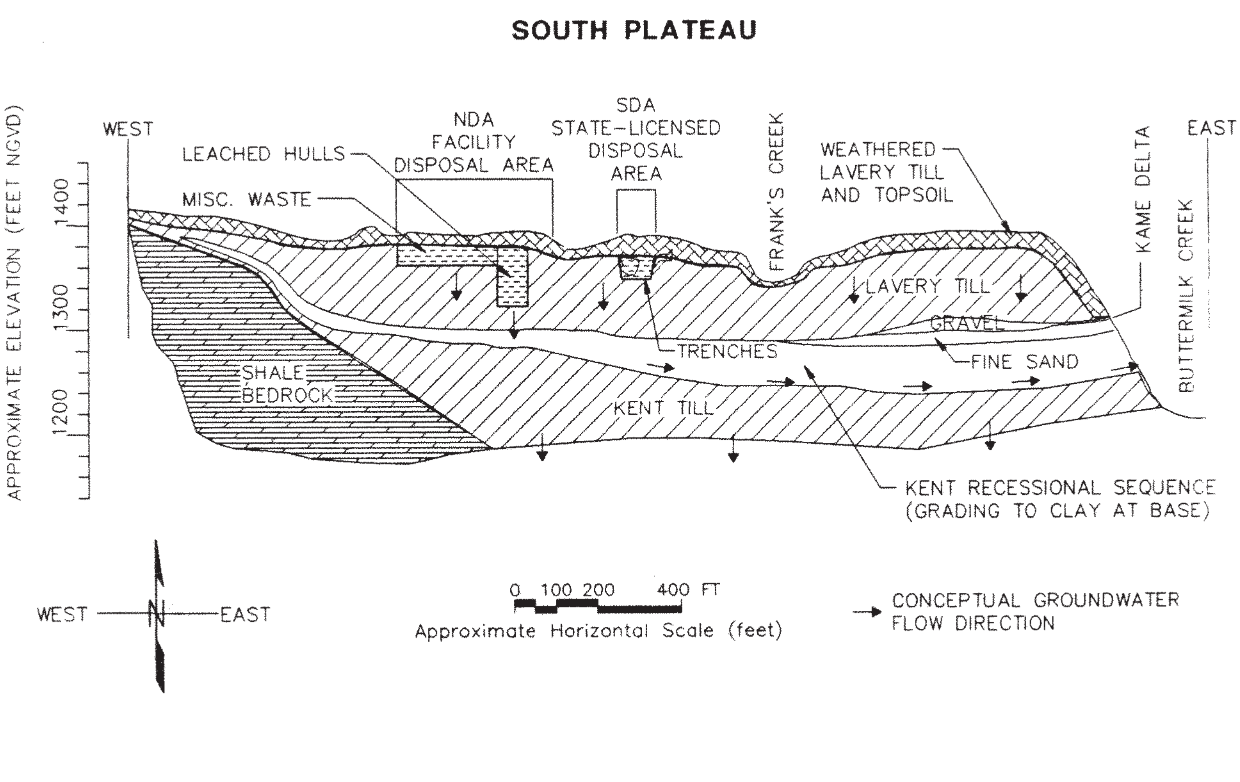

Figure 3-3. Geologic Cross Section through the South Plateau

Weathered Lavery Till

On the south plateau, the upper portion of Lavery till exposed at the surface is referred to as the weathered till. It is physically distinct from the underlying unweathered till: it has been oxidized to a brown color and contains numerous fractures and root tubes. The thickness of this layer generally varies from 0.9 meters to 4.9 meters (3 ft to 16 ft). On the north plateau, the weathered till layer is much thinner or nonexistent.

Groundwater flow in the weathered till that occurs in the upper 4.9 meters (16 ft) has both horizontal and vertical components. This enables the groundwater to move laterally across the plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. The hydraulic conductivity of the weathered till as determined from the testing of eight wells in 1997 ranges from 9.1 x 10^{-8} cm/sec (0.00026 ft/day) to 3.5 x 10^{-5} cm/sec (0.1 ft/day), with a geometric mean of 1.5 x 10-6 cm/sec (.004 ft/day). The highest conductivities are associated with the dense fracture zones (found within the upper 2 meters [7 ft] of the unit).

Routine Groundwater Monitoring Program Overview

Groundwater Monitoring Activities

Current groundwater monitoring activities at the WVDP are summarized in two primary documents, the Groundwater Monitoring Plan (West Valley Nuclear Services Co., Inc. December 1996) 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 specified under the RCRA facilities investigation and DOE programs. The Groundwater Protection Plan provides additional information regarding protection of groundwater from on-site activities.

The categories of groundwater analytical parameters and the 1997 sampling schedule for these parameters are noted in Table 3-1 (p.3-7). Potentiometric (water level) measurements also are collected from the wells listed in Table E-1 (*Appendix E,* p. E-3) in conjunction with the quarterly analytical sampling schedule. Water-level data are used to determine groundwater flow directions and gradients.

Monitoring Well Network

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

Table E-1 (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 1997. Note that monitoring of wells marked by an asterisk is required by the RCRA 3008(h) Administrative Order on Consent. (See the ***Environmental Compliance Summary: Calendar Year 1997***, *RCRA Facility Investigation [RFI] Program* [p. xlvi].)

Figure 3-1 (p. 3-3) shows the boundaries of these eleven super solid waste management units at the WVDP. (Twenty-one additional wells 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-3, p. A-47 in *Appendix A*.) Although the SDA is a closed radioactive waste landfill contiguous with the Project premises, the

Table 3-1
1997 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-6 (pp. E-7 through E-14)
Radiological Indicator Parameters (RI)	Gross alpha, gross beta, tritium	Tables E-2 through E-6 (pp. E-7 through E-14)
RCRA Hazardous Constituent Metals (M +)	Antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium	Table E-11 (pp. E-17 through E-23)
Appendix IX Metals (M9)	Metals listed above plus cobalt, copper, tin, vanadium, zinc	Table E-11 (pp. E-17 through E-23)
Volatile Organic Compounds (V)	Appendix IX VOCs (See Table E-13[p.E-24])	Table E-9 (p. E-16)
Semivolatile Organic Compounds (SV)	Appendix IX SVOCs (See Table E-13 [p.E-24])	Table E-10 (p. E-16)
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-24 through E-25)
Strontium-90 (S)	Sr-90	Table E-13 (pp. E-24 through E-25)
Pilot Program for Investigating Chromium and Nickel Concentrations (M)	Chromium, nickel	Table E-11 (pp. E-17 through E-23)
Special Monitoring Parameters for Early Warning Wells (SM)	Aluminum, iron, manganese	Table E-12 (p. E-24)

1997 Quarterly Sampling Schedule:
1st Qtr - December 2, 1996 to December 12, 1996
2nd Qtr - March 3, 1997 to March 12, 1997
3rd Qtr - June 2, 1997 to June 18, 1997
4th Qtr - September 2, 1997 to September 18, 1997

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

> *Four designations are often used to indicate a well's function within the groundwater monitoring program:*
>
> ***Upgradient well.*** *A well installed hydraulically upgradient of a SSWMU that is capable of yielding groundwater samples that are representative of local conditions and that are not affected by the SSWMU being monitored.*
>
> ***Downgradient well.*** *A well installed hydraulically downgradient of a SSWMU that is capable of detecting the migration of contaminants from the SSWMU.*
>
> ***Background well.*** *A well installed hydraulically upgradient of all SWMUs and SSWMUs that is capable of yielding groundwater samples that are representative of conditions not affected by site activities. In some cases upgradient wells may be downgradient of other SSWMUs or SWMUs, which makes them unsuitable for use as true background wells. However, they are still useful for providing upgradient information about the waste management unit under study.*
>
> ***Crossgradient well.*** *A well installed to the side of the major downgradient flow path such that the well is neither upgradient nor downgradient of the monitored SSWMU.*

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 1997 groundwater monitoring results for the SDA are reported in this document in *Appendix F* [pp. F-3 through F-10] but are not discussed here.

Table E-1 (p. E-3) identifies the position of a monitoring location relative to the waste management unit. The wells monitoring a given hydrogeologic unit (e.g., sand and gravel, weathered Lavery till) also may be 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 hydrogeologic unit perspective.

History of the Monitoring Program

The groundwater monitoring program is designed to support DOE Order 5400.1 requirements and the RCRA 3008(h) Administrative Order on Consent. 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.

Groundwater Monitoring Program Highlights 1982 to 1997

WVDP groundwater monitoring activities 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.

- Fourteen new wells, a groundwater seep location, and the french drain outfall were added in 1986 to provide monitoring of 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 1995 groundwater monitoring program evaluations. A comprehensive assessment reduced the number of sampling locations from ninety-one to sixty-five, for a more efficient and cost-effective program.

• Wells, analytes, and sampling frequencies continued to be modified in 1997 in response to DOE and RCRA monitoring requirements.

Annual Analytical Trigger Limit Review

A computerized data evaluation program using "trigger limits" for all chemical and radiological analytes was instituted in 1995. These preset limits are conservative values for chemical or radiological concentrations that were developed to expedite a prompt focus on any monitoring anomalies. Early in 1997 these statistically derived trigger limits were updated by incorporating data collected during 1996.

1997 Groundwater Monitoring Results

Successful implementation of the WVDP's groundwater monitoring program includes proper placement of groundwater monitoring wells, using appropriate methods of sample collection, reviewing analytical data and quality assurance information, and presenting, summarizing, and evaluating the resulting data appropriately. Data are presented in this report through tables and graphs.

Presentation of Results in Tables

The tables in *Appendix E* (pp. E-7 through E-25) present the results of groundwater monitoring grouped 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 1997 sampling for the radiological and nonradiological analyte groups noted on Table 3-1 (p. 3-7). Table E-14 (pp. E-26 through E-28) lists the practical quantitation limits (PQLs) for individual analytes. *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 de-

Measuring Water Levels in a Groundwater Monitoring Well

noted 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 on-site.

Grouping the wells by hydraulic position provides a logical basis for presenting the groundwater monitoring data in the tables and figures in this report.

These tables also list the sample collection periods. The 1997 sampling year covers the period from December 1996 (the first quarter of 1997) through September 1997 (the fourth quarter of 1997).

Presentation of Results in Graphs

High-Low Graphs

Graphs showing the 1997 measurements 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 pp. E-29 through E-38). These graphs allow results for all wells within a given hydrogeologic unit to be visually 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 nonradiological graphs (pH and conductivity), the upper and lower tick marks on the vertical bar indicate the highest and lowest measurements recorded during 1997. The middle tick represents the arithmetic mean of all 1997 results. The vertical bar thus represents the total range of the data set for each monitoring location.

On the radiological graphs (gross alpha, gross beta, and tritium), the middle tick is again used to represent the arithmetic mean of all 1997 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 1997 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. 5-7] in ***Chapter 5, Quality Assuranc***e .)

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, and in previous years well NB1S was used as the background reference well for the sand and gravel unit. However, the collective monitoring results from three upgradient wells (301, 401, and 706) currently are used for comparison with other sand and gravel wells as a way of better representing the natural spatial variability within the geologic unit. Both DOE and NYSDEC have accepted the use of this collective background reference instead of well NB1S.

Trend-Line Graphs

Trend-line graphs (pp. 3-21 through 3-24) have been used to show concentrations of a particular parameter over time at monitoring locations that have historically shown concentrations above background values: the volatile organic compounds 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-trichloroethylene (1,1,1-TCA) at well 8612 (see *Volatile and Semivolatile Organic Compounds* below [p. 3-14]); and gross beta and tritium at selected groundwater monitoring locations (104, 111, 408, 501, 502, 801, 8603, 8604, 8605, and GSEEP).

Results of Radiological Analyses

Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations

Figures 3-6 through 3-9 (pp. 3-21 through 3-24) show the trends of gross beta activity and tritium at selected monitoring locations. These specific groundwater monitoring locations in the sand and gravel unit were selected for trending because they have shown elevated or rising levels of gross beta activity or steady or falling levels of tritium. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations.

The average background concentration is plotted on each graph for comparison purposes. All wells shown in these figures monitor the sand and gravel unit.

Gross Beta

The groundwater plume of gross beta activity in the sand and gravel unit on the north plateau (Fig. 3-4 [p. 3-12]) continues to be monitored closely. The source of the plume's activity can be traced to a subsurface area beneath the former process building. Nine wells (104, 111, 408, 501, 502, 801, 8603, 8604, and 8605) contain elevated levels of gross beta activity, i.e., greater than 1.0E-06μCi/mL, the DOE DCG for strontium-90. Gross beta results for wells 804 and 105 were one and two orders of magnitude less than the DOE DCG, respectively, thereby indicating the downgradient limits of the plume.

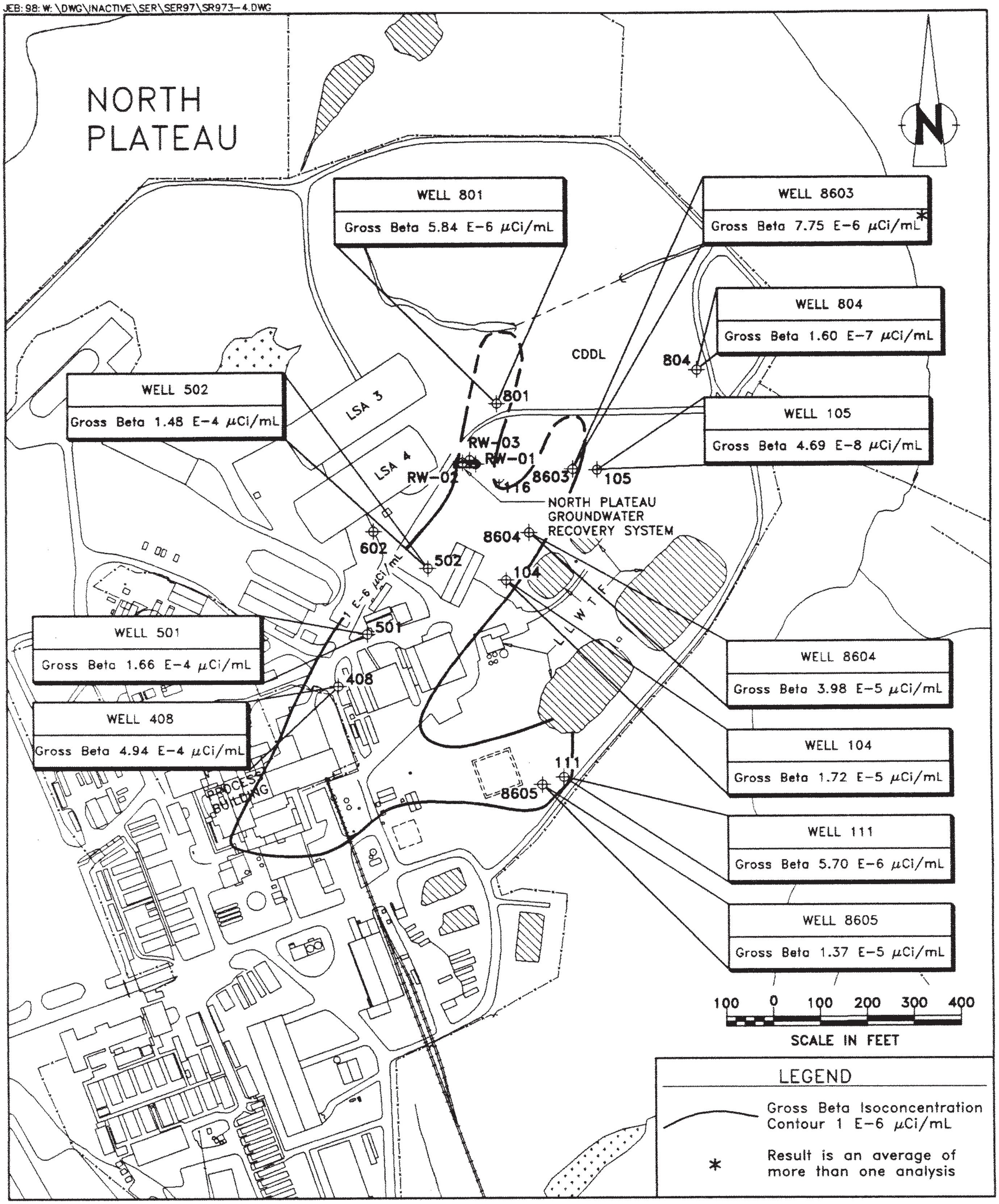

Figure 3-4. North Plateau Gross Beta Plume Area Fourth-Quarter 1997 Results.

• Figure 3-6 (p. 3-21) shows gross beta concentrations in wells 104, 111, 408, 501, 502, and 801 over the seven-year period that the WVDP's current groundwater monitoring program has been in place.

As in previous years, well 408 continued to contain the highest gross beta levels of all the wells within the north plateau gross beta plume area. The yearly average gross beta concentration at well 408 decreased slightly in 1997 as compared to levels in 1995 and 1996. The gross beta concentrations in wells 501 and 502 have remained relatively consistent over the last several years. Concentration trends for wells 104 and 801 are continuing to increase but at a slower rate than in previous years.

• Figure 3-7 (p. 3-21) is a graph of gross beta activity at monitoring locations 8603, 8604, 8605, and GSEEP. The trend at 8604 appears to have leveled off after several years of steep increases. Results from well 8603 have continued to show a steady upward trend, apparently due to migration of 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 both wells have remained relatively steady over most of the twelve-year monitoring period (well 8605) and seven-year monitoring period (well 111), but are now starting to show decreasing trends.

Tritium

• Figure 3-8 (p. 3-22) shows the tritium concentrations in wells 104, 111, 408, 501, 502, and 801 over the seven-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 steady concentration trends.

• Figure 3-9 (p.3-22) shows the twelve-year trend of tritium concentrations at monitoring locations 8603, 8604, 8605, and GSEEP. Wells 8603 and 8604 indicate gradually declining trends in tritium, and 8605 shows a significant decrease over time.

North Plateau Seeps

Analytical results of semiannual sampling of the sand and gravel unit seepage locations for radiological parameters were time-trended and compared to the results from GSEEP, a seep monitored since 1991 that apparently exhibits no influences from the gross beta plume. (See Fig. 3-1 [p. 3-3].) Two rounds of routine samples to be analyzed for VOCs were collected at SP-12 in 1997. (See *Volatile and Semivolatile Organic Compounds* [p. 3-14].) Results were compared to concentrations in wells downgradient of the CDDL. Seep SP-23 could not be sampled in 1997 because it was dry.

Gross alpha and gross beta concentrations at the seeps remained similar in magnitude to GSEEP. There were a few minor fluctuations, but these did not appear to indicate elevated radiological activity or increasing trends. Gross alpha and gross beta results at all monitored seeps (including GSEEP) generally remained at background levels.

Tritium concentrations at the seeps remained similar in magnitude or were less than concentrations at GSEEP. Minor seasonal fluctuations over time also are apparent. Concentrations at all the seeps are slightly above background but are generally consistent with tritium levels seen in sand and gravel wells on the north plateau.

Results thus far appear to indicate that gross beta activity from the north plateau plume has not migrated as far as these seepage areas.

North Plateau Well Points

Seven well points were installed in 1990 downgradient of the process building and were sampled annually between 1993 and 1997 for radiological indicator parameters. These well points were used to supplement data collected from groundwater monitoring wells.

An evaluation concluded that gross alpha concentrations were at or near background levels at all well points. While gross beta concentrations were elevated, they were within historical ranges in wells downgradient of the process building.

Well points A, C, and H (Fig. 3-1 [p. 3-3]) have yielded samples with elevated concentrations of tritium with respect to historical monitoring of wells in the area. However, the tritium concentrations are well below the DOE derived concentration guide of 2.0E-03μCi/mL. Data from downgradient monitoring wells have not indicated similarly elevated levels of tritium.

This area east of the process building and west of lagoon 1 may be an area of localized contamination, and it will continue to be monitored annually for contamination indicator and radiological indicator parameters in the future. Well points D, E, F, and G will no longer be sampled because adequate coverage is provided by active monitoring wells. Sampling will continue at well points A,C, and H to further evaluate the presence of tritium in this localized area.

Results of Monitoring at the NDA

Gross beta and tritium concentrations in samples from well 909 and location NDATR (Fig. 3-1[p. 3-3]) 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 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 this well is the suspected source. There were no monitoring results in 1997 that indicated the presence of TBP, confirming historical results.

Results of Radioisotopic Sampling

Groundwater samples for radioisotopic analyses are collected regularly from fifteen monitoring points in the sand and gravel unit and the weathered Lavery till. (See Table E-2 [pp. E-7 through E-10] and Table E-4 [p. E-12].) Results from 1997 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 radionuclides, which were previously noted at several monitoring locations at concentrations above background levels (at specific wells within the gross beta plume and downgradient of inactive lagoon 1), have been demonstrated to contribute very small percentages of total gross beta concentrations. None of these concentrations have been above DCGs, and gross beta analyses continue to provide surveillance on a quarterly basis.

Volatile and Semivolatile Organic Compounds

Volatile and semivolatile organic compounds were sampled at specific locations (wells 8612, 8609, 803, and 111 [Fig. 3-1, p. 3-3]) that have shown historical results above their respective practical quantitation levels (PQLs). (The PQL is the lowest level that can be measured within specified limits of precision during routine laboratory operations on most matrices. [New York State Department of Environmental Conservation 1991]. See Table E-14 [pp. E-26 through E-28] for a list of PQLs.) Other monitoring locations are sampled for volatile and semivolatile organic compounds because they are downgradient of locations showing positive results.

The 1991 through 1997 trends in concentrations of the compound 1,1-dichloroethane (1,1-DCA) are illustrated in Figure 3-10 (p.3-23). Concentrations of 1,1-DCA at well 8612 remained consistent with results from previous years. The compound 1,1-DCA was not detected at wells 8609 and 803 during 1997. At groundwater seep SP-12 the compound was reported at estimated concentrations below the PQL. (See Table E-9 [p. E-16].)

Trends of dichlorodifluoromethane (DCDFMeth) concentrations are shown in Figure 3-11 (p.3-23). The concentrations of DCDFMeth at well 8612 remained at low levels in 1997 — near the detection limit. DCDFMeth was identified at well 803 at concentrations below the PQL. DCDFMeth was not detected at SP-12 during 1997.

Another positive VOC detection (Fig. 3-12 [p. 3-24]) was 1,2-dichloroethylene (1,2-DCE) at well 8612, which showed an increasing trend during 1997. (This compound was first detected in 1995.) Concentrations of the compound 1,1,1- trichloroethane (1,1,1-TCA) also were detected at well 8612 at or below the PQL.

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.

Aqueous concentrations of tributyl phosphate (TBP) were detected at well 8605, near lagoon 1, at higher concentrations than in 1996. Current results are closer to the levels reported in 1994 and 1995. TBP was not detected in well 111, which is next to and downgradient of well 8605, although positive detections of TBP have been reported in the past.

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 indicates that these results reflect residual contamination from previous waste disposal activities in the former lagoon 1 area during historical fuel reprocessing. TBP concentrations detected in groundwater in this area during 1997 were limited to well 8605. Future trends of TBP will be evaluated as part of the routine groundwater monitoring program.

Special Groundwater Monitoring

Interim Mitigative Measures Near the Leading Edge of the 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 former process building (Fig. 3-4 [p. 3-12]). The most likely source of the gross beta activity is previous fuel reprocessing activities by NFS. 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, of groundwater and soil 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 located near the southeast corner of the process building. The maximum activity in groundwater was 3.6E-03μCi/mL, and the maximum activity in soil reached 2.4E-02μCi/g. Strontium-90 and its daughter product, yttrium-90, were determined to be the isotopes responsible for most of the elevated gross beta activity in the groundwater and soil beneath and downgradient of the former process building (West Valley Nuclear Services Co., Inc. 1995). In 1995 the north plateau groundwater recovery system (NPGRS) was installed as a mitigative measure for minimizing the spread of the gross beta plume. The NPGRS was located near the leading edge of the main lobe of the plume where groundwater flows preferentially towards the edge of the plateau. The NPGRS initially consisted of two extraction wells (RW-01 and RW-02) to recover the contaminated groundwater. In September 1996 a third well (RW-03) was added to the NPGRS along with other system upgrades. The upgraded recovery system more effectively captures the contaminant plume in this area.

Water recovered by the NPGRS is treated by ion exchange to remove strontium-90. Treated water is transferred to lagoon 4 or 5 and then to lagoon 3 for ultimate discharge to Erdman Brook.

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.

The north plateau groundwater recovery system operated successfully throughout 1997, recovering and processing approximately 5.5 million gallons of water, a total of about 10 million gallons since November 1995.

Improvements to the site's north parking lot to divert surface water runoff away from the north plateau minimized groundwater recharge upgradient of the former process building and also reduced the amount of water needing to be recovered and processed by the NPGRS.

1997 Geoprobe® Investigation on the North Plateau

During the summer and fall of 1997, a second investigation was conducted using a Geoprobe® unit to provide additional characterization of the northeast leading edge of the north plateau gross beta groundwater plume. It was known that the main lobe of the plume was migrating northward, in the general direction of well 801. (See Fig. 3-4 [p. 3-12].) Recent groundwater sampling results northeast of the main lobe had indicated a second lobe of elevated gross beta activity migrating to the northeast, in the direction of well 8603. The objectives of the 1997 investigation included three-dimensional characterization of the second lobe and an evaluation of the geology of the soils within that area.

Investigation activities consisted of sampling soil and groundwater in the areas of interest. Three well points also were installed to provide additional groundwater sampling locations (West Valley Nuclear Services Co., Inc. June 1997). A summary report is being prepared, with completion scheduled for the first quarter of 1998.

Preliminary results of the 1997 Geoprobe® investigation provided improved definition of the eastern lobe of the plume and indicated that the main (western) lobe of the plume remains the primary route

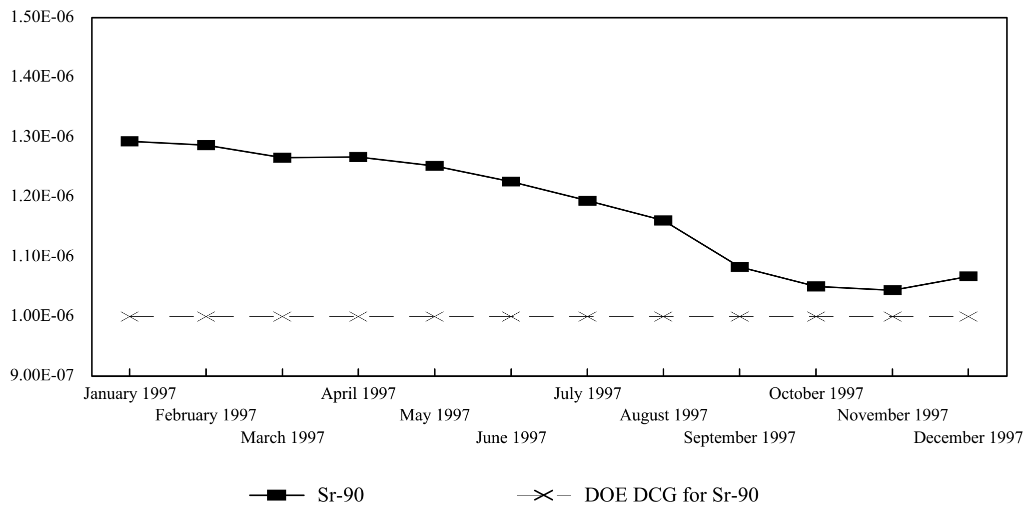

Figure 3-5. Annualized Average Strontium-90 Concentrations at Sampling Location WNSWAMP

of strontium-90 migration. Minor gross beta activity near well 804 appears to be related to residual soil contamination rather than plume migration.

Northeast Swamp Drainage Monitoring

In 1993 trend analyses of surface and groundwater monitoring results indicated increasing gross beta concentrations in waters discharged through the northeast swamp drainage as monitored at sampling points WNDMPNE and WNSWAMP, as discussed above. (WNDMPNE and WNSWAMP monitored the same location; samples collected as part of the groundwater program were identified as WNDMPNE, since discontinued, and surface water samples were identified as WNSWAMP.)

Routine surface water sampling during 1997 continued to monitor radiological discharges through the northeast swamp drainage. (See *Appendix C-1*, Table C-1.7 [p. C1-8]). Gross beta and strontium-90 concentrations continued to fluctuate due to seasonal effects. The annualized average strontium-90 concentrations trended downward during 1997 (see Fig. 3-5 above), which may be an indication of the effectiveness of the groundwater recovery system. WNSWAMP concentrations tend to decrease during periods of rainfall or snowmelt and to increase during dry weather.

The maximum average monthly gross beta concentration observed at WNSWAMP in 1997 was 3.22±0.03E-06μCi/mL (119±1.11 Bq/L), observed during July. The average minimum monthly gross beta concentration was 1.49±0.02E-06μCi/mL (55±0.74 Bq/L), observed in January.

Strontium-90 values ranged from a low of 6.82±0.2E-07μCi/mL (25±0.7Bq/L) in January to a high of 1.60±0.02E-06μCi/mL (59±0.74 Bq/L) in July. The strontium-90 DOE DCG, 1.0E-06μCi/mL (37 Bq/L), pertains to an annualized rolling average, which currently (January 1997 to December 1997) is 1.07±0.02E-06μCi/mL (107% of the DOE DCG). This value is down from the 1996 level of 133%. It is probable that the operation of the groundwater recovery system has contributed to this decrease.

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 accesss (WFFELBR) continued to show strontium-90 concentrations to be nearly indistinguishable from background (WFBIGBR) concentrations. (See *Off-site Surface Water Sampling*, p. 2-12, in ***Chapter 2, Environmental Monitoring***.

Special Monitoring for the North Plateau Groundwater Quality Early Warning Evaluation

An early warning evaluation of selected monitoring well data was devised to identify possible changes in groundwater quality 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 parameters (mostly total and dissolved metals) not routinely analyzed under the groundwater monitoring program.

Evaluation of 1997 early warning data indicated one exceedance during the third quarter. Metallic cobalt was detected at a concentration of 0.024 mg/L; the early warning level is 0.015mg/L. However, no associated exceedance of the SPDES permit limit for cobalt (0.005mg/L) occurred at outfall 001. No other early warning level exceedances occurred during 1997.

Pilot Program Investigating Chromium and Nickel in the Sand and Gravel Unit

Long-term groundwater monitoring results have shown a wide range of chromium and nickel concentrations in the sand and gravel unit, both spatially and over time. The randomness of elevated concentrations indicated that the source probably was not related to a release from an on-site facility.

However, a possible source of elevated metals in groundwater samples is corrosion of stainless steel monitoring well screens and casings: Metals leached from the well materials can adsorb to sediment particles within the well and these particles can then become entrained in the groundwater sample by vigorous purging and sampling techniques, which are known to agitate the water and suspend sediment particles in a well.

A study was initiated in 1997 to determine the effect of modifying sampling equipment and methodology on the concentrations of chromium and nickel in the groundwater. Twelve sand and gravel wells were selected for the investigation. The equipment and sampling methods for six of the wells were left unchanged and these wells were sampled according to routine procedures. The sampling equipment and methodology of the other six wells were modified in order to minimize the amount of solids collected during sampling.

Test results are being evaluated, and a final report will be issued in June 1998. A preliminary evaluation of the data results indicates that the modified sampling equipment and methodology may contribute to lower measured chromium and nickel concentrations, which are believed to be more representative of actual groundwater conditions.

Results of Off-Site Groundwater Monitoring

Ten off-site wells, used by site neighbors as sources of drinking water, were sampled for radiological parameters, pH, and conductivity as part of the groundwater monitoring program during 1997. (See Fig. A-5 [p. A-49].) Sampling and analysis indicated no evidence of contamination by the WVDP of these off-site water supplies. Analytical results are found in Table C-1.26 (p. C1-20) in *Appendix C-1*.

Summary of Site Groundwater Monitoring

One of the primary functions of routine groundwater monitoring at the WVDP is to provide timely detection of contaminant release, if any, from SSWMUs to site groundwater. Program specifications, such as monitoring well locations and selected analytes, were designed for this purpose. Groundwater monitoring data collected during 1997 did not indicate new releases from SSWMUs or any other new groundwater concerns.

Groundwater seep samples from the sand and gravel unit are collected quarterly from several points near the northeast corner of the north plateau. These points are hydraulically downgradient of the site. Analytical results from seep samples obtained during 1997 indicated no concentrations of radiological or chemical parameters above regulatory guidelines.

The 1997 groundwater monitoring program reflects continuous refinements of a systematic routine based on historic groundwater data, site-use information, and recent trends. These data and information are also used to make responsible, proactive decisions such as the Geoprobe® investigations to better define the north plateau gross beta plume and installation and operation of the NPGRS. The pilot study to investigate chromium and nickel in groundwater, discussed earlier in this chapter, is another example of an action resulting from historic data evaluation. Sample collection methods may be permanently modified, depending on this study's conclusions.

Groundwater monitoring will continue on a quarterly basis during 1998. If and when items of concern are discovered, they will be addressed in order to protect groundwater resources in the vicinity of the WVDP.

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.

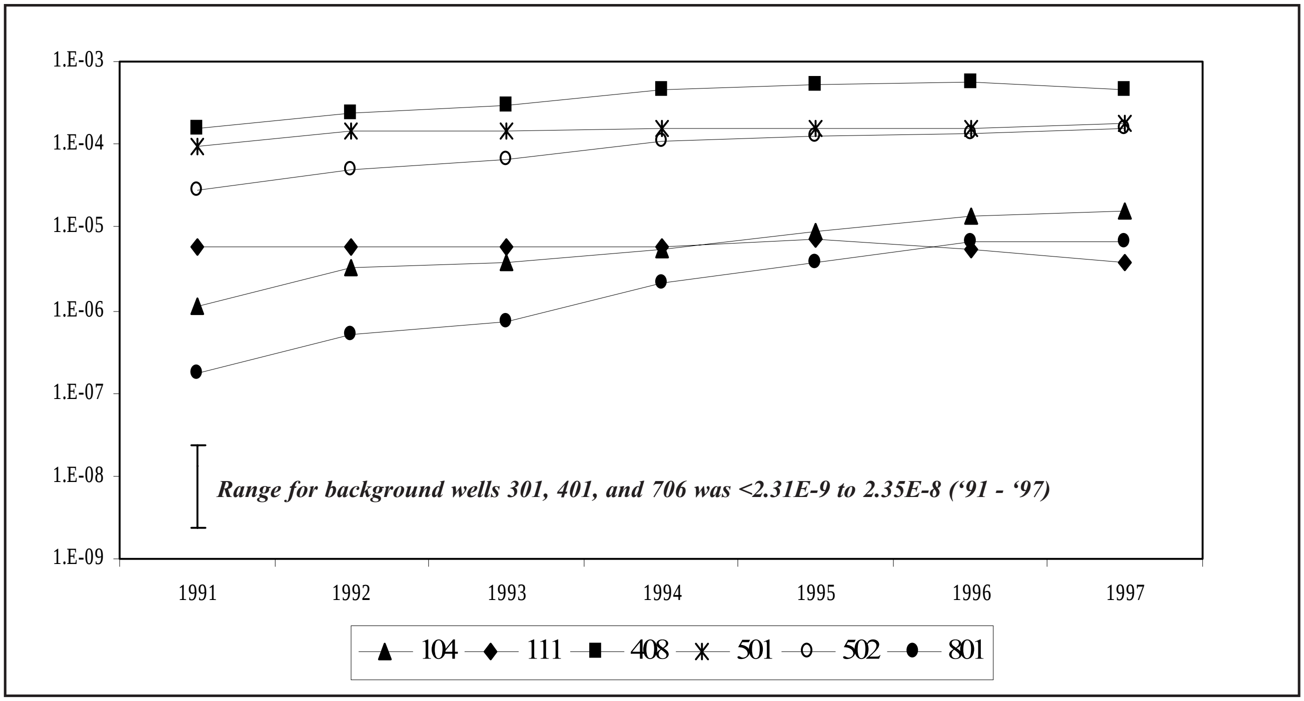

Figure 3-6. Seven-Year Trends of Averaged Gross Beta Activity (µCi/mL) at Selected Locations in the Sand and Gravel Unit

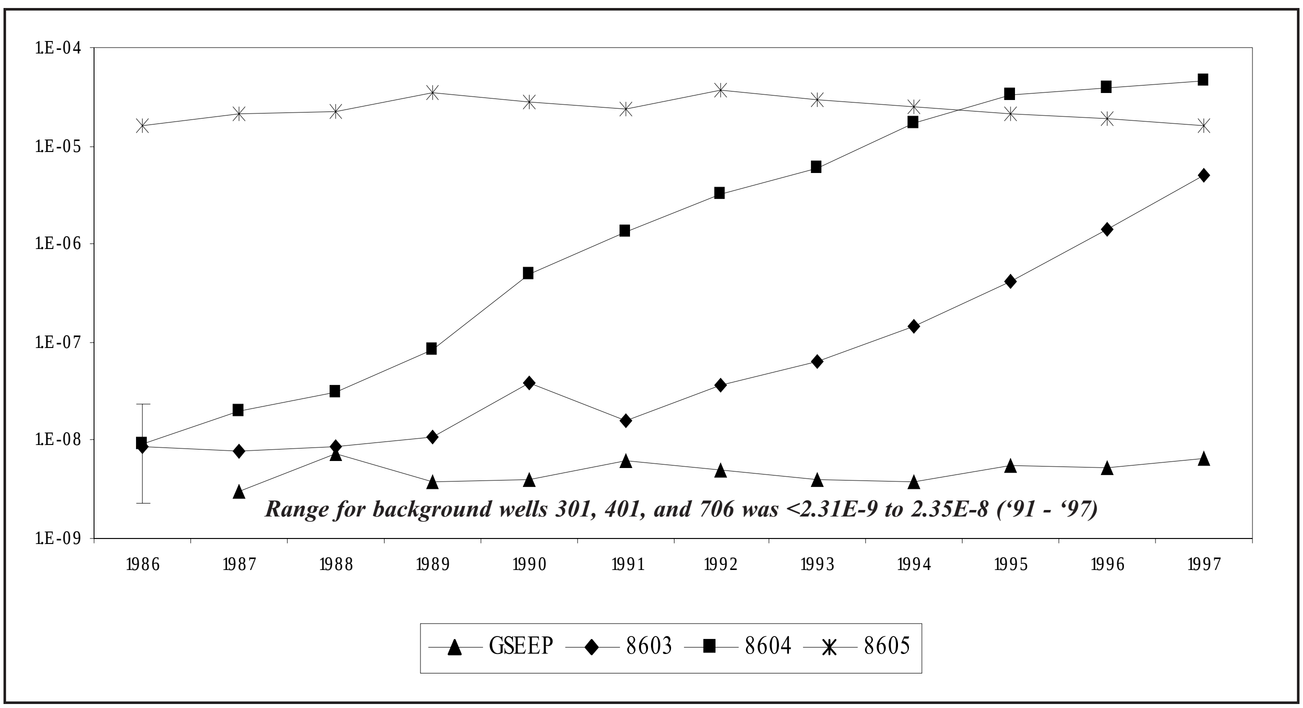

Figure 3-7. Twelve-Year Trends of Averaged Gross Beta Activity (µCi/mL) at Selected Locations in the Sand and Gravel Unit

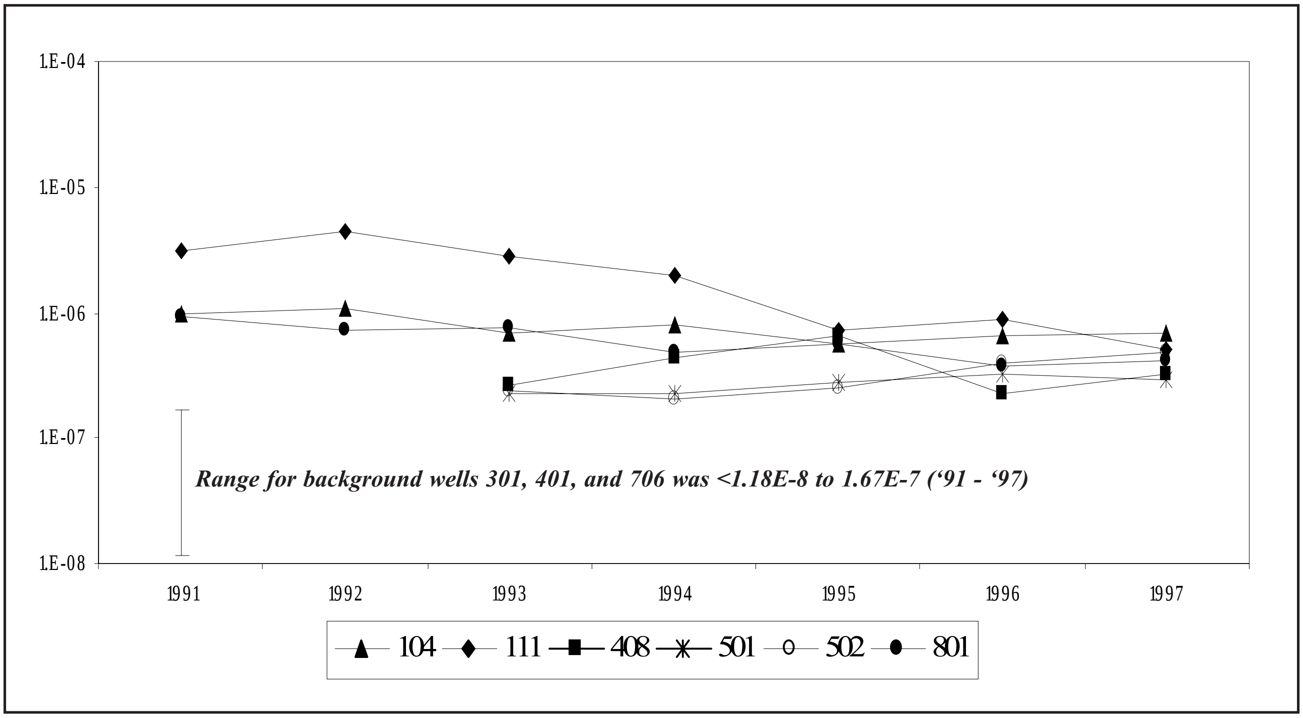

Figure 3-8. Seven-Year Trends of Averaged Tritium Activity (µCi/mL)
at Selected Locations in the Sand and Gravel Unit

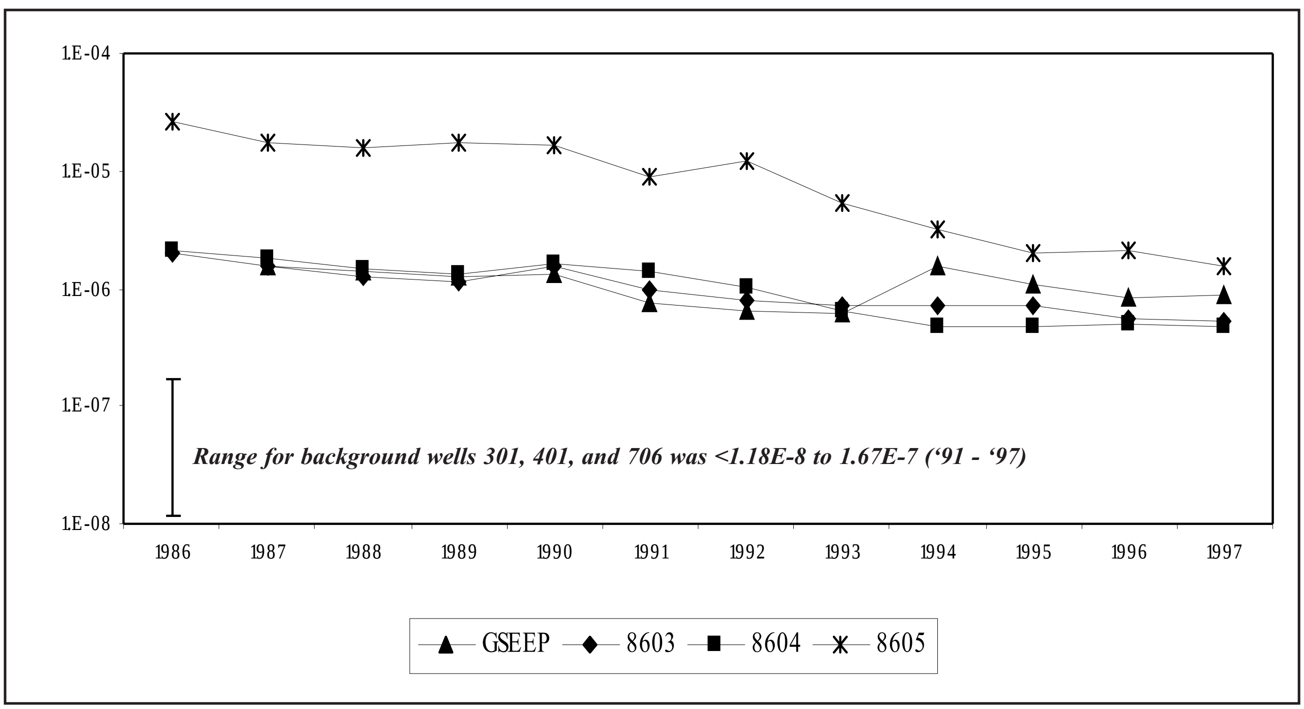

Figure 3-9. Twelve-Year Trends of Averaged Tritium Activity (µCi/mL)
at Selected Locations in the Sand and Gravel Unit

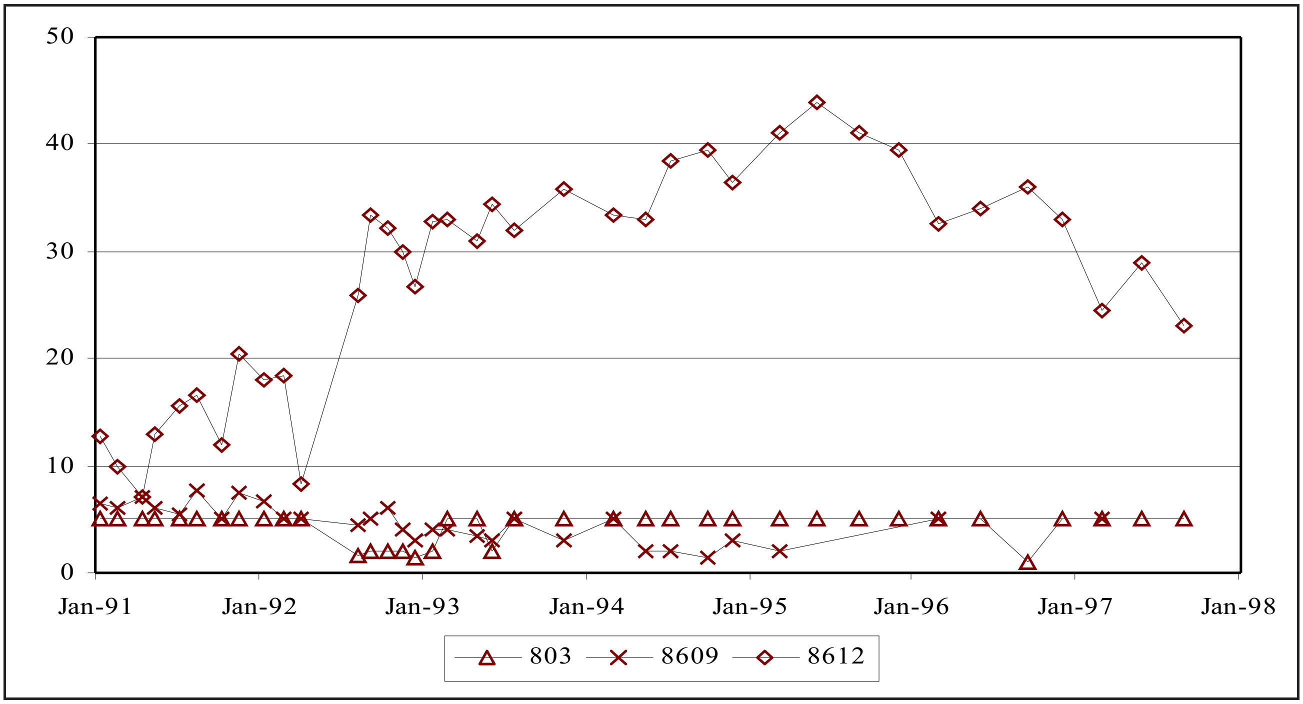

Figure 3-10. Eight-Year Trends (1991 through 1997) of 1,1-DCA (µg/L) at Selected Monitoring Locations

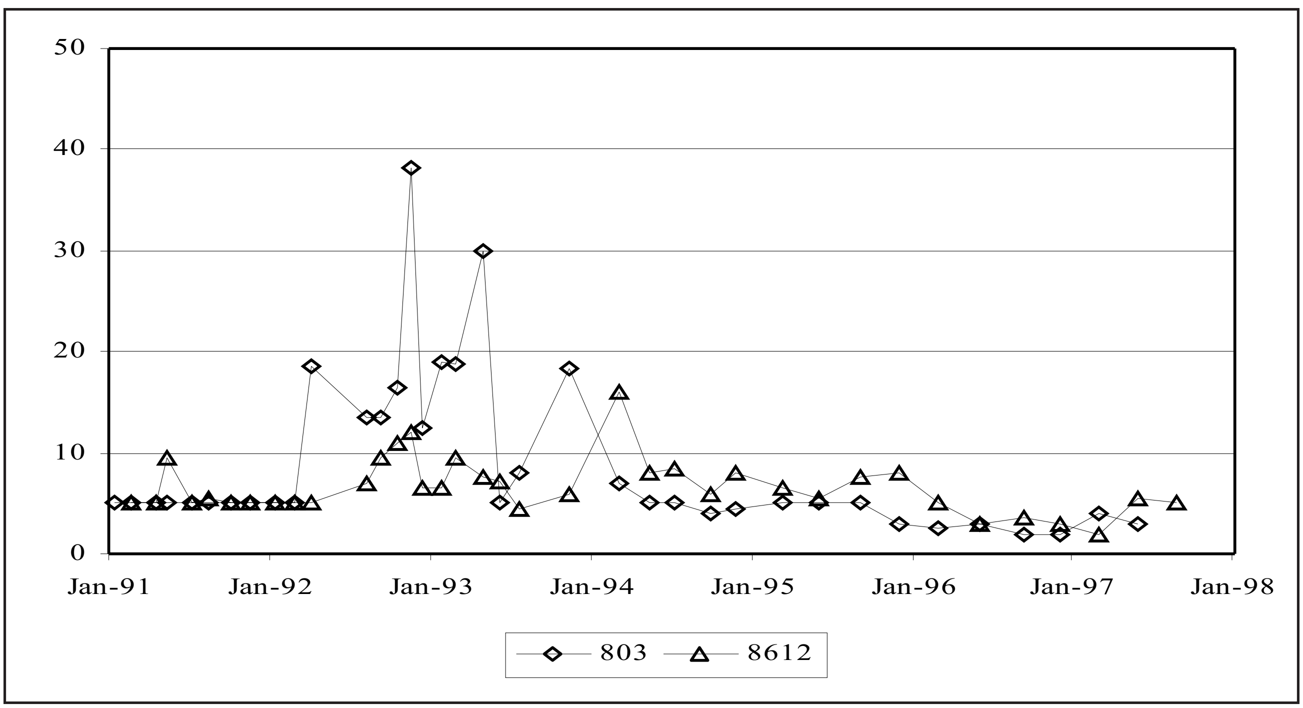

Figure 3-11. Seven-Year Trends (1991 through 1997) of Dichlorodifluoromethane (DCDFMeth) (µg/L) at Selected Groundwater Locations

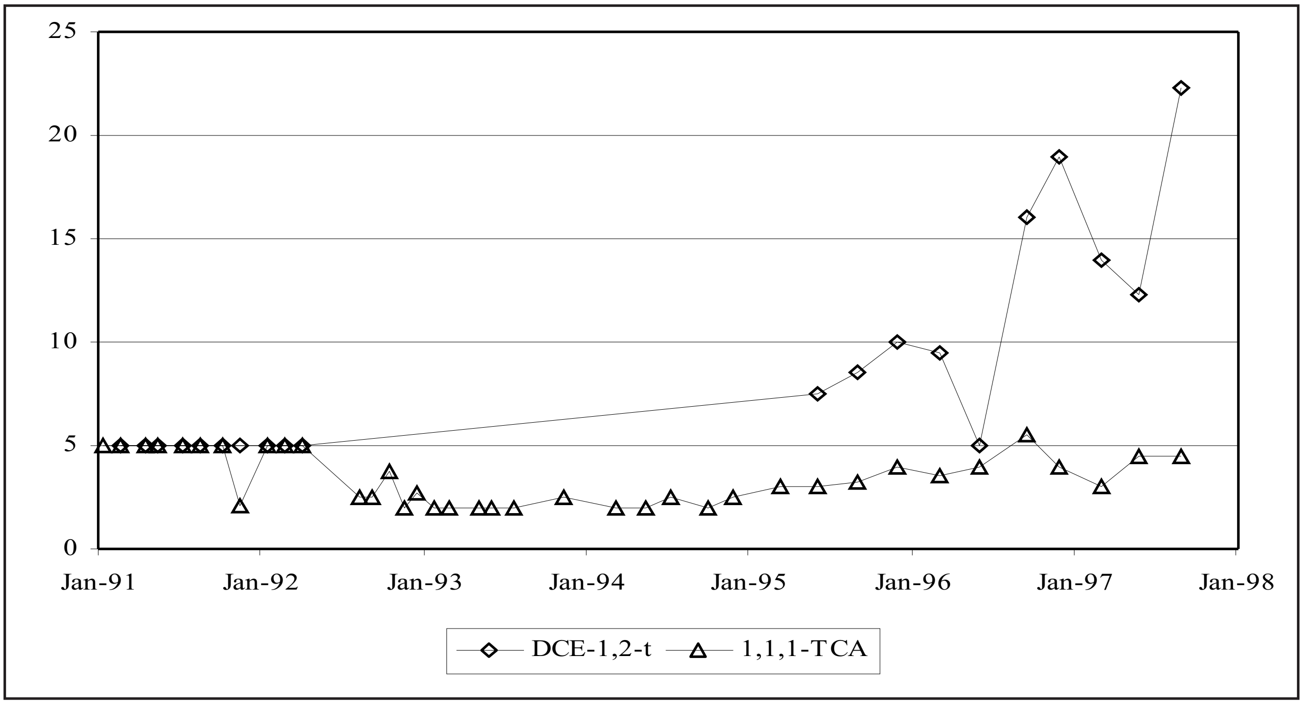

Figure 3-12. Seven-Year Trends of 1,2-DCE and 1,1,1-TCA (µg/L) (1991 through 1997) at Well 8612

RADIOLOGICAL DOSE ASSESSMENT

Each year the potential radiological dose to the public that is attributable to operations and effluents from the West Valley Demonstration Project (the WVDP or Project) 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.

Introduction

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 1997.

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 1997 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.

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 1997 would have measured 2.0 millicuries in 1967 and will be 0.5 millicuries in 2027.

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, exposing the internal organs.

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 1997 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. The WVDP contributes a very small amount (0.073 mrem [0.00073 mSv] per year) to the total annual manmade radiation dose to the

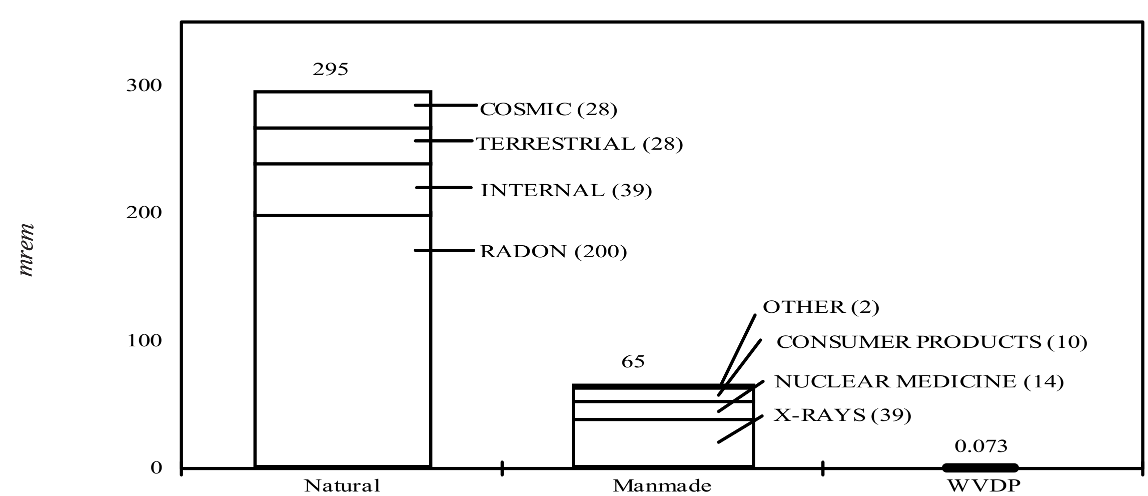

Figure 4-1. Comparison of Annual Background Radiation Dose to the Dose from 1997 WVDP Effluents

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.

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 local 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 because surveys of drinking water usage by the local population surrounding and residing downstream of the WVDP site revealed no use by local residents. Table 4-1 (p. 4-5) summarizes the potential exposure pathways for the general off-site population.

Land Use Survey

Periodic surveys of local residents provide information about local family sizes, sources of food, and gardening practices. Information frpm 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 *Predictive Computer Modeling* [p. 4-6] for more information on the computer model used.)

1997 Deer Management Program

On October 27, 1997, NYSDEC biologists assisted the Project in collecting four on-site deer in order to obtain tissue samples. Tissue samples also had been obtained earlier, on October 13,

Table 4-1
Potential 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, vension, 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

1997, from an on-site deer. The deer sampling and analysis data were used to determine whether radioactivity levels in on-site deer were sufficiently low to allow the animals to be driven from the Project premises to the WNYNSC. As described in the Deer Management Program Plan (West Valley Nuclear Services Co., Inc. October 27, 1997), this drive was necessary because on-site sources of food could not support the large number of deer.

The results of deer sample analyses indicated that the average concentration of cesium-137 in venison samples collected from the north plateau was approximately thirty times higher than average concentrations in venison collected from control locations more than sixteen kilometers from the Project. As the element cesium has a biological half-life in deer of less than thirty days, once the deer were removed from the north plateau during the deer drive, which took place January 8 and 9, 1998, the cesium-137 in their bodies began to be naturally eliminated at a rate of at least half of the remaining amount each month. The calculated hypothetical effective dose equivalent that could have been received by an individual eating 100 pounds of venison taken from deer immediately after the deer drive was 0.76 mrem. However, the deer will not be legally hunted again until mid-October 1998, by which time the estimated effective dose equivalent from exposure to the remaining cesium-137 in venison will be no greater than that from consuming venison collected from control locations.

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 1,200μCi in 1996 and 7,430μCi in 1997 as a result of the processing of the high-level waste. (See ***Chapter 2***, p. 2-31, *Special Monitoring*, 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 *Appendices C-1* and *C-2*.) 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 local population. 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.

Predictive Computer Modeling

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 were 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 were calculated using models that have been approved by the DOE and the EPA to demonstrate compliance with radiation standards.

Radiological dose was 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 were then summed to obtain the total dose estimates reported in Table 4-2 (p. 4-7).

Separate dose calculations are performed if any of the near-site food samples contain radionuclide concentrations that are statistically higher than the concentrations in control samples. However, these calculated doses are not added to the estimates that are based on predictive computer modeling (Table 4-2 [p. 4-7]) because the models already include contributions from all environmental pathways.

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, cesium-134, and cesium-137. The measured radionuclide concentrations reported in *Appendix C-3*, Tables C-3.1 through C-3.4 (pp. C3-3 through C3-8) are the basis for comparing near-site and background concentrations.

Table 4-2

Summary of Annual Effective Dose Equivalents to an Individual and Population from WVDP Releases in 1997

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]	4.9E-02 (4.9E-04)	3.9E-01 (3.9E-03)
% EPA standard (10 mrem)	0.49%	*NA*
Waterborne Releases[4]		
Effluents only	1.2E-02 (1.2E-04)	8.6E-03 (8.6E-05)
Effluents plus north plateau drainage	2.4E-02 (2.4E-04)	3.8E-02 (3.8E-04)
Total from all Pathways	7.3E-02 (7.3E-04)	4.3E-01 (4.3E-03)
% DOE standard (100 mrem) — air and water combined	0.073%	
% natural background (295 mrem; 380,000 person-rem) — air and water combined	0.025%	0.0001%

Exponents are expressed as "E" in this report: a value of 1.2×10^{-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.

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[1] Maximum exposure to air discharges occurs at a residence 1.8 kilometers northwest of the main plant.
[2] Population of 1.3 million within 80 kilometers of the site.
[3] From atmospheric release points. 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).

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

The maximum potential dose to nearby residents from the consumption of foods with radionuclide concentrations above background was 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).

Airborne Releases

Releases of airborne radioactive materials from nominal 10-meter stacks and from the main 60-meter stack were 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 were used as input parameters. Resulting output from the CAP88-PC code was 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 1997. The activity that was released to the atmosphere from these stacks is listed in Tables C-2.1 through C-2.10 and was used as input to the CAP88-PC code. (See *Appendix C-2* [pp. C2-3 through C2-11] and Tables C-2.14 and C-2.15 (*Appendix C-2* [pp. C2-15 and C2-16].)

Wind data collected from the on-site meteorological tower during 1997 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.

Waterborne Releases

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 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).

Six planned batch releases of liquid radioactive effluents from lagoon 3 occurred during 1997. The radioactivity that was discharged in these effluents is listed in *Appendix C-1*, Table C-1.1 (p. C1-3) and 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-1*, Tables C-1.5 and C-1.6 (p. C1-7).

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-1.7 and C-1.8 (pp. C1-8 and C1-9). These release points are included in the EDE calculations for the maximally exposed off-site individual and the collective population.

Environmental Media Concentrations

Radionuclide concentrations in samples of fish, milk, beef, venison, and local crops were assessed to determine if near-site concentrations were statistically above concentrations for corresponding background (control) samples.

Fish

Samples of fish were collected from Cattaraugus Creek from May 1997 through November 1997. 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 gamma-emitting radionuclides, and the values were compared to background values. (See Table C-3.4 [pp. C3-6 through C3-8].)

Average values for cesium-134 and cesium-137 were either below detection limits or not statistically different than control concentrations.

Strontium-90 concentrations in some individual fish collected downstream of the site, above the Springville Dam, were higher than control sample concentrations. The calculated maximum dose to an individual from consuming 21 kilograms (46 lbs) of near-site fish was 0.035 mrem (0.00035 mSv). This annual dose is roughly equivalent to the dose received every two hours from natural background radiation.

Milk

Milk samples were collected from various nearby dairy farms throughout 1997. Control samples were collected from farms 25-30 kilometers (15-20 mi) to the south and north of the WVDP. Milk samples were measured for tritium, strontium-90, iodine-129, cesium-134, cesium-137, and potassium-40. (See Table C-3.1 [p. C3-3].) Ten near-site milk samples were collected and compared with eight background samples. Average values for tritium, strontium-90, iodine-129, cesium-134, and cesium-137 were either below detection limits or not statistically different than control concentrations.

Beef

Near-site and control samples of locally raised beef were collected in 1997. These samples were measured for tritium, strontium-90, and gamma-emitting radionuclides such as cesium-134 and cesium-137. Two samples of beef muscle tissue were collected from background locations and two from near-site locations.

Individual concentrations of strontium-90, cesium-137, and cesium-134 in near-site samples were either below detection limits or not statistically different than concentrations at control locations. (See Table C-3.2 [p. C3-4].) The tritium concentration in one near-site beef sample was higher than the control concentration. The hypothetical maximum dose to an individual from consuming 110 kilograms (243 lbs) of beef from this location was 0.0079 mrem (0.000079 mSv). This annual dose is roughly equivalent to the dose received every fifteen minutes from natural background radiation.

Venison

Meat samples from three near-site and three control deer were collected in 1997. (See Table C-3.2 [p. C3-4].) These samples were measured for tritium, strontium-90, cesium-134, cesium-137, and other gamma-emitting radionuclides. Individual concentrations of cesium-134 and strontium-90 in near-site venison samples were either below detection limits or not statistically different than concentrations at control locations. One near-site venison sample contained tritium concentrations higher than the average control sample concentration, and another near-site venison sample contained cesium-137 concentrations higher than the control sample concentrations. The calculated maximum dose to an individual from consuming 45 kilograms (100 lbs) of near-site venison is 0.46 mrem (0.0046 mSv). This annual dose is roughly equivalent to the dose received every fourteen hours from natural background radiation.

Produce (corn, beans, and apples)

Near-site and background samples of corn, beans, and apples were collected during 1997 and analyzed for tritium, cobalt-60, strontium-90, potassium-40, and cesium-137. (See *Appendix C-3*, Table C-3.3 [p. C3-5].)

Individual concentrations of cobalt-60 and cesium-137 in near-site produce samples were either below detection limits or not statistically different than concentrations at control locations. Strontium-90 concentrations in annual near-site corn and apple samples were above the control concentrations. Tritium concentrations in near-site apples also were above control sample concentrations.

The hypothetical maximum dose to an individual from consuming 52 kilograms (115 lbs) each of near-site apples and corn is 0.033 mrem (0.00033 mSv). This annual dose is roughly equivalent to the dose received every eighteen hours from natural background radiation.

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

Predicted Dose from Airborne Emissions

Applicable Standards

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 Emissions Standards for Hazardous Air 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.

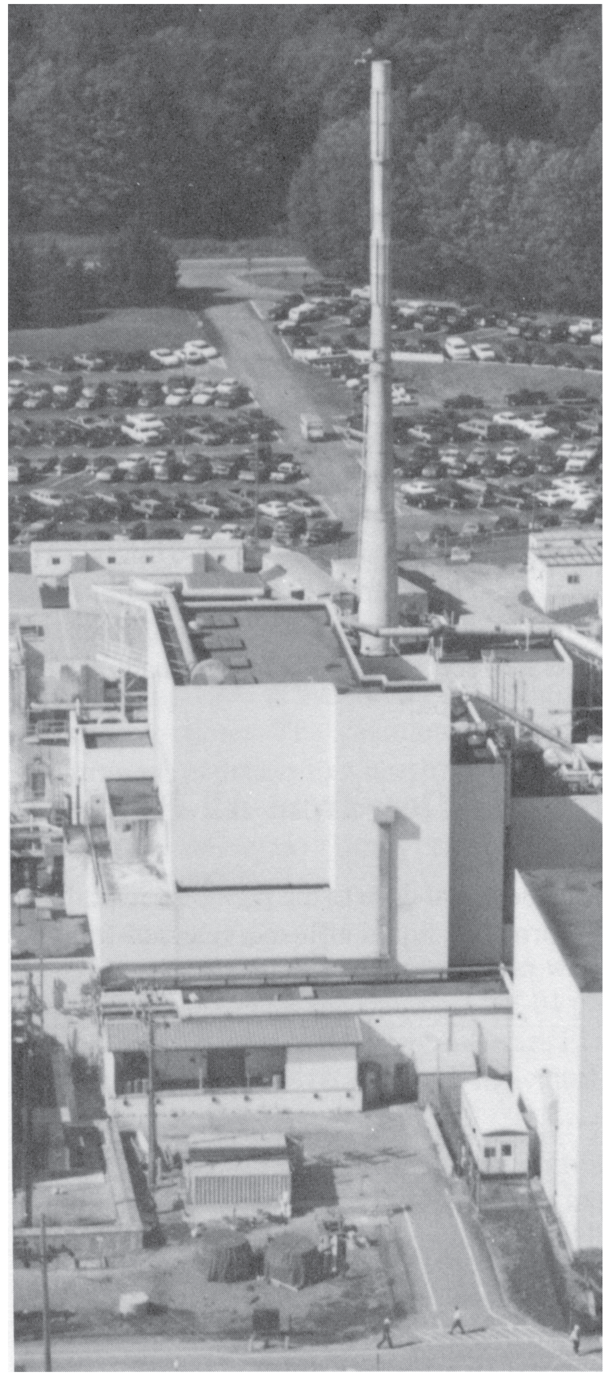
Maximum Dose to an Off-site Individual

Based on the airborne radioactivity released from the permitted point sources at the site during 1997, it was estimated that a person living in the vicinity of the WVDP could have received a total EDE of 0.049 mrem (0.00049 mSv). The computer model has established that this maximally exposed off-site individual is located 1.8 kilometers northwest 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 0.049 mrem (0.00049 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 one and one-half hours 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 1997 assessment are from the most recent census projection, which was for 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 0.39 person-rem (0.0039 person-Sv) total EDE from radioactive airborne effluents released from the permitted WVDP point sources during 1997. The resulting average EDE per individual was 0.0003 mrem (0.000003 mSv).



The Main Plant Ventilation Stack at the West Valley Demonstration Project

Predicted Dose from Waterborne Releases

Applicable Standards

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 with the applicable guidelines provided in DOE Order 5400.5.

Maximum Dose to an Off-site Individual

Based on the radioactivity in effluents released from the WVDP (lagoon 3, sewage treatment plant, and french drain) during 1997, an off-site individual could have received a maximum EDE of 0.012 mrem (0.00012 mSv). Approximately 86% of this dose would be from cesium-137 and 6% from strontium-90. This dose of 0.012 mrem (0.00012 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 0.012 mrem (0.00012 mSv). (See *Appendix C-1*, Tables C-1.7 and C-1.8 [pp. C1-8 and C1-9].) The combined EDE to the maximally exposed individual from liquid effluents and drainage is 2.4E-02 mrem (2.4E-04 mSv). This annual dose of 0.024 mrem (0.00024 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.

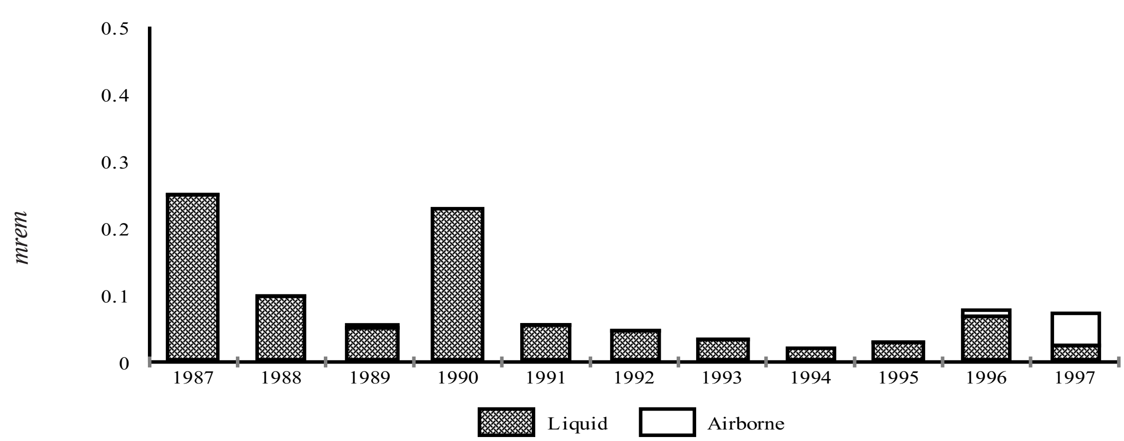


Figure 4-2. Effective Dose Equivalent from Liquid and Airborne Effluents to a Maximally Exposed Individual Residing near the WVDP

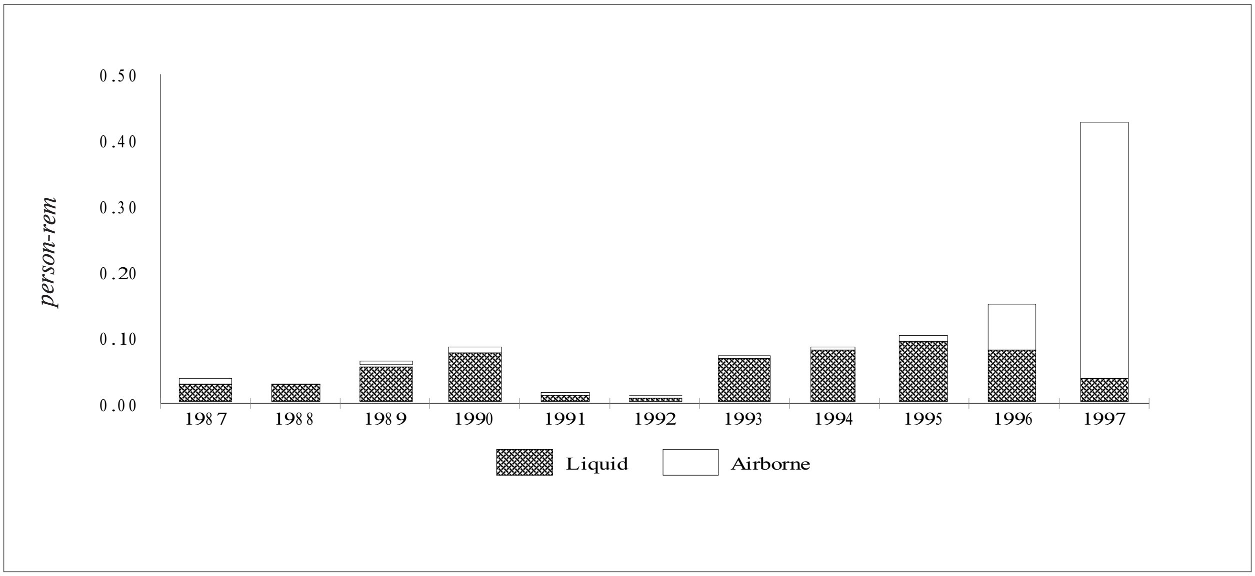


Figure 4-3. Collective Effective Dose Equivalent to the Population Residing within 80 Kilometers of the WVDP from Liquid and Airborne Effluents

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 1997, the population living within 80 kilometers (50 mi) of the site received a collective EDE of 0.0086 person-rem (0.000086 person-Sv). The collective dose to the population from the north plateau drainage is 0.03 person-rem (0.0003 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 2.9E-05 mrem (2.9E-07 mSv). This dose of 0.000029 mrem (0.00000029 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 1997 is the sum of the individual dose contributions. The calculated maximum EDE from all pathways to a nearby resident was 0.073 mrem (0.00073 mSv). This dose is 0.07% 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 0.43 person-rem (0.0043 person-Sv), with an average EDE of 0.00033 mrem (0.0000033 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 1997 is slightly lower than the annual dose reported for 1996. The increase in dose fraction from air emissions in 1997 is attributed to iodine-129 emissions. The reduced dose from the liquid pathway was the result of a decrease in average concentrations of most nuclides and an approximate 13% decrease in total effluent volume from lagoon 3.

Figure 4-3 (p. 4-13) shows the collective dose to the population over the last eleven years. The upward trend results primarily from an increase in iodine-129 emissions from the main plant stack after the start of radioactive vitrification operations in June/July 1996.

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

There were no off-site unplanned releases (as defined by DOE Order 5400.1) of air or liquid effluent identified or reported in 1997.

Risk Assessment

Estimates of cancer risk from ionizing radiation have been presented by the International Commission on Radiological Protection (1990), the National Council on Radiation 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 on Radiological Protection 1990) 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 0.000000037 probability of a cancer fatality (1 chance in 27 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 was performed for airborne and waterborne releases. This analysis resulted in estimated doses to the hypothetical 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 was also 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 1997.

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 Co., Inc. (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 1994), and DOE Order 5700.6C, Quality Assurance (U.S. Department of Energy 1991) 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 upon assigning responsibilities and upon 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 check and 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. Any 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.

√ C*orrective 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 WVNS requirements.

Procedures

Activities affecting 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; it 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 made 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 homogenous, 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 collected only 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 any possible influence from the site can be determined.

Quality Control in the Laboratory

More than 11,000 samples were handled as part of site monitoring in 1997. 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' directions. 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 a known concentration 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 deemed usable.

Laboratory 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.

Laboratory 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:

1) to determine if contamination is present in the counting instrument

2) to determine if the instrument is responding in an acceptable manner

3) to determine the background correction that should be applied when calculating radiological activity in certain samples.

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.

Laboratory 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 formal radiological crosscheck programs conducted by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). 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. WVNS also participates in crosscheck programs from the EPA's National Exposure Research Laboratory, Environmental Sciences Division (NERL-ESD). Crosscheck samples for radiological analyses are analyzed by both the Environmental Laboratory on-site and by the subcontract laboratories.

Results from radiological crosschecks are summarized in *Appendix D*, Tables D-1 through D-3 (pp. D-3 through D-9). A total of 169 radiological crosscheck analyses were performed by or for WVNS and reported in 1997. One hundred and sixty-seven results (98.8%) were within control limits. Forty-seven of the results were produced by the on-site Environmental Laboratory; 100% were within control limits. Out-of-control results were followed up through formal corrective action processes.

Results for nonradiological EPA crosschecks are summarized in *Appendix D*, Table D-5 (p. D-11). Twenty-one parameters were analyzed by Ecology and Environment and two by WVNS. Of the twenty-three results, twenty-two (95.6%) were within control limits.

By contract with WVNS, subcontract 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.

Table D-4 (p. D-10) summarizes environmental TLD results and the results from U.S. Nuclear Regulatory Commission (NRC) TLDs placed in the same locations but collected and analyzed by the NRC. Although not a formal crosscheck, the agreement of these sets of results demonstrates the precision of these measurements and substantiates confidence in results from the remainder of the environmental TLD locations.

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 lock-up 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

The WVNS Quality Assurance Department assesses compliance with and the effectiveness of WVNS programs by performing audits, assessments, surveillances, and/or inspections of processes.

In 1997 WVNS Quality Assurance conducted several surveillances of various aspects of specific environmental programs at the WVDP. Topics addressed were releasing and shipping samples, archiving samples, and disposing of samples. Surveillances were conducted also at contract laboratories that analyze WVDP samples.

Activities were assessed against applicable regulations, safety requirements, or procedures. Results of all surveillances were satisfactory.

Self-Assessments

A special compliance self-assessment of the site's NESHAP program was conducted by the Environmental Affairs Department in 1997. A representative from the Savannah River site assisted in the assessment, focusing on monitoring and sampling instrumentation and equipment. One finding and eight observations were noted, as were several comments. Deficiencies are being addressed through formal corrective actions procedures. (For more information on site audits and assessments see the *Environmental Compliance Summary: Calendar Year 1997* [p. lxi]).

Two routine self-assessments of the environmental monitoring program were conducted in 1997. The primary topics addressed by the assessments were the effects of new procedures on data collection activities, the implementation of the split sample crosscheck program with NYSDOH, and the application and implementation of conduct of operations requirements in the environmental monitoring program and in the Environmental Laboratory.

Areas of inquiry were liquid effluent monitoring; airborne effluent monitoring; meteorological monitoring; environmental surveillance; laboratory procedures; data analysis and statistical treatment of data; dose assessment; records and reports; quality assurance; and conduct of operations.

No findings and four observations were noted. Deficiencies were addressed through formal corrective action procedures. In addition, several comments regarding possible program improvements were noted and commendable practices identified.

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.

In 1997 the WVNS Environmental Affairs Department conducted a safety and maintenance inspection of all WVDP ambient air sampling locations. As a result, various upgrades were made, including upgrades of electrical service, trimming of grass and trees, and placement of stone walkways.

No formal audits encompassing environmental monitoring issues were conducted by external agencies in 1997. Project Appraisals audited the vitrification facility in 1997. Effluent release systems were included within the scope of this audit. No conditions were found during the audit and surveillances that would adversely affect environmental monitoring data.

Lessons Learned Program

Information from audits, appraisals, and self-assessments that may be important to WVNS organizations other than the originating department may be shared through the WVNS Lessons Learned Program. WVNS 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 on 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 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 sub-contractor laboratories.

All software used to generate data is subjected to verification and validation before use.

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.

The data are then evaluated and reports are prepared. Before each technical report is issued it undergoes a peer review in which 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.

The multiple levels of scrutiny built into data generation, validation, and reporting ensure that reliable and accurate data are reported from the environmental monitoring program.

Data Reporting

There is inherent uncertainty associated with all environmental radioactivity measurements. The uncertainty that is associated with individual measurements is expressed as a confidence interval, i.e., the range of measurement values above and below the test result within which the “true” value is expected to lie.This interval is derived mathematically using statistical concepts. The width of the interval is based primarily on a predetermined level of confidence that the “true” value lies within the interval.This confidence level is expressed in terms of a probability that the confidence interval actually encompasses the “true” value. For example, the WVDP environmental monitoring program uses a 95% confidence level for all radioactivity measurements and calculates confidence intervals accordingly.

Radiological measurements require that analytical or instrumental background counts be subtracted from sample measurement values to obtain net values. If background values are equal to or greater than the gross sample measurement value, then the net sample measurement value can be zero or negative. Although a negative value does not represent a physical reality, a reliable long-term average of many measurements can be obtained only if the very small and negative values are included in the calculations.

Averages of radioactivity measurements from a particular sampling location are calculated by taking a simple arithmetic mean. What is not so clear, even as a professional consensus, is how to represent the confidence interval that is associated with an average of many measurements.

One method in use by other facilities is to represent an average of a set of samples by using an arithmetic mean of the values and then using the standard error of the mean to represent the confidence interval. This method does not consider the value of the confidence interval for each of the individual measurements. Thus, in situations where the measurements are near the minimum detectable concentration and may all include zero within their confidence interval, the confidence interval for the average may not include zero; therefore, even though it is doubtful that any individual sample contained detectable radioactivity the confidence interval for the average may not include zero.

For this reason, in this report we have opted to express the confidence interval of the average of repeated measurements of independent samples taken over time or in various locations by pooling the confidence intervals from the individual measurements. In this manner, we are expressing a reasonable and representative estimate of the confidence interval for the average ($\bar{x}$) as follows:

$$e_m = \frac{\sqrt{e_1^2 + e_2^2 + \ldots + e_n^2}}{\sqrt{n}}$$

where e_1 through e_n represent the estimates of variability for each of n measurements, and e_m equals the estimate of variability for the mean. The confidence interval of the average is equal to:

$$\bar{x} \pm e_m$$

where $\bar{x}$ is equal to the average.

Wherever possible, the actual calculated value, whether positive, negative, or zero, is reported, along with its confidence interval.

Summary

By implementing the quality assurance elements described in this chapter, the WVDP ensures 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

1997 Environmental Monitoring Program

The WVDP Supports a Bluebird and Wood Duck Nesting-box Program Sponsored by the Springville Field and Stream Club

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1997 Environmental Monitoring Program

The following schedule represents the West Valley Demonstration Project (WVDP) routine environmental monitoring program for 1997. This schedule met or exceeded the minimum program specifications needed to satisfy the requirements of DOE Order 5400.1. It also met requirements of DOE 5400.5 and DOE/EH-0173T. Specific methods and recommended monitoring program elements are found in DOE/EP-0096, *Effluent Monitoring*, and DOE/EP-0023, *Environmental Surveillance*, 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.

Results from all locations except groundwater monitoring points are summarized in Quarterly Environmental Monitoring Data Reports (QEMDRs). Groundwater monitoring data are summarized in quarterly groundwater monitoring reports. A computerized environmental data-screening system identifies analytical data that exceed pre-set limits. All locations are checked monthly for trends or noticeable results in accordance with criteria established in Documentation and Reporting of Environmental Monitoring Data (West Valley Nuclear Services Co., Inc. April 13, 1995). 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 following table is a schedule of environmental sampling at the WVDP. Locations of the sampling points are shown on Figures A-1 through A-9. The index on pp. A-v through A-vii is a list of the codes for various sample locations. 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/Sediment, **B**iological, or **D**irect Measurement. The second character specifics 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).

- ***Monitoring/Reporting Requirements.*** Notes the bases for monitoring that location, any additional references to permits, and the reports generated from sample data. Routine reports cited in Appendix A are the Effluent Summary Report (ESR), the Monthly Trend Analysis Report (MTAR), the Quarterly Environmental Monitoring Data Report (QEMDR), the On-site Discharge Information System (ODIS) report, 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 for 1997

Location Code	*Description of Changes*
Well Points	Four of seven radiological sampling points on the north plateau east of the main plant were discontinued in 1997.

Index of Environmental Monitoring Program Sample Points

Air Effluent and On-site Ambient Air (Fig. A-1 [p. A-45])

Liquid Effluent and On-site Water (Fig. A-2 [p. A-46])

* *Not detailed on map*

Index of Environmental Monitoring Program Sample Points
(continued)

On-site Groundwater and Seeps (Fig. A-3 [p. A-47])

Off-site Surface Water (Fig. A-4 [p. A-48])

Off-site Drinking Water (Figs. A-5 [p. A-49] and A-9 [p. A-53])

Off-site Ambient Air (Figs. A-6 [p. A-50] and A-9 [p. A-53])

** Not detailed on map*

Index of Environmental Monitoring Program Sample Points
(concluded)

Fallout, Sediment, and Soil (Figs. A-2 [p. A-46], A-4 [p. A-48], A-6 [p. A-50], and A-9 [p. A-53])

Off-site Biological (Figs. A-5 [p. A-49] and A-9 [p. A-51])

Direct Measurement Dosimetry (Figs. A-7 [p. A-51], A-8 [p. A-52], and A-9 [p. A-53])

1997 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 **ANVITSK** Vitrification HVAC Exhaust	Airborne radioactive effluent points including LWTS and vitrification off-gas Required by: • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitors	Continuous measurement of fixed filter, replaced weekly	N/A	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 composite for Sr-90, Pu/U isotopic, total U, Am-241, gamma isotopic
		Continuous off-line desiccant columns for water vapor collection	Weekly	52 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 • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	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.

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) and head end ventilation, analytical area. Requires continuous effluent monitoring per 40 CFR Subpart H, Section 61.93(b) because potential emissions may exceed 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 Subpart H, Section 61.93(b) because potential emissions may exceed 0.1 mrem limit.

ANCSSTK DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from 01-14 building, which houses equipment used to treat ceramic melter off-gas. Requires continuous effluent monitoring per Subpart H, Section 61.93(b) because potential emissions may exceed 0.1 mrem limit.

ANCSRFK DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from process area where radioactive tanks, pipes, and other equipment are reduced in volume by cutting with a plasma torch.

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 effluent exhaust stack. Sampler brought on-line in late 1995 when nonradioactive operations began. Radioactive operation began with 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 of primary vitrification HVAC stack failure.

- Sampling locations are shown on Figure A-1 (p. A-45).

1997 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
ANSUPCV Supercompactor Exhaust	Airborne radioactive effluent point Required by: • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitor during operation	→ Continuous measurement of fixed filter	→ N/A	→ Real-time beta monitoring
		Continuous off-line air particulate filter	→ Weekly (when operating)	→ 52 maximum	→ Filters for gross alpha/beta, gamma isotopic* upon collection
				Collected filters composited to 4	→ Quarterly composites for Sr-90, Pu/U isotopic, total U, Am-241, gamma isotopic
OVEs/PVUs Outdoor Ventilated Enclosures/ Portable Ventilation Units	Airborne radioactive effluent points Required by: • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • 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, Pu/U isotopic, total U, Am-241, gamma isotopic

* Gamma isotopic only if gross activity rises significantly.

** If gross determination of individual filter is significantly higher than background, individual sample would be submitted immediately for isotopic analysis.

Sampling Rationale

ANSUPCV	DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from area where low-level radioactive waste volume is reduced by compaction.
OVEs/PVUs	DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3. Outdoor ventilated enclosures; portable ventilation units used for handling of radioactive materials or for decontamination in areas without containment ventilation.

- Sampling locations are shown on Figure A-1 (p. A-45).

1997 Monitoring Program
Environmental Surveillance:

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
ANLLWTVC Low-level Waste Treatment and Ventilation, "cold" side **ANLLWTVH** Low-level Waste Treatment and Ventilation, "hot" side **ANLAUNV** Laundry Change Room Ventilation	Airborne radioactive effluent point Required by: • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter	→ Weekly (monthly at ANLAUNV)	→ 52 each location (12 at ANLAUNV)	→ Gross alpha/beta, gamma isotopic* upon collection
ANLAGAM Lag Storage Area Ambient Air **ANNDAAM** NDA Ambient Air	Ambient "diffuse source" air emissions Reported in: • MTAR • QEMDR • SER • Air Emissions Annual Report (NESHAP)	Continuous air particulate filter	→ Weekly	→ 52 each location Weekly filter composited to 4 each location	→ Gross alpha/beta → Quarterly composite for Sr-90, gamma isotopic, Pu/U isotopic, total U, Am-241
ANSDAT9** SDA Trench 9 Ambient Air	Ambient "diffuse source" air emissions Reported in: • Quarterly reports to NYSDEC • MTAR • QEMDR • SER	Continuous air particulate filter	→ Weekly	→ 52 Weekly filter composited to 4	→ Gross alpha/beta → Quarterly composite for gamma isotopic
		Continuous off-line desiccant columns for water vapor collection	→ 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

ANLLWTVC DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3.
ANLLWTVH

Samples nonradioaactive and radioactive sides of ventilation exhaust from low-level waste treatment facility.

ANLAUNV DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3.

Samples ventilation from 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 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-1 (p. A-45).

1997 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 • QEMDR • ODIS • SER	Grab liquid	→ Daily, during lagoon 3 discharge*	→ 40-80	→ Daily for gross beta, conductivity, flow
				7-12	→ 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, Pu/U isotopic, total U, 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 between four and eight times per year, as necessary, averaging ten days per discharge.

Sampling Rationale

WNSP001 DOE 5400.5; DOE/EH-0173T, 2.3.3.

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

New York State SPDES permit no. NY0000973.

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-46).

1997 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 Security Fence	Combined facility liquid discharge Required by: • SPDES Permit Reported in: • MTAR • QEMDR • 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 (monthly composite shared with NYSDOH)
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, 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
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 • QEMDR • ODIS • 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 samples	→ 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
WNSDADR SDA Run-off	Surface water run-off from south portion of SDA Required by: • Interim Measures Compliance Reported in: • Quarterly reports to NYSDEC • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ pH, total suspended solids, oil & grease, flow, gross alpha/beta, H-3, gamma isotopic

Sampling Rationale

WNSP006 DOE/EH-0173T, 5.10.1.1.

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

In accordance with 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).

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 for discharge of radioactivity to and from the sewage treatment plant.

WNSDADR NYSERDA interim measures compliance.

WVDP support of NYSERDA.

Grab sample monitoring surface water runoff from south portion of SDA.

- Sampling locations are shown on Figure A-2 (p. A-46).

1997 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 NE Swamp Drainage	Site surface drainage Reported in: • ESR • MTAR • QEMDR • ODIS • 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 (monthly composite shared with NYSDOH)
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, 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 • QEMDR • ODIS • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic, Sr-90
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, 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 • QEMDR • SER	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic, Sr-90

Sampling Rationale

WNSWAMP DOE/EH-0173T, 5.10.1.1.

NE site surface water drainage; provides for the sampling of this discrete drainage path for uncontrolled surface waters 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.

N site surface water drainage; provides for the sampling of this discrete drainage path for uncontrolled surface waters 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.

- Sampling locations are shown on Figure A-2 (p. A-46).

1997 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
WNSP008 French Drain	Drains subsurface water from LLWTF lagoon area <u>Required by</u>: • SPDES Permit <u>Reported in</u>: • Monthly SPDES DMR • ESR • MTAR • QEMDR • ODIS • 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 <u>Reported in</u>: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNCOOLW Cooling Tower Basin	Cools plant utility steam system water <u>Reported in</u>: • MTAR • QEMDR • 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.

French drain of subsurface water from lagoon (LLWTF) area. NYSDEC SPDES permit no. NY0000973 also provides for the sampling of this discrete drainage path for uncontrolled subsurface waters before they 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 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 NYSDEC SPDES permit no. NY0000973.

Provides for the sampling of this discrete drainage path for uncontrolled surface waters just after outfall 007 discharge into the drainage and before they flow to 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 no migration of radiological contamination 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-46).

1997 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
WNFRC67* Frank's Creek E of SDA	Drains NYS Low-level Waste Disposal Area Reported in: • MTAR • QEMDR • SER • Reported to NYSERDA	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNERB53* Erdman Brook N of Disposal Areas	Drains NYS and WVDP disposal areas Reported in: • MTAR • QEMDR • 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 • QEMDR • SER	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	→ Semiannual	→ 2	→ NPOC, TOX
WNDCELD Drainage S of Drum Cell	Drains WVDP storage area Reported in: • MTAR • QEMDR • SER	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 • QEMDR • 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 collected by 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 the 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 disposal area into Erdman Brook upstream of the confluence with Frank's Creek.

WNNDADR DOE/EH-0173T, 5.10.1.1.

Monitors the potential influence of the WVDP storage and disposal area drainage into Lagoon Road Creek upstream from confluence with Erdman Brook.

WNDCELD DOE/EH-0173T, 5.10.1.1.

Monitors potential influence of drum cell drainage into Frank's Creek south of the SDA and upstream of WNFRC67.

WNNDATR DOE Order 5400.1, IV.9.

Monitors groundwater in 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-46).

1997 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
WNSTAW Series On-site standing water ponds not receiving effluent include: **WNSTAW4** Border pond SW of AFRT240 **WNSTAW5** Border pond SW of DFTLD13 **WNSTAW6** Borrow pit NE of Project facilities **WNSTAW9** North reservoir near intake **WNSTAWB** Background pond at Sprague Brook maintenance building	Water within vicinity of plant airborne or water effluent Reported in: • MTAR • QEMDR • 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 built over or are now dry.

WNSTAW4 Border pond located south of AFRT240. Chosen to be a location for obtaining high potential concentration, based on meteorological data. Perimeter location adjacent to a working farm. Drainage extends through private property and is accessible to the public.

WNSTAW5 Border pond located west of Project facilities near the perimeter fence and DFTLD13. Chosen to be a location for obtaining high potential concentration, based on meteorological data. Location is adjacent to private residence and potentially accessible by the general public.

WNSTAW6 Borrow pit northeast of Project facilities just outside of inner security fence. Considered to be the closest standing water to the main plant and high-level waste facilities (in lieu of the availability 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-4, and A-9 (pp. A-46, A-48, and A-53, respectively).

1997 Monitoring Program
Environmental Surveillance:

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 includes: **WNDNKMS** Maintenance Shop Drinking Water **WNDNKMP** Main Plant Drinking Water **WNDNKEL** Environmental Laboratory Drinking Water **WNDNKUR*** Utility Room (EP-1) Potable Water Storage Tank	Sources of potable water within site perimeter <u>Reported in</u>: • MTAR • QEMDR • SER • also reported to Cattaraugus County	Grab liquid	→ Monthly	→ 12 per location	→ Gross alpha/beta, H-3, pH, conductivity
		Grab liquid	→ Annual	→ 1	→ As, Ba, Cd, Cr, Hg, Se, fluoride, NO_3

* **WNDNKUR.** Sample for NO_3 to be collected in March. Pb and Cu also will be 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 carried out to confirm no migration of radiological and/or nonradiological contamination into the site's drinking water supply.
WNDNKMS	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2. 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	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2. Same rationale as WNDNKMS but sampled at the main plant water fountain.
WNDNKEL	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2. Potable water sampled at the Environmental Laboratory.
WNDNKUR	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2. Sampled at the utility room potable water storage tank before the site drinking water distribution system. Sample location is entry point EP-1.

- Sampling points are within site facilities and are not detailed on figures.

1997 Monitoring Program
Environmental Surveillance:

On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
North Plateau background well (not in a SSWMU) **NB1S**	Groundwater monitoring points around site super solid waste management units (SSWMUs)	Grab liquid →	Four times per year (generally)* →	4 each well (generally)* →	Gross alpha, gross beta, tritium*
Low-level Waste Treatment Facilities (SSWMU #1)	Reported in: • SER • Quarterly Groundwater Reports				
103 **104 C** **105 C** **106** **107** **108** **110** **111** **116 C** **8604 C** **8605**		Direct field measurement of sample discharge water →	Each sampling event* →	Twice each sampling event →	Conductivity, pH
Miscellaneous Small Units (SSWMU #2)					
201 U **204 U** **205** **206 C** **208**					
Liquid Waste Treatment System (SSWMU #3)					
301 U **302 U**					

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. 3-7) for a summary sampling schedule and a listing of analytes and Table E-1 (App. E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for a listing of 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 focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Management Program, 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-3 (p. A-47).

1997 Monitoring Program
Environmental Surveillance:

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 U** **402 U** **403 U** **405 C** **406** **408** **409**	Groundwater monitoring points around site super solid waste management units (SSWMUs) <u>Reported in</u>: • SER • Quarterly Groundwater Reports	Grab liquid	→ Four times per year (generally)*	→ 4 each well (generally)*	→ Gross alpha, gross beta, tritium*
Maintenance Shop Leach Field (SSWMU #5) **501 U** **502**		Direct field measurement of sample discharge water	→ Each sampling event*	→ Twice each sampling event	→ Conductivity, pH
Low-level Waste Storage Area (SSWMU #6) **601 D** **602** **604** **605** **8607 U** **8609 U**					
Chemical Process Cell Waste Storage Area (SSWMU #7) **704** **706 U** **707 C**					

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. 3-7) for a summary sampling schedule and a listing of analytes and Table E-1 (App. E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for a listing of 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 focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for 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 covered 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 WVNS 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 wastes being stored for future disposal.
SSWMU #7	Chemical process cell (CPC) waste storage area contains packages of pipes, vessels, and debris from decontamination and cleanup of chemical process cell in the former reprocessing plant.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1997 Monitoring Program
Environmental Surveillance:

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** NRC-licensed Disposal Area (NDA) (SSWMU #9) **901 U** **902 U** **903** **906** **908 U** **909** **910** **8610** **8611** **NDATR** IRTS Drum Cell (SSWMU #10) **1005 U** **1006** **1007** **1008b B** **1008c B**	Groundwater monitoring points around site super solid waste management units (SSWMUs) <u>Reported in</u>: • SER • Quarterly Groundwater Reports	Grab liquid Direct field measurement of sample discharge water	→ Four times per year (generally)* → Each sampling event*	→ 4 each well (generally)* → Twice each sampling event	→ Gross alpha, gross beta, tritium* → 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. 3-7) for a summary sampling schedule and a listing of analytes and Table E-1 (App. E, p. E-3) for a listing of analytes monitored at each location. See Appendix E for a listing of 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 focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in WVDP-091, the Groundwater Plan Program. Groundwater monitoring is covered in WVDP-239, the Groundwater Monitoring Plan.
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-stabilized low-level radioactive waste.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1997 Monitoring Program
Environmental Surveillance:

On-site Groundwater

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	Per NYSERDA	Per NYSERDA	Per NYSERDA
Well Points (Not in a SSWMU) **WP-A** **WP-C** **WP-H**	Well points downgradient of main plant Reported in: • SER • Quarterly groundwater reports	Grab liquid	→ Annual	→ 1 each well	→ Gross alpha/beta, H-3
		Field Measurement	→ Each event	→ 2 each	→ pH, conductivity
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: • Quarterly groundwater reports	Grab liquid	→ Semiannual	→ 2 each seep	→ Gross alpha/beta, H-3 (pH, conductivity, and VOCs at SP12)

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 focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Management Program, WVDP-091. Groundwater monitoring is covered in the Groundwater Monitoring Plan, WVDP-239.
SSWMU #11	The state-licensed disposal area (SDA) was operated by NFS as a commercial low-level disposal facility and also received wastes from NFS reprocessing operations.
Well Points	Monitor groundwater of known subsurface contamination in the north plateau area. All well points are downgradient of the main plant.
North Plateau Seeps	Monitor groundwater emanating at the ground surface along the edge of the site's north plateau.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1997 Monitoring Program
Environmental Surveillance:

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 Cattaraugus Creek confluence at Thomas Corners Road	Restricted surface waters receiving plant effluents Reported in: • MTAR • QEMDR • 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 • QEMDR • 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 (background)	Unrestricted surface water background Reported in: • MTAR • QEMDR • 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, Sr-90, C-14, I-129, Pu/U isotopic, total U, 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 • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, Sr-90, and gamma isotopic

Monthly composites at **WFBCTCB, WFBCBKG,** and **WFFELBR** are also sent to NYSDOH.

Sampling Rationale

WFBCTCB DOE/EH-0173T, 5.10.1.1.

Buttermilk Creek is the surface water receiving all WVDP effluents. **WFBCTCB** monitors the potential influence of WVDP drainage into Buttermilk Creek upstream of 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 for 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 for comparison to downstream conditions.

- Sampling locations are shown on Figure A-4 (p. A-48).

1997 Monitoring Program
Environmental Surveillance:

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 near WVDP outside WNYNSC perimeter **WFWEL01** 3.0 km WNW **WFWEL02** 1.5 km NW **WFWEL03** 3.5 km NW **WFWEL04** 3.0 km NW **WFWEL05** 2.5 km SW **WFWEL06** (background) 29 km S **WFWEL07** 4.4 km NNE **WFWEL08** 2.5 km ENE **WFWEL09** 3.0 km SE **WFWEL10** 7.0 km N	Drinking water supply; groundwater near facility* Reported in: • MTAR • QEMDR • 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 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-5 and A-9 (pp. A-49 and A-53).

1997 Monitoring Program
Environmental Surveillance:

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 SSE at Fox Valley **AFTCORD** 3.7 km NNW at Thomas Corners Road **AFRT240*** 2.0 km NE on Route 240 **AFSPRVL** 7 km N at Springville **AFWEVAL** 6 km SSE at West Valley **AFNASHV** 37 km W at Village of Nashville, town of Hanover (background) **AFBOEHN** 2.3 km SW on Dutch Hill Road **AFRSPRD** 1.5 km NW on Rock Springs Road **AFGRVAL** 29 km S at Great Valley (background) **AFBLKST** Bulk Storage Warehouse 2.2 km ESE at Buttermilk Road	Particulate air samples around WNYNSC perimeter Reported in: • MTAR • QEMDR • SER	Continuous air particulate filter	→ Weekly	→ 52 each location Weekly filters composited to 4 each location	→ Gross alpha/beta → Quarterly composite for Sr-90, gamma isotopic Total U, U/Pu isotopic, and Am-241 for **AFRSPRD** and **AFGRVAL** only
		Continuous desiccant column for water vapor collection	→ Weekly	→ 52 each location (**AFRSPRD** and **AFGRVAL** only)	→ H-3
		Continuous charcoal cartridge	→ Monthly	→ 12 composited to 4 each location (**AFRSPRD** and **AFGRVAL** only)	→ Quarterly composite for I-129

* Filter from duplicate sampler sent to NYSDOH.

Sampling Rationale

AFFXVRD DOE/EH-0173T, 5.7.4.
AFTCORD
AFRT240 Air samplers put into service by NFS as part of the site's original monitoring program. Perimeter locations chosen to obtain data from places most likely to provide highest concentrations, 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 to be representative of natural background radiation. Located 37 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 highest elevated release concentrations based on meteorological data. AFBOEHN is located on NYSERDA property at the perimeter.

AFRSPRD DOE/EH-0173T, 5.7.4.

Perimeter location chosen to obtain data from the place most likely to provide highest ground-level release concentrations, based on meteorological data. AFRSPRD is on WVDP property but outside the main plant operations fence line. 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.

AFGRVAL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Off-site (remote) sampler considered to be representative of natural background radiation. Located on privately owned property 29 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 site perimeter.

- Sampling locations are shown on Figures A-6 and A-9 (pp. A-50 and A-53).

1997 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 SW **AFFXFOP** 3.0 km SSE **AFTCFOP** 3.7 km NNW **AF24FOP** 2.0 km NE **ANRGFOP** Rain gauge on-site	Collection of fallout particulates and precipitation around WNYNSC perimeter Reported in: • MTAR • QEMDR • SER	Integrated precipitation	→ Monthly	→ 12 each location	→ Gross alpha/beta, H-3, pH, gamma isotopic
SF Soil Series Surface soil (at each of ten air samplers)	Long-term fallout accumulation Reported in: • MTAR • QEMDR • SER	Surface plug composite soil	→ Annual	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, Pu-239/240, Am-241, plus U-isotopic 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 • QEMDR • SER	Grab stream sediment	→ Annual (Split of **SFSDSED** and **SFBCSED** with **NYSDOH**)	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, U/Pu isotopic, total U, Am-241
SN On-site Soil Series: **SNSW74A** (Near WNSW74A) **SNSWAMP** (Near WNSWAMP) **SNSP006** (Near WNSP006)	Reported in: • MTAR • QEMDR • SER	Surface plug or grab	→ Annual	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, Pu-239/240, Am-241, U-isotopic, total U, 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	Collection of fallout particles and precipitation on-site 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.
SFTCSED	DOE/EH-0173T, 5.12.1. Sediment deposition at Thomas Corners in Buttermilk Creek immediately downstream of all facility liquid effluents.
SFBCSED	DOE/EH-0173T, 5.12.1. Sediment deposition in Buttermilk Creek upstream of facility effluents (background).
SFCCSED	DOE/EH-0173T, 5.12.1. Sediment deposition in Cattaraugus Creek at Felton Bridge. Location is first access point to Cattaraugus Creek downstream of the 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. 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 a Cattaraugus Creek background location.
SN Soil Series	DOE/EH-0173T, 5.9.1. On-site soil. (Samples may be partially composed of sediments.)
SNSW74A	Surface soil near **WNSW74A**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).
SNSWAMP	Surface soil near **WNSWAMP**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).
SNSP006	Surface soil near **WNSP006**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).

■ Sampling locations are shown on Figures A-2, A-4, A-6, and A-9 (pp. A-46, A-48, A-50, and A-53).

1997 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 **BFFCTRL** Control sample from nearby stream not affected by the WVDP (7 km or more upstream of site effluent point; background) **BFFCATD** Fish from Cattaraugus Creek downstream of Springville Dam	Fish in waters up- and downstream of facility effluents Reported in: • MTAR • QEMDR • 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
			Annual (**BFFCATD** only) →	10 fish →	Gamma isotopic and Sr-90 in edible portions of each individual fish
BFMREED Dairy farm, 3.8 km NNW **BFMCOBO** Dairy farm, 1.9 km WNW **BFMCTLS** Control location 25 km S (background) **BFMCTLN** Control location 30 km N (background) **BFMWIDR** Dairy farm, 3.0 km SE of site **BFMSCHT** Dairy farm 4.8 km S	Milk from animals foraging around facility perimeter and at background sites Reported in: • MTAR • QEMDR • SER	Grab biological →	Monthly (**BFMREED, BFMCOBO, BFMCTLS, BFMCTLN.** 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
			Annual (**BFMWIDR, BFMSCHT**) →	1 each location →	Gamma isotopic, Sr-90, H-3, and I-129

Sampling Rationale

BFFCATC **BFFCATD**	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 to provide background data for comparison with data from fish caught downstream of facility effluents.
BFMREED **BFMCOBO** **BFMWIDR** **BFMSCHT**	DOE/EH-0173T, 5.8.2.1. Milk from animals foraging around facility perimeter. 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.
BFMCTLS **BFMCTLN**	Control milk samples collected far from site to provide background data for comparison with data from near-site milk.

- Sampling locations are shown on Figures A-5 and A-9 (pp. A-49 and A-53).

1997 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) **BFHNEAR** Beef cattle/milk cow forage from near-site location	Fruit and vegetables grown near facility perimeter, downwind if possible Reported in: • MTAR • QEMDR • SER	Grab biological (fruits and vegetables)	Annual, at harvest (**BFVNEAR** and **BFVCTRL**)	3 each (split with NYSDOH)	Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture
BFHCTLS or **BFHCTLN** Beef cattle/milk cow forage from control location south or north (background)		Grab biological	Annual (**BFHNEAR**, **BFHCTLS**, or **BFHCTLN**)	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) Reported in: • MTAR • QEMDR • SER	Grab biological	Semiannual	2 each location	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture
BFDNEAR Deer in vicinity of the site **BFDCTRL** Control deer 16 km or more from facility (background)	Meat (deer foraging near facility perimeter) Reported in: • MTAR • QEMDR • SER	Individual collection biological	Annual, during hunting season (**BFDNEAR** sample split with NYSDOH)	3	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture
			During year as available (**BFDCTRL** sample split with NYSDOH)	3	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture

* Corn, apple, and bean samples are identified specifically as follows: corn = BFVNEAC and BFVCTRC; apples = BFVNEAA and BFCTRA; beans = BFVNEAB and BFVCTRB.

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 to humans or indirectly through animals.

BFVCTRL DOE/EH-0173T, 5.8.2.2.

Fruits and vegetables collected from area remote from the site. Background fruits and vegetables collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

BFHNEAR DOE/EH-0173T, 5.8.2.2.

Hay collected from areas 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 site impact.

BFBNEAR DOE/EH-0173T, 5.8.2.3.

Beef collected from animals raised near the site and foraging downwind in areas of maximum probable site impact. Following the rationale for vegetable matter collected near 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 impact.

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 living far from the site. Background deer meat collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

- Sampling locations are shown on Figures A-5 and A-9 (pp. A-49 and A-53).

1997 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** At each of 16 compass sectors at nearest accessible perimeter point **#17** "5 Points" landfill, 19 km SW (background) **#20** 1,500 m NW (downwind receptor) **#21** Springville 7 km N **#22** West Valley 6 km SSE **#23** Great Valley 29 km S (background) **#37** Nashville 37 km NW (background) **#41** Sardinia-Savage Road 24 km NE (background)	Direct radiation around facility Reported in: • QEMDR • SER	Integrating LiF TLD	Quarterly	5 TLDs 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. In addition to general NRC crosschecks at selected sites, a biennial HPIC gamma radiation measurement is completed at all TLD locations.

- Sampling locations are shown on Figures A-7 and A-9 (pp. A-51 and A-53).

1997 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 SDA **#24, #26-32, #34** (9) at security fence around site **#35, #36, #38-40** (5) On-site near operational areas **#25** Rock Springs Road 500 m NNW of plant **#42** SDA T-1 Building **#43** SDA West Perimeter Fence	Direct radiation on facility grounds Reported in: • QEMDR • SER	Integrating LiF TLD	→ Quarterly	→ 5 TLDs at each of 20 sites 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/annum (1 mSv/annum) from site activities. In addition to general NRC crosschecks at selected sites, a biennial HPIC gamma radiation measurement is completed at all locations. Potential TLD sampling locations are continually evaluated with respect to site activities.

- Sampling locations are shown on Figure A-8 (p. A-52).

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-1.DWG

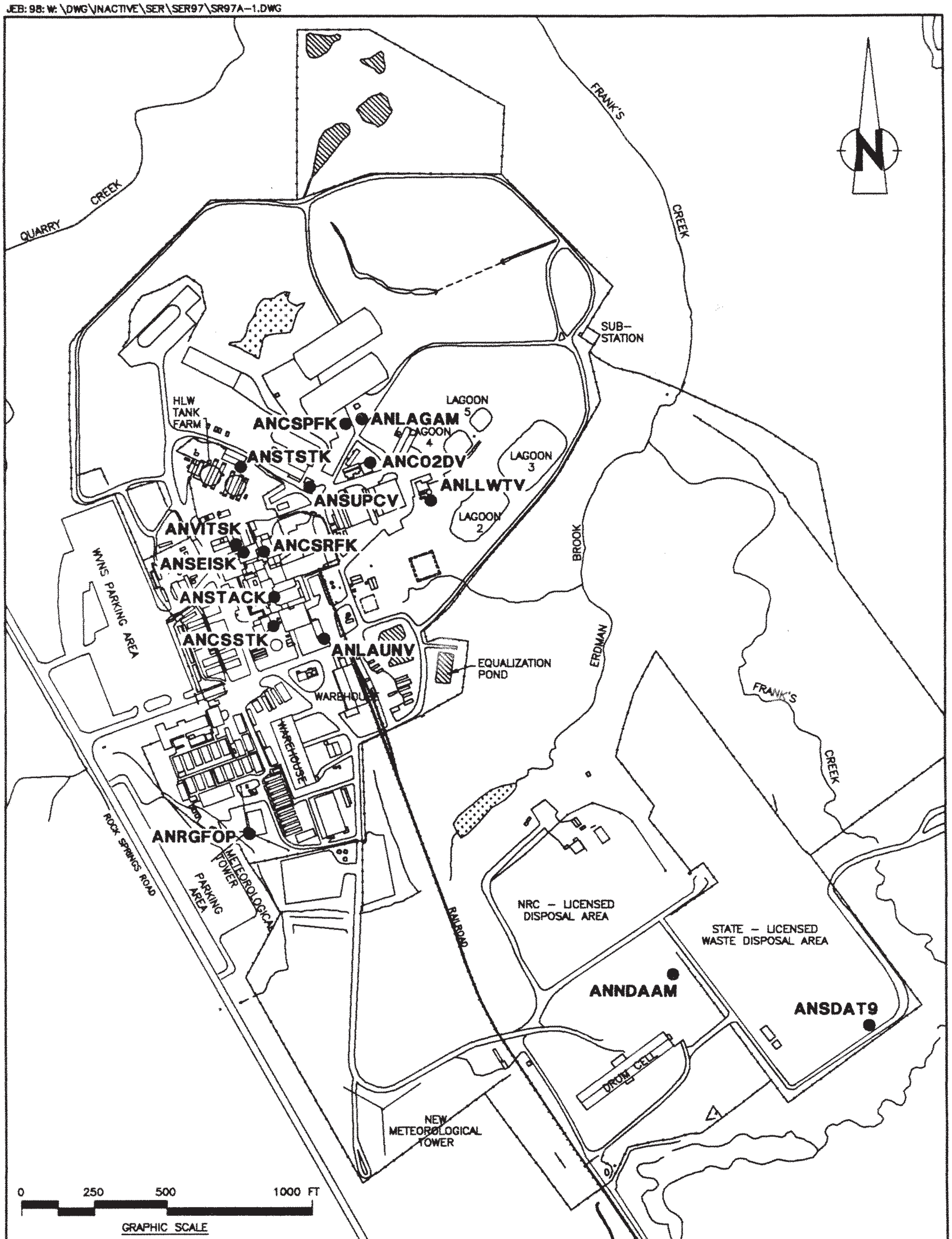


Figure A–1. On–site Air Monitoring and Sampling Points.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-2.DWG

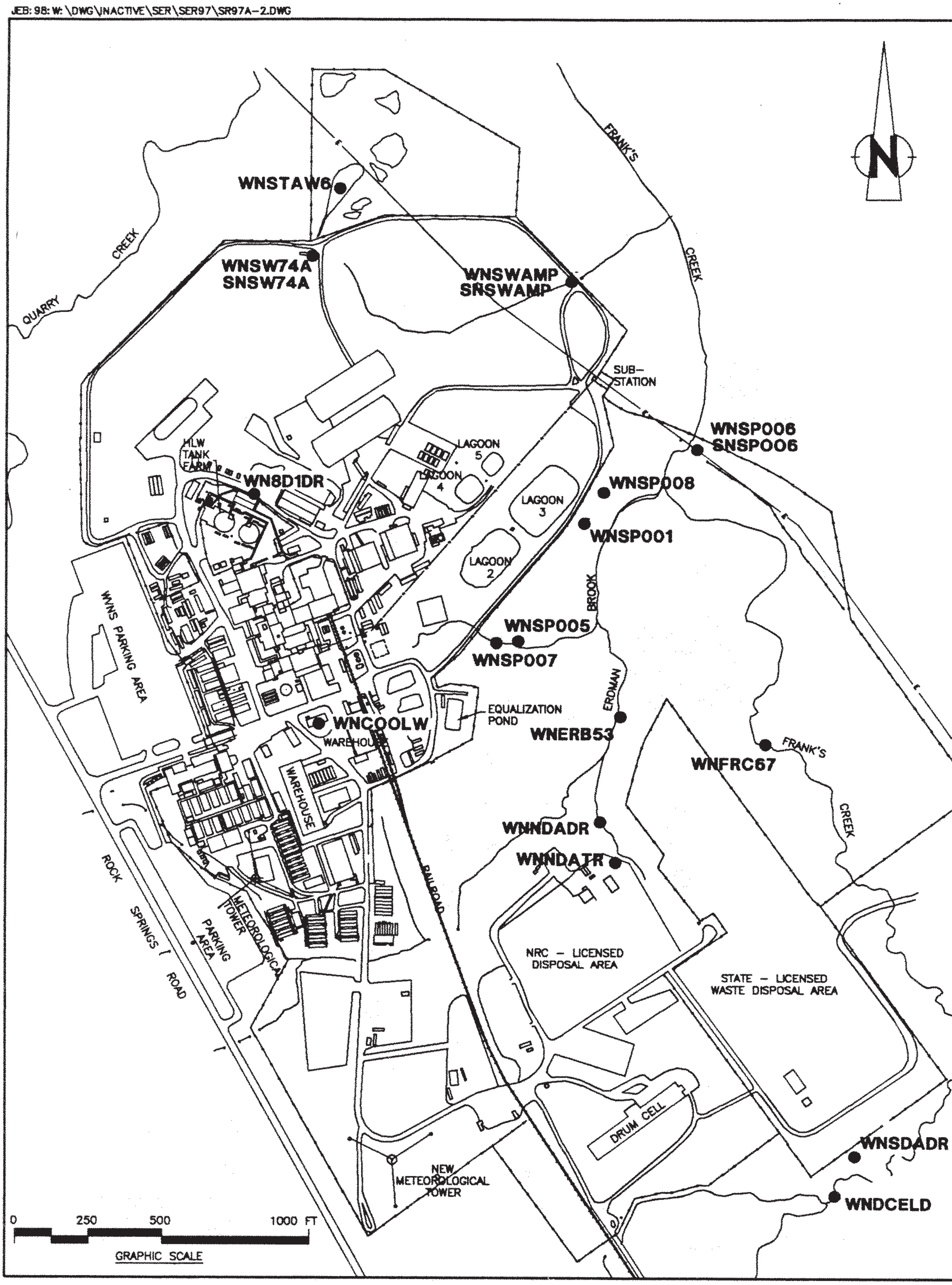


Figure A-2. On-site Surface Water and Soil Sampling Locations.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-3.DWG

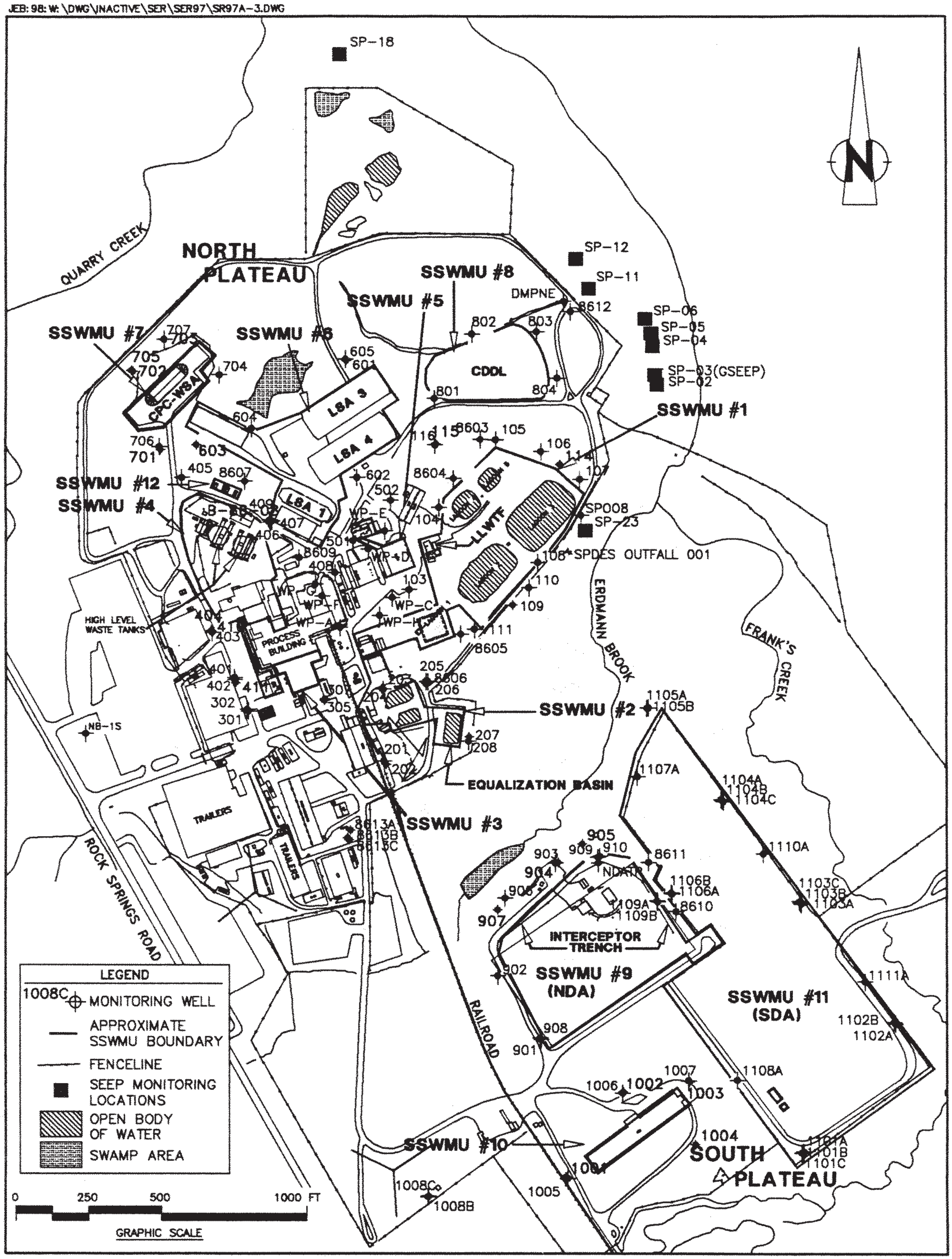


Figure A-3. On-Site Groundwater Monitoring Network (Includes wells not actively monitored following May 1995 but used for water level measurements).

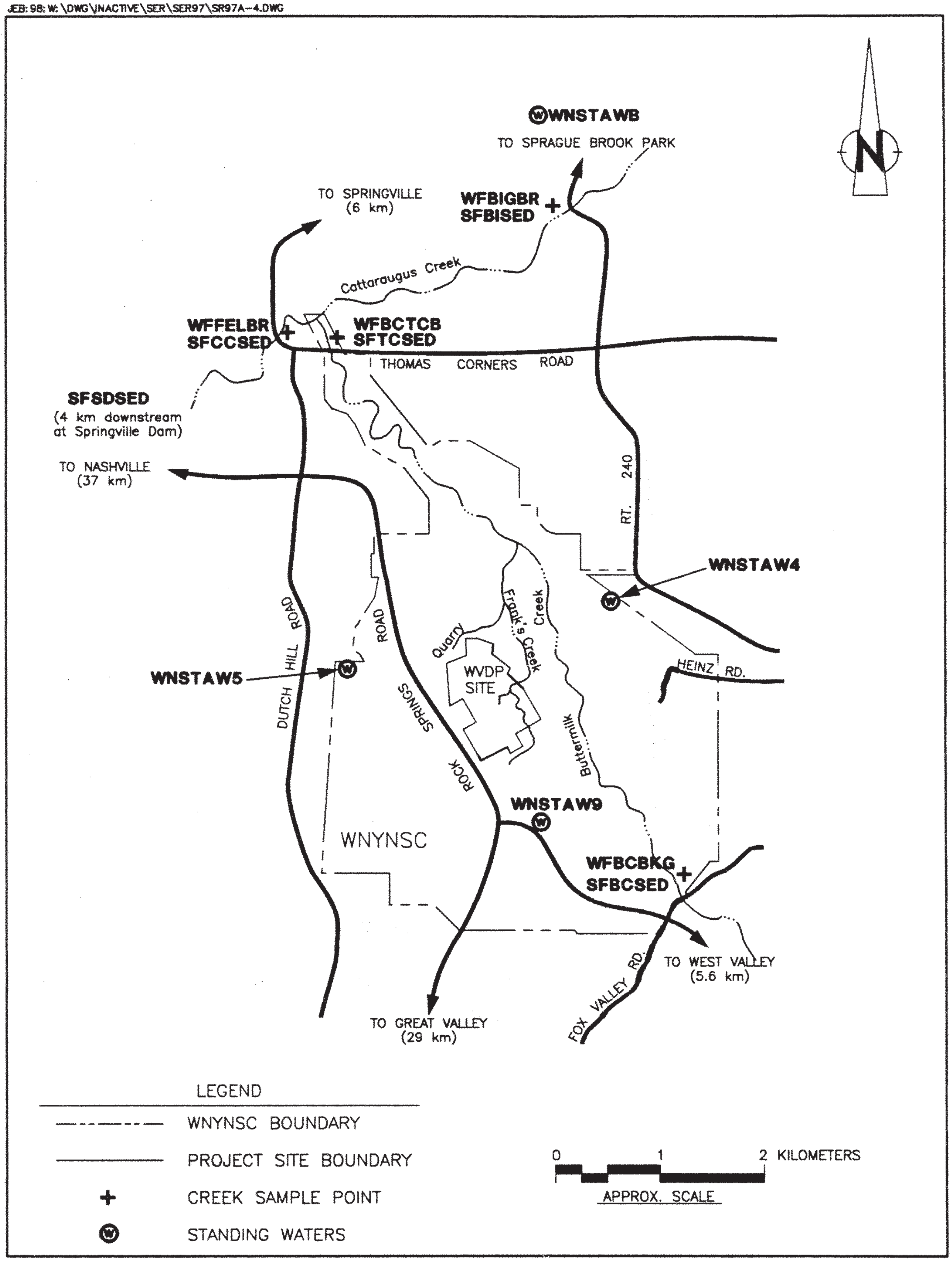


Figure A–4. Off–site Surface Water and Sediment Sampling Locations.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-5.DWG

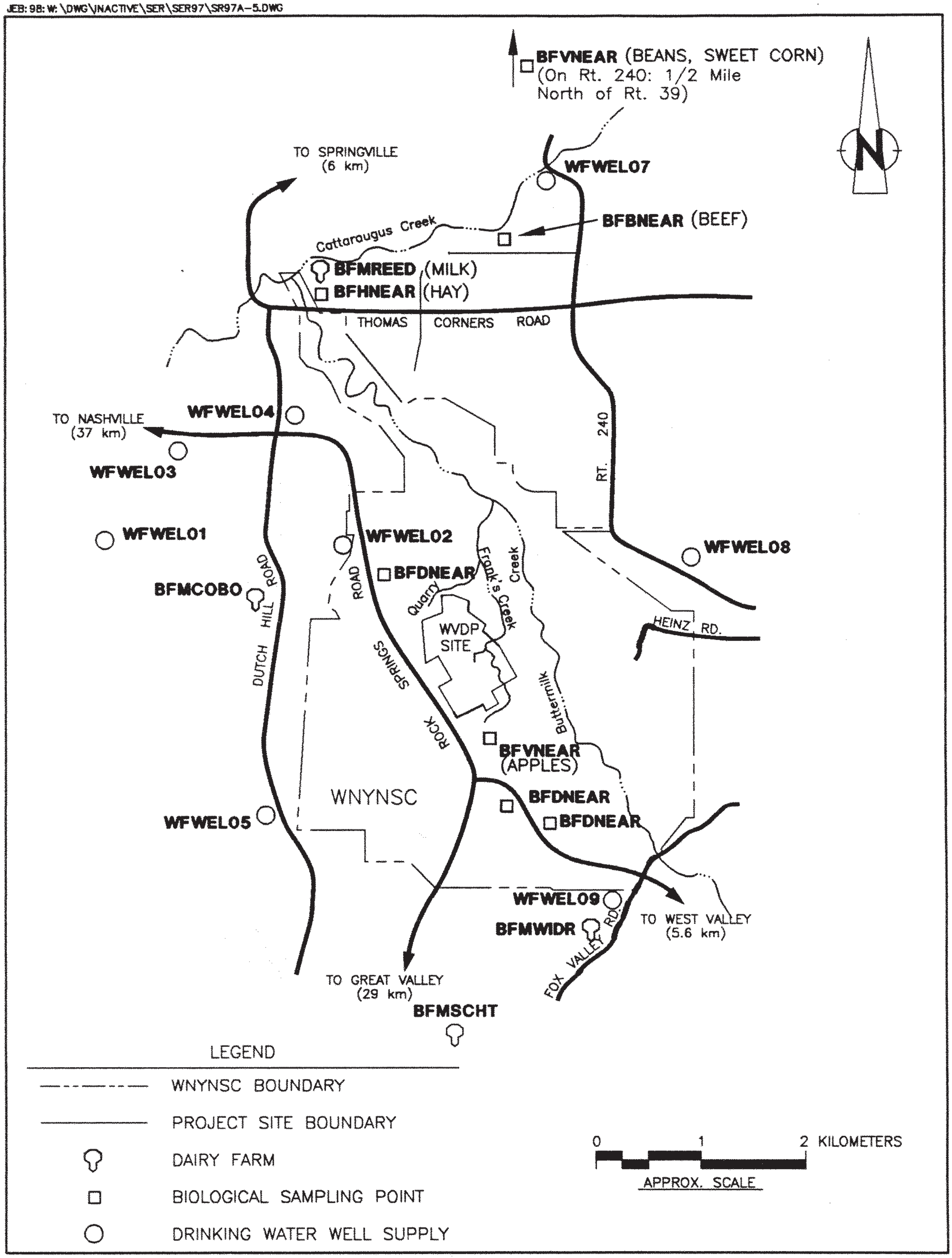


Figure A-5. Near-site Drinking Water and Biological Sample Points.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-6.DWG

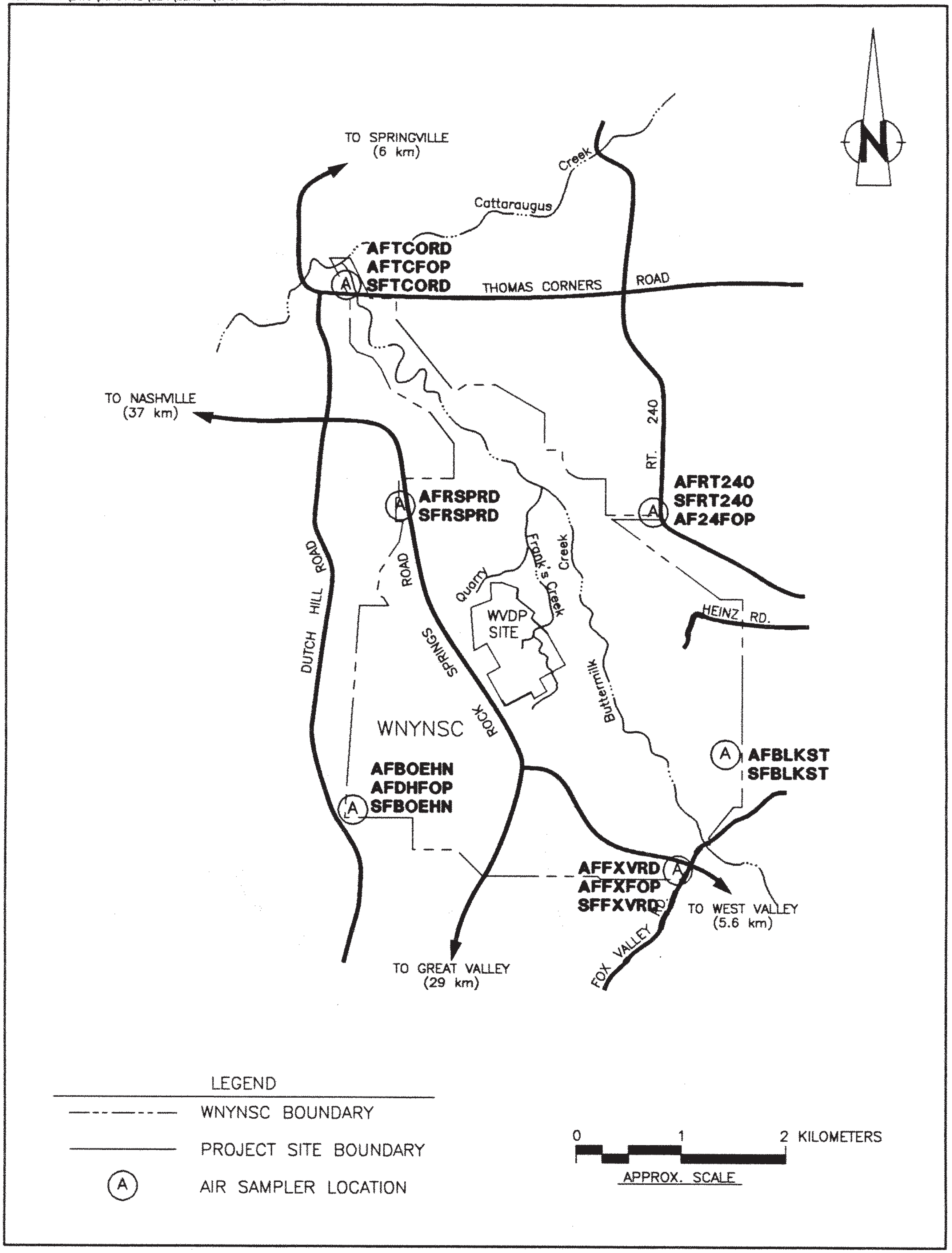


Figure A-6. Perimeter Air, Soil, and Fallout Sampling Point Locations.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-7.DWG

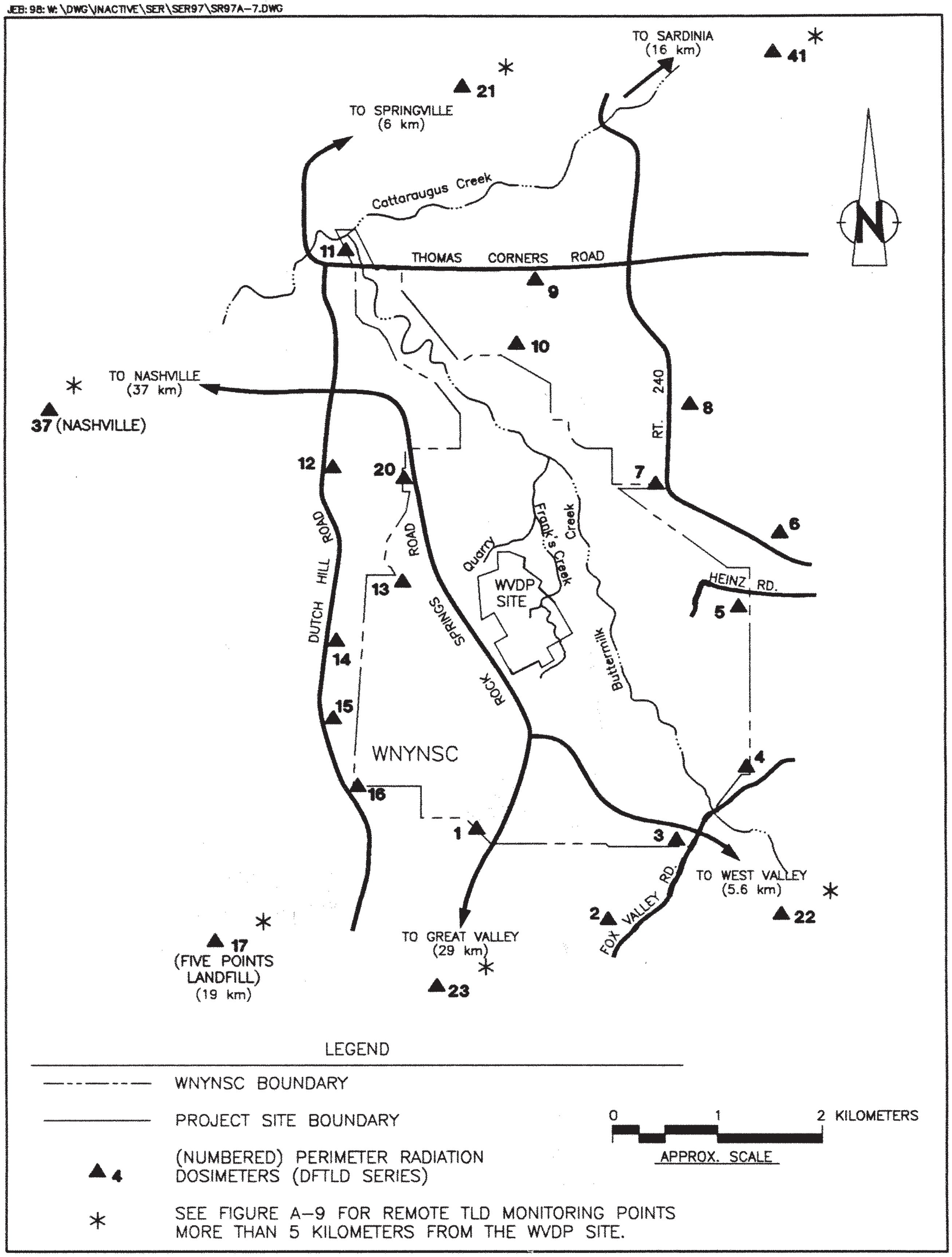


Figure A–7. Off–site Thermoluminescent Dosimeter (TLD) Locations.

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97A-8.DWG

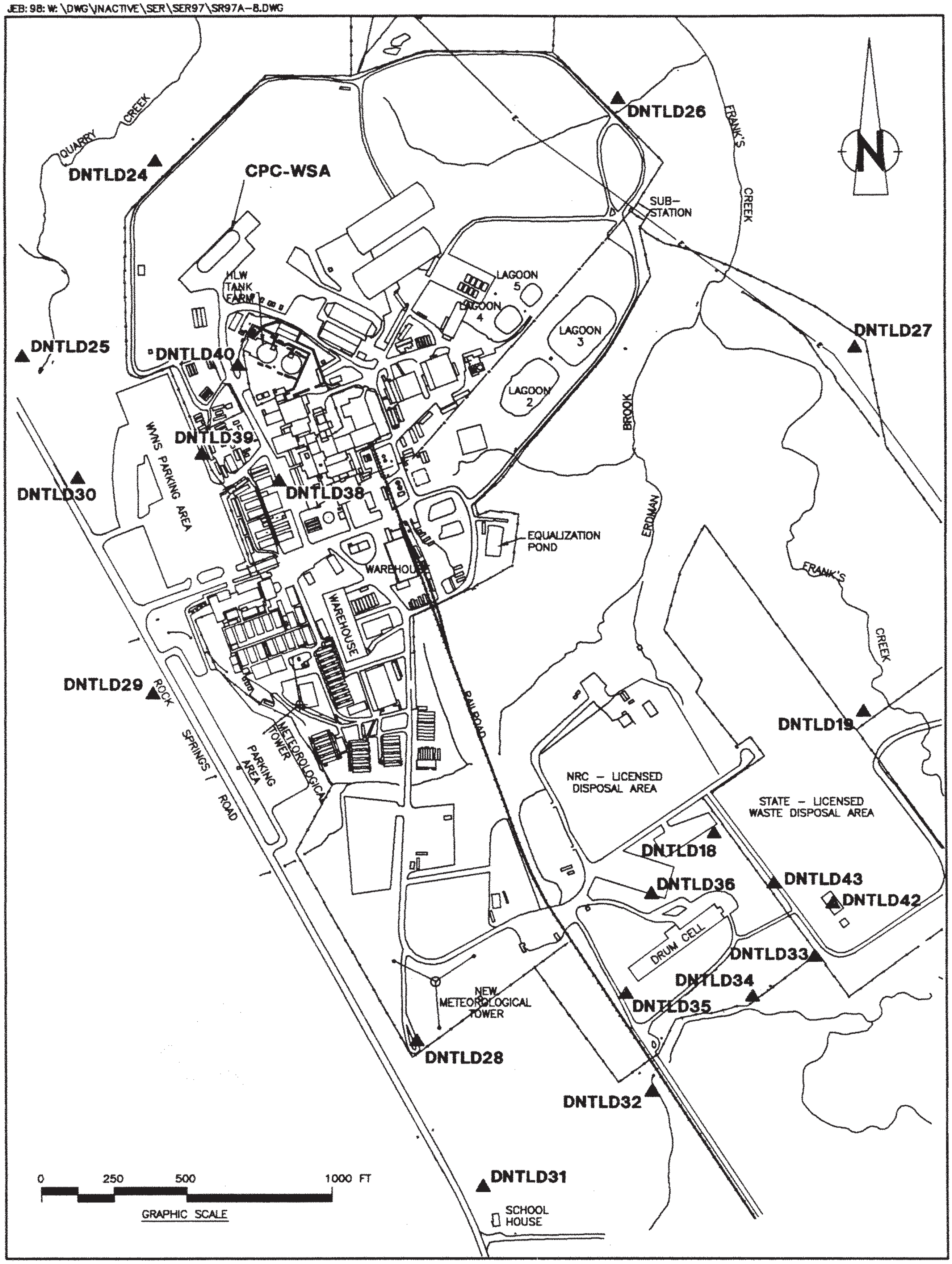
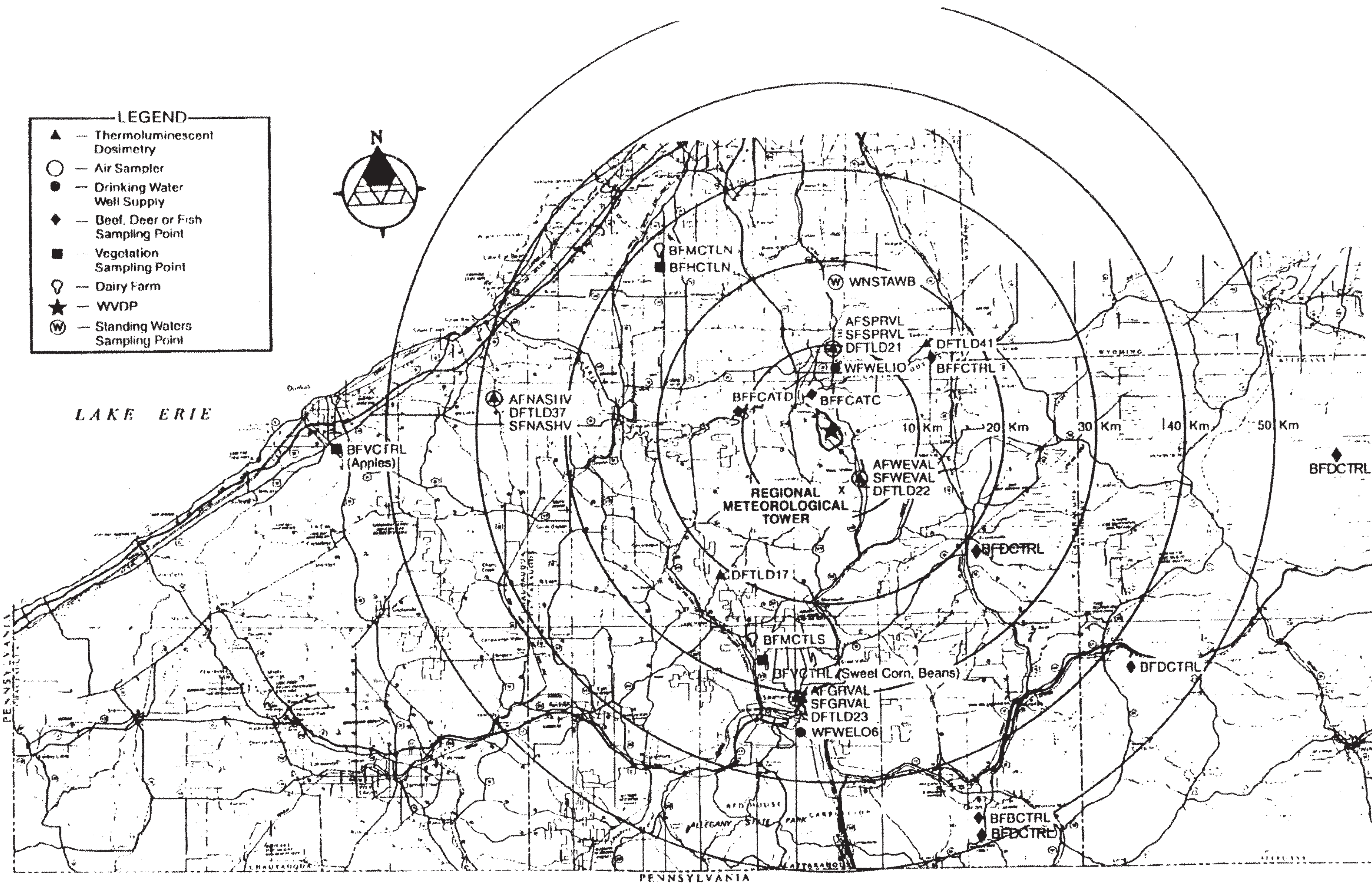


Figure A-8. On-site Thermoluminescent Dosimeters (TLD) Locations.



REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

Figure A-9. Environmental sample points more than 5 kilometers from the WVDP site.

Appendix B

Environmental Regulations, Orders, Standards, and Permits

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Table B-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*
H-3*	1.23E+01	1E-07	2E-03
C-14*	5.73E+03	6E-09	7E-05
K-40	1.28E+09	9E-10	7E-06
Fe-55	2.70E+00	5E-09	2E-04
Co-60*	5.27E+00	8E-11	5E-06
Ni-59	7.50E+04	4E-09	7E-04
Ni-63	1.00E+02	2E-09	3E-04
Sr-90*	2.86E+01	9E-12	1E-06
Y-90	7.31E-03	1E-09	1E-05
Zr-93	1.53E+06	4E-11	9E-05
Nb-93m	1.46E+01	4E-10	3E-04
Tc-99*	2.13E+05	2E-09	1E-04
Ru-106	1.01E+00	3E-11	6E-06
Cd-113m	1.37E+01	8E-12	9E-07
Sn-126	1.00E+05	1E-10	8E-06
Sb-125	2.77E+00	1E-09	5E-05
Te-125m	1.59E-01	2E-09	4E-05
I-129*	1.57E+07	7E-11	5E-07
Cs-134*	2.06E+00	2E-10	2E-06
Cs-135	2.30E+06	3E-09	2E-05
Cs-137*	3.02E+01	4E-10	3E-06
Pm-147	2.62E+00	3E-10	1E-04
Sm-151	9.00E+01	4E-10	4E-04

Radionuclide	*Half-life [2]*	*In Air*	*In Water*
Eu-152	1.36E+01	5E-11	2E-05
Eu-154*	8.80E+00	5E-11	2E-05
Eu-155	4.96E+00	3E-10	1E-04
Th-232	1.40E+10	7E-15	5E-08
U-232*	7.20E+01	2E-14	1E-07
U-233*	1.59E+05	9E-14	5E-07
U-234*	2.44E+05	9E-14	5E-07
U-235*	7.04E+08	1E-13	6E-07
U-236*	2.34E+07	1E-13	5E-07
U-238*	4.47E+09	1E-13	6E-07
Np-239	6.45E-03	5E-09	5E-05
Pu-238*	8.78E+01	3E-14	4E-08
Pu-239*	2.41E+04	2E-14	3E-08
Pu-240*	6.57E+03	2E-14	3E-08
Pu-241	1.44E+01	1E-12	2E-06
Am-241*	4.32E+02	2E-14	3E-08
Am-242m	1.52E+02	2E-14	3E-08
Am-243	7.38E+03	2E-14	3E-08
Cm-243	2.85E+01	3E-14	5E-08
Cm-244	1.81E+01	4E-14	6E-08
Gross Alpha (as Am-241)	*NA*	2E-14	3E-08
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. 1-6, in Chapter 1, Environmental Monitoring 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 B - 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 232.1, September 25, 1995. *Occurrence Reporting and Processing of Operations Information*, including Change 2 (August 12, 1996).

DOE Order 5400.1, November 9, 1988. *General Environmental Protection Program*, including Change 1 (June 29, 1990).

DOE Order 5480.1B, September 23, 1986. *Environment, Safety, and Health Program for DOE Operations*, including Change 5 (May 10, 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).

The standards and guidelines applicable to releases of radionuclides from the West Valley Demonstration Project are found in DOE Order 5400.5 (February 8, 1990), including Change 2 (January 7, 1993).

Water quality standards contained in the State Pollutant Discharge Elimination System (SPDES) permit issued for the facility are listed in Table C-5.1. 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 B-3
West Valley Demonstration Project Environmental Permits

Permit Name and Number	Agency/Permit Type	Description	1997 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.
Boilers (042200-0114-00002 and (042200-0114-00003)	NYSDEC/ Certificate to Operate (CO) an Air Emission Source (2 COs)	Boilers located in the utility room	None	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.
Cement storage silo ventilation system (042200-0114-CSS01)	NYSDEC/CO	Exhaust from the cement storage silo baghouse	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
Analytical & Process Chemistry Laboratory (042200-0114-15F-1)	NYSDEC/CO	Analytical & Process Chemistry Laboratory equipment from various laboratories in the main plant	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
Tank #35157 vent (042200-0114-35157)	NYSDEC/CO	Vent from 3,000-gal sulfuric acid tank #35157	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
Source-capture welding system (042200-0114-MS001)	NYSDEC/CO	Maintenance shop welding ventilation using “elephant trunk” ducts to vent welding fumes at the source of generation	None	CO issued 2/27/91. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201.
Blueprint machine (042200-0114-00012)	NYSDEC/CO	Blueprint machine vent for ammonia emissions	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
Blower exhaust, welding only (042200-0114-00013) Welding/painting (042200-0114-00014) Painting only (04220-0144-00015)	NYSDEC/CO (3 COs)	Portable blowers (some with and some without filters) for venting emissions from typical painting and welding operations occurring at the site	One CO cancelled	Welding CO (-00013) issued 1/31/94. Painting CO (-00015) issued 5/4/93. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201. Welding/painting CO (-00014) cancelled.
Analytical cell mock-up unit (042200-0114-00027)	NYSDEC/CO	Analytical cell mock-up unit (located in the vitrification test facility) emissions from use of laboratory chemicals	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
Scale vitrification system (SVS) solids transfer system (04220-0114-SVS01) SVS vessel vent system (042200-0114-SVS02) SVS mini-melter off-gas system (04220-0114-SVS04) SVS ammonia vent system (04220-0114-SVS07)	NYSDEC/CO (4 COs)	Scale vitrification system vac-u-max solids transfer system vent, feed mix tank vent, melter off-gas treatment system emissions, and ammonia vent system for relieving pressure before cylinder change-outs	None	Solids transfer system CO (-SVS01), vessel vent system CO (-SVS02), and ammonia vent system CO (-SVS07) issued 8/11/94. Mini-melter off-gas system CO (-SVS04) issued 6/26/92. No expiration date. Extended indefinitely in accordance with revised 6 NYCRR § 201.

Table B-3 (continued)
West Valley Demonstration Project Environmental Permits

Permit Name and Number	Agency/Permit Type	Description	1997 Changes	Status
Environmental Analytical Annex laboratory hoods (042200-0114-00016) through 042200-0114-00026)	NYSDEC/CO (11 COs)	Eleven separate blowers for laboratory hoods and analytical equipment in the Environmental Analytical Annex (EAA), i.e., vitrification cold operations laboratory	Exempted	Exempt source in accordance with NYSDEC negotiations and revised 6 NYCRR § 201.
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)	EPA/NESHAP	Slurry-fed ceramic melter radionuclide emissions	Submitted final report on total effective dose equivalent to the EPA 1/7/97	Permit approved February 18, 1997. No expiration date.
Vitrification facility HVAC system	EPA/NESHAP	Vitrification facility HVAC system for radionuclide emissions	None	Permit approved February 18, 1997. No expiration date.
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.
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.

Table B-3 (concluded)
West Valley Demonstration Project Environmental Permits

Permit Name and Number	Agency/ Permit Type	Description	1997 Changes	Status
Supernatant testment systen (WVDP-387-01)	EPA/NESHAP	Supernatant treatment system ventilation for radinuclide emissions	None	Issued 10/5/87. No expiration date.
Low-level waste supercompactor (WVDP-487-01)	EPA/NESHAP	Low-level waste super-compactor ventilation system for radionuclide emissions	None	Issued 10/5/87. 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.
Process building ventilation system (WVDP-687-01)	EPA/NESHAP	Original main plant ventilation for radionu-clide emissions	Modification to include slurry-fed ceramic melter approved 2/18/97.	Issued 12/22/97. No expiration date.
State Pollutant Discharge Elimination System (NY-0000973)	NYSDEC/ Water discharge	Covers discharge to surface waters from various sources on-site	None	Expires 2/1/99. Renewed permit issued 2/1/95. NYSDEC has prepared a draft permit modifica-tion for storm water discharges and for a groundwater recovery system dishcarge increase, which is currently undergoing final preparation by NYSDEC. Awaiting comments and/or draft permit modification.
Buffalo Pollutant Discharge Elimination System (95-05-TR096)	Buffalo Sewer Authority/ Sanitary sewage and sewage sludge disposal	Permit issued to hauler of waste from the wastewater treatment facility	Renewed 5/7/97	Hauler must renew permit by 6/30/98.
Chemical bulk storage (9-000158)	NYSDEC/ Chemical bulk storage tank registration	Registration of bulk storage tanks used for listed hazardous chemicals	None	Permanently closed one nitric acid storage tank. Registration expires 7/5/99. Will renew before expiration.
Petroleum bulk storage (9-008885)	NYSDEC/ Petroleum bulk storage tank registration	Registration of bulk storage tanks used for petroleum	None	Added a 2,000-gallon aboveground gasoline tank and a 1,000-gallon aboveground diesel fuel tank. Expires 9/2/01. Will renew before expiration.
Bird depredation permit	New York State Division of Fish and Wildlife	State license for the removal of inactive nests of migratory birds	The WVDP no longer is required to file for a U.S. Fish and Wildlife permit for these activities.	State license will expire 12/31/98.

Appendix C - 1

Summary of Water and Sediment Monitoring Data

Collecting a Sample at a WVDP Stream Sampling Location

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Table C - 1.1

Total Radioactivity of Liquid Effluents Released from Lagoon 3 (WNSP001) in 1997 (curies)

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Alpha	-0.29±1.12E-04	5.90±9.73E-05	*NA*	1.23±1.49E-04	1.54±2.10E-04
Beta	2.82±0.20E-03	3.05±0.20E-03	*NA*	6.01±0.30E-03	1.19±0.04E-02
H-3	1.94±0.05E-01	1.46±0.04E-01	*NA*	1.14±0.03E-01	4.54±0.07E-01
C-14	1.41±0.49E-04	5.38±8.35E-05	*NA*	2.34±0.63E-04	4.29±1.16E-04
K-40	1.30±7.19E-04	0.26±6.68E-04	*NA*	2.09±8.11E-04	0.37±1.27E-03
Co-60	0.00±5.35E-05	0.00±5.06E-05	*NA*	0.00±7.06E-05	0.00±1.02E-04
Sr-90	5.69±0.40E-04	7.22±0.57E-04	*NA*	1.28±0.06E-03	2.57±0.09E-03
Tc-99	2.30±0.06E-03	2.88±0.11E-03	*NA*	7.32±0.14E-03	1.25±0.02E-02
I-129	3.23±1.19E-05	1.91±1.72E-05	*NA*	3.66±1.28E-05	8.80±2.45E-05
Cs-137	7.47±0.58E-04	4.08±0.46E-04	*NA*	2.00±0.51E-04	1.36±0.09E-03
U-232	4.85±0.55E-05	1.12±0.08E-04	*NA*	4.43±0.35E-04	6.04±0.36E-04
U-233/234	3.73±0.44E-05	7.01±0.54E-05	*NA*	1.35±0.11E-04	2.43±0.13E-04
U-235/236	1.87±1.03E-06	3.17±0.63E-06	*NA*	6.09±1.70E-06	1.11±0.21E-05
U-238	2.02±0.30E-05	4.25±0.39E-05	*NA*	6.65±0.66E-05	1.29±0.08E-04
Total U (g)	3.95±0.09E+01	1.18±0.03E+02	*NA*	1.41±0.04E+02	2.99±0.05E+02
Pu-238	2.33±1.48E-06	1.92±0.68E-06	*NA*	6.61±2.36E-06	1.09±0.29E-05
Pu-239/240	1.21±0.70E-06	1.37±0.48E-06	*NA*	3.64±1.52E-06	6.22±1.74E-06
Am-241	1.09±0.57E-06	5.24±5.40E-07	*NA*	1.54±1.99E-06	3.16±2.14E-06

NA- Not applicable. No lagoon 3 discharges in the 3rd quarter of 1997.

Table C - 1.2

Comparison of 1997 Lagoon 3 (WNSP001) Liquid Effluent Radioactivity Concentrations with Department of Energy Guidelines

Isotope	Discharge Activity[a] (Ci)	Radioactivity (Bequerels)	Concentration (μCi/mL)	DCG (μCi/mL)	% of DCG
Alpha	1.54±2.10E-04	5.69±7.77E+06	3.04±4.15E-09	*NA*[b]	*NA*
Beta	1.19±0.04E-02	4.40±0.15E+08	2.35±0.08E-07	*NA*[b]	*NA*
H-3	4.54±0.07E-01	1.68±0.02E+10	8.97±0.13E-06	2E-03	0.45
C-14	4.29±1.16E-04	1.59±0.43E+07	8.48±2.29E-09	7E-05	0.01
K-40	0.37±1.27E-03	1.35±4.71E+07	0.72±2.52E-08	*NA*[b]	*NA*
Co-60	0.00±1.02E-04	0.00±3.77E+06	0.00±2.02E-09	5E-06	<0.04
Sr-90	2.57±0.09E-03	9.51±0.33E+07	5.08±0.18E-08	1E-06	5.08
Tc-99	1.25±0.02E-02	4.62±0.07E+08	2.47±0.04E-07	1E-04	0.25
I-129	8.80±2.45E-05	3.26±0.91E+06	1.74±0.49E-09	5E-07	0.35
Cs-137	1.36±0.09E-03	5.01±0.33E+07	2.68±0.18E-08	3E-06	0.89
U-232[c]	6.04±0.36E-04	2.23±0.13E+07	1.19±0.07E-08	1E-07	11.9
U-233/234[c]	2.43±0.13E-04	8.99±0.49E+06	4.80±0.26E-09	5E-07	0.96
U-235/236[c]	1.11±0.21E-05	4.12±0.77E+05	2.20±0.41E-10	5E-07[d]	0.04
U-238[c]	1.29±0.08E-04	4.78±0.30E+06	2.55±0.16E-09	6E-07	0.43
Pu-238	1.09±0.29E-05	4.02±1.06E+05	2.48±0.65E-10	4E-08	0.62
Pu-239/240	6.22±1.74E-06	2.30±0.65E+05	1.23±0.35E-10	3E-08	0.41
Am-241	3.16±2.14E-06	1.17±0.79E+05	7.18±4.86E-11	3E-08	0.24
Total % of DCGs					**21.7**

[a] *Total volume released: 4.40E+10 mL.*
[b] *Derived concentration guides (DCGs) are not applicable (NA) to gross alpha, gross beta, or naturally occurring background potassium-40 activity.*
[c] *Total U (g) = 2.99±0.07E+02; average U (μg/mL) = 5.90±0.14E-03*
[d] *DCG for U-236 is used for this comparison*
Half-lives are listed in Table B-1.

Table C-1.3

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Facility Yard Drainage (WNSP005)

Month	Alpha	Beta	H-3	pH (standard units)
January	-0.42±2.66E-09	1.17±0.08E-07	1.31±0.79E-07	7.65
February	3.45±2.01E-09	7.27±0.61E-08	-2.75±7.98E-08	7.78
March	1.45±1.72E-09	1.96±0.08E-07	3.06±8.08E-08	7.70
April	1.94±3.34E-09	2.22±0.11E-07	8.84±8.32E-08	7.80
May	-3.53±2.57E-09	1.59±0.09E-07	5.30±8.16E-08	7.83
June	5.36±3.93E-09	7.31±0.70E-08	1.48±0.79E-07	6.88
July	-0.61±3.39E-09	8.83±0.75E-08	-6.49±7.99E-08	7.05
August	-0.97±3.78E-09	8.57±0.77E-08	-3.02±8.56E-08	7.31
September	2.90±2.95E-09	1.58±0.07E-07	-0.16±7.99E-08	7.06
October	3.45±9.71E-10	3.75±0.40E-08	0.28±8.20E-08	7.34
November	-0.02±2.45E-09	2.00±0.08E-07	-4.78±7.99E-08	7.64
December	1.36±1.03E-09	8.81±0.49E-08	2.29±8.10E-08	7.53

Table C - 1.4

1997 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	6.13±9.08E-10	2.03±0.35E-08	1.12±0.78E-07	6.34±1.69E-09	0.00±1.44E-08
*February**	1.47±0.93E-09	3.80±0.38E-08	1.41±0.11E-06	1.42±0.25E-08	1.05±0.29E-08
*March**	0.30±1.29E-09	3.34±0.39E-08	4.14±0.89E-07	9.72±2.28E-09	0.00±1.55E-08
*April**	1.62±9.10E-10	1.95±0.33E-08	1.02±0.81E-07	7.61±2.66E-09	0.00±2.42E-08
May	0.74±1.23E-09	2.81±0.37E-08	7.77±1.04E-07	1.14±0.38E-08	0.00±1.99E-08
*June**	2.14±1.34E-09	4.80±0.44E-08	9.40±1.03E-07	1.20±0.34E-08	0.00±1.49E-08
July	0.61±1.49E-09	4.02±0.43E-08	-1.26±8.18E-08	1.79±0.35E-08	0.00±2.23E-08
August	1.16±1.79E-09	4.39±0.44E-08	9.14±7.68E-08	1.93±0.30E-08	0.00±1.89E-08
September	0.47±1.37E-09	3.85±0.39E-08	-0.28±8.12E-08	1.76±0.31E-08	0.00±1.38E-08
*October**	1.70±1.09E-09	4.36±0.40E-08	5.22±0.89E-07	1.52±0.27E-08	0.00±1.98E-08
November	2.67±8.66E-10	1.67±0.31E-08	6.33±8.19E-08	1.09±0.30E-08	0.00±1.16E-08
*December**	1.94±0.98E-09	3.68±0.40E-08	3.84±0.88E-07	1.23±0.30E-08	0.00±2.06E-08

Quarter	C-14	Tc-99	I-129	U-232	U-233/234
1st Quarter	1.97±4.44E-09	7.44±1.52E-09	6.56±5.88E-10	2.12±0.92E-10	2.05±0.66E-10
2nd Quarter	-1.24±1.27E-08	1.28±0.13E-08	7.29±8.38E-10	4.41±1.00E-10	3.73±0.82E-10
3rd Quarter	6.37±4.94E-09	0.60±1.90E-09	3.27±7.61E-10	8.14±6.20E-11	2.86±0.63E-10
4th Quarter	0.35±1.32E-08	1.48±0.23E-08	3.77±9.21E-10	5.04±1.08E-10	3.59±0.82E-10

	U-235/236	U-238	Total U (µg/mL)	Pu-238	Pu-239/240
1st Quarter	1.77±2.14E-11	1.66±0.62E-10	9.39±0.21E-04	1.39±4.45E-11	1.97±2.73E-11
2nd Quarter	3.34±2.45E-11	2.22±0.62E-10	7.62±0.36E-04	8.43±6.40E-11	4.80±4.05E-11
3rd Quarter	2.68±1.87E-11	2.06±0.53E-10	8.53±0.41E-04	-0.01±1.64E-10	3.85±7.74E-11
4th Quarter	2.44±2.56E-11	2.21±0.62E-10	6.84±0.15E-04	9.56±6.83E-11	2.65±4.33E-11

	Am-241
1st Quarter	0.86±4.02E-11
2nd Quarter	2.47±2.76E-11
3rd Quarter	1.19±0.46E-10
4th Quarter	4.61±6.26E-11

** Month of discharge from WNSP001. See Table C-1.27 for a summary of water quality data at WNSP006.*

Table C-1.5

1997 Radioactivity Concentrations (µCi/mL) in Surface Water Sewage Treatment Facility (WNSP007)

Month	Alpha	Beta	H-3	Cs-137
January	-0.97±2.70E-09	2.96±0.58E-08	4.78±7.25E-08	
February	1.92±3.00E-09	3.34±0.66E-08	3.14±7.42E-08	
March	-0.60±3.16E-09	4.43±0.67E-08	-2.02±8.00E-08	
1st Qtr				0.00±4.79E-09
April	0.94±3.32E-09	2.41±0.56E-08	5.09±8.27E-08	
May	-1.92±3.69E-09	2.24±0.57E-08	0.20±7.42E-08	
June	-0.41±3.18E-09	1.88±0.52E-08	0.77±7.96E-08	
2nd Qtr				0.00±2.14E-08
July	1.08±3.20E-09	1.68±0.55E-08	-2.76±8.42E-08	
August	0.34±3.84E-09	1.61±0.62E-08	-2.21±8.15E-08	
September	2.31±3.48E-09	2.07±0.56E-08	1.24±8.01E-08	
3rd Qtr				0.00±2.05E-08
October	0.25±2.14E-09	3.28±0.58E-08	-3.06±8.07E-08	
November	1.29±3.12E-09	2.23±0.60E-08	2.50±7.48E-08	
December	2.31±2.67E-09	2.73±0.67E-08	4.22±7.54E-08	
4th Qtr				0.00±4.38E-09

Table C - 1.6

1997 Radioactivity Concentrations (µCi/mL) in Surface Water French Drain (WNSP008)

Month	Alpha	Beta	H-3
January	-0.96±1.65E-09	3.60±0.42E-08	1.51±0.11E-06
February	1.21±1.42E-09	3.55±0.41E-08	2.10±0.12E-06
March	1.18±1.39E-09	2.63±0.36E-08	1.21±0.10E-06
April	0.40±1.69E-09	3.32±0.41E-08	2.16±0.13E-06
May	-1.59±1.46E-09	3.02±0.27E-08	2.20±0.13E-06
June	1.26±1.92E-09	2.86±0.38E-08	2.24±0.12E-06
July	1.11±2.21E-09	2.30±0.37E-08	1.57±0.11E-06
August	1.68±2.26E-09	2.81±0.40E-08	2.63±0.13E-06
September	1.12±1.29E-09	2.36±0.27E-08	2.56±0.13E-06
October	2.80±2.16E-09	2.29±0.36E-08	1.88±0.12E-06
November	0.70±1.68E-09	1.92±0.35E-08	2.18±0.13E-06
December	1.41±1.67E-09	2.70±0.47E-08	1.52±0.11E-06

Table C - 1.7
1997 Radioactivity Concentrations (µCi/mL) in Surface Water at the Northeast Swamp (WNSWAMP)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	0.78±1.12E-09	1.49±0.02E-06	1.90±0.78E-07	6.82±0.20E-07	0.00±4.61E-09
February	0.46±1.15E-09	2.08±0.02E-06	2.01±0.81E-07	9.75±0.27E-07	0.00±6.88E-09
March	0.11±1.17E-09	1.53±0.02E-06	1.62±0.81E-07	7.34±0.23E-07	0.00±6.75E-09
April	0.64±1.40E-09	1.93±0.02E-06	1.43±0.83E-07	9.53±0.19E-07	0.00±4.51E-09
May	-0.17±1.38E-09	1.98±0.02E-06	1.78±0.81E-07	9.36±0.23E-07	0.00±4.61E-09
June	0.78±1.47E-09	2.18±0.03E-06	1.73±0.82E-07	1.03±0.03E-06	0.00±6.67E-09
July	0.64±1.72E-09	3.22±0.03E-06	2.18±0.83E-07	1.60±0.02E-06	0.00±7.03E-09
August	2.35±1.76E-09	3.16±0.03E-06	1.79±0.83E-07	1.55±0.02E-06	0.00±4.24E-09
September	0.25±1.43E-09	2.63±0.03E-06	1.57±0.82E-07	1.33±0.02E-06	0.00±4.54E-09
October	0.73±1.27E-09	2.27±0.03E-06	1.59±0.81E-07	1.08±0.03E-06	0.00±6.80E-09
November	1.08±1.23E-09	2.02±0.02E-06	2.23±0.82E-07	9.61±0.15E-07	0.00±2.12E-08
December	0.88±1.10E-09	2.02±0.02E-06	7.15±8.28E-08	9.76±0.22E-07	0.00±6.53E-09

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	-0.89±1.20E-08	0.00±1.08E-09	-1.98±6.09E-11	1.56±0.60E-10	0.64±1.76E-11
2nd Quarter	-1.10±5.58E-09	-0.07±1.23E-09	-0.62±8.69E-11	1.11±0.64E-10	1.97±3.47E-11
3rd Quarter	-0.16±6.71E-09	3.91±5.03E-10	0.70±3.72E-11	1.89±0.54E-10	0.63±1.27E-11
4th Quarter	0.27±5.48E-08	0.81±1.17E-09	1.41±0.80E-10	2.13±0.98E-10	1.00±4.08E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	7.72±4.02E-11	6.96±0.10E-04	4.30±4.98E-11	1.66±2.45E-11	3.64±5.45E-11
2nd Quarter	1.15±0.63E-10	3.94±0.30E-04	6.16±4.20E-11	-0.82±2.52E-11	1.67±2.68E-11
3rd Quarter	1.17±0.42E-10	3.40±0.26E-04	1.07±0.64E-10	0.31±1.41E-11	6.05±4.00E-11
4th Quarter	1.02±0.67E-10	3.64±0.12E-04	6.36±1.69E-10	1.73±3.36E-11	9.28±8.33E-11

See Table C-1.27 for a summary of water quality data at WNSWAMP.

Table C - 1.8
1997 Radioactivity Concentrations (µCi/mL) in Surface Water North Swamp (WNSW74A)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	-0.32±1.13E-09	1.19±0.24E-08	4.78±7.31E-08	4.10±1.50E-09	0.00±1.48E-08
February	0.80±1.71E-09	1.26±0.27E-08	1.49±7.80E-08	6.79±1.94E-09	0.00±1.66E-08
March	-0.09±1.42E-09	1.39±0.25E-08	-0.56±7.98E-08	4.36±1.71E-09	0.00±1.60E-08
April	0.39±1.19E-09	1.17±0.25E-08	4.23±7.97E-08	3.25±1.52E-09	0.00±1.19E-08
May	-0.64±1.26E-09	9.04±2.33E-09	2.19±7.60E-08	4.57±3.29E-09	0.00±1.46E-08
June	0.54±1.32E-09	9.94±2.32E-09	9.02±7.96E-08	5.60±2.38E-09	0.00±1.47E-08
July	0.54±1.13E-09	6.98±2.14E-09	-5.86±7.45E-08	2.59±2.46E-09	0.00±1.15E-08
August	0.71±1.21E-09	8.24±2.31E-09	-2.67±7.85E-08	3.48±1.96E-09	0.00±1.38E-08
September	0.59±1.13E-09	8.69±2.30E-09	-8.62±6.85E-08	5.91±2.23E-09	0.00±1.84E-08
October	8.28±9.94E-10	9.95±2.29E-09	-3.51±8.08E-08	6.20±3.04E-09	0.00±1.00E-08
November	0.28±9.84E-10	8.29±2.31E-09	-0.77±7.53E-08	5.95±2.59E-09	0.00±1.77E-08
December	1.90±1.45E-09	6.81±2.65E-09	1.06±8.06E-08	3.61±2.30E-09	0.00±1.08E-08

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	-1.83±4.33E-09	1.90±5.72E-10	3.89±7.53E-11	1.21±0.58E-10	-0.82±2.12E-11
2nd Quarter	-0.83±1.27E-08	2.19±8.02E-10	0.06±4.47E-11	7.33±3.68E-11	0.81±1.15E-11
3rd Quarter	0.67±4.73E-09	1.69±2.43E-10	1.13±2.56E-11	6.38±3.01E-11	0.00±9.85E-12
4th Quarter	-0.19±1.30E-08	0.14±1.17E-09	2.52±3.46E-11	1.24±0.50E-10	1.40±0.48E-10

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	4.09±4.08E-11	2.32±0.03E-03	-0.15±2.96E-11	1.01±1.54E-11	-2.08±4.73E-11
2nd Quarter	5.73±3.46E-11	4.86±0.24E-04	-4.37±3.94E-11	-2.81±2.32E-11	1.35±4.37E-11
3rd Quarter	4.67±2.39E-11	1.64±0.10E-04	1.49±3.44E-11	2.23±1.94E-11	1.66±3.46E-11
4th Quarter	9.02±3.93E-11	1.77±0.05E-04	1.45±0.64E-10	1.15±3.83E-11	5.04±4.63E-11

See Table C-1.27 for a summary of water quality parameters at WNSW74A.

Table C - 1.9
1997 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	-3.20±6.45E-10	-0.39±1.87E-09	-9.94±7.99E-08	7.86
February	5.60±5.52E-10	2.78±1.86E-09	-5.57±5.63E-08	7.64
March	-1.72±6.67E-10	3.99±1.86E-09	-2.57±8.03E-08	8.17
April	2.99±5.99E-10	2.07±1.88E-09	-1.04±0.80E-07	7.90
May	-1.91±7.71E-10	1.45±1.76E-09	0.33±8.14E-08	7.70
June	0.45±7.59E-10	2.66±1.87E-09	8.94±7.84E-08	6.78
July	4.23±7.32E-10	1.27±2.00E-09	-1.16±0.81E-07	6.47
August	0.05±1.06E-09	4.13±2.74E-09	5.16±7.96E-08	7.46
September	0.04±1.07E-09	2.78±2.39E-09	-2.48±8.01E-08	6.78
October	-1.72±7.86E-10	1.48±2.40E-09	7.63±8.20E-08	7.32
November	1.88±7.36E-10	1.47±2.51E-09	-0.28±8.00E-08	7.18
December	6.80±8.05E-10	2.38±2.72E-09	1.79±8.08E-08	7.96

Table C - 1.10
1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Erdman Brook (WNERB53)

Month	Alpha	Beta	H-3	pH (standard units)
January	1.46±1.86E-09	1.40±0.33E-08	1.12±0.78E-07	7.47
February	3.58±8.58E-10	1.23±0.28E-08	5.12±7.92E-08	7.29
March	-0.22±1.01E-09	1.46±0.28E-08	3.86±8.01E-08	8.20
April	0.09±1.01E-09	1.21±0.29E-08	7.89±8.05E-08	7.41
May	-0.59±1.14E-09	1.20±0.30E-08	6.86±8.03E-08	7.68
June	0.42±1.23E-09	1.56±0.31E-08	1.07±0.80E-07	7.06
July	0.56±1.61E-09	1.46±0.33E-08	-1.94±8.03E-08	7.09
August	1.02±1.48E-09	1.42±0.30E-08	3.06±7.97E-08	7.50
September	0.55±1.38E-09	1.63±0.33E-08	-1.55±8.05E-08	7.35
October	0.78±1.05E-09	1.50±0.31E-08	3.50±7.71E-08	7.04
November	0.09±1.14E-09	1.66±0.33E-08	3.20±8.15E-08	7.69
December	1.09±0.93E-09	1.62±0.31E-08	1.24±0.81E-07	7.82

Table C - 1.11

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Cooling Tower Basin (WNCOOLW)

Month	Alpha	Beta	H-3	Cs-137	pH (standard units)
January	-1.20±1.56E-09	1.91±0.36E-08	4.75±8.09E-08		8.44
February	2.57±1.62E-09	2.18±0.35E-08	0.00±7.82E-08		8.72
March	0.55±1.33E-09	1.64±0.43E-08	1.12±7.89E-08		8.58
1st Qtr				0.00±1.44E-08	
April	0.74±1.27E-09	1.44±0.32E-08	6.38±7.84E-08		8.42
May	-1.80±1.92E-09	1.85±0.34E-08	-9.60±5.66E-08		8.39
June	0.35±1.44E-09	1.63±0.32E-08	6.81±7.78E-08		7.21
2nd Qtr				0.00±1.98E-08	
July	2.00±2.29E-09	1.76±0.37E-08	-5.03±5.64E-08		8.44
August	0.59±1.69E-09	2.23±0.27E-08	4.46±7.89E-08		7.86
September	1.17±2.72E-09	1.82±0.38E-08	-0.22±7.95E-08		8.58
3rd Qtr				0.00±1.73E-08	
October	-0.32±2.41E-09	2.70±0.39E-08	4.11±8.20E-08		8.16
November	1.10±1.90E-09	2.38±0.38E-08	6.16±8.08E-08		8.92
December	5.60±8.06E-10	1.16±0.32E-08	2.98±8.14E-08		8.22
4th Qtr				0.00±1.60E-08	

Table C - 1.12

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water SDA Drainage (WNSDADR)

Month	Alpha	Beta	H-3	Cs-137	pH (standard units)
January	3.20±2.32E-10	2.25±0.88E-09	9.26±7.79E-08	0.00±1.55E-08	6.80
February	5.04±2.63E-10	3.50±0.92E-09	9.72±8.18E-08	0.00±1.21E-08	6.53
March	-0.63±2.43E-10	1.81±0.75E-09	2.69±0.81E-07	0.00±1.50E-08	8.99
April	-2.23±5.20E-10	0.91±1.28E-09	3.71±0.85E-07	0.00±9.93E-09	6.31
May	-0.44±4.24E-10	0.56±1.22E-09	6.01±8.16E-08	0.00±1.48E-08	6.59
June	9.48±6.36E-10	3.53±1.31E-09	1.32±0.82E-07	0.00±1.69E-08	6.21
July	5.46±2.72E-10	4.63±0.94E-09	0.57±8.06E-08	0.00±1.64E-08	5.88
August	7.24±3.18E-10	2.61±0.82E-09	2.32±0.57E-07	0.00±2.26E-08	7.90
September	4.86±2.66E-10	7.02±1.06E-09	2.74±0.83E-07	0.00±1.23E-08	6.03
October	1.23±0.32E-09	8.72±1.08E-09	1.68±0.82E-07	0.00±1.34E-08	6.86
November	2.56±2.28E-10	2.50±0.81E-09	2.39±0.83E-07	0.00±1.81E-08	7.37
December	3.74±2.15E-10	9.59±1.19E-09	-5.29±8.00E-08	0.00±1.39E-08	6.65

Table C - 1.13

1997 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	2.88±3.97E-09	1.86±0.53E-08	4.86±7.36E-08	6.57±1.92E-09	0.00±1.54E-08	7.57
February	7.19±5.30E-09	2.56±0.65E-08	0.31±8.23E-08	8.07±2.14E-09	0.00±2.03E-08	7.29
March	0.32±2.90E-09	1.09±0.52E-08	-5.14±7.59E-08	4.75±1.88E-09	0.00±2.09E-08	7.98
April	1.20±3.76E-09	5.03±0.55E-08	5.87±0.82E-07	2.30±0.37E-08	0.00±1.93E-08	7.54
May	-2.81±4.14E-09	1.47±0.58E-08	-0.52±8.02E-08	1.72±3.04E-09	0.00±1.72E-08	7.29
June	0.99±2.66E-09	9.38±4.86E-09	3.13±7.91E-08	6.55±3.01E-09	0.00±1.73E-08	7.08
July	0.11±2.53E-09	8.77±5.09E-09	-9.37±7.90E-08	6.06±2.11E-09	0.00±1.79E-08	7.23
August	0.37±2.61E-09	1.11±0.55E-08	-2.17±7.42E-08	4.00±1.82E-09	0.00±1.72E-08	7.29
September	1.12±3.42E-09	1.08±0.60E-08	-5.47±7.96E-08	4.52±2.50E-09	0.00±1.95E-08	7.14
October	0.53±2.56E-09	1.62±0.49E-08	7.24±8.11E-08	3.41±2.77E-09	0.00±1.56E-08	6.75
November	1.66±2.78E-09	1.42±0.55E-08	-0.93±8.10E-08	8.29±2.76E-09	0.00±1.88E-08	7.73
December	3.85±3.53E-09	1.28±0.57E-08	-2.58±8.14E-08	2.30±2.21E-09	0.00±1.91E-08	7.39

Table C - 1.14

1997 Radioactivity Concentrations (µCi/mL) in Surface Water Drum Cell Drainage (WNDCELD)

Month	Alpha	Beta	H-3	Sr-90	I-129	Cs-137
January	6.86±3.28E-10	1.23±0.84E-09				
February	2.83±4.32E-10	0.15±1.25E-09				
March	3.45±5.22E-10	2.64±1.31E-09				
1st Qtr			-5.53±8.01E-08	0.76±1.33E-09	-2.04±8.55E-10	0.00±1.22E-08
April	-2.05±4.78E-10	0.56±1.25E-09				
May	1.31±0.79E-09	0.76±1.26E-09				
June	0.92±6.05E-10	4.66±1.39E-09				
2nd Qtr			0.28±8.11E-08	0.59±1.22E-09	7.05±8.87E-10	0.00±2.60E-08
July	-0.24±7.20E-10	2.41±1.37E-09				
August	1.28±0.91E-09	3.19±1.34E-09				
September	7.62±5.92E-10	2.31±1.30E-09				
3rd Qtr			-8.95±7.67E-08	0.97±1.03E-09	2.91±7.52E-10	0.00±1.59E-08
October	4.35±4.40E-10	1.49±1.29E-09				
November	5.96±4.27E-10	2.92±1.29E-09				
December	5.12±4.32E-10	4.04±1.52E-09				
4th Qtr			3.41±8.15E-08	3.09±1.34E-09	0.37±1.00E-09	0.00±1.38E-08

Table C - 1.15

1997 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°C)
January	-1.85±2.64E-10	1.67±0.61E-09	-1.22±0.78E-07	7.86	187
February	5.31±3.65E-10	1.61±0.80E-09	-1.01±0.75E-07	8.35	203
March	0.82±2.62E-10	1.43±0.75E-09	-8.30±7.83E-08	8.36	166
April	1.28±3.10E-10	5.71±7.53E-10	-6.54±8.05E-08	8.27	159
May	-3.05±4.38E-10	1.11±0.76E-09	3.02±8.11E-08	8.65	188
June	-0.29±2.48E-10	1.42±0.55E-09	-0.65±7.52E-08	6.97	186
July	1.34±5.13E-10	1.82±0.86E-09	-2.99±7.96E-08	7.35	211
August	3.71±4.99E-10	1.97±0.89E-09	-2.34±7.71E-08	7.41	232
September	1.20±7.46E-10	2.04±0.94E-09	1.14±7.89E-08	8.20	242
October	2.18±2.84E-10	1.76±0.58E-09	0.38±5.65E-08	8.04	205
November	1.08±4.21E-10	0.23±7.68E-10	2.69±0.81E-07	7.82	210
December	4.25±3.28E-10	1.96±0.76E-09	-6.42±7.90E-08	7.78	182

Table C - 1.16

1997 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Maintenance Shop Potable Water (WNDNKMS)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-0.29±3.80E-10	2.98±7.94E-10	-1.20±0.78E-07	7.14	189
February	2.11±3.08E-10	1.38±0.78E-09	-1.26±0.76E-07	8.29	195
March	1.68±2.84E-10	1.32±0.75E-09	-1.38±5.51E-08	8.45	160
April	1.50±3.01E-10	0.23±7.18E-10	-7.02±5.70E-08	8.19	184
May	-5.30±4.13E-10	7.63±7.37E-10	-9.65±7.91E-08	8.61	196
June	-1.05±3.08E-10	9.20±7.51E-10	7.53±5.50E-08	7.10	170
July	-0.38±3.73E-10	2.41±0.94E-09	-2.09±7.98E-08	7.78	195
August	5.27±5.07E-10	1.73±0.87E-09	-3.74±7.77E-08	7.29	225
September	2.31±4.62E-10	1.78±0.87E-09	1.78±7.90E-08	7.21	250
October	-0.50±3.82E-10	1.24±0.79E-09	-0.22±8.00E-08	8.28	210
November	2.49±4.31E-10	1.65±0.86E-09	-9.44±7.93E-08	7.74	213
December	1.97±2.91E-10	5.18±0.71E-09	-8.03±7.99E-08	7.80	170

Table C - 1.17

1997 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Main Plant Potable Water (WNDNKMP)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-2.12±3.63E-10	1.84±7.90E-10	-5.70±7.91E-08	7.70	191
February	1.84±2.19E-10	1.31±0.55E-09	-1.22±0.76E-07	8.20	198
March	2.23±2.92E-10	1.27±0.75E-09	-1.07±0.78E-07	8.32	163
April	0.98±3.01E-10	4.11±7.43E-10	1.35±8.10E-08	8.18	162
May	-3.94±4.21E-10	1.43±0.77E-09	-3.72±7.98E-08	8.58	199
June	2.85±3.86E-10	1.11±0.77E-09	6.13±7.69E-08	6.95	183
July	2.33±4.65E-10	1.47±0.91E-09	1.92±8.05E-08	7.57	215
August	2.92±5.01E-10	1.48±0.86E-09	-2.70±5.45E-08	7.69	252
September	3.17±4.82E-10	7.53±8.12E-10	-2.86±5.56E-08	8.37	240
October	2.36±4.10E-10	1.33±0.80E-09	-3.22±7.93E-08	7.52	197
November	3.85±4.08E-10	1.45±0.84E-09	1.44±8.02E-08	7.84	211
December	0.30±2.61E-10	7.31±0.78E-09	8.14±8.09E-08	7.43	169

Table C - 1.18

1997 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°C)
January	-1.22±3.77E-10	-0.23±7.78E-10	-1.64±5.50E-08	7.44	193
February	3.63±3.32E-10	1.01±0.76E-09	-7.96±7.60E-08	8.48	216
March	0.30±2.60E-10	1.16±0.74E-09	-1.29±0.78E-07	8.72	162
April	1.78±3.05E-10	6.60±7.56E-10	-0.81±8.04E-08	8.73	160
May	-2.41±4.44E-10	1.52±0.78E-09	-6.18±7.94E-08	7.61	190
June	0.21±3.43E-10	1.38±0.78E-09	6.92±7.73E-08	6.82	179
July	2.01±4.78E-10	1.38±0.90E-09	-2.55±8.00E-08	8.33	211
August	3.39±5.11E-10	1.25±0.84E-09	-6.80±7.64E-08	7.23	247
September	4.27±5.29E-10	1.06±0.83E-09	-1.46±7.88E-08	7.12	238
October	8.01±4.59E-10	1.46±0.80E-09	4.56±8.04E-08	7.22	199
November	-1.69±3.36E-10	1.41±0.84E-09	-8.19±7.87E-08	7.76	211
December	1.72±2.91E-10	5.80±0.73E-09	8.14±8.10E-08	7.60	173

Date	Nitrate-N (mg/L)	Arsenic Total (µg/L)	Cadmium Total (µg/L)	Chromium Total (µg/L)	Mercury Total (µg/L)
12/10	0.56	<25.0	<2.0	<10.0	<0.40

	Selenium Total (µg/L)	Barium Total (µg/L)	Fluoride (mg/L)
12/10	<2.0	<200	<0.2

Table C - 1.19

1997 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters Storage and Disposal Area Drainage (WNNDADR)

Month	**Alpha**	**Beta**	**H-3**	**Sr-90****	**I-129****	**Cs-137**
January	2.11±1.18E-09	1.45±0.06E-07	1.16±0.10E-06			0.00±1.53E-08
February	1.16±1.33E-09	1.47±0.06E-07	1.65±0.11E-06			1.78±1.48E-08
March	1.23±0.77E-09	1.18±0.04E-07	8.41±0.92E-07			0.00±1.65E-08
1st Qtr				6.24±0.47E-08	4.57±7.20E-10	
April	-1.26±1.78E-09	1.18±0.06E-07	1.55±0.11E-06			0.00±1.45E-08
May	1.10±1.55E-09	1.68±0.06E-07	2.08±0.12E-06			0.00±1.73E-08
June	1.28±1.58E-09	1.62±0.06E-07	2.29±0.13E-06			0.00±1.89E-08
2nd Qtr				6.40±0.61E-08	4.41±7.16E-10	
July	0.34±1.62E-09	1.64±0.06E-07	3.75±0.17E-06			0.00±1.33E-08
August	1.05±1.31E-09	1.43±0.06E-07	3.25±0.15E-06			0.00±1.48E-08
September	1.02±1.39E-09	1.58±0.06E-07	2.47±0.13E-06			0.00±1.47E-08
3rd Qtr				5.29±0.34E-08	5.97±6.91E-10	
October	7.39±7.75E-10	1.62±0.04E-07	2.39±0.13E-06			0.00±2.08E-08
November	1.54±1.10E-09	1.38±0.06E-07	9.77±0.96E-07			0.00±1.02E-08
December	1.04±0.87E-09	1.23±0.06E-07	7.03±0.90E-07			0.00±1.60E-08
4th Qtr				3.17±1.36E-09	0.62±9.48E-10	

	NPOC (mg/L)	**TOX** (µg/L)	**pH*** (standard units)
January	6.28	9.6	7.4
February	5.28	11.0	7.5
March	4.90	10.5	8.1
April	9.26	8.6	7.3
May	6.98	10.6	7.5
June	6.85	11.2	6.8
July	7.68	15.0	7.4
August	7.68	17.2	7.4
September	9.15	17.4	7.4
October	9.58	14.9	6.7
November	7.88	13.0	7.5
December	5.46	11.8	7.8

** pH is monthly average of weekly measurements.*
*** Monthly samples are composited and analyzed quarterly.*

Table C - 1.20
1997 Radioactivity Concentrations (µCi/mL), NPOC, and TOX in Groundwater at the NDA Interceptor Trench (WNNDATR)

Month	Alpha	Beta	H-3	I-129	Cs-137
January	0.75±1.06E-09	6.46±0.42E-08	1.46±0.10E-06		0.00±1.37E-08
February	2.17±1.40E-09	7.73±0.46E-08	8.82±0.31E-06		0.00±2.61E-08
March	1.28±1.28E-09	6.86±0.43E-08	6.76±0.25E-06		0.00±1.65E-08
1st Qtr				-0.71±5.62E-10	
April	1.66±1.37E-09	1.13±0.04E-07	1.52±0.05E-05		0.00±1.34E-08
May	2.38±2.06E-09	9.34±0.51E-08	1.89±0.06E-05		0.00±1.49E-08
June	2.39±0.88E-09	6.84±0.30E-08	3.04±0.15E-06		0.00±1.40E-08
2nd Qtr				0.69±1.11E-09	
July	1.89±1.89E-09	7.87±0.48E-08	5.90±0.23E-06		0.00±1.95E-08
August	3.23±2.24E-09	6.94±0.46E-08	1.75±0.06E-05		0.00±1.02E-08
September	2.24±1.40E-09	7.72±0.35E-08	1.14±0.04E-05		0.00±1.56E-08
3rd Qtr				5.46±5.25E-10	
October	2.36±1.49E-09	7.38±0.47E-08	3.04±0.15E-06		0.00±1.91E-08
November	1.40±0.70E-09	4.84±0.31E-08	2.91±0.15E-06		0.00±1.07E-08
December	0.75±1.11E-09	9.44±0.57E-08	4.02±0.18E-06		0.00±2.04E-08
4th Qtr				1.33±1.13E-09	

	NPOC (mg/L)	**TOX** (µg/L)
January	7.00	10.6
February	5.60	10.9
March	4.50	7.6
April	4.50	12.7
May	4.00	9.1
June	*NR*	8.6
July	5.05	12.3
August	4.20	19.6
September	5.20	10.3
October	7.20	22.8
November	6.00	20.2
December	5.50	12.4

NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table C - 1.21

1997 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	10/23	4.90±4.43E-10	4.77±1.69E-09	2.22±0.72E-07	6.40	114
WNSTAW5	10/23	3.39±4.60E-10	2.95±1.83E-09	1.94±0.82E-07	6.35	64
WNSTAW6	10/24	4.47±6.06E-10	3.33±1.88E-09	1.68±0.81E-07	6.72	310
WNSTAW9	10/28	1.34±5.52E-10	2.66±1.84E-09	2.25±0.82E-07	6.39	231
WNSTAWB*	10/28	1.10±0.85E-09	3.28±1.91E-09	2.23±0.82E-07	6.96	361

	Date	Chloride (mg/L)	Iron Total (µg/L)	Manganese Total (µg/L)	Sodium Total (µg/L)	Nitrate+ Nitrite (mg/L)	Sulfate (mg/L)
WNSTAW4	10/23	6.8	509	76.5	5,190	<0.05	7.9
WNSTAW5	10/23	1.2	888	173.0	1,410	<0.05	7.0
WNSTAW6	10/24	1.9	112	18.8	1,330	<0.05	10.8
WNSTAW9	10/28	4.8	680	226.0	4,790	0.11	15.6
WNSTAWB*	10/28	17.2	217	93.5	13,400	0.05	18.8

* *Background location.*

Table C - 1.22

1997 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP in Buttermilk Creek at Fox Valley (WFBCBKG)*

Month	Alpha	Beta	H-3
January	5.10±4.48E-10	1.40±1.13E-09	2.51±7.82E-08
February	2.21±5.26E-10	0.72±1.31E-09	1.68±0.79E-07
March	8.07±5.42E-10	1.72±1.25E-09	2.05±8.11E-08
April	7.20±6.26E-10	0.57±1.26E-09	-1.14±0.79E-07
May	1.64±0.82E-09	1.53±1.30E-09	-5.02±8.04E-08
June	1.08±0.75E-09	2.16±1.25E-09	4.89±8.18E-08
July	4.73±7.31E-10	2.20±1.35E-09	-1.09±0.80E-07
August	3.48±6.95E-10	2.10±1.30E-09	7.15±7.88E-08
September	8.55±7.39E-10	2.32±1.33E-09	-9.02±7.92E-08
October	2.34±4.68E-10	1.17±1.28E-09	8.39±8.18E-08
November	8.31±5.45E-10	1.62±1.23E-09	3.29±8.21E-08
December	6.44±3.42E-10	4.71±9.56E-10	0.11±8.07E-08

Quarter	C-14	Sr-90	Tc-99	I-129	Cs-137
1st Quarter	2.59±4.46E-09	0.59±1.04E-09	-0.97±1.03E-09	-0.44±1.02E-09	0.00±4.47E-09
2nd Quarter	-0.36±1.31E-08	0.96±1.19E-09	-1.19±1.12E-09	0.19±1.22E-09	0.00±4.18E-09
3rd Quarter	6.35±5.11E-09	6.04±8.67E-10	1.08±1.92E-09	3.50±5.08E-10	0.00±7.23E-09
4th Quarter	-0.45±1.27E-08	2.77±1.30E-09	-1.06±1.60E-09	-1.80±8.97E-10	0.00±4.26E-09

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	2.94±3.09E-11	2.40±0.41E-10	2.90±1.26E-11	1.79±0.39E-10	5.62±0.05E-04
2nd Quarter	-0.18±3.13E-11	4.96±3.92E-11	-0.67±1.40E-11	5.58±3.38E-11	3.42±0.17E-04
3rd Quarter	6.51±5.35E-11	1.12±0.38E-10	1.31±1.74E-11	7.59±3.01E-11	1.18±0.06E-03
4th Quarter	2.02±3.87E-11	6.80±4.04E-11	1.28±1.48E-11	4.68±2.85E-11	6.84±0.22E-05

	Pu-238	Pu-239/240	Am-241
1st Quarter	0.57±3.80E-11	0.09±2.53E-11	3.09±5.88E-11
2nd Quarter	0.52±4.70E-11	-1.27±2.51E-11	1.94±3.80E-11
3rd Quarter	3.00±0.83E-10	8.57±3.63E-11	2.46±3.27E-11
4th Quarter	1.02±0.55E-10	4.44±3.02E-11	3.28±4.51E-11

* *Background location. See Table C-1.27 for a summary of water quality parameters at WFBCBKG.*

Table C - 1.23
1997 pH and Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP in Buttermilk Creek at Thomas Corners (WFBCTCB)

Month	pH (standard units)	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.72	8.96±5.37E-10	4.78±1.39E-09	-0.27±7.81E-08		
*February**	7.27	1.99±0.89E-09	5.31±1.57E-09	1.67±0.79E-07		
*March**	8.41	1.80±0.79E-09	3.52±1.37E-09	-2.40±8.13E-08		
1st Qtr					4.38±1.72E-09	0.00±6.90E-09
*April**	6.65	-0.55±6.07E-10	3.78±1.44E-09	-5.04±8.04E-08		
May	7.00	2.07±1.03E-09	4.77±1.50E-09	2.67±8.03E-08		
*June**	6.74	1.31±0.65E-09	6.45±1.06E-09	9.52±8.17E-08		
2nd Qtr					3.03±1.40E-09	0.00±6.52E-09
July	7.04	6.64±8.48E-10	6.38±1.58E-09	-0.29±8.08E-08		
August	7.13	1.37±0.90E-09	5.85±1.51E-09	1.34±0.79E-07		
September	7.20	9.06±7.84E-10	8.05±1.63E-09	-1.42±8.02E-08		
3rd Qtr					3.29±1.14E-09	0.00±4.26E-09
*October**	6.40	4.44±5.32E-10	6.84±1.58E-09	8.04±8.16E-08		
November	7.12	8.22±5.63E-10	5.06±1.42E-09	-3.85±8.12E-08		
*December**	7.27	1.37±0.59E-09	6.50±1.53E-09	-6.21±8.02E-08		
4th Qtr					3.40±1.38E-09	0.00±4.29E-09

Table C - 1.24
1997 pH and Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)

Month	pH (standard units)	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.94	1.96±0.80E-09	4.40±1.40E-09	9.19±8.21E-08	1.03±1.38E-09	0.00±6.60E-09
*February**	6.84	1.80±0.96E-09	1.71±1.40E-09	-2.66±8.70E-08	3.74±1.69E-09	0.00±4.61E-09
*March**	8.19	2.53±1.03E-09	3.90±1.42E-09	5.61±8.94E-08	1.66±1.10E-09	0.00±4.53E-09
*April**	7.14	1.17±0.65E-09	1.79±0.97E-09	-7.38±8.85E-08	0.63±2.32E-09	0.00±6.88E-09
May	7.24	1.28±0.97E-09	4.64±1.49E-09	-8.41±8.63E-08	2.55±2.54E-09	0.00±4.53E-09
*June**	6.99	1.29±0.97E-09	3.16±1.56E-09	-6.56±8.28E-08	0.56±1.80E-09	0.00±6.60E-09
July	7.27	7.22±7.74E-10	3.41±1.04E-09	-1.16±0.83E-07	2.12±1.43E-09	0.00±4.49E-09
August	7.36	8.94±7.74E-10	3.53±0.98E-09	-1.24±0.81E-07	7.90±8.94E-10	0.00±4.18E-09
September	7.16	1.77±0.97E-09	3.42±1.41E-09	-1.11±0.81E-07	-0.34±1.42E-09	0.00±4.27E-09
*October**	6.69	9.87±6.98E-10	3.47±1.44E-09	-2.00±0.81E-07	1.83±1.08E-09	0.00±4.42E-09
November	6.56	5.13±4.19E-10	1.53±0.88E-09	-5.76±8.36E-08	1.34±1.68E-09	0.00±4.27E-09
*December**	7.57	1.38±0.46E-09	3.12±0.97E-09	-2.52±0.85E-07	1.84±1.94E-09	0.00±4.15E-09

** Month of discharge from WNSP001.*

Table C - 1.25
*1997 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	6.96±4.48E-10	1.98±0.74E-09	2.00±5.48E-08	0.66±1.17E-09	0.00±4.44E-09
February	1.52±0.70E-09	1.82±1.08E-09	1.60±5.70E-08	3.15±1.62E-09	0.00±6.80E-09
March	6.91±4.07E-10	2.35±0.72E-09	2.85±8.06E-08	1.34±1.39E-09	0.00±4.61E-09
April	1.16±8.00E-10	1.42±1.06E-09	-2.94±8.01E-08	1.16±1.05E-09	0.00±4.09E-09
May	-0.09±8.86E-10	0.52±1.01E-09	9.96±7.87E-08	0.85±2.95E-09	0.00±4.24E-09
June	4.04±9.60E-10	1.27±1.17E-09	-6.18±7.93E-08	0.55±1.15E-09	0.00±6.40E-09
July	0.56±1.11E-09	1.75±1.07E-09	1.36±7.77E-08	8.28±6.98E-10	0.00±4.74E-09
August	0.46±1.06E-09	2.44±1.07E-09	-1.13±0.56E-07	5.26±8.62E-10	0.00±6.81E-09
September	4.23±8.46E-10	1.75±1.04E-09	2.31±5.51E-08	-0.22±1.16E-09	0.00±4.66E-09
October	2.67±6.49E-10	0.71±1.00E-09	-7.06±8.22E-08	0.12±1.88E-09	0.00±4.22E-09
November	6.09±6.22E-10	3.22±1.00E-09	1.55±0.83E-07	2.93±1.94E-09	0.00±4.34E-09
December	3.84±5.55E-10	1.62±1.07E-09	-1.42±0.80E-07	-0.46±1.92E-09	0.00±1.58E-08

Table C - 1.26

1997 pH, Conductivity, and Radioactivity Concentrations (μCi/mL) in Potable Well Water around the WVDP

Well	pH (standard units)	Conductivity (μmhos/cm@25°C)	Alpha	Beta	H-3	Cs-137
WFWEL01	7.34	383	2.59±7.82E-10	2.10±1.85E-09	-6.13±7.92E-08	0.00±1.66E-08
WFWEL02	7.10	340	1.44±5.18E-10	0.48±1.24E-09	-1.34±8.05E-08	0.00±2.13E-08
WFWEL03	6.91	514	5.26±9.05E-10	3.04±1.92E-09	-0.83±5.62E-08	0.00±1.78E-08
WFWEL04	7.97	1686	2.14±2.41E-09	3.92±2.25E-09	6.42±0.88E-07	0.00±2.08E-08
WFWEL05	6.22	313	8.27±7.59E-10	3.87±1.89E-09	1.95±5.80E-08	0.00±2.31E-08
WFWEL06*	6.77	276	4.43±6.71E-10	0.17±1.71E-09	-6.71±8.03E-08	0.00±1.94E-08
WFWEL07	7.02	350	5.10±7.72E-10	1.42±1.81E-09	-5.92±7.93E-08	0.00±1.39E-08
WFWEL08	7.27	489	4.64±9.28E-10	4.03±1.99E-09	-1.08±0.78E-07	0.00±2.04E-08
WFWEL09	7.71	652	0.44±1.05E-09	3.96±2.00E-09	-1.30±0.79E-07	0.00±2.29E-08
WFWEL10	7.69	663	0.50±1.00E-09	-0.64±1.72E-09	-1.32±0.79E-07	0.00±1.34E-08

** Background location*

Table C - 1.27
1997 Surface Water Quality at Locations WFBCBKG, WNSP006, WNSWAMP, and WNSW74A*

Location	Date	pH	Conductivity (µmhos/cm@25C)	NPOC (mg/L)	TOX (µg/L)	Chloride (mg/L)	Sulfate (mg/L)
WFBCBKG*	7/1	7.01	209	2.2	6.0	6.6	21.6
WFBCBKG*	12/23	6.90	236	2.6	6.6	7.4	22.0
WNSP006	6/25	7.41	474	4.7	47.3	98.4	26.1
WNSP006	12/24	7.32	536	5.3	42.2	76.8	25.6
WNSW74A	6/25	7.28	952	4.2	16.7	78.1	29.8
WNSW74A	12/24	7.20	844	4.8	16.8	68.3	32.0
WNSWAMP	6/25	7.32	673	6.1	21.0	87.0	21.0
WNSWAMP	12/24	7.29	668	5.4	22.5	81.5	22.5

Location	Date	Nitrate/ Nitrite (mg/L)	Fluoride (mg/L)	Bicarbonate Alkalinity (as $CaCO_3$) (mg/L)	Carbonate Alkalinity (as $CaCO_3$) (mg/L)
WFBCBKG*	7/1	0.12	<0.10	83.6	<1.0
WFBCBKG*	12/23	0.12	<0.10	90.0	<1.0
WNSP006	6/25	4.80	0.11	112.0	<1.0
WNSP006	12/24	4.40	0.10	113.0	<1.0
WNSW74A	6/25	<0.05	0.14	186.0	<1.0
WNSW74A	12/24	<0.05	0.12	176.0	<1.0
WNSWAMP	6/25	0.23	0.47	180.0	<1.0
WNSWAMP	12/24	0.28	0.49	180.0	<5.5

Location	Date	Ca Total (µg/L)	Mg Total (µg/L)	Na Total (µg/L)	K Total (µg/L)	Ba Total (µg/L)	Mn Total (µg/L)	Fe Total (µg/L)
WFBCBKG*	6/17	35,700	5,020	5,710	1,700	<200	38.1	1,200
WFBCBKG*	10/24	36,800	4,820	7,390	1,170	<200	21.6	385
WNSP006	6/17	46,700	7,140	62,300	3,820	<200	16.0	525
WNSP006	10/24	43,900	6,460	40,200	3,320	<200	50.8	893
WNSW74A	6/17	74,500	8,400	41,200	1,400	<200	33.6	<100
WNSW74A	10/24	71,300	7,880	32,000	1,310	<200	24.5	<100
WNSWAMP	6/17	79,000	9,900	38,000	1,600	90	680.0	290
WNSWAMP	10/24	80,000	11,000	35,000	1,900	86	62.0	47

* *Backgound location.*

Table C - 1.28
1997 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	Cs-137
SNSP006	1.32±0.35E-05	5.60±0.46E-05	1.67±0.19E-05	6.39±3.30E-08	9.66±0.67E-07	2.99±0.29E-05
SNSW74A	2.20±0.55E-05	2.13±0.35E-05	1.34±0.16E-05	0.71±2.20E-08	3.10±0.50E-07	1.31±0.14E-06
SNSWAMP	1.18±0.38E-05	3.24±0.37E-05	1.71±0.21E-05	0.00±3.23E-08	8.97±0.73E-07	6.63±0.87E-07

Location	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)	Pu-239/240
SNSP006	1.43±1.31E-07	7.73±1.63E-07	7.45±4.55E-08	7.43±1.59E-07	1.47±0.03E+00	2.49±2.21E-08
SNSW74A	-2.89±5.65E-08	7.72±1.64E-07	9.38±5.32E-08	7.52±1.61E-07	1.70±0.05E+00	3.16±5.90E-08
SNSWAMP	3.61±8.53E-08	9.05±1.40E-07	1.77±0.53E-07	8.37±1.32E-07	1.91±0.05E+00	2.44±2.65E-08

Location	Am-241
SNSP006	4.22±2.53E-08
SNSW74A	7.98±4.36E-08
SNSWAMP	6.58±3.10E-08

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
SNSP006	7,500	2.3	5.0	38.0	0.36	<0.50
SNSW74A	13,500	<6.0	7.1	59.5	0.56	<0.50
SNSWAMP	11,000	3.9	6.9	86.0	0.48	<0.50

Location	Calcium	Chromium	Cobalt	Copper	Iron	Lead
SNSP006	9,700	9.9	5.2	9.9	13,000	8.6
SNSW74A	3,050	15.5	6.2	25.5	21,000	14.0
SNSWAMP	7,300	13.0	5.0	19.0	17,000	11.0

Location	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
SNSP006	3,900	360	<0.02	13.0	1,600	0.05
SNSW74A	4,200	420	<0.02	17.5	2,300	0.68
SNSWAMP	4,600	190	<0.02	14.0	2,200	0.42

Location	Silver	Sodium	Thallium	Vanadium	Zinc
SNSP006	< 1.00	80.0	< 1.0	16.0	45
SNSW74A	< 1.00	75.5	< 1.0	21.5	105
SNSWAMP	0.71	84.0	< 1.0	18.0	53

Table C - 1.29

1997 Radioactivity Concentrations in Surface Soil Collected at Air Sampling Stations around the WVDP (µCi/g dry weight from upper 5 cm)

Location	Alpha	Beta	K-40	Co-60
SFBLKST	1.95±0.54E-05	2.96±0.46E-05	1.89±0.22E-05	-0.73±2.37E-08
SFBOEHN	1.63±0.49E-05	3.06±0.46E-05	1.53±0.23E-05	-1.18±3.26E-08
SFFXVRD	1.76±0.48E-05	2.07±0.40E-05	1.12±0.16E-05	-0.44±2.54E-08
SFGRVAL*	1.85±0.56E-05	2.31±0.46E-05	1.09±0.15E-05	2.12±2.54E-08
SFNASHV*	1.35±0.47E-05	2.50±0.45E-05	1.71±0.20E-05	-1.20±2.62E-08
SFRSPRD	1.70±0.53E-05	2.44±0.49E-05	1.48±0.17E-05	1.56±2.50E-08
SFRT240	1.38±0.46E-05	2.17±0.42E-05	1.19±0.15E-05	-0.99±2.27E-08
SFSPRVL	2.02±0.62E-05	2.57±0.48E-05	1.29±0.15E-05	-0.24±1.68E-08
SFTCORD	2.49±0.64E-05	2.32±0.43E-05	1.97±0.23E-05	-3.11±2.84E-08
SFWEVAL	2.72±0.66E-05	2.28±0.43E-05	7.54±1.12E-06	0.25±2.19E-08

	Sr-90	Cs-137	Pu-239/240	Am-241
SFBLKST	8.80±3.68E-08	2.78±0.50E-07	2.34±0.45E-07	1.52±3.36E-08
SFBOEHN	2.57±0.74E-07	6.33±1.03E-07	1.72±1.00E-08	1.93±0.67E-07
SFFXVRD	1.31±0.49E-07	5.32±0.82E-07	1.54±1.08E-08	1.41±1.79E-08
SFGRVAL*	1.65±0.38E-07	6.93±0.95E-07	2.80±1.79E-08	2.98±4.14E-08
SFNASHV*	1.84±3.91E-08	2.18±0.58E-07	4.32±1.60E-08	1.01±3.11E-08
SFRSPRD	2.78±0.87E-07	1.40±0.16E-06	1.90±0.95E-08	0.91±1.97E-08
SFRT240	1.56±0.69E-07	7.47±1.00E-07	0.94±1.66E-08	1.99±2.21E-08
SFSPRVL	2.07±0.89E-07	5.69±0.67E-07	6.41±2.37E-08	2.96±2.79E-08
SFTCORD	1.57±0.25E-06	2.17±0.54E-07	-1.54±1.41E-08	2.36±5.69E-08
SFWEVAL	3.01±1.40E-07	5.46±0.82E-07	9.16±2.89E-08	1.46±2.91E-08

	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)
SFBOEHN	1.37±0.98E-08	8.12±1.03E-07	3.10±1.75E-08	8.32±1.04E-07	1.78±0.05E+00
SFGRVAL*	4.71±9.19E-09	6.60±0.90E-07	2.29±1.35E-08	6.86±0.93E-07	2.31±0.04E+00
SFRSPRD	8.59±8.13E-09	6.80±0.86E-07	1.80±1.16E-08	7.02±0.89E-07	1.73±0.03E+00

** Background location.*

Table C - 1.30

1997 Radioactivity Concentrations in Stream Sediments around the WVDP (µCi/g dry weight from upper 15 cm)

Location	Alpha	Beta	K-40	Co-60	Sr-90	Cs-137
SFBCSED*	8.61±3.85E-06	1.63±0.34E-05	1.07±0.13E-05	-0.45±1.72E-08	4.91±4.26E-08	0.11±1.65E-08
SFBISED*	1.57±0.42E-05	2.00±0.28E-05	1.08±0.13E-05	0.15±1.68E-08	2.35±4.62E-08	0.42±1.55E-08
SFCCSED	1.12±0.40E-05	1.73±0.30E-05	1.20±0.15E-05	2.03±1.91E-08	8.57±5.08E-08	3.37±0.60E-07
SFSDSED	1.56±0.54E-05	1.97±0.36E-05	1.55±0.19E-05	0.59±2.26E-08	2.22±4.49E-08	3.94±0.65E-07
SFTCSED	7.91±4.54E-06	3.74±0.46E-05	1.29±0.15E-05	-0.57±1.50E-08	5.01±3.49E-08	8.24±0.95E-07

Location	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)	Pu-238
SFBCSED*	2.46±1.64E-08	2.40±0.46E-07	5.47±7.75E-09	1.71±0.36E-07	2.00±0.07E+00	1.29±0.28E-07
SFBISED*	0.96±1.99E-08	1.82±0.36E-07	1.13±0.90E-08	1.71±0.35E-07	1.93±0.07E+00	1.12±0.26E-07
SFCCSED	1.23±0.25E-07	2.03±0.27E-07	1.31±0.68E-08	1.92±0.26E-07	2.16±0.05E+00	9.52±2.27E-08
SFSDSED	9.54±2.61E-08	2.24±0.35E-07	1.42±0.77E-08	1.76±0.31E-07	2.08±0.06E+00	1.11±0.24E-07
SFTCSED	1.66±0.31E-07	2.77±0.33E-07	1.64±0.68E-08	2.46±0.30E-07	2.12±0.05E+00	7.28±1.60E-08

Location	Pu-239/240	Am-241
SFBCSED*	4.89±2.14E-08	0.04±1.04E-08
SFBISED*	5.24±2.12E-08	0.25±1.62E-08
SFCCSED	5.43±9.40E-09	0.81±1.15E-08
SFSDSED	1.20±1.24E-08	0.19±1.54E-08
SFTCSED	3.11±6.39E-09	0.32±1.17E-08

** Background location.*

Appendix C - 2

Summary of Air Monitoring Data

Ambient Air and Atmospheric Fallout Samples are Collected from Numerous Locations in the West Valley Area

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Table C - 2.1

1997 Airborne Radioactive Effluent Totals (curies) from the Main Ventilation Stack (ANSTACK)

Month	Alpha	Beta	H-3
January	2.49±0.36E-07	3.29±0.04E-05	5.24±0.12E-03
February	2.43±0.36E-07	1.36±0.01E-04	3.86±0.31E-04
March	3.17±0.44E-07	1.79±0.01E-04	1.65±0.03E-03
April	5.98±2.66E-08	7.13±0.20E-06	2.54±0.24E-04
May	2.67±2.18E-08	6.40±0.16E-06	6.31±0.12E-03
June	3.65±1.91E-08	1.59±0.02E-05	1.55±0.02E-02
July	1.57±1.74E-08	1.07±0.02E-05	2.32±0.03E-02
August	3.04±1.74E-08	6.82±0.16E-06	2.60±0.04E-02
September	9.15±2.54E-08	2.34±0.03E-05	1.54±0.02E-02
October	1.37±2.51E-08	4.80±0.16E-06	2.47±0.03E-02
November	4.10±2.45E-08	2.31±0.11E-06	1.47±0.02E-02
December	5.79±2.31E-08	7.77±0.19E-06	6.98±0.14E-03
Annual Total	1.18±0.10E-06	4.34±0.01E-04	1.40±0.01E-01

Quarter	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Quarter	1.94±3.88E-08	3.43±0.05E-05	8.13±0.95E-04	0.16±1.21E-07	2.74±0.41E-04
2nd Quarter	0.03±3.06E-08	2.24±0.05E-06	2.37±0.28E-03	4.58±4.14E-08	1.77±0.26E-05
3rd Quarter	-0.99±3.45E-08	7.98±0.28E-06	1.65±0.20E-03	1.92±3.78E-08	1.74±0.18E-05
4th Quarter	3.27±3.30E-08	1.45±0.04E-06	2.60±0.30E-03	-0.87±2.54E-08	7.32±0.75E-06
Annual Total	4.25±6.87E-08	4.60±0.06E-05	7.43±0.47E-03	0.72±1.36E-07	3.17±0.41E-04

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Quarter	0.00±1.76E-07	1.07±2.26E-09	9.26±3.15E-09	2.12±8.65E-10	9.84±3.55E-09
2nd Quarter	2.51±8.67E-08	4.65±3.57E-09	1.25±0.49E-08	1.83±2.57E-09	6.15±3.93E-09
3rd Quarter	0.48±1.04E-07	0.42±1.07E-09	1.21±0.59E-08	3.12±0.94E-08	6.52±4.65E-09
4th Quarter	1.32±7.12E-08	2.97±0.76E-08	9.10±3.44E-09	0.57±1.62E-09	1.28±0.40E-08
Annual Total	0.87±2.33E-07	3.58±0.87E-08	4.30±0.90E-08	3.38±1.00E-08	3.53±0.81E-08

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Quarter	5.46±0.07E-02	1.56±0.22E-07	1.55±0.21E-07	5.96±0.68E-07
2nd Quarter	2.12±0.09E-02	1.38±0.49E-08	1.52±0.41E-08	4.86±1.04E-08
3rd Quarter	2.04±0.11E-02	1.95±0.47E-08	1.60±0.41E-08	7.18±1.08E-08
4th Quarter	4.68±0.06E-02	-6.41±4.59E-09	0.01±3.08E-09	1.37±0.71E-08
Annual Total	1.43±0.02E-01	1.82±0.23E-07	1.86±0.22E-07	7.31±0.70E-07

Table C - 2.2

Comparison of 1997 Main Stack (ANSTACK) Exhaust Radioactivity Concentrations with Department of Energy Guidelines

Isotope	**Total Radioactivity Released**[a] (Ci)	(Bequerels)	**Average Concentration** (μCi/mL)	**DCG** (μCi/mL)	**% of DCG**
Alpha	1.18±0.10E-06	4.37±0.37E+04	1.59±0.13E-15	*NA*[b]	*NA*
Beta	4.34±0.01E-04	1.61±0.00E+07	5.83±0.02E-13	*NA*[b]	*NA*
H-3	1.40±0.00E-01	5.18±0.03E+09	1.88±0.01E-10	1E-07	0.19
Co-60	4.25±6.87E-08	1.57±2.54E+03	5.72±9.24E-17	8E-11	<0.01
Sr-90	4.60±0.06E-05	1.70±0.02E+06	6.18±0.08E-14	9E-12	0.69
I-129	7.43±0.47E-03	2.75±0.17E+08	9.99±0.63E-12	7E-11	14.27
Cs-134	0.72±1.36E-07	2.66±5.07E+03	0.97±1.83E-16	2E-10	<0.01
Cs-137	3.17±0.41E-04	1.17±0.15E+07	4.26±0.55E-13	4E-10	0.11
Eu-154	0.87±2.33E-07	3.21±8.62E+03	1.17±3.14E-16	5E-11	<0.01
U-232[c]	3.58±0.87E-08	1.32±0.32E+03	4.82±1.17E-17	2E-14	0.24
U-233/234[c]	4.30±0.90E-08	1.59±0.33E+03	5.78±1.21E-17	9E-14	0.06
U-235/236[c]	3.38±1.00E-08	1.25±0.37E+03	4.54±1.34E-17	1E-13	0.05
U-238[c]	3.53±0.81E-08	1.31±0.30E+03	4.74±1.09E-17	1E-13	0.05
Pu-238	1.82±0.23E-07	6.73±0.85E+03	2.45±0.31E-16	3E-14	0.82
Pu-239/240	1.86±0.22E-07	6.88±0.81E+03	2.50±0.30E-16	2E-14	1.25
Am-241	7.31±0.70E-07	2.70±0.26E+04	9.82±0.94E-16	2E-14	4.91
Total % of DCGs[d]					**22.7**

[a] Total volume released at 50,000 cfm = 7.44E+14 mL/yr.

[b] Derived concentration guides (DCGs) are not specified for gross alpha and gross beta activity.

[c] Total uranium = 1.43±0.02E-01 g; average = 1.92±0.02E-10 µg/mL.

[d] Total percent DCGs for applicable measured radionuclides.

N/A - Not applicable.

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.

Half-lives are listed in Table B-1 (p. B-3).

Table C - 2.3

1997 Airborne Radioactive Effluent Totals (curies) from the Vitrification System (HVAC) Ventilation Stack (ANVITSK)

Month	Alpha	Beta
January	2.81±6.41E-09	0.59±2.22E-08
February	-0.99±5.06E-09	-0.89±2.04E-08
March	-3.60±5.29E-09	-1.00±2.09E-08
April	-0.59±5.61E-09	0.59±1.97E-08
May	-5.40±8.12E-09	2.43±2.14E-08
June	-1.98±6.70E-09	1.57±1.79E-08
July	-7.57±5.65E-09	-1.34±1.90E-08
August	-2.24±5.57E-09	0.12±2.07E-08
September	-3.30±6.54E-09	-1.78±1.89E-08
October	-7.08±9.96E-09	0.08±2.79E-08
November	-6.79±7.96E-09	1.79±2.21E-08
December	-3.65±6.00E-09	-1.62±1.99E-08
Annual Total	-4.04±2.33E-08	0.53±7.29E-08

Quarter	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Quarter	2.56±3.26E-08	7.99±6.47E-09	4.31±7.37E-08	-1.39±1.87E-08	0.32±1.75E-08
2nd Quarter	0.80±2.58E-08	0.86±1.03E-08	1.90±1.11E-07	0.66±1.65E-08	-0.59±1.62E-08
3rd Quarter	1.05±2.30E-08	0.79±1.08E-08	2.25±1.16E-07	0.00±2.30E-08	-1.06±1.53E-08
4th Quarter	-0.75±1.14E-08	1.15±0.87E-08	0.00±6.54E-08	-0.53±1.12E-08	0.41±1.07E-08
Annual Total	3.66±4.89E-08	3.60±1.85E-08	4.59±1.88E-07	-1.26±3.58E-08	-0.91±3.03E-08

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Quarter	-1.88±5.36E-08	5.77±8.75E-10	5.13±1.60E-09	2.95±4.31E-10	4.93±1.66E-09
2nd Quarter	2.33±4.46E-08	-0.79±1.35E-09	5.01±1.90E-09	9.04±8.29E-10	3.94±1.65E-09
3rd Quarter	-1.18±5.32E-08	0.30±1.82E-09	4.15±2.00E-09	3.12±8.50E-10	3.34±1.76E-09
4th Quarter	0.67±3.03E-08	3.98±0.77E-09	3.28±1.38E-09	5.68±8.82E-10	2.26±1.38E-09
Annual Total	-0.07±9.28E-08	4.06±2.55E-09	1.76±0.35E-08	2.08±1.54E-09	1.45±0.32E-08

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Quarter	1.65±0.02E-02	0.78±1.36E-09	1.28±5.21E-10	0.13±1.77E-09
2nd Quarter	3.90±0.19E-03	1.73±1.36E-09	-0.09±8.35E-10	0.57±1.46E-09
3rd Quarter	1.03±0.05E-02	-1.77±7.17E-10	-1.03±1.47E-10	-0.08±6.54E-10
4th Quarter	1.19±0.02E-02	-4.12±4.18E-09	4.56±6.48E-10	0.58±1.69E-09
Annual Total	4.25±0.06E-02	-1.79±4.66E-09	0.47±1.19E-09	1.27±2.92E-09

Table C - 2.4

1997 Airborne Radioactive Effluent Totals (curies) from the Seismic Sampler (ANSEISK) for the Vitrification System (HVAC) Ventilation Stack

Month	Alpha	Beta
January	5.59±7.21E-09	-1.82±2.26E-08
February	-0.65±5.28E-09	-1.35±2.04E-08
March	-3.74±5.48E-09	-1.52±2.13E-08
April	-3.18±5.72E-09	-1.31±2.13E-08
May	-6.34±9.06E-09	1.55±2.35E-08
June	1.14±6.99E-09	1.79±1.75E-08
July	-3.86±5.95E-09	-0.56±1.83E-08
August	-1.62±5.69E-09	0.30±2.05E-08
September	-2.73±6.56E-09	-0.88±1.92E-08
October	-1.28±0.74E-08	-0.02±2.22E-08
November	-5.04±7.36E-09	2.21±2.02E-08
December	-4.45±5.22E-09	-1.57±1.79E-08
Annual Total	-3.76±2.28E-08	-3.17±7.09E-08

ANSEISK provides back-up samples for the primary vitrification sampler (ANVITSK).

Table C - 2.5

1997 Airborne Radioactive Effluent Totals (curies) from the O1-14 Building Ventilation Exhaust (ANCSSTK)

Month	**Alpha**	**Beta**
January	1.14±2.67E-09	-4.07±9.43E-09
February	0.21±1.91E-09	3.11±7.25E-09
March	-0.20±2.03E-09	-4.70±7.05E-09
April	0.92±2.44E-09	-4.43±7.92E-09
May	-3.48±3.13E-09	9.83±8.74E-09
June	-1.22±2.94E-09	3.98±7.73E-09
July	-0.76±2.76E-09	-4.20±8.07E-09
August	0.93±2.91E-09	4.36±9.56E-09
September	-0.74±3.08E-09	-5.77±8.67E-09
October	-3.20±3.42E-09	-1.29±9.25E-09
November	-1.42±3.30E-09	5.73±8.46E-09
December	1.37±2.97E-09	0.98±8.37E-09
Annual Total	-6.47±9.80E-09	0.35±2.91E-08

Quarter	**Co-60**	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
1st Quarter	-2.24±6.80E-09	3.15±1.69E-09	0.00±2.78E-08	-3.57±6.36E-09	0.78±6.75E-09
2nd Quarter	-2.05±6.49E-09	-2.68±3.41E-09	5.34±2.39E-08	6.21±5.88E-09	4.09±6.82E-09
3rd Quarter	1.34±5.18E-09	6.06±5.77E-09	2.15±0.53E-07	-4.78±6.94E-09	6.16±7.34E-09
4th Quarter	0.36±4.48E-09	1.19±0.46E-08	2.14±0.62E-07	1.98±4.72E-09	1.74±4.23E-09
Annual Total	-0.26±1.16E-08	1.85±0.83E-08	4.82±0.90E-07	-0.02±1.21E-08	1.28±1.28E-08

	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Quarter	1.36±1.62E-08	0.11±3.34E-10	1.50±0.58E-09	0.96±1.87E-10	1.64±0.65E-09
2nd Quarter	1.02±1.95E-08	0.18±3.84E-10	1.66±0.82E-09	3.32±3.93E-10	1.66±0.82E-09
3rd Quarter	-0.85±2.03E-08	5.33±6.85E-10	1.54±0.89E-09	0.45±5.18E-10	1.39±0.86E-09
4th Quarter	0.29±1.24E-08	8.13±1.84E-09	1.94±0.67E-09	0.93±1.32E-10	1.15±0.49E-09
Annual Total	1.83±3.48E-08	8.69±2.03E-09	6.64±1.49E-09	5.66±6.89E-10	5.85±1.44E-09

	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**
1st Quarter	4.62±0.06E-03	-4.30±6.62E-10	0.06±2.13E-10	-1.42±6.27E-10
2nd Quarter	3.41±0.15E-03	4.46±4.75E-10	0.95±2.70E-10	5.55±6.58E-10
3rd Quarter	4.14±0.26E-03	1.86±3.64E-10	1.04±1.34E-10	0.81±3.51E-10
4th Quarter	4.05±0.10E-03	-2.20±0.77E-10	0.00±2.31E-10	1.65±4.05E-10
Annual Total	1.62±0.03E-02	-0.19±8.96E-10	2.05±4.36E-10	0.66±1.06E-09

Table C - 2.6

1997 Airborne Radioactive Effluent Totals (curies) from the Contact Size-reduction Facility Ventilation Stack (ANCSRFK)

Month	**Alpha**	**Beta**
January	3.44±1.91E-10	2.66±0.65E-09
February	1.91±2.01E-10	2.98±0.80E-09
March	-0.69±1.21E-10	1.47±0.51E-09
April	9.54±9.51E-11	1.19±0.33E-09
May	-1.17±2.03E-10	2.05±0.57E-09
June	1.86±1.68E-10	8.28±4.28E-10
July	*NA*	*NA*
August	1.80±5.00E-10	0.71±1.56E-09
September	-0.77±8.65E-10	1.17±2.78E-09
October	1.76±6.92E-10	1.71±1.74E-09
November	*NA*	*NA*
December	4.13±8.94E-10	0.35±2.31E-09
Annual Total	1.32±1.56E-09	1.51±0.45E-08

Quarter	**Co-60**	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
1st Quarter	-1.59±3.57E-10	0.75±1.28E-10	1.26±0.87E-09	-1.18±3.91E-10	0.10±3.48E-10
2nd Quarter	-0.40±2.96E-10	1.29±1.52E-10	3.53±1.95E-09	-0.34±3.05E-10	-2.08±2.51E-10
3rd Quarter	0.74±2.93E-09	1.77±1.76E-09	3.62±3.41E-09	-1.69±3.39E-09	4.75±4.13E-09
4th Quarter	1.07±3.13E-09	1.65±1.68E-09	-0.34±6.25E-09	0.01±1.77E-09	0.88±1.69E-09
Annual Total	1.61±4.31E-09	3.62±2.45E-09	8.07±7.43E-09	-1.83±3.86E-09	5.43±4.48E-09
	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Quarter	-8.71±9.05E-10	3.34±3.60E-11	1.31±0.38E-10	0.25±1.14E-11	1.45±0.47E-10
2nd Quarter	4.79±7.96E-10	1.61±2.00E-11	9.64±3.45E-11	0.71±1.24E-11	1.02±0.36E-10
3rd Quarter	5.89±3.99E-09	1.69±2.33E-10	3.32±2.93E-10	0.58±1.58E-10	1.82±2.02E-10
4th Quarter	-1.35±4.74E-09	3.21±0.69E-09	5.78±2.53E-10	0.79±1.90E-10	0.26±2.03E-10
Annual Total	4.15±6.31E-09	3.43±0.73E-09	1.14±0.39E-09	1.46±2.48E-10	4.56±2.92E-10
	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**	
1st Quarter	3.79±0.05E-04	2.50±4.16E-11	0.17±8.34E-12	1.76±3.23E-11	
2nd Quarter	2.42±0.10E-04	1.50±2.51E-11	0.50±1.14E-11	0.26±2.21E-11	
3rd Quarter	8.78±0.45E-04	1.50±1.63E-10	6.98±7.33E-11	1.26±1.49E-10	
4th Quarter	2.59±0.06E-04	-5.16±3.47E-10	0.19±1.16E-10	-0.81±2.77E-10	
Annual Total	1.76±0.05E-03	-3.25±3.87E-10	0.94±1.38E-10	0.66±3.17E-10	

NA - Not applicable. Ventilation was off.

Table C - 2.7

1997 Airborne Radioactive Effluent Totals (curies) from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

Month	Alpha	Beta	H-3
January	0.37±1.14E-09	-1.96±4.46E-09	7.45±0.55E-06
February	0.37±1.14E-09	1.24±0.46E-08	*Dry**
March	0.24±1.25E-09	1.89±4.31E-09	*Dry**
April	0.00±1.23E-09	-1.33±4.18E-09	*Dry**
May	-1.13±1.79E-09	1.14±0.08E-07	6.20±2.75E-07
June	-1.00±1.38E-09	3.67±0.53E-08	1.34±1.29E-06
July	-0.50±1.43E-09	1.09±0.08E-07	1.43±0.07E-05
August	0.98±1.52E-09	1.20±0.08E-07	3.51±0.54E-06
September	0.49±1.64E-09	1.75±4.45E-09	3.27±2.69E-06
October	-0.88±1.86E-09	-1.19±4.77E-09	9.14±3.46E-07
November	-1.57±1.66E-09	2.40±0.54E-08	*Dry**
December	-0.35±1.33E-09	5.61±0.63E-08	1.59±0.27E-06
Annual Total	-2.98±5.08E-09	4.72±0.20E-07	3.30±0.32E-05

Quarter	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Quarter	1.84±3.81E-09	0.72±1.09E-09	2.10±0.56E-07	2.61±3.09E-09	1.60±0.87E-08
2nd Quarter	-3.24±3.95E-09	1.79±0.24E-08	3.04±0.51E-07	-1.93±4.45E-09	8.35±1.66E-08
3rd Quarter	-1.42±3.63E-09	3.02±0.39E-08	3.22±0.45E-07	-0.82±3.68E-09	1.65±0.21E-07
4th Quarter	1.34±2.33E-09	1.71±1.79E-09	2.55±0.50E-07	-3.45±2.09E-09	4.92±0.74E-08
Annual Total	-1.48±6.98E-09	5.05±0.51E-08	1.09±0.10E-06	-3.59±6.88E-09	3.14±0.29E-07

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Quarter	2.81±8.75E-09	2.36±1.69E-10	9.93±3.07E-10	7.72±9.33E-11	7.82±2.90E-10
2nd Quarter	-8.13±9.66E-09	2.42±2.74E-10	1.70±0.57E-09	2.32±2.54E-10	7.54±3.93E-10
3rd Quarter	-0.36±1.00E-08	2.70±4.44E-10	1.11±0.43E-09	-0.45±1.88E-10	1.02±0.38E-09
4th Quarter	0.81±6.07E-09	3.55±0.76E-09	7.40±3.10E-10	1.71±1.41E-10	9.10±3.42E-10
Annual Total	-0.81±1.75E-08	4.30±0.94E-09	4.55±0.83E-09	4.36±3.59E-10	3.46±0.71E-09

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Quarter	2.66±0.03E-03	-0.37±3.74E-10	-0.88±1.35E-10	0.80±2.61E-10
2nd Quarter	2.01±0.08E-03	0.86±3.04E-10	0.90±1.05E-10	2.72±3.80E-10
3rd Quarter	3.29±0.17E-03	0.25±1.80E-10	3.73±8.69E-11	-0.02±1.61E-10
4th Quarter	3.85±0.06E-03	-4.67±2.13E-10	0.00±8.77E-11	0.96±3.12E-10
Annual Total	1.18±0.02E-02	-3.94±5.57E-10	0.39±2.10E-10	4.46±5.80E-10

** Dry means there was not enough moisture in the air stream collected from the stack to allow analysis.*

Table C - 2.8

1997 Airborne Radioactive Effluent Totals (curies) from the Container Sorting and Packaging Facility (ANCSPFK)

Month	Alpha	Beta
January	1.17±4.27E-10	-0.04±1.50E-09
February	-1.56±3.28E-10	-0.46±1.32E-09
March	2.29±4.11E-10	-0.58±1.25E-09
April	0.88±3.08E-10	0.31±1.01E-09
May	-3.53±4.05E-10	1.29±1.10E-09
June	-4.17±4.31E-10	2.58±1.34E-09
July	-2.40±3.21E-10	-7.68±9.79E-10
August	0.00±3.04E-10	-0.25±1.03E-09
September	-3.00±2.98E-10	-1.94±9.58E-10
October	-4.50±3.85E-10	0.36±1.11E-09
November	-2.23±4.46E-10	0.43±1.12E-09
December	-1.33±2.77E-10	-5.97±8.97E-10
Annual Total	-1.84±1.27E-09	2.06±3.98E-09

Quarter	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Quarter	-0.25±1.15E-09	1.68±3.00E-10	8.86±1.85E-08	-0.15±1.07E-09	-2.74±9.92E-10
2nd Quarter	1.42±8.02E-10	-0.29±4.40E-10	8.24±1.49E-08	0.80±8.70E-10	-8.26±8.58E-10
3rd Quarter	1.14±0.94E-09	-3.70±6.87E-10	8.68±1.18E-08	-0.56±8.99E-10	-4.03±8.71E-10
4th Quarter	-1.53±5.00E-10	4.89±4.37E-10	1.25±0.20E-07	-2.80±4.68E-10	5.37±6.90E-10
Annual Total	0.88±1.76E-09	2.58±9.73E-10	3.83±0.33E-07	-0.41±1.71E-09	-0.97±1.72E-09
	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Quarter	-0.30±3.36E-09	-0.62±7.80E-11	2.60±0.77E-10	4.81±3.38E-11	2.55±0.83E-10
2nd Quarter	1.01±2.36E-09	-4.80±6.59E-11	2.65±1.06E-10	1.91±4.34E-11	3.23±1.17E-10
3rd Quarter	-1.19±2.38E-09	6.37±8.49E-11	2.76±1.09E-10	-0.22±4.58E-11	2.51±0.98E-10
4th Quarter	0.05±1.20E-09	1.05±0.20E-09	2.41±0.84E-10	2.30±3.26E-11	3.38±0.95E-10
Annual Total	-0.43±4.89E-09	1.06±0.24E-09	1.04±0.19E-09	8.81±7.86E-11	1.17±0.20E-09
	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**	
1st Quarter	8.93±0.14E-04	3.48±8.86E-11	1.53±2.97E-11	1.57±1.25E-10	
2nd Quarter	7.27±0.29E-04	-2.71±5.40E-11	1.47±3.03E-11	8.95±5.92E-11	
3rd Quarter	6.98±0.36E-04	-0.87±5.42E-11	-0.23±1.71E-11	-2.55±2.38E-11	
4th Quarter	7.24±0.10E-04	-1.93±1.52E-10	1.54±1.79E-11	2.21±6.16E-11	
Annual Total	3.04±0.05E-03	-1.94±1.92E-10	4.31±4.92E-11	2.43±1.53E-10	

Table C - 2.9

1997 Airborne Radioactive Effluent Totals (curies) from the Low-level Waste Treatment Facility (ANLLWTVH)

Month	Alpha	Beta
January	1.81±1.08E-09	6.67±3.45E-09
February	1.42±0.98E-09	4.63±2.98E-09
March	8.45±9.16E-10	4.76±2.90E-09
April	1.00±0.94E-09	6.86±2.92E-09
May	-0.16±1.13E-09	7.58±2.95E-09
June	0.45±1.42E-09	8.60±3.90E-09
July	1.16±1.23E-09	5.64±3.20E-09
August	0.90±1.12E-09	8.00±3.62E-09
September	0.25±1.11E-09	3.78±3.14E-09
October	-0.66±1.24E-09	7.50±3.52E-09
November	0.17±1.22E-09	6.11±3.12E-09
December	0.45±1.04E-09	7.75±3.30E-09
Annual Total	7.63±3.90E-09	7.79±1.13E-08

Table C - 2.10

1997 Airborne Radioactive Effluent Totals (curies) from the Laundry Change Room (ANLAUNV)

Month	Alpha	Beta
January	3.26±3.20E-10	-0.57±1.53E-09
February	-1.63±3.91E-10	0.32±1.54E-09
March	2.44±3.57E-10	-0.70±1.44E-09
April	1.63±4.52E-10	0.51±1.38E-09
May	2.45±6.62E-10	-0.19±1.45E-09
June	-1.68±4.64E-10	0.13±1.46E-09
July	0.00±5.19E-10	0.00±1.53E-09
August	6.69±6.13E-10	1.17±1.40E-09
September	1.67±5.19E-10	-1.29±1.48E-09
October	-2.50±5.44E-10	0.32±1.55E-09
November	1.67±7.33E-10	-0.07±1.41E-09
December	0.00±4.40E-10	1.20±1.33E-09
Annual Total	1.40±1.78E-09	0.82±5.06E-09

Table C - 2.11

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Lag Storage Area Air Sampler (ANLAGAM)

Month	Alpha	Beta
January	1.50±0.81E-15	2.24±0.28E-14
February	7.08±5.77E-16	1.68±0.24E-14
March	1.58±4.50E-16	8.89±2.01E-15
April	9.45±6.64E-16	1.43±0.23E-14
May	4.08±6.47E-16	1.14±0.21E-14
June	7.21±6.86E-16	1.31±0.22E-14
July	6.66±6.64E-16	1.22±0.22E-14
August	6.49±6.53E-16	1.30±0.24E-14
September	2.64±6.33E-16	8.47±2.16E-15
October	2.40±6.69E-16	7.66±2.04E-15
November	5.88±7.39E-16	1.23±0.23E-14
December	7.13±6.66E-16	1.37±0.24E-14

Quarter	K-40	Co-60	Sr-90	Cs-137
1st Quarter	1.18±3.87E-15	0.16±1.62E-16	7.91±5.75E-17	0.85±1.83E-16
2nd Quarter	0.00±2.22E-15	-0.47±1.52E-16	-2.04±8.79E-17	0.16±1.51E-16
3rd Quarter	2.15±3.39E-15	-0.98±2.24E-16	0.36±1.19E-16	0.71±1.85E-16
4th Quarter	4.15±3.50E-15	0.49±1.24E-16	6.08±8.08E-17	0.17±1.15E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	1.08±1.23E-17	6.84±1.72E-17	2.54±5.28E-18	4.76±1.62E-17	1.40±0.02E-10
2nd Quarter	4.12±7.52E-18	1.05±0.31E-16	8.94±9.15E-18	1.17±0.33E-16	1.58±0.04E-10
3rd Quarter	2.25±2.18E-17	5.42±2.57E-17	-0.49±1.31E-17	1.47±1.90E-17	1.51±0.06E-10
4th Quarter	1.57±0.36E-16	6.04±2.15E-17	5.77±7.10E-18	5.46±1.90E-17	1.29±0.02E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	-0.09±1.43E-17	1.72±7.02E-18	0.39±1.72E-17
2nd Quarter	1.39±0.86E-17	2.11±6.71E-18	0.07±1.61E-17
3rd Quarter	-4.43±9.16E-18	-0.44±5.32E-18	-1.83±9.77E-18
4th Quarter	-4.08±3.40E-17	1.27±0.90E-17	1.52±2.59E-17

Table C - 2.12

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the NDA Air Sampler (ANNDAAM)

Month	Alpha	Beta
January	1.26±0.79E-15	2.18±0.29E-14
February	9.12±6.50E-16	1.84±0.26E-14
March	6.42±6.13E-16	1.49±0.24E-14
April	7.87±6.51E-16	1.59±0.25E-14
May	6.14±7.24E-16	1.13±0.21E-14
June	6.77±7.04E-16	1.39±0.23E-14
July	7.42±7.18E-16	1.39±0.24E-14
August	9.24±7.23E-16	1.77±0.27E-14
September	5.72±7.17E-16	1.96±0.28E-14
October	5.73±7.94E-16	1.91±0.28E-14
November	5.32±7.65E-16	2.17±0.28E-14
December	1.04±0.74E-15	1.78±0.26E-14

Quarter	K-40	Co-60	Sr-90	Cs-137
1st Quarter	2.57±4.01E-15	0.00±8.17E-16	3.32±6.16E-17	-1.95±2.09E-16
2nd Quarter	0.39±4.45E-15	0.61±1.96E-16	-2.77±9.20E-17	-0.56±2.01E-16
3rd Quarter	4.38±3.50E-15	-0.37±1.64E-16	1.73±1.33E-16	1.68±1.55E-16
4th Quarter	1.02±3.06E-15	-0.38±1.35E-16	1.32±0.97E-16	0.67±1.22E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	3.11±7.21E-18	5.18±1.03E-17	1.66±3.62E-18	5.39±1.15E-17	1.30±0.02E-10
2nd Quarter	1.02±0.67E-17	7.14±1.79E-17	1.30±0.76E-17	8.62±2.00E-17	1.66±0.03E-10
3rd Quarter	1.34±2.38E-17	8.05±2.98E-17	0.98±1.54E-17	9.15±2.95E-17	1.42±0.06E-10
4th Quarter	2.02±0.42E-16	5.47±1.87E-17	1.40±6.30E-18	5.61±1.90E-17	1.60±0.03E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	0.72±1.88E-17	-0.92±6.76E-18	1.74±2.16E-17
2nd Quarter	0.28±1.34E-17	-0.99±9.16E-18	1.55±2.00E-17
3rd Quarter	-0.09±1.81E-17	1.62±7.29E-18	-3.08±7.68E-18
4th Quarter	-4.55±5.98E-17	1.10±1.02E-17	3.02±2.47E-17

Table C - 2.13

1997 Airborne Radioactivity Concentrations (µCi/mL) at the SDA Trench 9 Air Sampler (ANSDAT9)

Month	Alpha	Beta	H-3
January	1.36±1.06E-15	2.34±0.38E-14	7.08±9.38E-13
February	3.73±6.94E-16	1.93±0.34E-14	1.69±0.64E-12
March	0.94±6.56E-16	1.65±0.33E-14	2.17±1.84E-12
April	1.09±0.95E-15	1.49±0.32E-14	3.76±0.38E-12
May	0.54±1.16E-15	1.41±0.34E-14	1.43±0.43E-12
June	0.88±1.15E-15	1.57±0.35E-14	2.51±0.90E-12
July	0.98±1.03E-15	1.55±0.32E-14	0.79±1.07E-12
August	4.01±7.61E-16	1.53±0.32E-14	1.14±1.02E-12
September	1.30±8.36E-16	1.76±0.34E-14	5.42±9.92E-13
October	0.72±1.07E-15	2.04±0.35E-14	0.99±1.85E-12
November	0.37±1.41E-15	2.02±0.46E-14	3.06±1.10E-12
December	6.71±8.80E-16	1.43±0.31E-14	1.28±0.39E-12

Quarter	K-40	Co-60	I-129	Cs-137
1st Quarter	3.58±5.03E-15	-0.26±3.09E-16	-4.38±4.79E-16	0.01±3.11E-16
2nd Quarter	2.68±5.48E-15	-0.50±2.98E-16	0.74±3.13E-16	0.57±2.80E-16
3rd Quarter	1.62±3.78E-15	0.00±7.01E-16	6.09±6.61E-16	0.51±2.28E-16
4th Quarter	5.75±5.06E-15	0.84±2.45E-16	1.84±6.73E-16	0.98±2.19E-16

Table C - 2.14

1997 Airborne Radioactive Effluent Totals (curies) from Outdoor Ventilation Enclosures/Portable Ventilation Units

Month	Alpha	Beta
January	*NA*	*NA*
February	*NA*	*NA*
March	*NA*	*NA*
April	*NA*	*NA*
May	-0.59±1.50E-10	3.84±3.62E-10
June	*NA*	*NA*
July	-6.29±5.28E-11	-0.92±1.40E-10
August	*NA*	*NA*
September	*NA*	*NA*
October	*NA*	*NA*
November	1.80±2.04E-10	9.80±4.17E-10
December	-1.43±6.29E-11	-0.78±2.65E-10
Annual Total	0.44±2.66E-10	1.19±0.63E-09

Quarter	Co-60	Sr-90	Cs-134	Cs-137	Eu-154
1st Quarter	*NA*	*NA*	*NA*	*NA*	*NA*
2nd Quarter	-0.57±2.52E-10	-1.39±1.57E-10	0.13±2.76E-10	-0.44±2.58E-10	0.39±6.78E-10
3rd Quarter	-0.81±2.59E-10	0.99±1.51E-10	1.26±2.61E-10	-0.97±2.16E-10	-7.06±7.65E-10
4th Quarter	4.74±5.13E-10	-0.45±2.97E-10	-1.09±3.49E-10	0.74±3.30E-10	5.01±9.32E-10
Annual Total	3.35±6.27E-10	-0.85±3.68E-10	0.30±5.16E-10	-0.67±4.72E-10	-0.17±1.38E-09

	U-232	U-233/234	U-235/236	U-238	**Total U** (g)
1st Quarter	*NA*	*NA*	*NA*	*NA*	*NA*
2nd Quarter	-0.12±1.84E-11	2.61±1.79E-11	1.54±1.53E-11	2.36±1.73E-11	1.17±0.10E-05
3rd Quarter	2.32±2.81E-11	2.47±2.72E-11	0.53±1.46E-11	2.31±1.65E-11	0.00±0.00E+00
4th Quarter	8.97±2.33E-10	5.79±5.48E-11	0.00±2.90E-11	5.79±5.48E-11	1.45±0.05E-05
Annual Total	9.19±2.35E-10	1.09±0.64E-10	2.07±3.59E-11	1.05±0.60E-10	2.62±0.12E-05

	Pu-238	Pu-239/240	Am-241
1st Quarter	*NA*	*NA*	*NA*
2nd Quarter	-0.18±2.30E-11	-0.47±1.20E-11	1.65±1.51E-11
3rd Quarter	-0.01±1.17E-11	-3.22±3.74E-12	1.55±1.40E-11
4th Quarter	-2.08±1.71E-10	2.48±5.90E-11	-0.39±1.07E-10
Annual Total	-2.10±1.73E-10	1.68±6.04E-11	-0.07±1.09E-10

NA = Not applicable: no OVEs/PVUs were operated during this month or quarter.

Table C - 2.15

1997 Airborne Radioactive Effluent Totals (curies) from the Demonstration CO_2 Decontamination Facility (ANCO2DV)

Month	Alpha	Beta
January	-5.90±8.65E-10	1.20±2.79E-09
February	0.70±1.14E-09	0.22±3.34E-09
March	-5.48±9.31E-10	-0.97±3.06E-09
April	-0.53±1.15E-09	1.31±3.62E-09
May	-0.90±1.38E-09	2.92±3.72E-09
June	-5.48±9.29E-10	-0.87±3.23E-09
July	2.73±5.35E-10	-0.32±2.38E-09
Annual Total	-2.14±2.70E-09	3.49±8.45E-09

Quarter	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Quarter	-0.01±3.61E-09	0.81±1.19E-09	9.44±6.77E-09	0.30±4.12E-09	1.27±3.84E-09
2nd Quarter	2.64±3.42E-09	-0.65±1.82E-09	-0.35±7.49E-09	-0.52±3.64E-09	0.63±3.23E-09
3rd Quarter	4.46±3.84E-09	*NA*	-3.04±7.21E-09	2.20±3.73E-09	-0.23±3.65E-09
4th Quarter	*NA*	*NA*	*NA*	*NA*	*NA*
Annual Total	7.09±6.28E-09	0.15±2.17E-09	0.61±1.24E-08	1.98±6.64E-09	1.67±6.20E-09

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Quarter	-0.47±1.10E-08	1.00±2.34E-10	7.04±2.94E-10	1.97±1.51E-10	3.66±2.14E-10
2nd Quarter	3.64±8.56E-09	0.47±1.97E-10	9.05±3.90E-10	3.58±2.62E-10	5.47±2.99E-10
3rd Quarter	1.74±1.83E-08	1.98±5.50E-10	4.00±4.11E-10	-2.26±3.70E-10	5.93±4.17E-10
4th Quarter	*NA*	*NA*	*NA*	*NA*	*NA*
Annual Total	1.63±2.30E-08	3.44±6.29E-10	2.01±0.64E-09	3.30±4.78E-10	1.51±0.56E-09

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Quarter	1.34±0.02E-03	2.42±3.58E-10	1.02±1.80E-10	1.54±2.27E-10
2nd Quarter	1.01±0.05E-03	-1.70±3.18E-10	1.09±1.80E-10	1.59±1.49E-10
3rd Quarter	1.47±0.25E-04	1.71±4.27E-10	2.19±2.14E-10	0.67±4.03E-10
4th Quarter	*NA*	*NA*	*NA*	*NA*
Annual Total	2.50±0.06E-03	2.43±6.42E-10	4.30±3.33E-10	3.80±4.86E-10

NA - Not applicable. CO_2 decontamination facility was not operated after July 1997.

Table C - 2.16

1997 Airborne Radioactivity Concentrations (µCi/mL) at the Rock Springs Road Air Sampler (AFRSPRD)

Month	Alpha	Beta	H-3
January	7.79±8.50E-16	1.79±0.34E-14	5.97±6.45E-13
February	9.10±8.88E-16	1.77±0.35E-14	1.24±0.66E-12
March	3.57±7.72E-16	1.28±0.32E-14	-0.13±3.23E-13
April	9.73±9.52E-16	1.39±0.32E-14	4.21±4.71E-13
May	2.29±9.44E-16	1.16±0.29E-14	1.96±3.66E-13
June	4.59±9.40E-16	1.48±0.31E-14	5.04±6.98E-13
July	6.21±9.65E-16	1.40±0.32E-14	-1.27±9.72E-13
August	6.66±8.56E-16	1.32±0.31E-14	3.27±8.53E-13
September	0.78±1.03E-15	1.64±0.34E-14	-2.44±7.81E-13
October	0.34±1.01E-15	1.75±0.34E-14	0.42±1.07E-12
November	3.44±9.90E-16	1.91±0.34E-14	3.90±3.85E-12
December	7.31±8.88E-16	1.69±0.33E-14	5.41±4.65E-13

Quarter	K-40	Co-60	Sr-90	I-129	Cs-137
1st Quarter	5.07±5.51E-15	-0.71±2.51E-16	1.00±0.96E-16	0.78±3.57E-16	1.79±2.33E-16
2nd Quarter	2.76±5.29E-15	-0.42±2.85E-16	0.38±1.75E-16	-0.93±4.84E-16	0.64±2.72E-16
3rd Quarter	2.69±4.58E-15	-2.08±4.20E-16	3.50±2.14E-16	-2.00±7.23E-16	0.46±3.03E-16
4th Quarter	5.95±5.48E-15	-0.90±1.94E-16	1.68±1.56E-16	2.12±4.94E-16	-0.33±1.82E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	2.10±2.16E-17	1.14±0.33E-16	5.59±8.18E-18	8.08±2.95E-17	3.43±0.04E-10
2nd Quarter	1.13±1.42E-17	1.27±0.30E-16	9.09±9.16E-18	1.06±0.28E-16	2.01±0.06E-10
3rd Quarter	1.26±2.75E-17	1.17±0.41E-16	0.80±1.25E-17	1.11±0.41E-16	2.77±0.14E-10
4th Quarter	2.96±0.60E-16	7.82±2.88E-17	0.83±1.75E-17	9.68±3.29E-17	2.64±0.05E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	-1.47±2.35E-17	2.41±7.94E-18	-0.62±1.71E-17
2nd Quarter	0.80±2.14E-17	4.13±7.81E-18	-0.07±2.78E-17
3rd Quarter	0.06±1.28E-17	9.04±9.02E-18	-0.17±1.14E-17
4th Quarter	9.74±3.21E-18	1.10±1.27E-17	1.63±3.00E-17

Table C - 2.17

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Dutch Hill Air Sampler (AFBOEHN)

Month	Alpha	Beta	Sr-90	Cs-137
January	9.56±8.97E-16	2.17±0.36E-14		
February	9.16±8.89E-16	1.98±0.36E-14		
March	1.06±0.97E-15	1.71±0.34E-14		
1st Qtr			7.08±7.77E-17	0.06±2.58E-16
April	6.46±8.58E-16	2.03±0.36E-14		
May	3.09±9.72E-16	1.44±0.31E-14		
June	0.81±1.03E-15	1.78±0.33E-14		
2nd Qtr			5.59±9.13E-17	1.46±2.31E-16
July	6.59±9.76E-16	1.83±0.35E-14		
August	8.78±9.20E-16	1.70±0.34E-14		
September	3.65±9.29E-16	2.20±0.37E-14		
3rd Qtr			4.05±2.10E-16	1.56±2.91E-16
October	0.78±1.11E-15	2.29±0.37E-14		
November	0.79±1.10E-15	2.44±0.37E-14		
December	8.60±9.29E-16	2.07±0.35E-14		
4th Qtr			1.36±1.44E-16	0.02±1.74E-16

Table C - 2.18

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Fox Valley Air Sampler (AFFXVRD)

Month	Alpha	Beta	Sr-90	Cs-137
January	9.27±8.68E-16	2.26±0.36E-14		
February	1.29±0.95E-15	2.00±0.34E-14		
March	8.72±8.96E-16	1.68±0.33E-14		
1st Qtr			1.20±0.73E-16	-1.95±2.42E-16
April	1.42±1.02E-15	1.64±0.32E-14		
May	1.97±9.09E-16	1.26±0.29E-14		
June	6.64±9.73E-16	1.55±0.31E-14		
2nd Qtr			1.41±0.90E-16	3.44±2.93E-16
July	7.96±9.88E-16	1.44±0.32E-14		
August	3.75±7.50E-16	1.34±0.31E-14		
September	0.79±1.01E-15	1.75±0.34E-14		
3rd Qtr			1.75±2.06E-16	1.43±2.81E-16
October	2.07±9.50E-16	1.94±0.35E-14		
November	1.91±9.66E-16	2.63±0.38E-14		
December	8.43±9.43E-16	2.11±0.36E-14		
4th Qtr			0.34±1.32E-16	1.22±1.84E-16

Table C - 2.19

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Bulk Storage Warehouse Air Sampler (AFBLKST)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.03±0.86E-15	1.96±0.33E-14		
February	6.54±7.54E-16	1.62±0.31E-14		
March	6.14±7.86E-16	1.37±0.30E-14		
1st Qtr			7.23±6.95E-17	1.85±3.33E-16
April	7.73±8.54E-16	1.58±0.32E-14		
May	2.46±9.23E-16	1.06±0.28E-14		
June	4.98±8.45E-16	1.54±0.27E-14		
2nd Qtr			0.74±5.64E-17	-1.07±2.24E-16
July	0.95±1.02E-15	1.35±0.31E-14		
August	5.44±8.46E-16	1.37±0.33E-14		
September	3.53±9.01E-16	1.71±0.34E-14		
3rd Qtr			2.58±1.88E-16	0.44±2.70E-16
October	2.04±9.50E-16	1.65±0.33E-14		
November	0.32±9.28E-16	1.87±0.35E-14		
December	4.10±8.14E-16	1.65±0.33E-14		
4th Qtr			-0.55±2.98E-16	-0.53±1.52E-16

Table C - 2.20

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Route 240 Air Sampler (AFRT240)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.08±0.96E-15	2.20±0.37E-14		
February	1.11±0.96E-15	1.93±0.36E-14		
March	6.05±8.73E-16	1.66±0.35E-14		
1st Qtr			1.51±0.85E-16	1.03±2.50E-16
April	8.35±9.05E-16	1.92±0.35E-14		
May	5.22±9.94E-16	1.27±0.30E-14		
June	5.71±9.47E-16	1.67±0.32E-14		
2nd Qtr			1.62±0.83E-16	-0.17±2.84E-16
July	4.45±8.97E-16	1.60±0.33E-14		
August	8.26±8.84E-16	1.50±0.32E-14		
September	0.82±1.17E-15	1.83±0.38E-14		
3rd Qtr			4.22±2.49E-16	-0.54±2.16E-16
October	2.82±9.70E-16	1.93±0.35E-14		
November	0.48±1.04E-15	2.00±0.35E-14		
December	5.62±8.58E-16	1.86±0.34E-14		
4th Qtr			3.12±1.53E-16	0.35±1.72E-16

Table C - 2.21

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Thomas Corners Road Air Sampler (AFTCORD)

Month	Alpha	Beta	Sr-90	Cs-137
January	8.21±8.36E-16	2.17±0.35E-14		
February	6.90±7.96E-16	1.84±0.34E-14		
March	5.28±7.97E-16	1.38±0.31E-14		
1st Qtr			1.64±0.67E-16	0.61±2.75E-16
April	9.64±9.20E-16	1.70±0.33E-14		
May	0.37±1.02E-15	1.10±0.30E-14		
June	5.52±9.65E-16	1.43±0.31E-14		
2nd Qtr			9.69±9.49E-17	1.94±2.84E-16
July	1.04±1.07E-15	1.45±0.32E-14		
August	4.25±8.09E-16	1.21±0.31E-14		
September	2.24±8.82E-16	1.52±0.33E-14		
3rd Qtr			5.90±2.98E-16	1.76±2.74E-16
October	0.91±1.14E-15	1.84±0.35E-14		
November	0.92±1.20E-15	2.11±0.38E-14		
December	7.27±9.46E-16	1.76±0.35E-14		
4th Qtr			0.87±1.88E-16	0.63±1.62E-16

Table C - 2.22

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the West Valley Air Sampler (AFWEVAL)

Month	Alpha	Beta	Sr-90	Cs-137
January	8.48±7.97E-16	2.06±0.33E-14		
February	5.80±7.19E-16	1.94±0.33E-14		
March	6.60±7.87E-16	1.43±0.30E-14		
1st Qtr			2.36±0.68E-16	1.66±2.79E-16
April	6.77±8.23E-16	1.71±0.33E-14		
May	0.25±8.67E-16	1.42±0.30E-14		
June	6.97±9.80E-16	1.66±0.32E-14		
2nd Qtr			0.88±8.67E-17	-1.65±2.81E-16
July	4.10±8.86E-16	1.79±0.34E-14		
August	6.26±8.29E-16	1.58±0.32E-14		
September	2.88±8.80E-16	1.92±0.35E-14		
3rd Qtr			-1.22±2.62E-16	-0.14±2.76E-16
October	0.92±1.12E-15	2.20±0.36E-14		
November	1.05±1.17E-15	2.34±0.37E-14		
December	8.08±9.22E-16	2.12±0.35E-14		
4th Qtr			0.39±1.18E-16	1.14±1.57E-16

Table C - 2.23

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Springville Air Sampler (AFSPRVL)

Month	Alpha	Beta	Sr-90	Cs-137
January	4.09±7.24E-16	1.71±0.33E-14		
February	8.60±8.57E-16	1.52±0.32E-14		
March	2.88±7.40E-16	1.36±0.32E-14		
1st Qtr			2.17±0.87E-16	-0.82±2.52E-16
April	9.32±9.18E-16	1.15±0.30E-14		
May	0.00±8.59E-16	1.03±0.28E-14		
June	6.97±9.79E-16	1.34±0.30E-14		
2nd Qtr			7.49±1.27E-16	-2.22±3.04E-16
July	0.81±1.11E-15	1.58±0.35E-14		
August	2.24±6.98E-16	1.28±0.30E-14		
September	1.96±8.52E-16	1.49±0.32E-14		
3rd Qtr			1.12±1.97E-16	-0.50±1.86E-16
October	0.45±1.01E-15	1.59±0.33E-14		
November	2.22±9.73E-16	1.99±0.35E-14		
December	6.60±8.82E-16	1.69±0.33E-14		
4th Qtr			1.24±1.24E-16	0.26±1.67E-16

Table C - 2.24

1997 Airborne Radioactivity Concentrations (µCi/mL) at the Great Valley Background Air Sampler (AFGRVAL)

Month	Alpha	Beta	H-3
January	1.22±0.95E-15	2.11±0.35E-14	1.81±2.10E-13
February	7.79±8.19E-16	1.77±0.33E-14	6.34±3.97E-13
March	8.40±8.89E-16	1.51±0.32E-14	1.34±2.45E-13
April	1.06±0.95E-15	1.53±0.32E-14	6.05±2.90E-13
May	-0.27±8.81E-16	1.15±0.29E-14	3.29±4.89E-13
June	0.72±1.01E-15	1.58±0.32E-14	7.75±9.00E-13
July	1.08±1.08E-15	1.52±0.33E-14	0.08±1.05E-12
August	4.64±7.99E-16	1.36±0.32E-14	0.76±1.06E-12
September	2.30±8.90E-16	1.69±0.34E-14	-3.07±8.45E-13
October	0.53±1.07E-15	1.69±0.34E-14	6.62±6.85E-13
November	0.51±1.05E-15	2.08±0.36E-14	5.31±3.49E-13
December	5.34±8.48E-16	1.70±0.33E-14	3.52±3.41E-13

Quarter	K-40	Co-60	Sr-90	I-129	Cs-137
1st Quarter	0.01±6.97E-15	0.06±2.98E-16	6.49±1.02E-16	1.03±2.85E-16	-0.14±3.11E-16
2nd Quarter	3.24±7.23E-15	-1.50±3.95E-16	0.95±1.54E-16	5.16±5.86E-16	-0.39±2.95E-16
3rd Quarter	0.10±7.76E-15	0.74±2.98E-16	3.71±2.35E-16	4.52±3.04E-16	1.13±2.81E-16
4th Quarter	0.00±2.44E-15	0.48±1.92E-16	1.22±3.29E-16	1.08±2.63E-16	-0.20±1.68E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	2.52±2.10E-17	9.34±2.50E-17	4.07±6.92E-18	8.69±2.71E-17	2.66±0.03E-10
2nd Quarter	4.36±1.63E-17	1.03±0.27E-16	1.19±1.24E-17	1.16±0.29E-16	1.04±0.03E-10
3rd Quarter	4.60±2.50E-17	8.95±4.04E-17	1.83±1.98E-17	1.24±0.46E-16	2.98±0.11E-10
4th Quarter	2.81±0.57E-16	7.75±2.62E-17	3.70±9.08E-18	9.04±2.81E-17	2.85±0.04E-10

	Pu-238	Pu-239/240	Am-241
1st Quarter	1.20±2.01E-17	-1.93±1.67E-17	0.30±2.10E-17
2nd Quarter	-1.47±1.83E-17	0.77±1.20E-17	2.68±3.30E-17
3rd Quarter	0.72±2.86E-17	1.80±1.49E-17	1.65±2.35E-17
4th Quarter	-1.62±0.70E-17	0.50±1.28E-17	1.62±2.09E-17

Table C - 2.25

1997 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Nashville Background Air Sampler (AFNASHV)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.18±0.94E-15	2.09±0.35E-14		
February	1.22±0.94E-15	2.00±0.35E-14		
March	9.34±9.14E-16	1.54±0.33E-14		
1st Qtr			1.93±0.99E-16	-1.29±2.62E-16
April	1.06±0.95E-15	1.59±0.33E-14		
May	0.29±1.23E-15	1.26±0.35E-14		
June	7.83±9.92E-16	1.40±0.30E-14		
2nd Qtr			1.31±8.46E-17	2.85±2.89E-16
July	5.82±9.26E-16	1.60±0.32E-14		
August	5.41±7.92E-16	1.31±0.30E-14		
September	2.78±8.64E-16	1.76±0.34E-14		
3rd Qtr			0.61±2.84E-16	1.96±2.07E-16
October	3.05±9.65E-16	1.96±0.35E-14		
November	0.51±1.05E-15	2.24±0.37E-14		
December	1.11±0.99E-15	1.89±0.34E-14		
4th Qtr			0.79±1.94E-16	1.82±1.63E-16

Table C - 2.26

Radioactivity and pH in Fallout During 1997 (nCi/m²/month)
Dutch Hill (AFDHFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH
January	2.45±0.53E-02	4.02±0.26E-01	1.32±0.76E-07	0.00±6.00E+00	0.00±4.38E-01	4.08
February	1.48±0.50E-02	3.03±0.26E-01	1.90±7.60E-08	0.00±7.97E+00	0.00±6.86E-01	4.46
March	6.07±1.23E-02	6.57±0.47E-01	-1.27±0.79E-07	0.00±1.76E-01	0.00±1.50E+00	4.36
April	2.66±0.54E-02	3.10±0.16E-01	2.30±8.30E-08	0.00±4.02E+00	0.00±3.68E-01	4.26
May	8.52±8.28E-02	4.05±0.18E+00	-3.42±1.03E-07	0.00±3.01E-01	0.00±1.75E+00	7.84
June	5.46±2.45E-02	5.30±0.90E-01	-2.83±8.15E-08	0.00±2.35E-01	0.00±1.83E+00	7.88
July	1.88±3.71E-02	2.84±0.16E+00	0.56±8.13E-08	0.00±2.77E-01	0.00±1.93E+00	8.17
August	5.08±3.75E-02	2.09±0.13E+00	2.21±7.87E-08	0.00±1.57E-01	0.00±1.15E+00	8.28
September	5.11±2.14E-02	5.28±0.83E-01	-7.44±7.86E-08	0.00±2.64E-01	0.00±2.18E+00	6.48
October	4.55±1.20E-02	6.77±0.50E-01	-5.99±9.18E-08	0.00±1.48E-01	0.00±8.39E-01	6.05
November	3.75±0.92E-02	3.94±0.38E-01	2.02±0.82E-07	0.00±1.56E-01	0.00±1.47E+00	4.10
December	3.59±0.69E-02	5.25±0.35E-01	1.39±0.78E-07	0.00±1.33E-01	0.00±9.70E-01	4.01

Table C - 2.27

Radioactivity and pH in Fallout During 1997 (nCi/m²/month)
Rain Gauge (ANRGFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH
January	3.63±1.05E-02	6.92±0.53E-01	1.34±0.75E-07	0.00±1.68E-01	0.00±1.89E+00	4.20
February	*(Sample lost due to severe weather)*					
March	4.24±1.52E-02	5.18±0.56E-01	-7.08±8.00E-08	0.00±3.19E-01	0.00±2.47E+00	6.13
April	1.56±0.84E-02	2.14±0.25E-01	3.96±8.18E-08	0.00±6.72E+00	0.00±4.31E-01	6.59
May	5.45±2.33E-02	5.79±0.76E-01	-2.30±7.72E-08	0.00±3.96E-01	0.00±3.38E+00	6.04
June	1.07±0.20E-01	6.70±0.61E-01	-8.04±8.52E-08	0.00±2.95E-01	0.00±1.84E+00	7.28
July	5.87±1.79E-02	1.22±0.08E+00	-7.54±8.16E-08	0.00±1.91E-01	0.00±1.34E+00	7.07
August	3.76±1.52E-02	6.63±0.58E-01	5.25±8.22E-08	0.00±1.96E-01	0.00±1.71E+00	4.92
September	4.22±0.93E-02	9.20±0.49E-01	6.59±7.78E-08	0.00±2.37E-01	0.00±1.27E+00	4.07
October	3.31±1.21E-02	6.55±0.65E-01	-6.70±5.77E-08	0.00±2.04E-01	0.00±1.50E+00	3.41
November	1.54±0.75E-02	4.04±0.42E-01	1.65±0.81E-07	0.00±1.25E-01	0.00±1.10E+00	4.17
December	4.07±0.99E-02	7.02±0.53E-01	-9.58±8.12E-08	0.00±1.67E-01	0.00±1.11E+00	4.24

Table C - 2.28

Radioactivity and pH in Fallout During 1997 (nCi/m²/month)
Route 240 (AF24FOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH
January	2.29±0.62E-02	4.55±0.32E-01	1.14±0.75E-07	0.00±1.19E-01	0.00±1.05E+00	4.14
February	2.66±0.56E-02	4.13±0.26E-01	8.35±7.64E-08	0.00±9.94E+00	0.00±7.71E-01	4.31
March	4.18±1.08E-02	5.92±0.48E-01	-1.01±0.80E-07	0.00±2.52E-01	0.00±1.62E+00	4.13
April	2.60±0.54E-02	3.18±0.20E-01	-3.12±8.18E-08	0.00±6.00E+00	0.00±5.30E-01	4.15
May	7.14±2.34E-02	1.38±0.10E+00	7.17±7.90E-08	0.00±2.58E-01	0.00±1.90E+00	3.82
June	5.17±1.19E-02	7.34±0.50E-01	9.42±8.12E-08	0.00±1.11E-01	0.00±6.86E-01	4.01
July	4.08±1.34E-02	7.61±0.62E-01	-3.56±8.07E-08	0.00±1.31E-01	0.00±1.15E+00	4.09
August	2.07±0.92E-02	4.38±0.41E-01	-2.13±8.12E-08	0.00±8.30E+00	0.00±9.95E-01	4.71
September	2.36±1.05E-02	6.54±0.59E-01	-2.24±7.66E-08	0.00±1.38E-01	0.00±1.43E+00	4.18
October	4.06±1.16E-02	5.09±0.54E-01	-9.06±8.18E-08	0.00±1.73E-01	0.00±1.26E+00	3.21
November	1.60±0.62E-02	3.50±0.33E-01	1.97±0.82E-07	0.00±1.23E-01	0.00±1.33E+00	4.16
December	5.26±1.01E-02	7.15±0.49E-01	-1.13±0.81E-07	0.00±1.49E-01	0.00±9.11E-01	4.07

Table C - 2.29

Radioactivity and pH in Fallout During 1997 (nCi/m²/month)
Thomas Corners Road (AFTCFOP)

Month	Alpha	Beta	H-3 (µCi/mL)	K-40	Cs-137	pH
January	3.75±1.06E-02	7.92±0.57E-01	1.27±0.75E-07	0.00±2.17E-01	0.00±1.82E+00	4.18
February	2.98±1.06E-02	3.48±0.43E-01	-2.94±5.29E-08	0.00±1.83E-01	0.00±1.76E+00	5.52
March	4.90±1.51E-02	7.42±0.66E-01	-8.72±7.95E-08	0.00±2.03E-01	0.00±2.46E+00	4.75
April	1.48±0.61E-02	2.99±0.25E-01	5.69±5.81E-08	0.00±8.88E+00	0.00±9.01E-01	7.09
May	5.32±1.50E-02	1.18±0.07E+00	3.14±7.85E-08	0.00±3.96E-01	0.00±2.98E+00	3.60
June	6.70±1.56E-02	8.81±0.64E-01	4.38±8.02E-08	0.00±2.89E-01	0.00±1.82E+00	4.00
July	5.17±1.01E-02	8.49±0.44E-01	-4.34±8.06E-08	0.00±1.98E-01	0.00±1.22E+00	4.09
August	5.29±1.48E-02	7.50±0.61E-01	-6.34±5.65E-08	0.00±1.44E-01	0.00±1.36E+00	5.55
September	5.68±1.57E-02	8.37±0.73E-01	4.75±7.77E-08	0.00±2.42E-01	0.00±1.52E+00	4.09
October	2.32±1.06E-02	5.03±0.58E-01	2.06±8.28E-08	0.00±1.82E-01	0.00±1.41E+00	3.51
November	2.66±0.81E-02	3.48±0.37E-01	1.38±0.81E-07	0.00±1.72E-01	0.00±1.52E+00	4.26
December	4.66±1.13E-02	8.75±0.63E-01	-0.03±5.84E-08	0.00±1.57E-01	0.00±1.12E+00	4.23

Table C - 2.30

Radioactivity and pH in Fallout During 1997 (nCi/m^2/month)

Fox Valley Road (AFFXFOP)

Month	Alpha	Beta	H-3 (μCi/mL)	K-40	Cs-137	pH
January	4.95±1.03E-02	7.74±0.49E-01	1.29±0.76E-07	0.00±1.71E-01	0.00±1.20E+00	4.17
February	4.75±1.11E-02	4.69±0.43E-01	-1.05±7.49E-08	0.00±1.17E-01	0.00±9.13E-01	4.97
March	4.88±1.50E-02	5.78±0.58E-01	-7.18±7.98E-08	0.00±2.86E-01	0.00±2.33E+00	5.37
April	1.29±0.49E-02	2.70±0.20E-01	-2.70±8.09E-08	0.00±6.30E+00	0.00±5.21E-01	6.93
May	9.88±2.50E-02	1.08±0.09E+00	5.73±7.87E-08	0.00±2.36E-01	0.00±3.34E+00	3.93
June	1.44±0.22E-01	1.02±0.07E+00	-7.74±7.89E-08	0.00±2.27E-01	0.00±2.14E+00	4.12
July	6.88±1.44E-02	6.62±0.53E-01	-6.54±8.06E-08	0.00±2.61E-01	0.00±1.69E+00	4.43
August	1.04±0.18E-01	7.48±0.57E-01	-2.78±8.24E-08	0.00±1.38E-01	0.00±1.32E+00	5.35
September	5.16±1.36E-02	7.15±0.61E-01	0.11±7.76E-08	0.00±2.28E-01	0.00±1.28E+00	4.03
October	7.36±1.48E-02	3.92±0.47E-01	-1.06±0.84E-07	0.00±2.06E-01	0.00±1.63E+00	5.70
November	1.95±0.77E-02	2.60±0.34E-01	1.46±0.58E-07	0.00±1.12E-01	0.00±5.26E-01	5.20
December	2.26±0.78E-02	3.38±0.39E-01	9.88±7.78E-08	0.00±1.40E-01	0.00±1.42E+00	5.06

Appendix C - 3

Summary of Biological Data

Milk and Meat Samples are Collected from Local Bovine Herds

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Table C - 3.1
1997 Radioactivity Concentrations in Milk (µCi/mL)

Location	H-3	K-40	Sr-90	I-129	Cs-134	Cs-137
BFMCOBO (WNW Farm)						
1st Quarter	-0.85±1.07E-07	1.25±0.25E-06	3.62±0.35E-09	1.15±4.33E-10	-1.41±4.65E-09	3.07±5.54E-09
2nd Quarter	-1.66±8.44E-08	1.32±0.15E-06	1.45±0.30E-09	0.96±5.22E-10	-0.69±1.49E-09	1.33±2.11E-09
3rd Quarter	-5.29±9.14E-08	1.17±0.14E-06	7.68±4.17E-10	7.16±6.56E-10	0.27±1.34E-09	1.01±1.96E-09
4th Quarter	7.92±1.18E-07	9.50±1.27E-07	1.87±0.93E-09	-2.82±6.52E-10	-1.30±2.03E-09	3.91±2.04E-09
BFMCTLN (Control)						
1st Quarter	-0.78±1.11E-07	1.46±0.31E-06	6.81±2.76E-10	3.44±3.80E-10	-4.88±8.91E-09	3.06±7.90E-09
2nd Quarter	-0.74±8.46E-08	1.44±0.16E-06	1.73±0.41E-09	2.33±4.15E-10	-1.44±1.70E-09	-0.71±1.62E-09
3rd Quarter	-1.07±0.91E-07	1.58±0.19E-06	8.73±4.37E-10	0.16±2.41E-10	1.94±2.04E-09	0.20±2.40E-09
4th Quarter	1.18±0.13E-06	8.93±1.32E-07	1.36±0.79E-09	-0.69±4.60E-10	0.63±2.03E-09	0.80±2.09E-09
BFMCTLS (Control)						
1st Quarter	-0.65±1.13E-07	1.66±0.29E-06	7.59±4.66E-10	2.39±2.76E-10	4.16±5.39E-09	0.31±5.11E-09
2nd Quarter	-1.65±8.37E-08	1.58±0.17E-06	1.42±0.24E-09	3.04±5.16E-10	-0.90±1.80E-09	0.92±1.78E-09
3rd Quarter	-3.62±0.73E-07	1.40±0.18E-06	3.45±3.59E-10	1.08±4.36E-10	-1.46±2.48E-09	1.54±2.34E-09
4th Quarter	6.38±1.11E-07	1.47±0.18E-06	9.30±3.36E-10	2.07±4.73E-10	-2.07±2.22E-09	1.62±2.23E-09
BFMREED (NNW Farm)						
1st Quarter	-0.84±1.08E-07	1.57±0.27E-06	7.84±1.59E-10	2.55±4.79E-10	-0.62±5.23E-09	2.22±4.68E-09
2nd Quarter	-0.36±8.33E-08	1.59±0.18E-06	1.60±0.36E-09	1.45±1.66E-10	-1.25±1.89E-09	2.16±1.90E-09
3rd Quarter	-7.44±8.50E-08	1.45±0.18E-06	8.37±3.75E-10	3.56±2.92E-10	0.02±2.28E-09	-0.15±2.77E-09
4th Quarter	2.43±1.10E-07	1.39±0.17E-06	6.84±3.17E-10	0.23±4.58E-10	0.12±2.06E-09	2.19±2.56E-09
BFMSCHT (S Farm)						
Annual	0.72±1.12E-07	1.54±0.17E-06	2.54±0.81E-09	2.07±3.84E-10	1.58±3.20E-09	0.00±2.10E-09
BFMWIDR (SE Farm)						
Annual	0.52±1.13E-07	1.52±0.16E-06	2.30±0.83E-09	2.26±4.47E-10	-1.40±1.39E-09	0.98±1.61E-09

Table C - 3.2
1997 Radioactivity Concentrations in Meat

1997 Radioactivity Concentrations in Beef
(μCi/g - Dry)

Location	% Moisture	H-3 (μCi/mL)	K-40	Sr-90	Cs-134	Cs-137
Beef Flesh Background (BFBCTRL 06/97)	71.0	-0.30±1.00E-07	2.81±0.47E-06	0.89±1.87E-09	-5.79±8.98E-09	5.07±9.56E-09
Beef Flesh Background (BFBCTRL 12/97)	65.2	5.13±1.17E-07	1.05±0.13E-05	2.28±1.01E-08	0.00±1.69E-08	0.35±1.80E-08
Beef Flesh Near-site (BFBNEAR 06/97)	73.5	-7.60±9.96E-08	2.67±0.44E-06	4.52±1.97E-09	-6.64±9.82E-09	-0.74±9.62E-09
Beef Flesh Near-site (BFBNEAR 12/97)	87.1	1.38±0.13E-06	9.07±1.12E-06	2.73±1.46E-08	-0.83±1.48E-08	0.06±1.56E-08

1997 Radioactivity Concentrations in Venison
(μCi/g - Dry)

Location	% Moisture	H-3 (μCi/mL)	K-40	Sr-90	Cs-134	Cs-137
Deer Flesh Background (BFDCTRL)	65.5	4.41±1.03E-07	9.27±1.08E-06	5.01±0.77E-08	-1.78±1.37E-08	2.80±4.14E-08
Deer Flesh Background (BFDCTRL)	70.8	1.10±0.12E-06	9.84±1.19E-06	3.14±0.69E-08	-0.26±1.71E-08	9.73±3.25E-08
Deer Flesh Background (BFDCTRL)	64.2	1.22±0.12E-06	1.23±0.14E-05	5.72±6.93E-09	0.05±1.36E-08	1.47±1.33E-08
Deer Flesh Near-site (BFDNEAR)	50.5	4.62±1.00E-07	1.09±0.13E-05	1.15±1.02E-08	-0.46±1.57E-08	4.44±0.59E-07
Deer Flesh Near-site (BFDNEAR)	61.0	1.15±0.12E-06	1.25±0.15E-05	7.87±8.15E-09	-0.77±1.67E-08	0.00±1.88E-08
Deer Flesh Near-site (BFDNEAR)	72.3	6.87±1.00E-07	7.70±0.91E-06	8.16±6.22E-09	-0.08±1.09E-08	0.67±1.11E-08

Table C - 3.3
1997 Radioactivity Concentrations in Food Crops (µCi/g-Dry)

Location	% Moisture	H-3 (µCi/mL)	K-40	Co-60	Sr-90	Cs-137
CORN						
Background (BFVCTRC)	82.6	5.23±1.31E-07	1.42±0.18E-05	-2.67±3.42E-08	4.71±3.88E-09	0.30±2.62E-08
Near-site (BFVNEAC)	84.3	-0.55±1.14E-07	1.71±0.20E-05	0.33±3.24E-08	2.33±1.20E-08	1.12±3.13E-08
BEANS						
Background (BFVCTRB)	93.3	2.85±1.19E-07	3.23±0.40E-05	-0.22±6.25E-08	9.95±2.79E-08	4.62±5.18E-08
Near-site (BFVNEAB)	93.6	1.26±1.14E-07	3.17±0.39E-05	1.84±5.42E-08	9.43±1.39E-08	1.50±4.59E-08
APPLES						
Background (BFVCTRA)	84.4	-0.16±1.13E-07	8.79±1.88E-06	7.31±5.69E-08	1.69±2.53E-09	0.68±4.85E-08
Near-site* (BFVNEAAF)	76.4	4.34±1.27E-07	5.14±0.95E-06	-0.23±2.73E-08	8.30±2.25E-09	1.42±2.44E-08
HAY						
Background (BFHCTLN)	*NA*	*NA*	3.29±0.41E-05	1.61±6.36E-08	3.72±0.56E-08	-6.36±5.56E-08
Near-site (BFHNEAR)	*NA*	*NA*	1.86±0.29E-05	-5.72±9.46E-08	3.45±0.10E-07	2.70±6.51E-08

** Apple sampling location changed to near the location of the maximally exposed off-site individual..*
NA - Not applicable.

Table C - 3.4

1997 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek above the Springville Dam (BFFCATC)
(µCi/g - dry)

1st half 1997

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	81.0	1.26±0.39E-08	-1.85±2.05E-08	0.46±2.22E-08
Hog-nosed Sucker	75.0	1.46±0.48E-08	-0.86±2.42E-08	-0.42±2.30E-08
Hog-nosed Sucker	80.0	5.66±6.54E-09	-2.14±1.79E-08	-1.12±1.74E-08
Hog-nosed Sucker	77.0	2.82±0.41E-09	-2.22±2.36E-08	-0.26±2.04E-08
Brown Trout	77.0	2.47±2.08E-09	1.57±1.58E-08	1.29±2.12E-08
Hog-nosed Sucker	80.0	7.99±6.19E-09	-0.46±1.26E-08	0.62±1.25E-08
Hog-nosed Sucker	75.0	2.54±0.48E-08	-0.56±1.12E-08	1.21±0.98E-08
Hog-nosed Sucker	77.0	2.24±0.71E-08	-0.91±1.19E-08	0.39±1.13E-08
Hog-nosed Sucker	74.0	2.86±0.86E-08	-0.37±1.10E-08	0.33±1.00E-08
Hog-nosed Sucker	84.0	1.89±2.36E-08	-0.80±1.06E-08	2.95±9.50E-09
Average % Moisture	78.0			
Median		1.85E-08	<1.42E-08	<1.50E-08
Maximum		2.86E-08	<2.42E-08	1.21E-08
Minimum		2.47E-09	<1.06E-08	<9.50E-09

2nd half 1997

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	74.2	4.77±0.51E-08	0.05±1.82E-08	2.09±1.89E-08
Hog-nosed Sucker	74.2	3.78±0.36E-08	-1.47±1.75E-08	3.00±2.30E-08
Hog-nosed Sucker	75.0	2.91±0.31E-08	-2.49±1.65E-08	0.00±3.16E-08
Hog-nosed Sucker	74.1	5.04±0.63E-08	-1.07±2.15E-08	1.69±1.97E-08
Hog-nosed Sucker	74.0	8.28±0.83E-08	-2.82±2.50E-08	2.16±2.58E-08
Hog-nosed Sucker	74.2	4.01±2.81E-08	-2.01±1.86E-08	0.80±4.84E-08
Hog-nosed Sucker	75.6	5.50±1.19E-08	-2.32±2.04E-08	0.10±2.02E-08
Hog-nosed Sucker	72.0	4.18±1.21E-08	-2.30±1.92E-08	0.20±1.85E-08
Hog-nosed Sucker	74.3	5.44±1.30E-08	-0.26±2.34E-08	-1.75±2.19E-08
Hog-nosed Sucker	74.0	9.23±1.40E-08	-4.02±2.71E-08	3.43±2.85E-08
Average % Moisture	74.2			
Median		4.91E-08	<1.98E-08	<2.39E-08
Maximum		9.23E-08	<2.71E-08	3.43E-08
Minimum		2.91E-08	<1.65E-08	<1.85E-08

Table C - 3.4 (continued)

1997 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek Background (BFFCTRL)

(μCi/g - dry)

1st half 1997

Species	% Moisture	Sr-90	Cs-134	Cs-137
Brown Trout	73.0	1.34±2.29E-09	-0.69±2.08E-08	-0.57±1.91E-08
Hog-nosed Sucker	83.0	0.03±4.51E-09	1.64±1.67E-08	2.10±2.49E-08
Hog-nosed Sucker	75.0	4.74±2.86E-09	-0.42±1.91E-08	0.65±1.96E-08
Brown Trout	79.0	1.19±2.44E-09	0.98±1.77E-08	0.63±1.75E-08
Hog-nosed Sucker	79.0	8.35±4.28E-09	0.45±1.23E-08	0.06±1.09E-08
Brown Trout	77.0	9.73±3.34E-09	-0.20±2.07E-08	-0.98±1.94E-08
Brown Trout	80.0	-0.23±1.68E-08	-0.26±1.94E-08	0.93±1.77E-08
Hog-nosed Sucker	76.0	1.68±1.59E-09	-0.20±1.11E-08	-0.08±1.07E-08
Brown Trout	82.0	-1.61±1.01E-07	-0.62±1.24E-08	0.36±1.09E-08
White Sucker	81.0	6.24±3.48E-09	-0.34±1.08E-08	0.54±1.02E-08
Average % Moisture	78.5			
Median		5.49E-09	<1.72E-08	<1.76E-08
Maximum		9.73E-09	<2.08E-08	<2.49E-08
Minimum		1.68E-09	<1.08E-08	<1.02E-08

2nd half 1997

Species	% Moisture	Sr-90	Cs-134	Cs-137
Brown Trout	75.6	2.95±1.43E-08	-1.93±4.19E-08	3.61±4.09E-08
Hog-nosed Sucker	72.5	7.23±3.84E-09	-2.93±1.98E-08	2.43±2.51E-08
Hog-nosed Sucker	74.4	3.36±0.95E-08	-1.26±1.96E-08	0.60±1.69E-08
Hog-nosed Sucker	76.1	7.75±3.76E-09	-0.35±2.04E-08	-0.33±2.05E-08
Brown Trout	75.2	4.18±1.83E-08	-1.32±0.76E-07	-0.82±7.11E-08
Hog-nosed Sucker	74.7	2.66±1.19E-08	0.25±2.07E-08	0.07±2.09E-08
Brown Trout	79.0	4.83±0.93E-08	-2.17±2.57E-08	0.82±2.47E-08
Brown Trout	78.3	1.91±1.95E-08	-3.73±4.14E-08	-1.10±3.68E-08
Hog-nosed Sucker	74.4	1.10±0.29E-08	-0.84±2.29E-08	-0.31±2.15E-08
Hog-nosed Sucker	75.1	1.28±1.78E-08	-2.28±1.51E-08	0.00±4.47E-08
Average % Moisture	75.5			
Median		2.31E-08	<2.18E-08	<2.49E-08
Maximum		4.83E-08	<7.62E-08	<7.11E-08
Minimum		7.23E-09	<1.51E-08	<1.69E-08

Table C - 3.4 (concluded)

1997 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek below the Springville Dam (BFFCATD)

(µCi/g - dry)

Annual

Species	% Moisture	Sr-90	Cs-134	Cs-137
Steelhead Trout	65.7	-1.57±4.00E-09	-1.49±1.53E-08	2.55±1.78E-08
Steelhead Trout	72.3	-2.42±5.01E-09	-0.17±1.68E-08	1.35±1.87E-08
Steelhead Trout	75.5	1.28±0.07E-07	-0.88±1.71E-08	3.88±2.50E-08
Steelhead Trout	71.7	5.25±3.91E-09	0.40±2.13E-08	4.37±2.76E-08
Steelhead Trout	75.3	6.24±4.05E-09	-0.12±2.50E-08	3.76±4.64E-08
Coho Salmon	73.8	2.63±0.38E-08	2.12±3.15E-08	1.95±1.79E-08
Steelhead Trout	74.4	1.25±0.46E-08	2.47±2.35E-08	1.76±2.89E-08
Steelhead Trout	72.6	4.69±2.42E-09	-0.99±1.14E-08	2.87±1.74E-08
Steelhead Trout	72.3	6.92±4.12E-09	-0.86±1.71E-08	5.33±2.95E-08
Steelhead Trout	71.1	8.73±3.46E-09	-0.80±2.14E-08	0.91±1.88E-08
Average % Moisture	72.5			
Median		6.58E-09	<1.92E-08	2.88E-08
Maximum		1.28E-07	2.47E-08	5.33E-08
Minimum		<4.00E-09	<1.14E-08	<1.87E-08

Appendix C - 4

Air Environmental TLD Package

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Table C - 4.1
Summary of 1997 Quarterly Averages of Off-site TLD Measurements
(mR ± 3 SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DFTLD01	17±3.5	18±2.8	19±2.8	18±3.2	18±3.1
DFTLD02	16±2.7	15±2.3	20±3.1	19±3.2	18±2.8
DFTLD03	17±5.3	17±4.7	22±6.4	23±6.6	20±5.8
DFTLD04	17±4.7	44±15.2**	23±5.6	20±2.8	20±4.4
DFTLD05	14±3.4	19±3.1	18±3.6	21±3.9	18±3.5
DFTLD06	19±3.6	19±4.6	20±3.9	22±6.9	20±4.8
DFTLD07	14±2.8	16±5.4	16±4.7	20±4.7	17±4.4
DFTLD08	15±2.6	20±8.0	24±6.7	19±6.7	20±6.0
DFTLD09	16±3.2	14±2.2	21±4.0	22±3.8	18±3.3
DFTLD10	15±5.6	97±19.8**	22±3.5	18±4.5	18±4.5
DFTLD11	17±3.1	20±3.8	21±4.8	22±2.4	20±3.5
DFTLD12	18±5.2	18±7.8	19±4.5	22±5.9	19±5.9
DFTLD13	15±2.9	19±3.4	21±3.5	19±4.5	19±3.6
DFTLD14	17±2.8	17±2.1	20±2.2	22±5.3	19±3.1
DFTLD15	16±4.1	*NA*	18±4.2	23±4.6	19±4.3
DFTLD16	16±2.5	18±3.7	17±2.1	18±4.1	17±3.1
DFTLD17	16±3.4	44±15.2**	28±2.6	*NR*	22±3.0
DFTLD20	13±1.3	14±1.5	19±5.0	*NR*	15±2.6
DFTLD21	15±1.9	19±3.3	19±4.1	*NR*	18±3.1
DFTLD22	15±2.4	16±2.2	20±2.4	*NR*	17±2.3
DFTLD23	15±3.9	17±1.9	16±2.7	*NR*	16±2.8
DFTLD37	19±4.0	17±2.1	23±2.1	24±7.0	21±3.8
DFTLD41	21±7.8	13±3.6	15±3.5	16±3.7	16±4.7

** Off-site locations are shown on Figures 2-14 (p. 2-27), A-7 (p. A-51), and A-9 (p. A-53). Background measurements are provided by off-site TLDs 17, 23, 37, and 41.*

*** Although passing data validation acceptance criteria, these values are believed to be analytical outliers. Since no reasonable justification for these values can be found they have been excluded from calculations of the average.*

NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

NA - Data not available. TLD missing.

Table C - 4.2
Summary of 1997 Quarterly Averages of On-site TLD Measurements
(mR ± 3 SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DNTLD18	26±4.2	26±3.1	35±4.1	NR	29±3.8
DNTLD19	17±2.7	22±8.0	21±5.2	NR	20±5.3
DNTLD24	641±30.4	677±4.9	692±28.4	NR	670±21
DNTLD25	23±5.7	19±2.8	24±3.5	23±2.9	22±3.7
DNTLD26	20±2.8	26±4.9	22±3.1	25±6.4	23±4.3
DNTLD27	15±3.9	20±9.5	18±1.6	20±4.9	18±5.0
DNTLD28	19±3.2	19±2.4	24±5.9	20±1.2	21±3.2
DNTLD29	19±2.9	18±2.1	21±3.6	25±1.0	21±2.4
DNTLD30	16±1.3	18±2.2	22±2.3	21±4.9	19±2.7
DNTLD31	17±2.5	17±1.7	17±4.9	19±2.2	18±2.8
DNTLD32	26±6.8	28±2.2	33±3.6	30±5.2	29±4.5
DNTLD33	28±3.3	29±3.8	33±7.2	33±4.7	31±4.8
DNTLD34	53±3.9	51±2.3	58±5.0	61±8.0	56±4.8
DNTLD35	76±5.0	75±4.5	80±9.4	81±4.8	78±5.9
DNTLD36	31±4.0	33±3.8	45±5.8	43±7.7	38±5.3
DNTLD38	32±4.8	27±2.4	32±3.8	35±9.4	32±5.1
DNTLD39	45±5.1	53±11.5	50±6.7	50±6.6	50±7.5
DNTLD40	133±9.4	132±8.5	132±9.7	123±13.4	130±10.3
DNTLD42	76±4.0	73±2.3	68±3.3	83±4.5	75±3.5
DNTLD43	25±4.4	27±3.0	31±3.7	30±3.6	28±3.7

** On-site locations are shown on Figures 2-13 (p. 2-26) and A-8 (p. A-52).*

NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table C - 4.3

3rd Quarter 1997 TLD Results and Instantaneous Dose Readings with a High-pressure Ion Chamber (HPIC) at Each Monitoring Location

Off-site Location Number	*3rd Quarter TLD Result* (μR/hr)	*August 1997 HPIC Results* (μR/hr)	*On-site Location Number*	*3rd Quarter TLD Result* (μR/hr)	*August 1997 HPIC Results* (μR/hr)
DFTLD01	8.43	9.78	DNTLD18	15.55	17.24
DFTLD02	8.87	9.44	DNTLD19	9.33	11.52
DFTLD03	9.76	8.61	DNTLD24	307.39	332.62
DFTLD04	10.20	9.02	DNTLD25	10.64	12.69
DFTLD05	7.99	9.72	DNTLD26	9.77	13.70
DFTLD06	8.87	9.53	DNTLD27	8.00	9.74
DFTLD07	7.10	8.34	DNTLD28	10.66	10.49
DFTLD08	10.65	8.76	DNTLD29	9.33	10.60
DFTLD09	9.32	9.04	DNTLD30	9.76	11.58
DFTLD10	9.76	9.47	DNTLD31	7.55	9.84
DFTLD11	9.32	9.90	DNTLD32	14.66	12.12
DFTLD12	8.41	9.41	DNTLD33	14.66	16.89
DFTLD13	9.30	9.22	DNTLD34	25.76	28.91
DFTLD14	8.85	8.50	DNTLD35	35.55	43.83
DFTLD15	7.97	8.54	DNTLD36	19.99	21.84
DFTLD16	7.52	8.82	DNTLD38	14.21	17.85
DFTLD17	12.42	8.63	DNTLD39	22.21	25.33
DFTLD20	8.42	9.24	DNTLD40	58.63	79.08
DFTLD21	8.43	9.21	DNTLD42	30.21	32.23
DFTLD22	8.87	9.92	DNTLD43	13.77	14.63
DFTLD23	7.10	9.32			
DFTLD37	10.20	9.61			
DFTLD41	6.65	8.91			

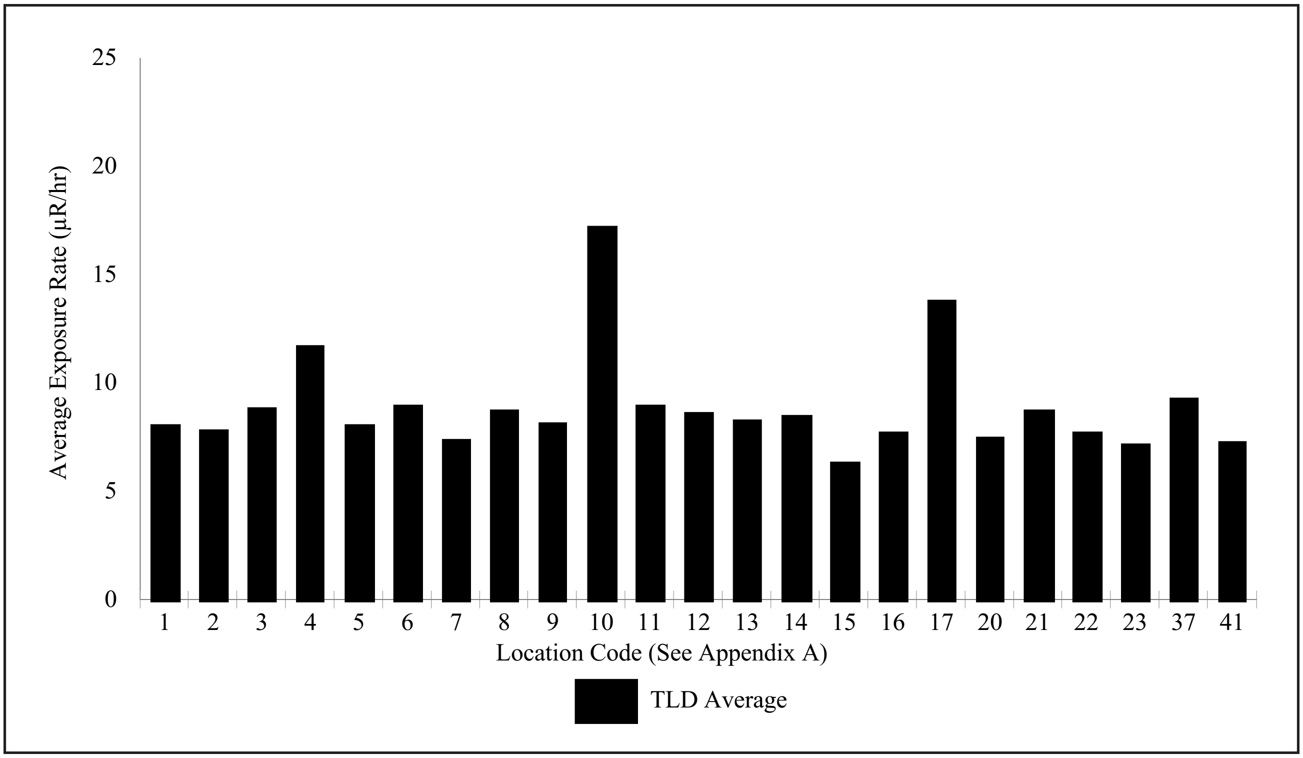

Figure C - 4.1

1997 Average Quarterly Gamma Exposure Rates around the West Valley Demonstration Project Site

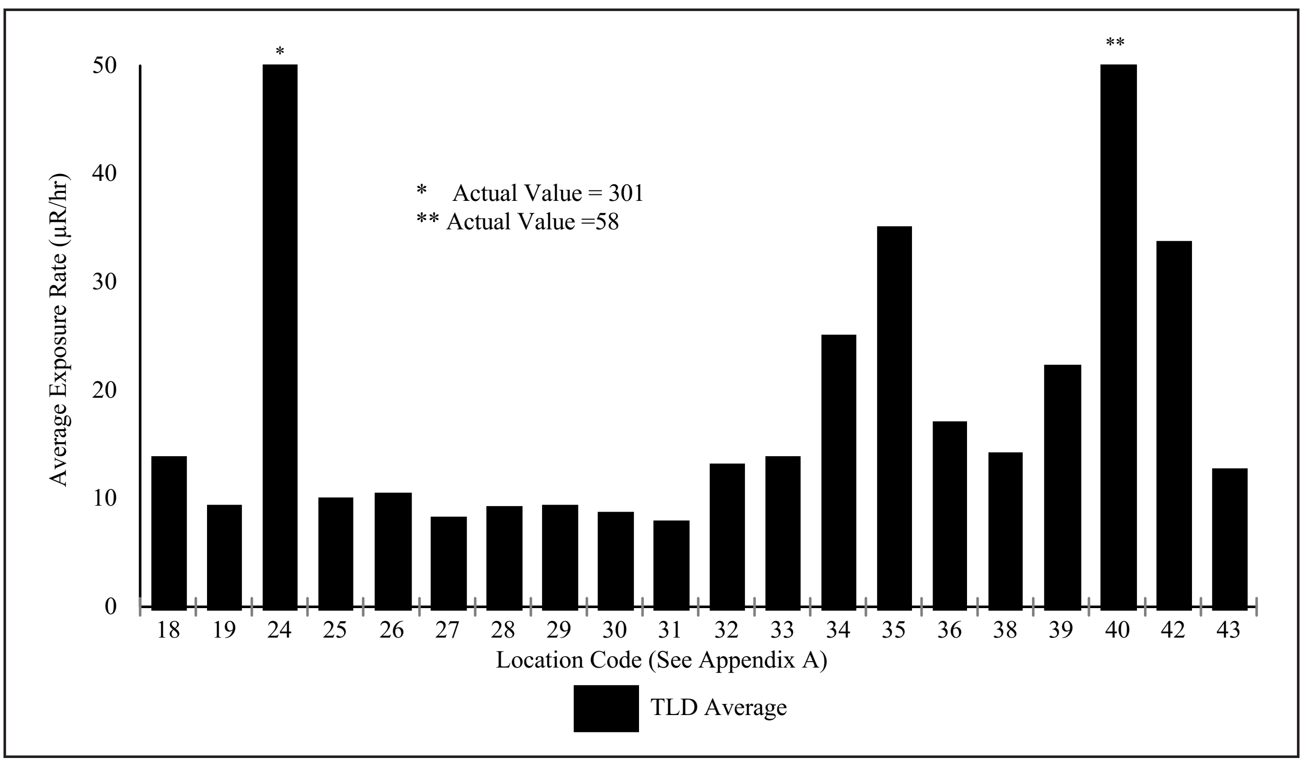

Figure C - 4.2

1997 Average Quarterly Gamma Exposure Rates on the West Valley Demonstration Project Site

Appendix C - 5

Summary of Nonradiological Monitoring Data

Shipping Water Samples to Off-site Laboratories for Analysis

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Table C - 5.1
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	Monitor	2 per discharge
	Sulfide, dissolved	0.4 mg/L	2 per discharge
	Manganese, total	2.0 mg/L	2 per discharge
	Nitrate	Monitor	2 per discharge
	Nitrite	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 every parameter except aluminum, total (daily average limit - 7.0 mg/L); solids, suspended (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 C - 5.1 (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 (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 every parameter except aluminum, total (daily average limit - 7.0 mg/L); solids, suspended (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 C - 5.2
West Valley Demonstration Project 1997 SPDES Noncompliance Episodes

Date	Outfall	Parameters	Limit	Value	Comments
Apr 24	116	TDS	500 mg/L	551 mg/L	Changes in Frank's Creek background concentration during 001 discharge event.
Sep 26	008	BOD_5	5.0 mg/L	9.3 mg/L	Algae dislodged from discharge pipe and/or non-homogeneity of seed and sample within dilution bottle.
Dec 05	001	NO_2-N	0.1 mg/L	0.2 mg/L	Backflushing of anthracite filter with nitric acid solution resulted in excessive levels of nitrates that disrupted the natural nitrification cycle; nitrification was also hindered by cold weather.
Dec 09	001	NO_2-N	0.1 mg/L	0.2 mg/L	Backflushing of anthracite filter with nitric acid solution resulted in excessive levels of nitrates that disrupted the natural nitrification cycle; nitrification was also hindered by cold weather.
Dec 09	008	BOD_5	5.0 mg/L	5.9 mg/L	Algae dislodged from discharge pipe and/or non-homogeneity of seed and sample within dilution bottle.

Table C - 5.3A

1997 SPDES Results for Outfall 001 (WNSP001)
Water Quality

	Ammonia (mg/L)		BOD-5 day[a] (mg/L)		Cyanide[a] (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	0.715	0.720	<2.0	<2.0	<0.010	<0.010	0.350	0.409
March	1.20	1.20	<2.0	<2.0	<0.010	<0.010	0.327	0.531
April	0.57	0.61	<2.0	<2.0	<0.010	<0.010	0.355	0.480
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	<0.18	0.31	<2.0	<2.0	<0.010	<0.010	0.318	0.841
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	0.13	0.15	8.3	9.8	<0.010	<0.010	0.285	0.642
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	<0.05	<0.05	3.2	3.4	<0.010	<0.010	0.386	0.570

	Nitrate (mg/L)		Nitrite (mg/L)		Oil & Grease[a] (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	1.45	1.50	0.06	0.07	<1.3	1.5
March	1.85	1.90	<0.05	<0.05	<1.7	2.3
April	1.90	2.00	0.06	0.06	<2.6	4.1
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	1.25	1.30	<0.05	<0.05	<5.0	<5.0
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	3.65	4.10	0.1	0.1	<5.0	<5.0
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	5.80	6.20	0.2	0.2	<5.0	<5.0

NA = Not applicable. No discharge this month.
a = No results exceed the permit limits.

Table C - 5.3A (concluded)

1997 SPDES Results for Outfall 001 (WNSP001)
Water Quality

	pH[a] (standard units)		Solids[a] Settleable (mL/L)		Solids Total Dissolved (mg/L)		Solids[a] Total Suspended (mg/L)	
Permit Limit	6.5 to 8.5		0.30 mL/L daily maximum		Monitor		30.0 mg/L daily average; 45.0 mg/L daily maximum	
Month	**Min**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
February	7.3	7.6	< 0.1	< 0.1	863	917	5.5	6.0
March	6.9	7.1	< 0.1	< 0.1	705	708	< 2.4	2.8
April	7.0	7.1	< 0.1	< 0.1	625	640	< 2.5	3.0
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	7.1	7.7	< 0.1	< 0.1	580	590	10.3	16.0
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	6.9	7.6	< 0.1	< 0.1	634	642	12.9	17.0
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	7.7	7.9	< 0.1	< 0.1	696	707	5.7	5.8

	Sulfate (mg/L)		Sulfide[a] Dissolved (mg/L)		Surfactants as LAS[a] (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	56	57	< 0.2	< 0.2	< 0.1	< 0.1
March	56	58	< 0.2	< 0.2	< 0.1	< 0.1
April	47	47	< 0.2	< 0.2	< 0.025	< 0.025
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	58	60	< 0.2	0.2	< 0.10	< 0.10
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	68	73	< 0.2	< 0.2	< 0.018	< 0.025
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	70	77	< 0.2	< 0.2	< 0.1	< 0.1

NA = Not applicable. No discharge this month.
[a] *No results exceeded the permit limits.*

Table C - 5.3B

1997 SPDES Results for Outfall 001 (WNSP001)
Metals

	Aluminum[a] (mg/L)		**Arsenic**[a] Dissolved (mg/L)		**Cadmium**[a] Total Recoverable (mg/L)		**Cobalt**[a] Total Recoverable (mg/L)	
Permit Limit	7.0 mg/L daily average;14.0 mg/L daily maximum		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	0.410	0.453	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
March	< 0.200	< 0.200	< 0.003	0.003	< 0.001	< 0.001	< 0.004	< 0.004
April	0.49	0.60	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	0.440	0.590	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.230	0.260	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	0.370	0.410	< 0.003	< 0.003	< 0.001	< 0.001	< 0.004	< 0.004

	Chromium [a] Total Recoverable (mg/L)		**Chromium IV** 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	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010
March	< 0.005	< 0.005	< 0.011	0.012	< 0.010	< 0.010
April	< 0.01	< 0.010	< 0.020	0.029	< 0.010	< 0.010
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

NA = Not applicable. No discharge this month.
[a] No results exceeded the permit limits.

Table C - 5.3B (concluded)
1997 SPDES Results for Outfall 001 (WNSP001)
Metals

	Copper[a] Total Recoverable (mg/L)		Iron Total (mg/L)		Lead[a] Total Recoverable (mg/L)		Manganese[a] 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	< 0.011	0.012	0.148	0.163	< 0.002	< 0.002	0.015	0.018
March	< 0.010	< 0.010	0.421	0.773	< 0.002	< 0.002	0.032	0.033
April	< 0.010	< 0.010	0.450	0.670	< 0.002	0.002	0.06	0.07
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	< 0.010	< 0.010	0.285	0.450	< 0.002	0.002	< 0.018	0.026
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.010	< 0.010	0.077	0.100	< 0.002	< 0.002	0.012	0.012
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	< 0.010	< 0.010	0.175	0.200	< 0.002	< 0.002	0.022	0.023

	Nickel[a] Total Recoverable (mg/L)		Selenium[a] Total Recoverable (mg/L)		Vanadium[a] Total Recoverable (mg/L)		Zinc[a] 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	0.068	0.110
March	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.013	0.016
April	< 0.020	< 0.020	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	< 0.010
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	< 0.010
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	< 0.010
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	< 0.040	< 0.040	< 0.003	< 0.003	< 0.010	< 0.010	< 0.010	< 0.010

NA = Not applicable. No discharge this month.
[a] No results exceeded the permit limits.

Table C - 5.3C

1997 SPDES Results for Outfall 001 (WNSP001)
Organics

VOLATILES

	2-Butanone[a] (mg/L)		**Dichlorodifluoromethane**[a] (mg/L)		**Trichlorofluoromethane**[a] (mg/L)		**Xylene**[a] (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	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
March	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
April	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	< 0.010	< 0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

SEMIVOLATILES

	Alpha-BHC[a] (mg/L)		**3,3'-Dichlorobenzidine**[a] (mg/L)		**Hexachlorobenzene**[a] (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	< 0.00001	< 0.00001	< 0.009	<0.009	< 0.010	< 0.010
March	< 0.00001	< 0.00001	< 0.009	<0.009	< 0.010	< 0.010
April	< 0.000005	< 0.000005	< 0.010	<0.010	< 0.010	< 0.010
May	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
June	< 0.000009	< 0.000009	< 0.010	< 0.010	< 0.010	< 0.010
July	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
October	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.010	< 0.010
November	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
December	< 0.000009	< 0.000009	< 0.0099	< 0.0099	< 0.010	< 0.010

NA = Not applicable. No discharge this month.
[a] *No results exceeded the permit limit.*

Table C - 5.3C *(concluded)*

1997 SPDES Results for Outfall 001 (WNSP001)
Organics

SEMIVOLATILES *(concluded)*

	Heptachlor[a] (mg/L)		**Tri-n-butyl-phosphate**[a] (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	<0.00001	<0.00001	<0.010	<0.010
March	<0.00001	<0.00001	<0.010	<0.010
April	<0.000005	<0.000005	<0.010	<0.010
May	*NA*	*NA*	*NA*	*NA*
June	<0.000009	<0.000009	<0.010	<0.010
July	*NA*	*NA*	*NA*	*NA*
August	*NA*	*NA*	*NA*	*NA*
September	*NA*	*NA*	*NA*	*NA*
October	<0.000009	<0.000009	<0.010	<0.010
November	*NA*	*NA*	*NA*	*NA*
December	<0.000009	<0.000009	<0.010	<0.010

NA = Not applicable. No discharge this month.
[a] *No results exceeded the permit limit.*

Table C - 5.4

1997 SPDES Results for Outfall 007 (WNSP007) Water Quality and Iron

	Ammonia (mg/L)		**BOD-5 day**[a] (mg/L)		**Chlorine**[a] Total Residue (mg/L)		**Discharge Rate** Total (MGD)		**Iron** (mg/L)	
Permit Limit	Monitor		10 mg/L daily maximum		0.1 mg/L daily maximum		Monitor		Monitor	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.066	0.078	< 2.2	2.6	0.02	0.02	0.013	0.016	< 0.050	0.090
February	0.060	0.069	< 2.2	2.5	0.02	0.03	0.018	0.023	0.125	0.188
March	< 0.055	0.066	< 2.1	2.3	0.02	0.02	0.022	0.028	0.114	0.170
April	< 0.055	0.062	2.6	3.5	0.03	0.04	0.026	0.035	0.093	0.125
May	0.377	0.850	< 2.0	2.0	0.03	0.04	0.015	0.024	< 0.037	0.050
June	< 0.127	0.280	< 2.1	2.2	0.02	0.03	0.009	0.025	0.034	0.038
July	0.477	0.850	< 2.0	<2.0	0.03	0.06	0.019	0.024	< 0.038	0.046
August	< 0.187	0.260	< 2.0	<2.0	0.02	0.02	0.018	0.022	< 0.030	< 0.030
September	0.120	0.140	< 3.5	5.5	0.03	0.04	0.011	0.018	< 0.080	0.180
October	0.200	0.220	< 2.3	2.7	0.03	0.04	0.010	0.019	< 0.098	0.210
November	0.173	0.190	< 2.0	2.0	0.02	0.02	0.010	0.012	< 0.049	0.087
December	0.310	0.520	< 2.6	3.1	0.02	0.02	0.021	0.051	0.052	0.062

	Nitrite[a] (mg/L)		**Oil & Grease**[a] (mg/L)		**pH**[a] (standard units)		**Solids**[a] Settleable (mL/L)		**Solids**[a] Total Suspended (mg/L)	
Permit Limit	0.1 mg/L daily maximum		15 mg/L daily maximum		6.5 to 8.5		0.3 mL/L daily maximum		30.0 mg/L daily average 45.0 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Min**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January	< 0.050	< 0.050	< 1.2	1.5	7.7	8.3	< 0.1	< 0.1	< 2.0	< 2.0
February	< 0.05	< 0.050	< 1.2	1.6	7.5	8.1	< 0.1	< 0.1	< 7.1	11.7
March	< 0.05	< 0.050	< 1.6	2.9	7.5	7.9	< 0.1	< 0.1	< 2.6	3.8
April	< 0.038	< 0.050	< 1.1	1.2	7.5	7.8	< 0.1	< 0.1	< 2.8	3.5
May	< 0.01	< 0.010	< 1.0	1.0	7.6	8.0	< 0.1	< 0.1	< 1.7	< 2.0
June	< 0.02	< 0.050	< 5.2	5.5	7.4	8.0	< 0.1	< 0.1	< 3.8	6.0
July	< 0.05	< 0.050	< 5.0	< 5.0	7.6	7.8	< 0.1	< 0.1	< 8.3	22.0
August	< 0.050	< 0.050	< 5.0	< 5.0	7.7	7.9	< 0.1	< 0.1	< 2.2	2.5
September	< 0.04	< 0.050	< 5.0	< 5.0	7.5	7.7	< 0.1	< 0.1	< 2.2	3.5
October	< 0.024	< 0.050	< 5.0	< 5.0	7.5	7.8	< 0.1	< 0.1	< 1.6	< 2.0
November	< 0.05	< 0.050	< 5.0	< 5.0	7.9	8.1	< 0.1	< 0.1	< 2.0	2.0
December	< 0.05	< 0.050	< 5.1	5.3	7.6	8.0	< 0.1	< 0.1	< 2.0	2.0

[a] *No results exceeded the permit limit.*

Table C - 5.5

1997 SPDES Results for Outfall 008 (WNSP008)
Water Quality

	BOD-5 day (mg/L)		Discharge Rate (GPD)		pH[a] (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	1562	2078	6.8	7.6
February	< 2.0	< 2.0	2574	3224	6.7	7.2
March	< 2.0	< 2.0	2726	3047	6.6	7.2
April	< 2.0	< 2.0	2001	2522	6.7	7.3
May	< 2.0	< 2.0	1924	1986	6.7	7.2
June	< 2.0	< 2.0	2542	3363	6.5	6.9
July	< 2.0	< 2.0	1403	1714	6.8	7.3
August	< 2.0	< 2.0	1471	1666	6.6	7.2
September	< 4.4	9.3	1525	1917	6.5	7.2
October	< 2.0	< 2.0	1340	1996	6.6	7.1
November	< 2.0	< 2.0	1956	2474	6.7	7.1
December	< 3.3	5.9	2154	2441	6.8	7.0

Metals

	Cadmium[a] Total Recoverable (mg/L)		Iron Total (mg/L)		Lead[a] 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	< 0.075	0.110	< 0.002	< 0.002
February	< 0.001	0.001	0.064	0.086	< 0.002	< 0.002
March	< 0.001	< 0.001	< 0.098	0.226	< 0.002	< 0.002
April	< 0.001	< 0.001	< 0.030	< 0.030	< 0.002	< 0.002
May	< 0.001	< 0.001	< 0.032	0.035	< 0.003	0.005
June	< 0.001	< 0.001	< 0.032	0.037	< 0.002	0.002
July	< 0.001	< 0.001	< 0.036	0.043	< 0.002	0.003
August	< 0.001	< 0.001	< 0.033	0.040	< 0.002	< 0.002
September	< 0.001	< 0.001	< 0.033	0.035	< 0.003	0.005
October	< 0.001	< 0.001	< 0.030	< 0.030	< 0.002	< 0.002
November	< 0.001	< 0.001	< 0.063	0.130	< 0.002	< 0.002
December	< 0.001	< 0.001	< 0.049	0.063	< 0.003	0.004

[a] *No results exceeded the permit limits.*

Table C - 5.6

1997 SPDES Results for Sums of Outfalls 001, 007, and 008
Water Quality

	Ammonia* [a] Flow-Weighted Average (mg/L)		BOD-5 day [a] (mg/L)		Iron[a] Flow-Weighted Average (mg/L)
Permit Limit	1.49 mg/L daily average; 2.1 mg/L daily maximum		5.0 mg/L daily average		0.30 mg/L daily average
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**
January	<0.066	0.078	< 2.2	< 2.5	0.00
February	0.475	0.692	< 2.0	< 2.0	0.00
March	< 0.757	< 1.100	< 2.0	< 2.0	0.00
April	< 0.218	< 0.539	< 2.5	< 3.4	0.00
May	0.377	0.850	< 2.0	< 2.0	0.00
June	< 0.167	0.280	< 2.1	< 2.2	0.00
July	0.477	0.850	< 2.0	< 2.0	0.00
August	< 0.187	0.260	< 2.0	< 2.0	0.00
September	0.120	0.140	< 3.6	5.9	0.00
October	0.158	0.220	< 4.5	< 9.6	0.00
November	0.173	0.190	< 2.0	< 2.0	0.00
December	0.170	0.210	< 2.9	< 3.1	0.00

1997 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	379	462
March	335	360
April	482	551
May	*NA*	*NA*
June	337	360
July	*NA*	*NA*
August	*NA*	*NA*
September	*NA*	*NA*
October	348	364
November	*NA*	*NA*
December	351	444

NA = Not applicable. No discharge this month.
** = Sum of outfalls 001 and 007 only*
[a] No results exceeded the permit limits.

Table C - 5.7

1997 Annual/Semiannual SPDES Results for Outfall 001 (WNSP001)

Water Quality

Measured Annually:	**Chloroform**[a] (mg/L)
Permit Limit	0.3 mg/L daily maximum
Monitoring period	**Max**
2/1/96 - 1/31/97	<0.002

Metals

Measured annually or semiannually:	**Antimony**[a] Total (mg/L)	**Barium**[a] Total (mg/L)	**Titanium**[a] 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	**Max**	**Max**	**Max**
2/1/96 - 1/31/97	<0.060	<0.050	*NA*
8/1/96 - 1/31/97	*NA*	*NA*	<0.050
2/1/97 - 7/31/97	*NA*	*NA*	<0.050

Organics

Measured semiannually:	**bis (2-Ethylhexyl) phthlate**[a] (mg/L)	**Dodecene, 4**[a] (mg/L)
Permit Limit	1.6 mg/L daily maximum	0.6 mg/L daily maximum
Monitoring period	**Max**	**Max**
8/1/96 - 1/31/97	<0.010	<0.06
2/1/96 - 1/31/97	<0.010	<0.06

NA - Not analyzed during this monitoring period.
[a] No results exceeded the permit limits.

Table C - 5.8

1997 Annual SPDES Results for Outfall 007 (WNSP007) and Outfall 008 (WNSP008)

Outfall 007

Water Quality

Measured annually:	**Chloroform**[a] (mg/L)
Permit Limit	0.20 mg/L daily maximum
Monitoring Period	**Max**
2/1/96 - 1/31/97	0.045

Outfall 008

Water Quality

Measured annually:	**Arsenic**[a] Total (mg/L)	**Chromium**[a] Total (mg/L)	**Silver**[a] 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**
2/1/96 - 1/31/97	<0.003	<0.010	<0.003	0.257

[a] *No results exceeded the permit limits.*

JEB: 98: W: \DWG\INACTIVE\SER\SER97\SR97C5-1.DWG

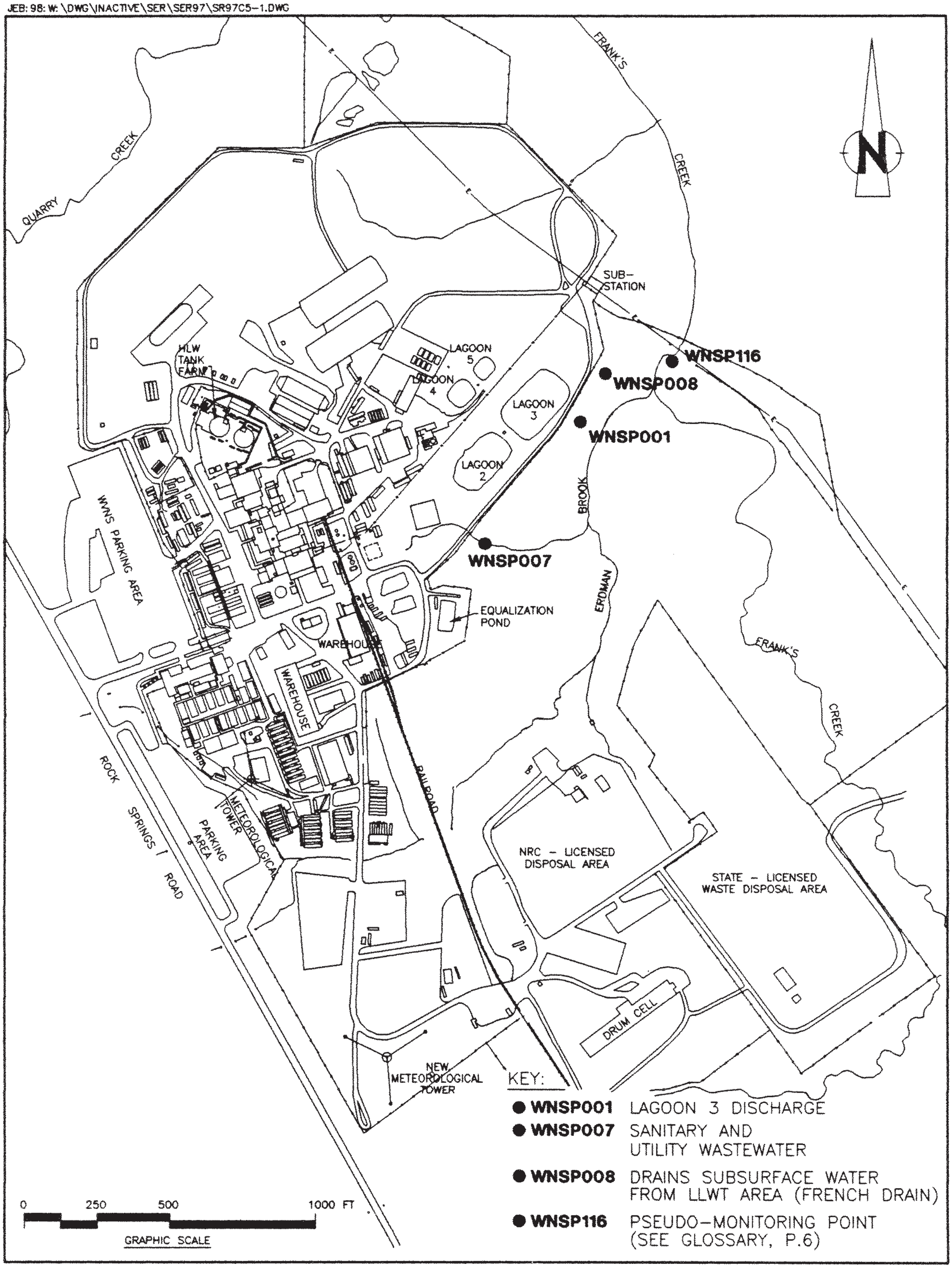

Figure C-5.1. SPDES Monitoring Points.

Appendix C - 6

Summary of Meteorological Data

On-site Meteorological Tower and Rain Gauge

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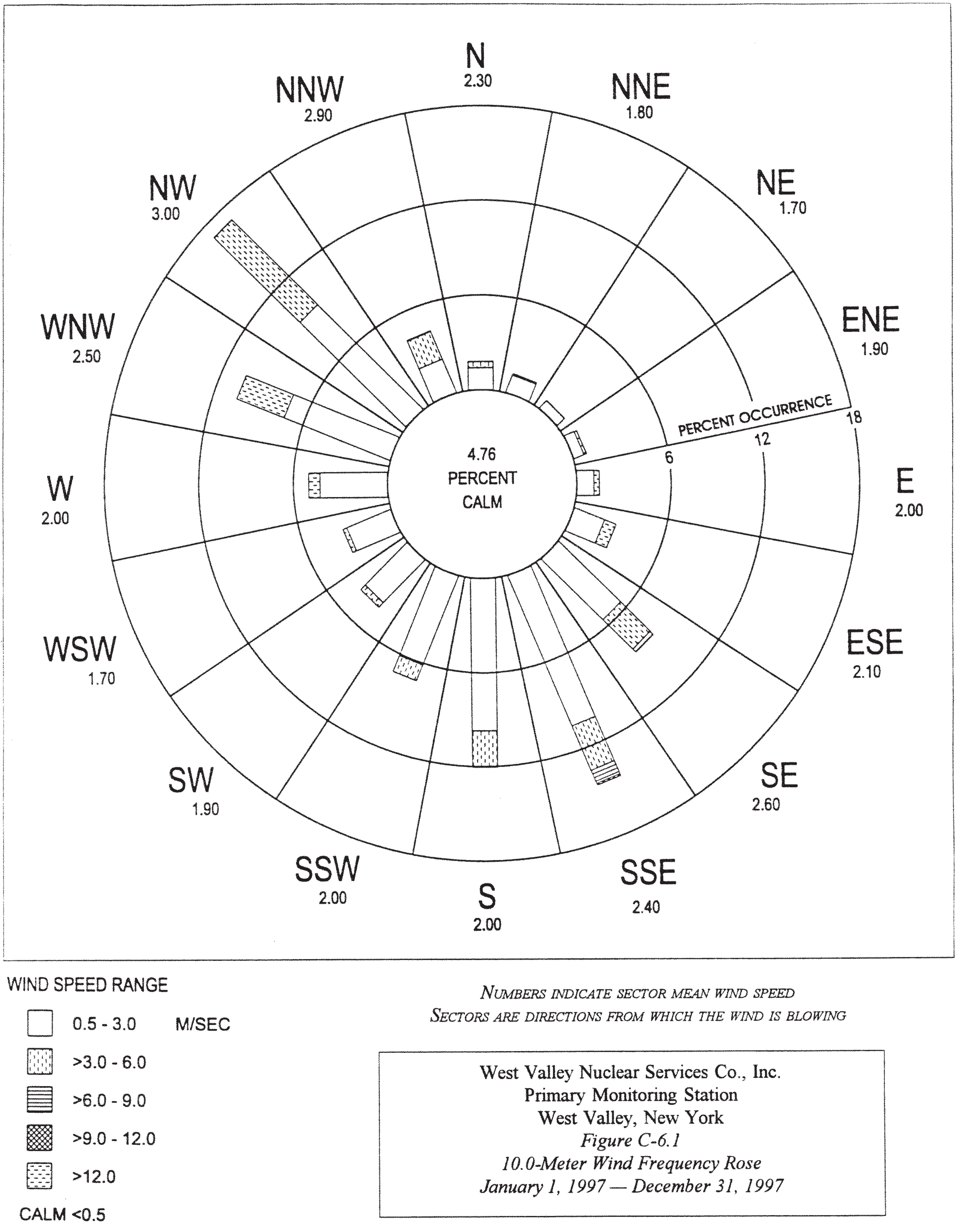
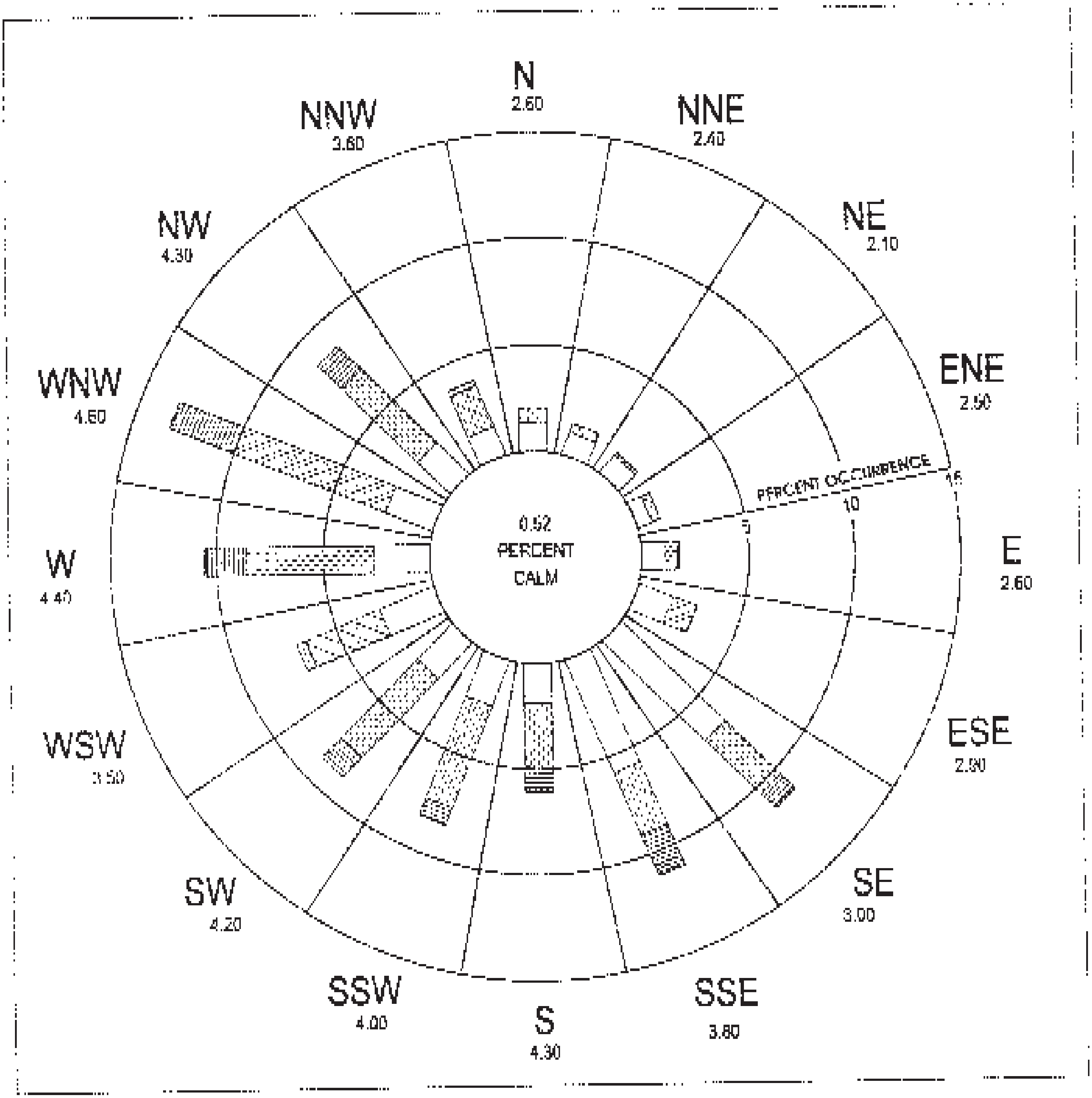


Numbers indicate sector mean wind speed
Sectors are directions from which the wind is blowing

West Valley Nuclear Services Co., Inc.
Primary Monitoring Station
West Valley, New York
Figure C-6.1
10.0-Meter Wind Frequency Rose
January 1, 1997 — December 31, 1997



WIND SPEED RANGE

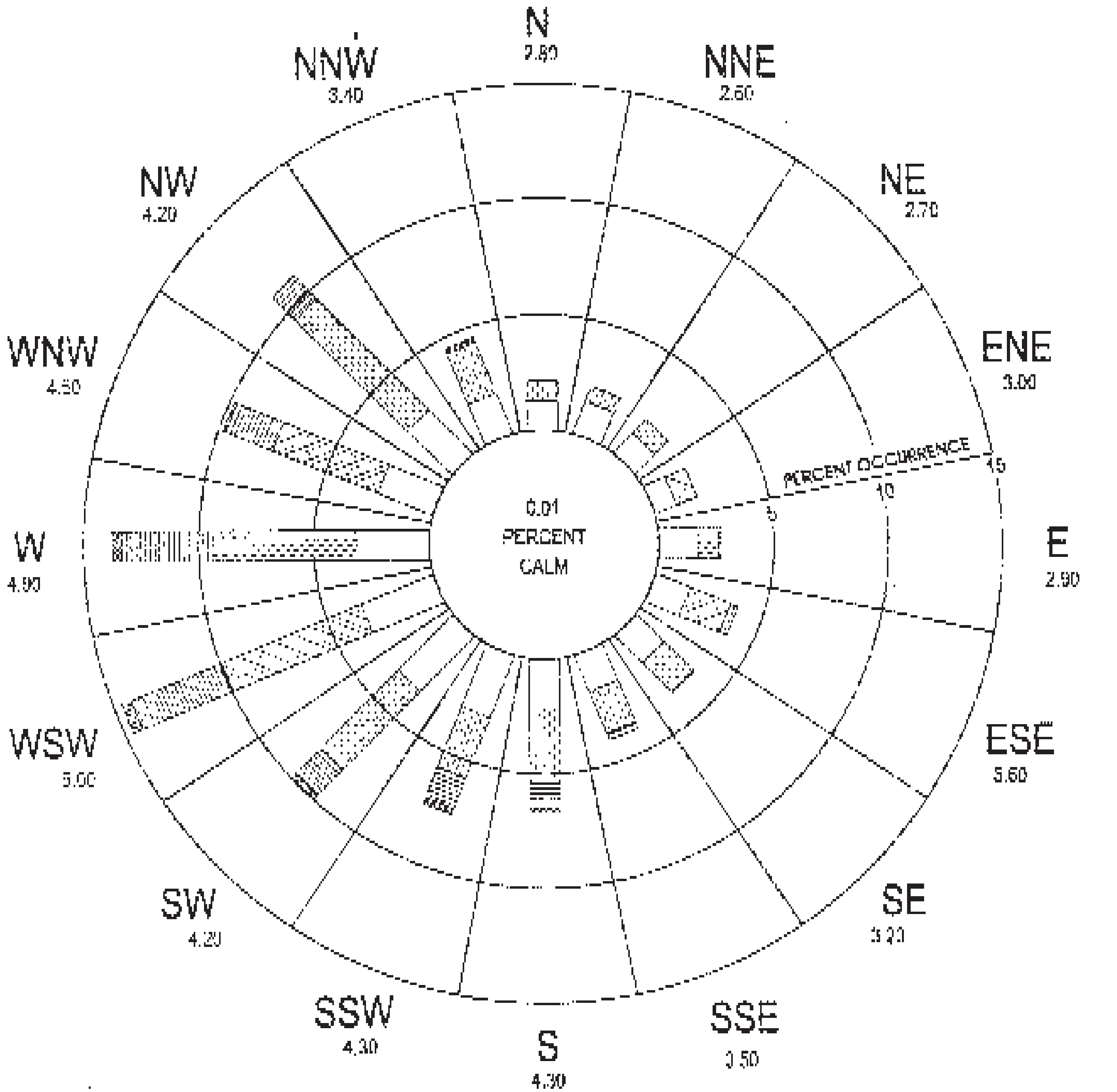
- 0.5 - 3.0 M/SEC
- >3.0 - 6.0
- >6.0 - 9.0
- >9.0 - 12.0
- >12.0

CALM <0.5

NUMBERS INDICATE SECTOR MEAN WIND SPEED

SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

West Valley Nuclear Services Co., Inc
Primary Monitoring Station
West Valley, New York
Figure C-6.2
60.0-Meter Wind Frequency Rose
January 1, 1997 — December 31, 1997



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., Inc.
Regional Monitoring Station
West Valley, New York
Figure C-6.3
10.0-Meter Wind Frequency Rose
January 1, 1997 -- December 31, 1997

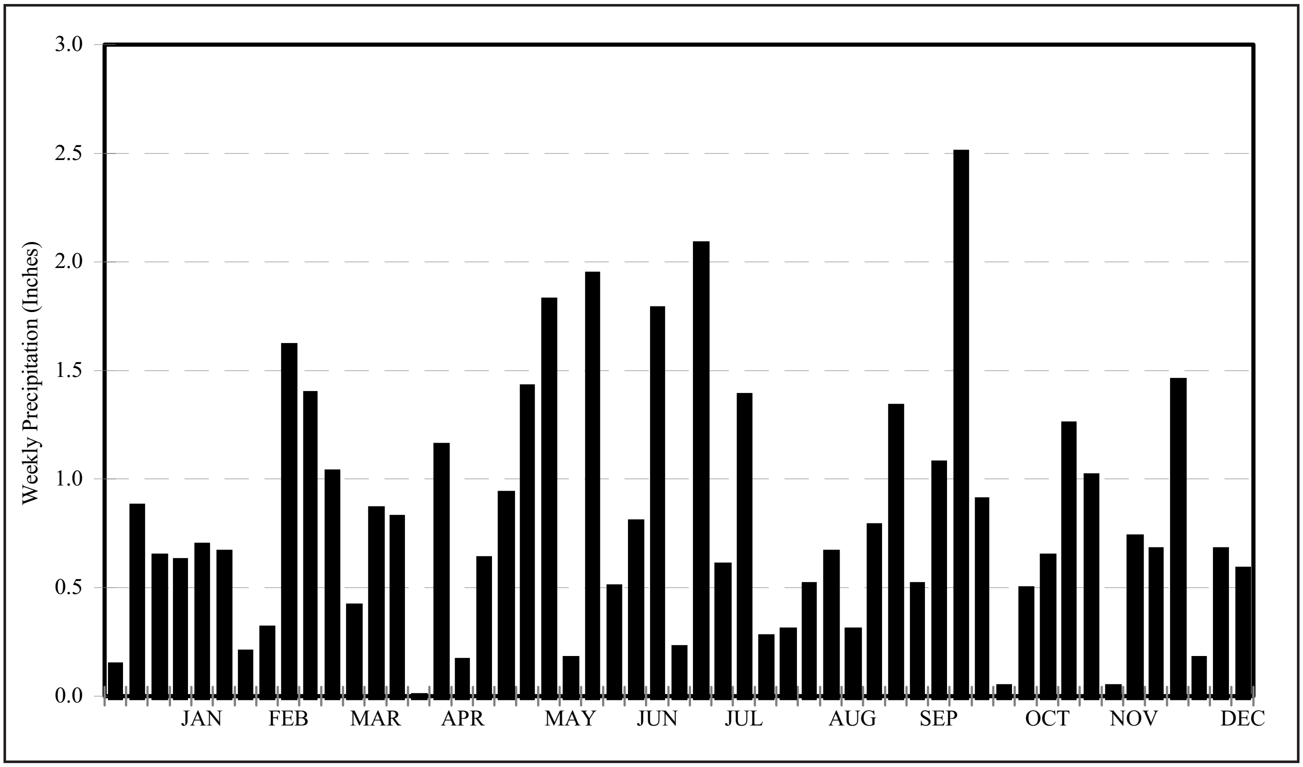


Figure C - 6.4. 1997 Weekly Precipitation

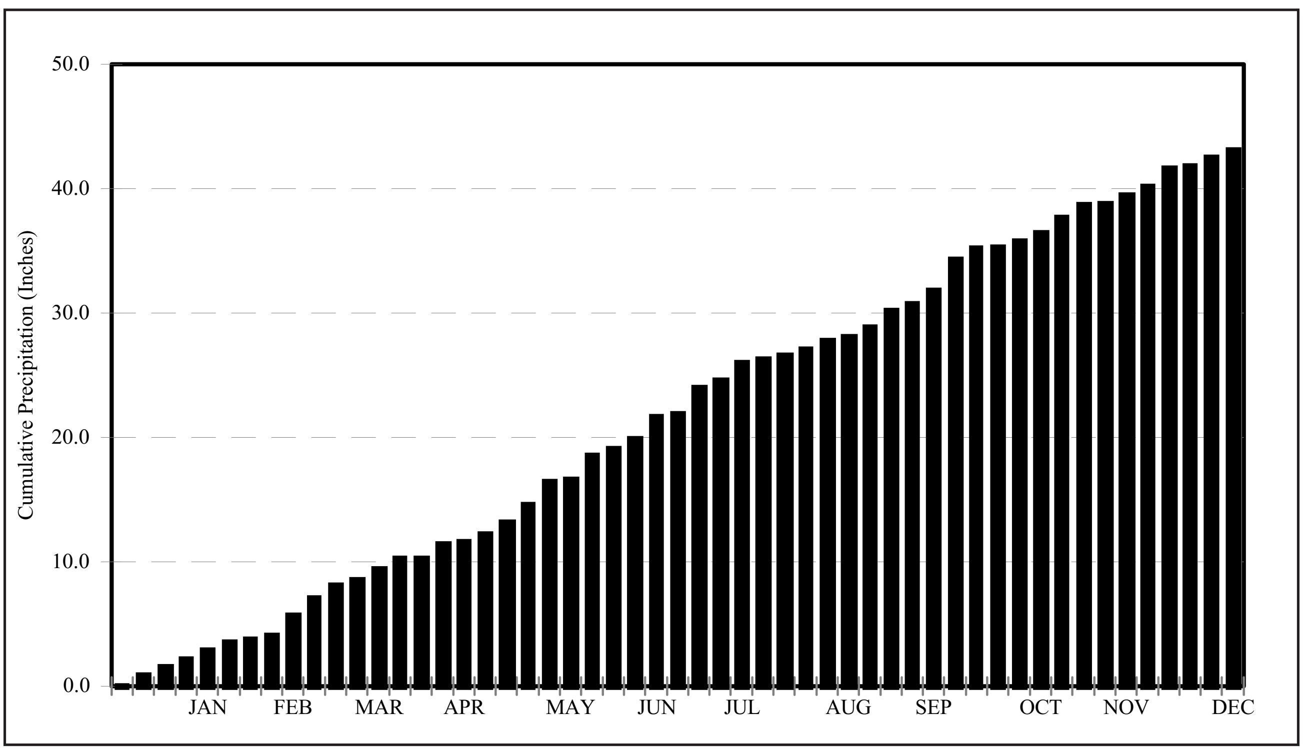


Figure C - 6.5. 1997 Cumulative Precipitation

Table C - 6.1

1997 Site Precipitation Collection Data

Week Ending	Weekly (inches)	Cumulative (inches)	Week Ending	Weekly (inches)	Cumulative (inches)
January 3	0.15	0.15	*July 4*	0.23	22.04
January 10	0.88	1.03	*July 11*	2.09	24.13
January 17	0.65	1.68	*July 18*	0.61	24.74
January 24	0.63	2.31	*July 25*	1.39	26.13
January 31	0.70	3.01	*August 1*	0.28	26.41
February 7	0.67	3.68	*August 8*	0.31	26.72
February 14	0.21	3.89	*August 15*	0.52	27.24
February 21	0.32	4.21	*August 22*	0.67	27.91
February 28	1.62	5.83	*August 29*	0.31	28.22
March 7	1.40	7.23	*September 5*	0.79	29.01
March 14	1.04	8.27	*September 12*	1.34	30.35
March 21	0.42	8.69	*September 19*	0.52	30.87
March 28	0.87	9.56	*September 26*	1.08	31.95
April 4	0.83	10.39	*October 3*	2.51	34.46
April 11	0.01	10.40	*October 10*	0.91	35.37
April 18	1.16	11.56	*October 17*	0.05	35.42
April 25	0.17	11.73	*October 24*	0.50	35.92
May 2	0.64	12.37	*October 31*	0.65	36.57
May 9	0.94	13.31	*November 7*	1.26	37.83
May 16	1.43	14.74	*November 14*	1.02	38.85
May 23	1.83	16.57	*November 21*	0.05	38.90
May 30	0.18	16.75	*November 28*	0.74	39.64
June 6	1.95	18.70	*December 5*	0.68	40.32
June 13	0.51	19.21	*December 12*	1.46	41.78
June 20	0.81	20.02	*December 19*	0.18	41.96
June 27	1.79	21.81	*December 26*	0.68	42.64
			December 31	0.59	43.23

Table C - 6.2

1997 Annual Temperature Summary at tbe 10-meter Primary Meteorological Tower

Month	Average Temperature		Maximum Temperature		Minimum Temperature	
	°C	°F	°C	°F	°C	°F
January	-5.4	22.3	15.2	59.4	-24.5	-12.1
February	-1.8	28.8	20.3	68.5	-21.5	-6.7
March	-0.2	32.4	19.7	67.5	-13.9	7.0
April	4.8	40.6	23.8	74.8	-9.9	14.2
May	9.2	48.6	22.0	71.6	-1.9	28.6
June	18.8	65.8	29.1	84.4	4.8	40.6
July	18.4	65.1	29.8	85.6	7.0	44.6
August	17.5	63.5	27.1	80.8	6.9	44.4
September	13.8	56.8	24.4	75.9	0.7	33.3
October	9.1	48.4	25.0	77.0	-3.1	26.4
November	2.0	35.6	15.5	59.9	-10.6	12.9
December	-1.2	29.8	7.3	45.1	-13.7	7.3
Annual Average	7.1	44.8	21.6	70.9	-6.6	20.1

Table C - 6.3

1997 Annual Barometric Pressure Summary
(station pressure - inches of mercury)

Month	Average Pressure	Maximum Pressure	Minimum Pressure
January	28.38	28.99	27.65
February	28.53	29.05	27.81
March	28.43	28.92	27.82
April	28.38	28.78	27.91
May	28.36	28.86	27.80
June	28.44	28.67	28.08
July	28.47	28.77	28.06
August	28.47	28.72	28.16
September	**28.42**	**28.73**	**27.74**
October	28.50	28.84	27.81
November	28.36	28.81	27.78
December	28.30	28.74	27.61
Annual Average	28.42	28.82	27.85

Appendix D

Summary of Quality Assurance Crosscheck Analyses

Keeping Up With Regulatory Changes

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Table D - 1

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 46; EML-591 QAP 9703, July 1, 1997

Radionuclide	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Air filter	1.52E-01	1.48E-01	0.97	Yes	EPI
Co-57	Air filter	1.08E+01	1.03E+01	0.95	Yes	EPI
Co-60	Air filter	5.01E+00	4.69E+00	0.94	Yes	EPI
Cs-134	Air filter	1.09E+01	1.08E+01	0.99	Yes	EPI
Cs-137	Air filter	8.70E+00	8.57E+00	0.99	Yes	EPI
Gross Alpha	Air filter	9.60E-01	1.01E+00	1.05	Yes	EPI
Gross Beta	Air filter	4.50E-01	4.59E-01	1.02	Yes	EPI
Mn-54	Air filter	7.62E+00	7.59E+00	1.00	Yes	EPI
Pu-238	Air filter	1.00E-01	9.80E-02	0.98	Yes	EPI
Pu-239	Air filter	1.19E-01	1.18E-01	0.99	Yes	EPI
Sb-125	Air filter	1.23E+01	1.32E+01	1.07	Yes	EPI
Sr-90	Air filter	1.45E+00	1.52E+00	1.05	Yes	EPI
U-234	Air filter	1.03E-01	9.80E-02	0.95	Yes	EPI
U-238	Air filter	1.05E-01	1.03E-01	0.99	Yes	EPI
U (µg/filter)	Air filter	8.45E+00	9.65E+00	1.14	Yes	EPI
Gross Alpha	Air filter	9.60E-01	8.41E-01	0.88	Yes	EL
Gross Beta	Air filter	4.50E-01	4.67E-01	1.04	Yes	EL
Am-241	Soil	5.68E+00	5.88E+00	1.04	Yes	EPI
Co-60	Soil	1.06E+00	8.68E-01	0.82	Pass	EPI
Cs-137	Soil	8.26E+02	8.85E+02	1.07	Yes	EPI
K-40	Soil	3.34E+02	3.69E+02	1.10	Yes	EPI
Pu-239	Soil	1.35E+02	1.35E+02	1.00	Yes	EPI
Sr-90	Soil	4.03E+01	3.03E+01	0.75	Yes	EPI
U-234	Soil	3.76E+01	3.96E+01	1.05	Yes	EPI
U-238	Soil	4.24E+01	4.07E+01	0.96	Yes	EPI
U (µg/g)	Soil	3.43E+00	3.70E+00	1.08	Yes	EPI
Am-241	Veg	1.18E+00	1.21E+00	1.02	Yes	EPI
Co-60	Veg	1.25E+01	1.56E+01	1.25	Pass	EPI
Cs-137	Veg	1.89E+02	2.36E+02	1.25	Yes	EPI
K-40	Veg	8.12E+02	1.10E+03	1.35	Pass	EPI
Pu-239	Veg	1.94E+00	2.11E+00	1.09	Yes	EPI
Sr-90	Veg	3.61E+02	4.22E+02	1.17	Pass	EPI

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Units for elemental uranium: µg/filter, µg/g, or µg/mL. Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on 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.*

Table D - 1 (concluded)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 46; EML-591 QAP 9703, July 1, 1997

Radionuclide	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Water	8.37E-01	8.07E-01	0.96	Yes	EPI
Co-60	Water	9.09E+01	9.59E+01	1.06	Yes	EPI
Cs-137	Water	6.98E+01	7.88E+01	1.13	Yes	EPI
Gross Alpha	Water	1.13E+03	1.30E+03	1.14	Yes	EPI
Gross Beta	Water	7.44E+02	6.12E+02	0.82	Yes	EPI
H-3	Water	2.50E+02	2.76E+02	1.10	Yes	EPI
Mn-54	Water	2.09E+01	2.34E+01	1.12	Yes	EPI
Pu-238	Water	1.29E+00	1.29E+00	1.00	Yes	EPI
Pu-239	Water	8.50E-01	7.59E-01	0.89	Pass	EPI
Sr-90	Water	2.32E+01	2.23E+01	0.96	Yes	EPI
U-234	Water	5.40E-01	6.03E-01	1.12	Yes	EPI
U-238	Water	5.50E-01	6.03E-01	1.10	Yes	EPI
U (µg/mL)	Water	4.40E-02	5.10E-02	1.14	Yes	EPI
Co-60	Water	9.09E+01	1.01E+02	1.11	Yes	EL
Cs-137	Water	6.98E+01	7.70E+01	1.10	Yes	EL
Gross Alpha	Water	1.13E+03	1.05E+03	0.92	Yes	EL
Gross Beta	Water	7.44E+02	6.14E+02	0.82	Yes	EL
H-3	Water	2.50E+02	2.56E+02	1.02	Yes	EL
Mn-54	Water	2.09E+01	2.48E+01	1.19	Pass	EL
Sr-90	Water	2.32E+01	2.40E+01	1.03	Yes	EL

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Units for elemental uranium: µg/filter, µg/g, or µg/mL. Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on 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.*

Table D - 2

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 47; EML-594 QAP 9709, January 1, 1998

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Air filter	2.10E-01	2.00E-01	0.98	Yes	EPI
Co-57	Air filter	1.26E+01	1.12E+01	0.88	Yes	EPI
Co-60	Air filter	1.07E+01	9.58E+00	0.89	Yes	EPI
Cs-134	Air filter	2.82E+01	2.34E+01	0.82	Yes	EPI
Cs-137	Air filter	7.31E+00	6.26E+00	0.85	Yes	EPI
Gross Alpha	Air filter	1.49E+00	2.48E+00	1.66	No	EPI
Gross Beta	Air filter	3.00E+00	2.86E+00	0.95	Yes	EPI
Mn-54	Air filter	6.72E+00	6.12E+00	0.91	Yes	EPI
Pu-238	Air filter	2.10E-01	2.20E-01	1.05	Yes	EPI
Sb-125	Air filter	1.61E+01	1.58E+01	0.98	Yes	EPI
Sr-90	Air filter	2.76E+00	1.80E+00	0.65	No	EPI
U-234	Air filter	5.00E-02	6.00E-02	1.17	Yes	EPI
U-238	Air filter	5.00E-02	6.00E-02	1.11	Yes	EPI
U (µg/filter)	Air filter	4.65E+00	5.02E+00	1.07	Yes	EPI
Gross Alpha	Air filter	1.49E+00	1.23E+00	0.82	Yes	EL
Gross Beta	Air filter	3.00E+00	3.14E+00	1.04	Yes	EL
Am-241	Soil	6.04E+00	5.96E+00	0.98	Yes	EPI
Co-60	Soil	1.50E+00	1.70E+00	1.13	Yes	EPI
Cs-137	Soil	8.10E+02	7.48E+02	0.92	Yes	EPI
K-40	Soil	3.15E+02	2.82E+02	0.89	Yes	EPI
Pu-239	Soil	1.02E+01	1.25E+01	1.22	Yes	EPI
U-234	Soil	3.72E+01	3.49E+01	0.93	Yes	EPI
U-238	Soil	3.49E+01	3.68E+01	1.05	Yes	EPI
U (µg/g)	Soil	2.82E+00	2.89E+00	1.02	Yes	EPI
Am-241	Veg	3.46E+00	3.53E+00	1.02	Yes	EPI
Co-60	Veg	3.24E+01	2.80E+01	0.86	Yes	EPI
Cs-137	Veg	6.24E+02	5.27E+02	0.84	Pass	EPI
K-40	Veg	1.13E+03	1.01E+03	0.89	Pass	EPI
Pu-239	Veg	5.48E+00	5.53E+00	1.00	Yes	EPI

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Units for elemental uranium: µg/filter, µg/g, or µg/mL. Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on 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.*

Table D - 2 (concluded)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 47; EML-594 QAP 9709, January 1, 1998

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Water	7.50E-01	7.40E-01	0.99	Yes	EPI
Co-60	Water	2.33E+01	2.38E+01	1.01	Yes	EPI
Cs-134	Water	6.60E+01	6.56E+01	0.99	Yes	EPI
Cs-137	Water	3.43E+01	3.52E+01	1.02	Yes	EPI
Gross Alpha	Water	5.57E+02	7.99E+02	1.43	Pass	EPI
Gross Beta	Water	7.12E+02	8.56E+02	1.20	Yes	EPI
H-3	Water	1.15E+02	1.34E+02	1.16	Yes	EPI
Mn-54	Water	3.78E+01	4.03E+01	1.06	Yes	EPI
Pu-238	Water	7.20E-01	7.40E-01	1.03	Yes	EPI
Pu-239	Water	7.50E-01	7.80E-01	1.05	Yes	EPI
Sr-90	Water	2.94E+00	2.60E+00	0.88	Yes	EPI
U-234	Water	2.30E-01	2.50E-01	1.08	Yes	EPI
U-238	Water	2.40E-01	2.50E-01	1.05	Yes	EPI
U (µg/mL)	Water	2.00E-02	2.00E-02	1.05	Yes	EPI
Co-60	Water	2.33E+01	2.43E+01	1.04	Yes	EL
Cs-134	Water	6.60E+01	6.62E+01	1.00	Yes	EL
Cs-137	Water	3.43E+01	3.51E+01	1.02	Yes	EL
Gross Alpha	Water	5.57E+02	5.44E+02	0.97	Yes	EL
Gross Beta	Water	7.12E+02	9.54E+02	1.33	Yes	EL
H-3	Water	1.15E+02	1.22E+02	1.06	Yes	EL
Mn-54	Water	3.78E+01	4.19E+01	1.10	Yes	EL
Sr-90	Water	2.94E+00	3.46E+00	1.17	Yes	EL

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Units for elemental uranium: µg/filter, µg/g, or µg/mL. Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on 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.*

Table D - 3

Comparison of Radiological Results with Known Results of Crosscheck Samples from the EPA National Exposure Research Laboratory, Environmental Science Division (NERL-ESD)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By:
ABW	Alpha	Water	5.2	5.63	Yes	EL
(January 1997)	Alpha	Water	5.2	4.83	Yes	EPI
	Beta	Water	14.7	13.63	Yes	EL
	Beta	Water	14.7	14.23	Yes	EPI
ABW	Alpha	Water	3.1	4.53	Yes	EL
(July 1997)	Alpha	Water	3.1	3.63	Yes	EPI
	Beta	Water	15.1	16.97	Yes	EL
	Beta	Water	15.1	14.07	Yes	EPI
ABW	Alpha	Water	14.7	16.13	Yes	EL
(October 1997)	Alpha	Water	14.7	15.13	Yes	EPI
	Beta	Water	48.9	52.00	Yes	EL
	Beta	Water	48.9	46.47	Yes	EPI
TRW	H-3	Water	7,900	7,882.33	Yes	EL
(March 1997)	H-3	Water	7,900	7,406.67	Yes	EPI
TRW	H-3	Water	11,010	10,861.67	Yes	EL
(August 1997)	H-3	Water	11,010	9,566.67	Pass	EPI
PE-A	Alpha	Water	48	38.97	Yes	EL
(April 1997)	Alpha	Water	48	52.90	Yes	EPI
	Ra-226	Water	13	10.97	Yes	EPI
	Ra-228	Water	3.1	3.67	Yes	EPI
	U(Nat)	Water	24	20.37	Pass	EPI

Units are in pCi/L.

Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI) as indicated.

Explanation of code(s): PE-A = performance evaluation (alpha); PE-B = performance evaluation (beta); GAM = gamma in water; TRW = tritium in water; ABW = alpha and beta in water.

Acceptance limits are statistically defined by NERL-ESD for individual analytes and matrices. ***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.*

Table D - 3 (continued)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the EPA National Exposure Research Laboratory, Environmental Science Division (NERL-ESD)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By:
PE-B	Beta	Water	102.1	104.70	Yes	EL
(April 1997)	Beta	Water	102.1	91.97	Yes	EPI
	Sr-89	Water	24	30	Pass	EPI
	Sr-90	Water	13	11.67	Yes	EPI
	Co-60	Water	21	22.33	Yes	EL
	Co-60	Water	21	21.67	Yes	EPI
	Cs-134	Water	31	26.00	Yes	EL
	Cs-134	Water	31	28.67	Yes	EPI
	Cs-137	Water	22	23.67	Yes	EL
	Cs-137	Water	22	24.00	Yes	EPI
PE-A	Alpha	Water	49.9	38.57	Yes	EL
(October 1997)	Alpha	Water	49.9	50.13	Yes	EPI
	Ra-226	Water	5.0	5.40	Yes	EPI
	Ra-228	Water	5.0	6.97	Pass	EPI
	U(Nat)	Water	31.0	30.53	Yes	EPI
PE-B	Beta	Water	143.4	136.30	Yes	EL
(October 1997)	Beta	Water	143.4	123.63	Yes	EPI
	Sr-89	Water	36.0	27.33	Pass	EPI
	Sr-90	Water	22.0	16.67	Yes	EPI
	Co-60	Water	10.0	13.67	Yes	EL
	Co-60	Water	10.0	11.33	Yes	EPI
	Cs-134	Water	41.0	35.67	Yes	EL
	Cs-134	Water	41.0	39.00	Yes	EPI
	Cs-137	Water	34.0	34.67	Yes	EL
	Cs-137	Water	34.0	37.00	Yes	EPI

Units are in pCi/L.

Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI), as indicated.

Explanation of code(s): PE-A = performance evaluation (alpha); PE-B = performance evaluation (beta); GAM = gamma in water; TRW = tritium in water; ABW = alpha and beta in water.

*Acceptance limits are statistically defined by NERL-ESD for individual analytes and matrices. **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.*

Table D - 3 *(concluded)*

Comparison of Radiological Results with Known Results of Crosscheck Samples from the EPA National Exposure Research Laboratory, Environmental Science Division (NERL-ESD)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By:
GAM	Co-60	Water	18.0	23.33	Yes	EL
(June 1997)	Co-60	Water	18.0	19.00	Yes	EPI
	Zn-65	Water	100.0	114.67	Pass	EL
	Zn-65	Water	100.0	111.33	Yes	EPI
	Cs-134	Water	22.0	19.33	Yes	EL
	Cs-134	Water	22.0	21.67	Yes	EPI
	Cs-137	Water	49.0	51.67	Yes	EL
	Cs-137	Water	49.0	52.67	Yes	EPI
	Ba-133	Water	25.0	24.00	Yes	EL
	Ba-133	Water	25.0	25.67	Yes	EPI
GAM	Co-60	Water	27.0	29.00	Yes	EL
(November 1997)	Co-60	Water	27.0	27.33	Yes	EPI
	Zn-65	Water	75.0	80.00	Yes	EL
	Zn-65	Water	75.0	81.33	Yes	EPI
	Cs-134	Water	10.0	8.00	Yes	EL
	Cs-134	Water	10.0	9.00	Yes	EPI
	Cs-137	Water	74.0	73.67	Yes	EL
	Cs-137	Water	74.0	78.33	Yes	EPI
	Ba-133	Water	99.0	92.00	Yes	EL
	Ba-133	Water	99.0	100.33	Yes	EPI

Units are in pCi/L.

Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI), as indicated.

Explanation of code(s): PE-A = performance evaluation (alpha); PE-B = performance evaluation (beta); GAM = gamma in water; TRW = tritium in water; ABW = alpha and beta in water.

Acceptance limits are statistically defined by NERL-ESD for individual analytes and matrices. ***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.*

Table D - 4

Comparison of the West Valley Demonstration Project's Thermoluminescent Dosimeters (TLDs) with the Co-located Nuclear Regulatory Commission (NRC) TLDs

NRC TLD#	WVDP TLD#	NRC mR/90days	WVDP* mR/Qtr	WVDP/NRC Ratio
1st Quarter 1997				
2	22	15.7	15	0.96
3	5	15.2	14	0.92
4	7	14.4	14	0.97
5	9	14.9	16	1.07
7	14	15.9	17	1.07
8	15	15.3	16	1.05
9	25	25.0	23	0.92
11	24	744.0	641	0.86
2nd Quarter 1997				
2	22	18.4	16	0.87
3	5	15.9	19	1.19
4	7	16.1	16	0.99
5	9	15.5	14	0.90
7	14	17.2	17	0.99
8	15	16.5	*Missing*	*NA*
9	25	28.6	19	0.66
11	24	698.0	677	0.97
3rd Quarter 1997				
2	22	16.5	20	1.21
3	5	17.9	18	1.01
4	7	17.1	16	0.94
5	9	17.1	21	1.23
7	14	17.6	20	1.14
8	15	17.8	18	1.01
9	25	26.2	24	0.92
11	24	662.0	692	1.05
4th Quarter 1997				
2	22	*Missing*	18**	*NA*
3	5	14.2	21	1.48
4	7	15.6	20	1.28
5	9	14.8	22	1.49
7	14	15.8	22	1.39
8	15	15.4	23	1.49
9	25	27.7	23	0.83
11	24	647.0	670**	1.04

** WVDP results produced under contract by Lockheed Martin Idaho Technologies Co. (LMITCO)*

Ratios of results are listed for each set of co-located TLDs.

*"Missing" indicates that a TLD was no longer in place at the time of collection so no analysis could be performed . NA = not available. ** = Data were flagged as unreliable.*

No control or warning limits are applicable to these results. Ratios of the duplicate measurements are presented for comparison purposes.

Table D-5

Comparison of Water Quality Parameters in Crosscheck Samples between the West Valley Demonstration Project and the EPA's 1997 Discharge Monitoring Report-Quality Assurance (DMR-QA) Study 17 for the National Pollutant Discharge Elimination System (NPDES)

Analyte	Units	Actual	Reported	Accept?	Analyzed by:
Aluminum	µg/L	1,903	1,850	Yes	E&E
Arsenic	µg/L	410	397	Yes	E&E
Cadmium	µg/L	69.0	64.3	Yes	E&E
Chromium	µg/L	420	410	Yes	E&E
Cobalt	µg/L	401	388	Yes	E&E
Copper	µg/L	277	277	Yes	E&E
Iron	µg/L	2,100	2,000	Yes	E&E
Lead	µg/L	430	421	Yes	E&E
Manganese	µg/L	1,100	1,090	Yes	E&E
Mercury	µg/L	3.85	1.56	No	E&E
Nickel	µg/L	188	192	Yes	E&E
Selenium	µg/L	1,951	1,780	Yes	E&E
Vanadium	µg/L	7,604	7,570	Yes	E&E
Zinc	µg/L	1,551	1,610	Yes	E&E
pH	s.u.	6.58	6.58	Yes	WVNS
Total cyanide	mg/L	0.19	0.165	Yes	E&E
Non-filterable residue (TSS)	mg/L	46.0	46.5	Pass	E&E
Oil and grease	mg/L	12.2	18.2	Pass	E&E
Total phenolics	mg/L	0.113	0.062	Yes	E&E
Total residual chlorine	mg/L	1.39	1.59	Yes	WVNS
Ammonia-nitrogen	mg/L	2.80	2.80	Yes	E&E
Nitrate-nitrogen	mg/L	31.0	30.8	Yes	E&E
BOD-5	mg/L	50.3	43.6	Yes	E&E

Analyses were conducted by Ecology & Environment, Inc. (E&E) or WVNS, as indicated.

Acceptance limits are determined by the EPA: ***Yes*** *indicates a result within warning limits;* ***Pass*** *indicates a result within control limits but outside warning limits;* ***No*** *indicates a result outside control limits.*

Appendix E

Summary of Groundwater Monitoring Data

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Table E-1
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SSWMUs	Well ID Number [1]	Additional Analytes Measured in 1997[2]	Well ID Nimber [1]	Additional Analytes Measured in 1997[2]
SSWMU #1 - Low-Level Waste Treatment Facilities:				
	103* (S:D)	M, V	110* (T:D)	M, V
• Former Lagoon 1	104 (S:U)	S, SV, V	111* (S:D)	S, SV, V, M9
• LLWTF Lagoons	105 (S:D)	M, V	114 (T:D)	*p*
• LLWTF Building	106 (S:D)	M, V	115 (T:U)	*p*
• Interceptors	107 (T:D)	M, V	116* (S:U)	M, S, V
• Neutralization Pit	108 (T:D)	M, V	8604 (S:U)	M, V
	109 (T:D)	*p*	8605* (S:D)	S, SV, M, V
SSWMU #2 - Miscellaneous Small Units:				
	201 (S:U)	M	206 (TS:D)	
• Sludge Ponds	202 (TS:U)	*p*	207 (S[T]:D)	*p*
• Solvent Dike	203 (S:D)	M	208 (TS:D)	V
• Equalization Mixing Basin	204* (TS:U)		8606 (S:D)	*p*
• Paper Incinerator	205 (S:D)	M		
SSWMU #3 - Liquid Waste Treatment System:				
• Liquid Waste Treatment System	301* (S:B)	M	307 (S:D)	*p*
• Cement Solidification System	302 (TS:U)	M	NB1S (S[WT]:B)	
• Main Process Bldg. (specific areas)	305 (S:D)	*p*		
SSWMU #4 - HLW Storage and Processing Area:				
• Vitrification Facility	401* (S[T]:B)	M, R	405 (T:C)	
• Vitrification Test Tanks	402 (TS:U)		406* (S:D)	R, V
• HLW Tanks	403 (S:U)	M, V	408* (S:D)	M, R, V
• Supernatant Treatment System	404 (TS:U)	*p*	409 (T:D)	

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[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). Units enclosed in brackets indicate the hydrogeologic unit is only a secondary monitoring unit. Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S[T]:B) monitors background conditions in the sand and gravel unit and secondarily in the unweathered Lavery till.*

[2] See Table 3-1 (p. 3-7) 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 for 1997. Wells measured for potentiometric (water-level) data only are designated by p.

Table E-1 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number [1]	Additional Analytes Measured in 1997 [2]	Well ID Number [1]	Additional Analytes Measured in 1997[2]
SSWMU #5 - Maintenance Shop Leach Field:				
• *Maintenance Shop Leach Field*	501* (S:U)	M, S, V	502* (S:D)	M, S, SM, V
SSWMU #6 - Low-level Waste Storage Area:				
• Hardstands (old & new)	601 (S:D)	M	605 (S[T]:D)	M, S
• Lag Storage	602 (S:D)	M, S	8607* (S:U)	M, V
• Lag Storage Additions	603 (S:U)	*p*	8608 (S:U)	*p*
(LSAs 1, 2, 3, 4)	604 (S:D)	M	8609* (S:U)	M, S, V
SSWMU #7 - CPC Waste Storage Area:				
	701 (TS:U)	*p*	705 (T:C)	*p*
• CPC Waste Storage Area	702 (T:C)	*P*	706 (S:B)	M
	703 (T:D)	*P*	707 (T[WT]:D)	M
	704 (T:D)	M, V		
SSWMU #8 - Construction and Demolition Debris Landfill:				
	801* (S:U)	M, S, V	804* (S:D)	M, V
• Former Construction and Demolition	802 (S[T]:D)	M, V	8603* (S:U)	M, S
Debris Landfill	803* (S:D)	M, SV, V	8612* (S:D)	M, SV, V

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[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). Units enclosed in brackets indicate the hydrogeologic unit is only a secondary monitoring unit. Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S[T]:B) monitors background conditions in the sand and gravel unit and secondarily in the unweathered Lavery till.*

[2] See Table 3-1 (p. 3-7) 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 for 1997. Wells measured for potentiometric (water-level) data only are designated by p.

Table E-1 (*continued*)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number [1]	Additonal Analytes Measured in 1997 [2]	Well ID Number [1]	Additional Analytes Measured in 1997 [2]
SSWMU #9 - NRC-licensed Disposal Area:				
	901* (K[T]:U)	M	908* (WT[T]:U)	M,
• NRC-licensed Disposal Area	902* (K[T]:U)	M9	909* (WT[T]:D)	M9, R, V,
SV				
• Container Storage Area	903* (K[T]:D)	M	910* (T:D)	M
• Trench Interceptor Project	904 (T:D)	*p*	8610* (K:D)	
	905 (S:D)	*p*	8611* (K:D)	M
	906* (WT:D)	M	NDATR* (Interceptor	M, R, V,
SV				
	907 (WT[T]:D)	*p*	Trench Manhole Sump:D)	
SSWMU #10 - IRTS Drum Cell:				
	1001 (K[T]:U)	*p*	1006* (WT[T]:D)	M
• IRTS Drum Cell	1002 (K[T]:D)	*p*	1007 (WT[T]:D)	
• Background (south plateau)	1003 (K:D)	*p*	1008B (K[T]:B)	M
	1004 (K[T]:D)	*p*	1008C* (WT[T]:B)	M
	1005* (WT[T]:U)	M		
SSMUW #11 - State-licensed Disposal Area:				
	1101A (WT[T]:U)	See	1105A (WT[T]:D)	See
• State-licensed Disposal Area (SDA) [NYSERDA]	1101B (T:U)	Appendix F	1105B (T:D)	Appendix F
	1101C (K:U)		1106A (K:U)	
	1102A (WT[T]:D)		1106B (T:U)	
NOTE: The SDA is sampled by NYSERDA under an independent monitoring program.	1102B (T:D)		1107A (T:D)	
	1103A (WT[T]:D)		1108A (WT[T]:U)	
	1103B (T:D)		1109A (T:U)	
	1103C (K:D)		1109B (WT[T]:U)	
	1104A (WT[T]:D)		1110A (WT[T]:D)	
	1104B (T:D)		1111A (WT[T]:D)	
	1104C (K:D)			

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[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). Units enclosed in brackets indicate the hydrogeologic unit is only a secondary monitoring unit. Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S[T]:B) monitors background conditions in the sand and gravel unit and secondarily in the unweathered Lavery till.*

[2] See Table 3-1 (p. 3-7) 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 for 1997. Wells measured for potentiometric (water-level) data only are designated by p.

Table E-1 (concluded)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number[1]	Additional Analytes Measured in 1997[2]	Well ID Number[1]	Additional Analytes Measured in 1997[2]
Motor Fuel Storage Area (Monitored underground storage tanks. Not a SSWMU. Wells were decommissioned in summer 1997 after the tanks were removed from service.)	R8613A (S[T]:C) R8613B (S:C)	*p* *p*	R8613C (S:C)	*p*
Main Plant Area Well Points: (Monitor groundwater at various locations north and east of the main plant. Not in a SSWMU.)	**Well Point ID Number**	**Analytes Measured in 1997**	**Well ID Number**	**Analytes Measured in 1997**
	WP-A (S) WP-C (S)	RI RI	WP-H (S)	RI
North Plateau Groundwater Seeps (Monitor groundwater emanating from seeps along the north plateau edge. Not in a SSWMU.	**Seep ID Number**	**Analytes Measured in 1997**	**Seep ID Number**	**Analytes Measured in 1997**
	SP02 (S) SP04 (S) SP05 (S) SP06 (S) SP11 (S)	RI RI RI RI RI	SP12 (S) SP18 (S) SP23 (S) GSEEP* (S)	I, RI, V RI RI V

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[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). Units enclosed in brackets indicate the hydrogeologic unit is only a secondary monitoring unit. Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient). Example: 401 (S[T]:B) monitors background conditions in the sand and gravel unit and secondarily in the unweathered Lavery till.*

[2] See Table 3-1 (p. 3-7) 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 for 1997. Wells measured for potentiometric (water-level) data only are designated by p.

Table E - 2
1997 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
301	UP(1)	7.31	475	-0.20±1.17E-09	9.87±2.97E-09	-0.34±5.91E-08
301	UP(2)	6.93	922	0.82±1.60E-09	2.47±3.05E-09	6.98±7.62E-08
301	UP(3)	6.96	492	0.09±1.15E-09	2.92±2.94E-09	9.98±7.98E-08
301	UP(4)	6.45	529	9.41±9.98E-10	4.39±2.07E-09	1.64±0.81E-07
401	UP(1)	6.95	1603	-1.22±3.16E-09	-1.39±5.02E-09	4.15±8.12E-08
401	UP(2)	6.71	2720	-3.75±4.90E-09	1.31±0.56E-08	7.14±7.65E-08
401	UP(3)	6.98	2390	-0.29±5.54E-09	5.89±5.56E-09	3.61±8.05E-08
401	UP(4)	6.93	2915	1.79±6.24E-09	-4.27±5.86E-09	1.12±0.81E-07
403	UP(1)	6.96	748	1.64±1.26E-09	0.06±2.31E-09	5.39±0.90E-07
403	UP(2)	7.06	1194	0.77±2.70E-09	6.04±3.55E-09	9.60±7.69E-08
403	UP(3)	6.86	1256	0.55±2.72E-09	1.17±0.28E-08	2.86±8.16E-08
403	UP(4)	7.38	1117	-0.76±2.75E-09	4.80±4.00E-09	1.66±0.80E-07
706	UP(1)	6.83	562	0.70±1.15E-09	1.09±0.26E-08	1.18±8.13E-08
706	UP(2)	7.47	871	1.20±1.20E-09	1.58±0.28E-08	7.14±7.68E-08
706	UP(3)	6.56	582	0.58±1.32E-09	1.10±0.26E-08	4.93±8.12E-08
706	UP(4)	6.66	573	0.37±1.68E-09	7.78±2.55E-09	2.59±8.03E-08
NB1S	UP(1)	6.08	377	5.81±6.91E-10	0.96±1.67E-09	-5.07±8.02E-08
NB1S	UP(2)	7.46	385	2.95±6.65E-10	2.90±1.76E-09	2.84±7.88E-08
NB1S	UP(3)	7.02	695	-0.03±1.11E-09	2.14±1.76E-09	5.59±7.96E-08
NB1S	UP(4)	6.75	634	0.11±1.55E-09	2.47±1.89E-09	6.76±8.08E-08
201	DOWN -B(1)	6.68	1913	3.13±2.76E-09	3.14±0.68E-08	-4.64±7.92E-08
201	DOWN -B(2)	6.67	1439	-0.22±2.88E-09	2.60±0.97E-08	4.14±8.02E-08
201	DOWN -B(3)	6.44	1875	-3.19±4.36E-09	4.30±0.65E-08	1.05±8.15E-08
201	DOWN -B(4)	6.62	1978	0.62±4.57E-09	2.36±0.65E-08	1.12±0.79E-07
103	DOWN - C(1)	10.55	2945	5.85±7.43E-09	4.54±0.69E-08	7.47±7.68E-08
103	DOWN - C(2)	10.11	4110	9.05±8.69E-09	8.39±0.77E-08	1.84±0.81E-07
103	DOWN - C(3)	10.99	4230	5.98±9.10E-09	5.75±0.73E-08	1.03±0.83E-07
103	DOWN - C(4)	10.66	3550	1.28±0.76E-08	3.61±0.91E-08	2.32±0.81E-07
104	DOWN - C(1)	7.27	1294	-2.67±7.38E-09	1.56±0.02E-05	7.85±0.84E-07
104	DOWN - C(2)	7.36	1143	-3.20±7.69E-09	1.56±0.02E-05	6.63±0.87E-07
104	DOWN - C(3)	6.91	1116	-0.83±1.00E-08	1.53±0.02E-05	5.82±0.89E-07
104	DOWN - C(4)	7.22	1188	-1.91±8.36E-09	1.72±0.02E-05	6.89±0.87E-07
111	DOWN - C(1)	6.61	491	0.00±5.07E-09	4.00±0.08E-06	3.01±0.80E-07
111	DOWN - C(2)	6.68	427	4.04±6.85E-09	3.05±0.07E-06	3.47±0.83E-07
111	DOWN - C(3)	6.89	460	-1.18±6.92E-09	2.81±0.07E-06	3.11±0.86E-07
111	DOWN - C(4)	6.90	682	2.98±8.26E-09	5.70±0.10E-06	1.02±0.09E-06

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 2 (*continued*)
1997 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
203	DOWN - C(2)	6.86	4035	*NS*	*NS*	*NS*
203	DOWN - C(3)	6.59	346	*NS*	*NS*	*NS*
203	DOWN - C(4)	6.85	3270	*NS*	*NS*	*NS*
205	DOWN - C(1)	6.93	1272	0.84±2.42E-09	6.42±5.12E-09	1.30±6.81E-08
205	DOWN - C(2)	7.16	1079	0.13±2.05E-09	1.22±0.38E-08	7.51±7.64E-08
205	DOWN - C(3)	6.88	1186	0.61±3.06E-09	8.74±5.33E-09	-2.38±8.12E-08
205	DOWN - C(4)	6.69	1667	-0.71±3.74E-09	1.06±0.61E-08	1.20±0.56E-07
406	DOWN - C(1)	7.13	566	1.11±1.17E-09	1.08±0.26E-08	1.63±0.98E-07
406	DOWN - C(2)	7.26	571	9.56±7.98E-10	9.39±1.77E-09	3.91±0.84E-07
406	DOWN - C(3)	6.59	577	1.77±1.13E-09	1.07±0.18E-08	1.16±0.97E-07
406	DOWN - C(4)	6.87	588	-0.38±1.54E-09	8.48±2.55E-09	3.24±0.87E-07
408	DOWN - C(1)	7.33	1718	1.20±0.90E-09	4.23±0.00E-04	7.11±1.96E-07
408	DOWN - C(2)	6.95	1560	1.60±2.20E-09	4.71±0.01E-04	1.21±1.07E-07
408	DOWN - C(3)	7.03	1679	*NR*	*NR*	*NR*
408	DOWN - C(4)	6.49	1730	-6.24±0.33E-06	4.94±0.03E-04	1.37±0.85E-07
501	DOWN - C(1)	7.50	1434	-3.92±7.68E-09	1.85±0.01E-04	3.29±0.80E-07
501	DOWN - C(2)	7.65	1289	-5.26±5.43E-09	1.92±0.00E-04	3.23±0.83E-07
501	DOWN - C(3)	7.04	1383	-0.78±1.35E-08	1.61±0.01E-04	2.22±0.84E-07
501	DOWN - C(4)	7.29	1411	-0.65±1.27E-08	1.66±0.01E-04	3.20±0.82E-07
502	DOWN - C(1)	7.59	1390	-5.85±6.62E-09	1.63±0.01E-04	5.16±0.82E-07
502	DOWN - C(2)	7.67	1244	-4.38±8.05E-09	1.49±0.01E-04	6.76±0.87E-07
502	DOWN - C(3)	7.02	1355	-0.80±1.38E-08	1.47±0.01E-04	3.72±0.86E-07
502	DOWN - C(4)	7.37	1343	0.26±1.36E-08	1.48±0.01E-04	3.41±0.83E-07
602	DOWN - C(1)	6.60	673	-0.25±1.46E-09	4.90±0.45E-08	2.88±0.17E-06
602	DOWN - C(2)	7.16	632	0.64±1.45E-09	1.36±0.35E-08	7.73±0.28E-06
602	DOWN - C(3)	6.62	638	0.56±1.56E-09	5.47±0.49E-08	1.43±0.12E-06
602	DOWN - C(4)	6.52	686	-0.53±1.29E-09	3.61±0.31E-08	4.78±0.20E-06
604	DOWN - C(1)	6.46	703	0.31±1.15E-09	5.48±2.39E-09	-9.35±1.28E-07
604	DOWN - C(2)	7.22	572	1.66±9.70E-10	3.46±2.23E-09	1.39±0.80E-07
604	DOWN - C(3)	6.52	549	1.13±1.46E-09	1.84±0.29E-08	-3.10±0.90E-07
604	DOWN - C(4)	6.43	592	0.40±1.80E-09	3.72±2.39E-09	2.15±0.81E-07
8605	DOWN - C(1)	6.96	885	1.47±7.62E-09	1.64±0.02E-05	1.88±0.11E-06
8605	DOWN - C(2)	7.15	909	4.44±9.63E-09	1.65±0.02E-05	1.75±0.11E-06
8605	DOWN - C(3)	7.54	964	0.18±1.18E-08	1.75±0.02E-05	1.74±0.11E-06
8605	DOWN - C(4)	7.09	1239	1.07±1.40E-08	1.37±0.02E-05	9.31±0.91E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.
NS - Not sampled.

Table E - 2 (continued)
1997 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
8607	DOWN - C(1)	6.26	633	0.16±1.55E-09	1.89±0.34E-08	-1.15±0.81E-07
8607	DOWN - C(2)	6.46	973	-0.11±1.44E-09	1.46±0.36E-08	-1.89±8.04E-08
8607	DOWN - C(3)	6.12	697	0.87±1.48E-09	1.33±0.34E-08	1.66±7.90E-08
8607	DOWN - C(4)	6.49	909	2.64±2.60E-09	1.77±0.37E-08	1.24±0.82E-07
8609	DOWN - C(1)	7.19	619	0.80±1.29E-09	3.82±0.08E-07	6.90±0.89E-07
8609	DOWN - C(2)	7.22	783	-0.23±1.01E-09	4.01±0.08E-07	7.80±0.88E-07
8609	DOWN - C(3)	7.14	820	-0.60±1.83E-09	4.23±0.12E-07	8.75±0.91E-07
8609	DOWN - C(4)	6.77	897	-0.22±2.57E-09	4.64±0.12E-07	8.98±0.92E-07
GSEEP	DOWN - D(1)	6.77	780	1.69±1.50E-09	8.02±3.18E-09	7.94±0.89E-07
GSEEP	DOWN - D(2)	7.02	746	1.04±1.40E-09	3.68±3.06E-09	8.04±0.88E-07
GSEEP	DOWN - D(3)	6.65	771	0.49±1.75E-09	7.32±3.24E-09	8.18±0.63E-07
GSEEP	DOWN - D(4)	6.62	969	-0.19±2.28E-09	6.68±3.26E-09	1.12±0.10E-06
105	DOWN - D(1)	6.99	1435	2.64±2.41E-09	3.60±0.25E-08	1.44±0.08E-06
105	DOWN - D(2)	7.13	1462	-0.65±3.21E-09	4.25±0.38E-08	8.37±0.90E-07
105	DOWN - D(3)	7.14	1425	2.14±4.19E-09	4.36±0.40E-08	6.08±0.89E-07
105	DOWN - D(4)	7.18	1431	2.47±3.47E-09	4.69±0.42E-08	6.07±0.90E-07
106	DOWN - D(1)	6.96	1190	-0.87±2.52E-09	5.97±2.67E-09	4.93±0.21E-06
106	DOWN - D(2)	7.01	1241	-1.24±2.59E-09	6.18±2.80E-09	2.48±0.13E-06
106	DOWN - D(3)	7.04	1148	0.78±2.79E-09	6.03±2.85E-09	2.41±0.09E-06
106	DOWN - D(4)	7.04	1160	-0.96±2.63E-09	0.68±2.99E-09	2.94±0.15E-06
116	DOWN - D(1)	7.34	1012	2.30±2.18E-09	1.64±0.09E-07	2.58±0.87E-07
116	DOWN - D(2)	7.24	1147	1.46±2.18E-09	1.14±0.08E-07	2.47±0.78E-07
116	DOWN - D(3)	7.02	650	0.62±1.73E-09	8.43±0.45E-08	1.17±0.80E-07
116	DOWN - D(4)	6.90	695	0.71±1.36E-09	6.97±0.32E-08	1.58±0.81E-07
601	DOWN - D(2)	6.85	528	*NS*	*NS*	*NS*
601	DOWN - D(3)	6.61	541	*NS*	*NS*	*NS*
601	DOWN - D(4)	6.13	495	*NS*	*NS*	*NS*
605	DOWN - D(1)	6.89	462	-1.69±9.94E-10	7.24±0.51E-08	4.17±0.89E-07
605	DOWN - D(2)	7.00	467	-0.69±9.19E-10	6.60±0.51E-08	-5.55±7.44E-08
605	DOWN - D(3)	6.93	516	-0.26±1.13E-09	6.15±0.50E-08	-1.33±8.14E-08
605	DOWN - D(4)	6.08	461	0.37±1.16E-09	6.98±0.52E-08	7.78±7.99E-08
801	DOWN - D(1)	6.85	1115	-2.49±4.87E-09	6.94±0.08E-06	4.67±0.81E-07
801	DOWN - D(2)	7.10	1482	-6.29±6.16E-09	7.94±0.12E-06	5.07±0.85E-07
801	DOWN - D(3)	6.64	1022	-9.72±8.52E-09	6.50±0.11E-06	3.57±0.86E-07
801	DOWN - D(4)	7.03	1016	0.25±1.28E-08	5.84±0.10E-06	3.23±0.82E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled.

Table E - 2 (concluded)
1997 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
802	DOWN - D(1)	6.89	380	8.54±9.68E-10	2.46±1.96E-09	3.07±0.56E-07
802	DOWN - D(2)	7.87	264	7.86±7.86E-10	2.71±2.14E-09	8.18±7.96E-08
802	DOWN - D(3)	6.89	194	4.71±6.92E-10	2.52±2.04E-09	-2.09±8.04E-08
802	DOWN - D(4)	6.96	768	1.09±2.15E-09	3.62±2.42E-09	3.94±0.83E-07
803	DOWN - D(1)	6.94	1413	2.74±3.41E-09	1.24±0.29E-08	5.03±0.82E-07
803	DOWN - D(2)	6.97	1456	2.46±3.44E-09	1.21±0.30E-08	4.30±0.83E-07
803	DOWN - D(3)	6.79	1370	4.49±3.59E-09	1.01±0.30E-08	4.75±0.87E-07
803	DOWN - D(4)	6.84	1488	0.50±3.66E-09	1.40±0.34E-08	4.31±0.85E-07
804	DOWN - D(1)	6.88	604	-0.09±1.22E-09	2.05±0.08E-07	1.88±0.78E-07
804	DOWN - D(2)	6.85	864	0.02±1.38E-09	2.12±0.08E-07	9.22±7.88E-08
804	DOWN - D(3)	7.61	609	1.09±1.50E-09	1.76±0.08E-07	1.32±0.81E-07
804	DOWN - D(4)	6.89	572	-0.13±1.58E-09	1.60±0.07E-07	2.26±0.82E-07
8603	DOWN - D(1)	7.39	1590	-4.64±9.09E-09	3.09±0.07E-06	5.20±0.82E-07
8603	DOWN - D(2)	7.42	1547	-0.43±1.02E-08	4.18±0.09E-06	6.95±0.87E-07
8603	DOWN - D(3)	7.20	1583	-1.21±1.01E-08	4.91±0.07E-06	4.48±0.87E-07
8603	DOWN - D(4)	7.42	1694	0.00±9.68E-09	7.75±0.08E-06	4.30±0.84E-07
8604	DOWN - D(1)	7.19	1664	-4.58±8.98E-09	4.75±0.03E-05	3.96±0.81E-07
8604	DOWN - D(2)	7.13	1633	-0.23±1.21E-08	5.00±0.03E-05	5.24±0.85E-07
8604	DOWN - D(3)	6.88	1618	-0.61±1.69E-08	4.64±0.03E-05	4.36±0.87E-07
8604	DOWN - D(4)	7.42	1474	-0.27±1.19E-08	3.98±0.03E-05	5.78±0.85E-07
8612	DOWN - D(1)	7.42	1077	2.02±2.31E-09	7.15±2.64E-09	9.41±0.92E-07
8612	DOWN - D(2)	7.49	1103	-0.08±2.32E-09	4.24±2.69E-09	8.81±0.89E-07
8612	DOWN - D(3)	7.01	1109	1.91±2.90E-09	2.64±2.74E-09	8.90±0.91E-07
8612	DOWN - D(4)	7.19	1108	0.38±2.81E-09	-0.68±2.94E-09	8.97±0.93E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 3
1997 Contamination Indicator and Radiological Indicator Results for the Till-Sand Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
302	UP(1)	7.34	2280	-2.20±3.08E-09	1.51±0.56E-08	-9.36±8.23E-08
302	UP(2)	7.27	2235	0.22±4.44E-09	4.98±5.25E-09	-6.21±7.80E-08
302	UP(3)	7.06	2440	-0.81±5.71E-09	3.59±5.49E-09	-6.74±8.06E-08
302	UP(4)	7.01	2320	2.74±5.40E-09	-3.70±5.78E-09	9.62±7.91E-08
402	UP(1)	7.22	1585	2.23±3.46E-09	-2.95±4.92E-09	8.36±7.95E-08
402	UP(2)	7.31	2230	-1.68±4.39E-09	2.59±5.20E-09	-0.17±8.13E-08
402	UP(3)	7.15	2230	-0.30±5.69E-09	1.50±5.50E-09	-9.92±8.22E-08
402	UP(4)	6.92	2220	0.70±5.11E-09	-4.15±5.76E-09	2.20±0.81E-07
204	DOWN - B(1)	8.20	775	-0.21±1.06E-09	8.46±1.32E-09	1.92±0.81E-07
204	DOWN - B(2)	8.05	775	1.26±1.05E-09	2.84±1.61E-09	-0.11±7.73E-08
204	DOWN - B(3)	7.68	774	2.51±8.52E-10	1.85±1.01E-09	3.88±8.06E-08
204	DOWN - B(4)	7.84	853	0.61±1.40E-09	3.75±1.65E-09	1.26±0.81E-07
206	DOWN - C(1)	7.70	875	0.89±1.20E-09	2.35±2.10E-09	4.83±7.90E-08
206	DOWN - C(2)	7.64	894	0.32±1.68E-09	-0.30±2.94E-09	1.44±5.61E-08
206	DOWN - C(3)	7.56	925	1.48±2.25E-09	2.02±0.38E-08	-2.87±8.01E-08
206	DOWN - C(4)	7.65	939	-0.57±2.31E-09	4.27±3.15E-09	1.34±0.80E-07
208	DOWN - C(1)	8.08	304	7.87±8.10E-10	1.78±1.46E-09	4.52±7.92E-08
208	DOWN - C(2)	7.93	303	8.90±7.35E-10	2.49±1.49E-09	1.09±7.91E-08
208	DOWN - C(3)	7.85	297	9.87±7.12E-10	0.58±1.25E-09	-7.91±8.00E-08
208	DOWN - C(4)	8.20	296	6.61±8.13E-10	2.12±1.47E-09	-1.34±7.74E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 4
1997 Contamination Indicator and Radiological Indicator Results for the Weathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
908	UP(1)	6.97	2440	8.23±5.20E-09	1.04±5.18E-09	4.14±8.20E-08
908	UP(3)	6.99	2860	7.09±7.61E-09	1.61±0.60E-08	1.11±0.81E-07
1005	UP(1)	7.23	784	4.15±2.10E-09	7.18±3.19E-09	8.61±7.93E-08
1005	UP(3)	7.24	765	2.97±2.38E-09	4.01±3.15E-09	5.94±7.72E-08
1008C	UP(1)	7.68	587	0.86±1.25E-09	4.60±1.95E-09	1.89±7.84E-08
1008C	UP(3)	7.58	580	0.73±1.06E-09	2.86±1.31E-09	7.10±5.58E-08
906	DOWN - B(1)	7.44	610	3.22±1.51E-09	1.29±2.19E-09	7.58±8.30E-08
906	DOWN - B(3)	7.26	611	3.30±1.75E-09	7.12±2.39E-09	1.06±0.82E-07
1006	DOWN - B(1)	6.94	2410	2.88±4.46E-09	-1.60±5.09E-09	7.08±7.96E-08
1006	DOWN - B(3)	7.01	2315	1.49±3.76E-09	1.16±0.40E-08	5.36±7.73E-08
1007	DOWN - B(1)	6.93	1152	0.76±2.75E-09	6.94±2.72E-09	9.73±8.18E-08
1007	DOWN - B(3)	6.99	1230	2.46±3.75E-09	8.59±3.00E-09	1.36±0.78E-07
NDATR	DOWN - C(1)	7.25	642	2.90±1.72E-09	7.14±0.51E-08	3.76±0.16E-06
NDATR	DOWN - C(2)	7.78	728	0.94±1.59E-09	7.31±0.54E-08	6.91±0.26E-06
NDATR	DOWN - C(3)	7.16	540	1.36±1.46E-09	6.71±0.52E-08	3.14±0.10E-06
NDATR	DOWN - C(4)	6.22	821	3.13±2.63E-09	8.63±0.58E-08	1.15±0.03E-05
909	DOWN - C(1)	6.67	1498	0.92±3.46E-09	3.00±0.14E-07	2.67±0.14E-06
909	DOWN - C(2)	7.01	1552	1.95±2.50E-09	3.78±0.11E-07	2.53±0.13E-06
909	DOWN - C(3)	6.73	1662	1.34±4.78E-09	3.96±0.10E-07	3.51±0.16E-06

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 5
1997 Contamination Indicator and Radiological Indicator Results for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
405	UP(1)	7.35	1018	0.07±2.80E-09	4.84±2.64E-09	1.88±8.40E-08
405	UP(2)	6.97	628	-0.30±1.46E-09	6.38±1.94E-09	1.81±0.78E-07
405	UP(3)	7.52	750	-0.25±1.76E-09	3.39±2.67E-09	-3.97±8.30E-08
405	UP(4)	6.88	882	-0.55±2.00E-09	-1.38±2.86E-09	-0.63±8.47E-08
110	DOWN - B(1)	7.49	564	0.85±1.11E-09	4.15±1.90E-09	1.56±0.11E-06
110	DOWN - B(2)	7.69	554	0.97±1.13E-09	2.03±1.80E-09	1.48±0.10E-06
110	DOWN - B(3)	7.22	538	3.49±1.70E-09	4.95±1.92E-09	1.47±0.11E-06
110	DOWN - B(4)	7.63	521	2.26±1.81E-09	0.28±1.78E-09	1.54±0.08E-06
704	DOWN - B(1)	6.69	923	0.38±1.94E-09	2.16±0.31E-08	4.60±9.03E-08
704	DOWN - B(2)	6.66	895	-0.42±2.07E-09	1.55±0.30E-08	6.19±8.02E-08
704	DOWN - B(3)	6.58	909	0.08±2.26E-09	1.49±0.31E-08	-7.31±8.19E-08
704	DOWN - B(4)	6.53	957	2.08±2.92E-09	1.44±0.33E-08	-2.94±9.21E-08
707	DOWN - B(1)	6.52	299	5.46±6.50E-10	1.14±0.21E-08	-4.58±8.35E-08
707	DOWN - B(2)	6.85	292	9.87±7.00E-10	4.50±1.83E-09	4.32±7.92E-08
707	DOWN - B(3)	6.58	369	4.70±8.87E-10	5.48±1.86E-09	-8.93±8.06E-08
707	DOWN - B(4)	6.27	541	0.54±1.48E-09	2.45±1.87E-09	4.56±8.00E-08
107	DOWN - C(1)	7.26	795	1.71±1.80E-09	5.57±2.81E-09	1.03±0.10E-06
107	DOWN - C(2)	7.28	679	0.88±1.49E-09	1.71±2.99E-09	8.44±0.88E-07
107	DOWN - C(3)	7.33	660	5.33±1.58E-09	3.58±2.16E-09	9.54±0.94E-07
107	DOWN - C(4)	7.27	759	0.47±2.10E-09	3.89±3.08E-09	1.10±0.09E-06
108	DOWN - C(1)	7.48	586	2.58±1.34E-09	1.14±1.76E-09	6.47±8.42E-08
108	DOWN - C(2)	7.46	599	1.75±1.24E-09	5.48±1.96E-09	1.20±0.80E-07
108	DOWN - C(3)	7.52	588	2.69±1.52E-09	3.09±1.81E-09	1.58±0.83E-07
108	DOWN - C(4)	6.96	613	2.41±1.28E-09	2.18±1.32E-09	8.97±7.89E-08
409	DOWN - C(1)	8.07	361	9.80±8.08E-10	5.11±1.61E-09	8.60±7.92E-08
409	DOWN - C(2)	7.99	348	1.18±0.80E-09	4.28±1.58E-09	2.19±7.90E-08
409	DOWN - C(3)	8.09	344	1.37±0.85E-09	3.41±1.42E-09	-1.07±0.80E-07
409	DOWN - C(4)	8.00	305	3.57±6.92E-10	2.70±1.49E-09	1.23±0.79E-07
910	DOWN - C(1)	7.14	643	0.04±1.58E-09	2.46±0.07E-07	-1.48±7.97E-08
910	DOWN - C(3)	7.12	1013	0.82±2.28E-09	1.30±0.05E-07	0.76±7.74E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 6
1997 Contamination Indicator and Radiological Indicator Results for the Kent Recessional Sequence

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
901	UP(1)	7.93	408	3.86±8.85E-10	3.95±1.59E-09	-8.70±7.68E-08
901	UP(3)	7.64	379	4.08±7.07E-10	1.23±0.18E-08	5.46±7.87E-08
902	UP(1)	8.21	450	1.14±1.18E-09	3.92±1.62E-09	-7.88±5.45E-08
902	UP(3)	7.91	448	9.24±8.62E-10	2.98±1.41E-09	-0.39±7.89E-08
1008B	UP(1)	8.05	372	4.32±9.91E-10	4.68±1.64E-09	-0.11±7.78E-08
1008B	UP(3)	8.15	310	6.03±6.95E-10	2.85±1.38E-09	4.19±7.92E-08
903	DOWN - B(1)	7.77	768	2.03±1.61E-09	2.18±2.27E-09	-1.43±0.76E-07
903	DOWN - B(3)	7.94	702	2.44±1.91E-09	2.71±2.23E-09	1.63±5.39E-08
8610	DOWN - B(1)	8.22	930	1.96±1.74E-09	2.73±2.32E-09	-1.24±0.80E-07
8610	DOWN - B(3)	8.13	958	1.34±1.94E-09	2.86±0.33E-08	-3.85±7.59E-08
8611	DOWN - B(1)	7.52	1013	2.57±2.37E-09	3.32±2.75E-09	-1.24±0.56E-07
8611	DOWN - B(3)	7.55	970	0.56±1.41E-09	-0.12±2.07E-09	1.49±7.62E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

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Table E - 7
1997 Contamination Indicator and Radiological Indicator Results at North Plateau Seep Monitoring Locations

Location Code	Date Collected	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
SP02	12/12/96	*NS*	*NS*	0.50±1.46E-09	1.28±3.67E-09	8.50±0.88E-07
SP02	6/17/97	*NS*	*NS*	1.53±1.90E-09	7.36±2.83E-09	7.83±0.90E-07
SP04	12/12/96	*NS*	*NS*	5.06±2.51E-09	7.59±3.31E-09	3.92±0.82E-07
SP04	6/17/97	*NS*	*NS*	1.65±0.46E-08	2.08±0.40E-08	3.07±0.86E-07
SP04	9/9/97	*NS*	*NS*	-0.06±2.53E-09	2.13±2.99E-09	6.27±0.86E-07
SP05	12/12/96	*NS*	*NS*	3.07±9.63E-10	2.40±2.25E-09	2.79±0.80E-07
SP05	6/17/97	*NS*	*NS*	1.28±1.50E-09	2.74±1.91E-09	1.31±0.82E-07
SP06	12/12/96	*NS*	*NS*	4.65±8.38E-10	0.95±1.76E-09	2.63±0.69E-07
SP06	6/17/97	*NS*	*NS*	0.21±1.02E-09	1.68±1.55E-09	8.89±7.05E-08
SP11	12/12/96	*NS*	*NS*	1.20±1.54E-09	5.73±2.79E-09	2.92±0.80E-07
SP11	6/17/97	*NS*	*NS*	0.72±2.05E-09	5.54±3.18E-09	8.30±8.13E-08
SP12	12/12/96	7.62	721	1.05±2.04E-09	4.50±4.51E-09	1.06±0.09E-06
SP12	6/2/97	7.00	840	1.14±2.15E-09	3.39±3.90E-09	7.46±0.89E-07
SP18	12/12/96	*NS*	*NS*	1.04±0.44E-09	0.00±2.71E-09	-8.64±6.03E-08
SP18	6/17/97	*NS*	*NS*	0.90±3.70E-10	2.75±1.48E-09	6.65±7.80E-08

NS - Not sampled.

Table E - 8

1997 Contamination Indicator and Radiological Indicator Results at Well Points

Location Code	Date Collected	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
WP-A	12/97	8.56	111	0.69±4.65E-10	4.83±0.33E-08	1.86±0.06E-05
WP-C	12/97	7.22	135	3.38±6.56E-10	2.19±0.38E-08	9.79±0.21E-05
WP-H	12/97	7.65	490	1.00±1.05E-09	2.55±0.03E-06	4.02±0.17E-06

NS - Not sampled

Table E - 9

Detections of Volatile Organic Compounds at Selected Groundwater Monitoring Locations

Location Code	Date	1,1,1-TCA (µg/L)	1,1-DCA (µg/L)	DCDFMeth (µg/L)	1,2-DCE (Total) (µg/L)	TCE (µg/L)
SP-12	12/12/96	<5.0	2.0*	<5.0	N/A	<5.0
	6/2/97	<5.0	1.5*	<5.0	N/A	<5.0
801	6/3/97	<5.0	<5.0	<5.0	N/A	1.7*
803	12/5/96	<5.0	<5.0	2.0*	N/A	<5.0
	3/6/97	<5.0	<5.0	2.0*	N/A	<5.0
	6/2/97	<5.0	<5.0	4.0*	N/A	<5.0
	9/2/97	<5.0	<5.0	3.0*	N/A	<5.0
8609	3/6/97	<5.0	<5.0	<5.0	N/A	<5.0
8612	12/9/96	4.0*	33.0	3.0*	19.0	<5.0
	3/6/97	3.0*	24.5	2.0*	14.0	<5.0
	6/2/97	4.0*	29.0	4.0*	15.5	<5.0
	9/2/97	4.5*	23.0	5.0	22.2	<5.0

Note: Samples are collected according to different schedules (annual, semiannual, or quarterly schedules).

** Compound was detected below the practical quantitation limit (PQL).*

Table E - 10

Tributyl Phosphate Sampling Results for 1997 at Selected Groundwater Monitoring Locations

Location Code	Date	Tributyl Phosphate (TBP) (µg/L)
111	12/4/96	<10.0
	6/4/97	<10.0
8605	12/4/96	700
	6/3/97	445

Note: Samples are collected according to different schedules (annual, semiannual, or quarterly schedules). Practical quantitation limit for TBP is 10 µg/L.

Table E - 11
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
301	UP(2)	*NS*	*NS*	*NS*	*NS*	*NS*	48.1	*NS*	*NS*
301	UP(3)	*NS*	*NS*	*NS*	*NS*	*NS*	77.4	*NS*	*NS*
301	UP(4)	*NS*	*NS*	*NS*	*NS*	*NS*	23.5	*NS*	*NS*
401	UP(1)	<10.0	<10.0	323	<1.0	<5.0	219	*NS*	*NS*
401	UP(2)	*NS*	*NS*	*NS*	*NS*	*NS*	214	*NS*	*NS*
401	UP(3)	*NS*	*NS*	*NS*	*NS*	*NS*	193	*NS*	*NS*
401	UP(4)	*NS*	*NS*	*NS*	*NS*	*NS*	898	*NS*	*NS*
403	UP(1)	<10.0	71.2	776	4.0	13.4	1270	*NS*	*NS*
403	UP(2)	*NS*	*NS*	*NS*	*NS*	*NS*	835	*NS*	*NS*
403	UP(3)	*NS*	*NS*	*NS*	*NS*	*NS*	1390	*NS*	*NS*
403	UP(4)	*NS*	*NS*	*NS*	*NS*	*NS*	1360	*NS*	*NS*
706	UP(1)	<10.0	13.2	240	1.3	<5.0	23.8	*NS*	*NS*
201	DOWN - B(1)	<10.0	<10.0	259	<1.0	<5.0	<10.0	*NS*	*NS*
201	DOWN - B(2)	*NS*	*NS*	*NS*	*NS*	*NS*	<1.7	*NS*	*NS*
201	DOWN - B(3)	*NS*	*NS*	*NS*	*NS*	*NS*	*NR*	*NS*	*NS*
201	DOWN - B(4)	*NS*	*NS*	*NS*	*NS*	*NS*	<1.3	*NS*	*NS*
103	DOWN - C(1)	<10.0	110	39	0.26	<5.0	13.0	*NS*	*NS*
104	DOWN - C(1)	<10.0	<10.0	155	0.60	<5.0	18.0	*NS*	*NS*
111	DOWN - C(1)	<10.0	<10.0	65	0.26	<5.0	2.60	<50.0	<20.0
203	DOWN - C(2)	*NS*	*NS*	*NS*	*NS*	*NS*	352	*NS*	*NS*
203	DOWN - C(3)	*NS*	*NS*	*NS*	*NS*	*NS*	149	*NS*	*NS*
203	DOWN - C(4)	*NS*	*NS*	*NS*	*NS*	*NS*	118	*NS*	*NS*
205	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	454	*NS*	*NS*
205	DOWN - C(2)	*NS*	*NS*	*NS*	*NS*	*NS*	228	*NS*	*NS*
205	DOWN - C(3)	*NS*	*NS*	*NS*	*NS*	*NS*	104	*NS*	*NS*
205	DOWN - C(4)	*NS*	*NS*	*NS*	*NS*	*NS*	164	*NS*	*NS*
408	DOWN - C(1)	<10.0	<10.0	310	0.32	<5.0	49.0	*NS*	*NS*
408	DOWN - C(2)	*NS*	*NS*	*NS*	*NS*	*NS*	66.0	*NS*	*NS*
408	DOWN - C(3)	*NS*	*NS*	*NS*	*NS*	*NS*	120	*NS*	*NS*
408	DOWN - C(4)	*NS*	*NS*	*NS*	*NS*	*NS*	120	*NS*	*NS*
501	DOWN - C(1)	<10.0	<10.0	320	<1.0	<5.0	53.0	*NS*	*NS*

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled.
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table E - 11 (continued)
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
301	UP(2)	*NS*	*NS*	148	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
301	UP(3)	*NS*	*NS*	192	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
301	UP(4)	*NS*	*NS*	179	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
401	UP(1)	<3.0	<0.20	308	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
401	UP(2)	*NS*	*NS*	185	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
401	UP(3)	*NS*	*NS*	142	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
401	UP(4)	*NS*	*NS*	340	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
403	UP(1)	110	0.29	419	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
403	UP(2)	*NS*	*NS*	198	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
403	UP(3)	*NS*	*NS*	271	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
403	UP(4)	*NS*	*NS*	454	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
706	UP(1)	22	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
201	DOWN - B(1)	<3.0	<0.20	40.1	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
201	DOWN - B(2)	*NS*	*NS*	*NR*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
201	DOWN - B(3)	*NS*	*NS*	32.6	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
201	DOWN - B(4)	*NS*	*NS*	56.6	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
103	DOWN - C(1)	24	0.09	31.0	11	<10.0	<50.0	*NS*	*NS*	*NS*
104	DOWN - C(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
111	DOWN - C(1)	<3.0	*NS*	<40.0	<5.0	5.40	<10.0	<100	<50.0	<20.0
111	DOWN - C(2)	*NS*	0.07	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
203	DOWN - C(2)	*NS*	*NS*	224	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
203	DOWN - C(3)	*NS*	*NS*	698	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
203	DOWN - C(4)	*NS*	*NS*	835	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
205	DOWN - C(1)	3.0	<0.20	60.7	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
205	DOWN - C(2)	*NS*	*NS*	30.6	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
205	DOWN - C(3)	*NS*	*NS*	44.9	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
205	DOWN - C(4)	*NS*	*NS*	39.4	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
408	DOWN - C(1)	<3.0	<0.20	210	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
408	DOWN - C(2)	*NS*	*NS*	280	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
408	DOWN - C(3)	*NS*	*NS*	320	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
408	DOWN - C(4)	*NS*	*NS*	270	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
501	DOWN - C(1)	<3.0	<0.20	58.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table E - 11 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
502	DOWN - C(1)	<10.0	<10.0	460	0.2	<5.0	3400	11.0	34.0
502	DOWN - C(2)	*NS*	<10.0	290	*NS*	<5.0	640	12.5	<25.0
502	DOWN - C(3)	*NS*	<10.0	300	*NS*	<5.0	240	24.0	<25.0
502	DOWN - C(4)	*NS*	<10.0	310	*NS*	<5.0	450	12.0	<25.0
602	DOWN - C(1)	<10.0	54.7	608	2.6	6.8	78.8	*NS*	*NS*
604	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
8605	DOWN - C(1)	<10.0	5.7	91	<1.0	<5.0	2.20	<50.0	<20.0
8607	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
8609	DOWN - C(1)	<10.0	<10.0	212	<1.0	<5.0	<10.0	*NS*	*NS*
105	DOWN - D(1)	<10.0	13.8	221	<1.0	<5.0	11.0	*NS*	*NS*
106	DOWN - D(1)	<10.0	12.7	220	1.0	<5.0	210	*NS*	*NS*
106	DOWN - D(2)	*NS*	*NS*	*NS*	*NS*	*NS*	1520	*NS*	*NS*
106	DOWN - D(3)	*NS*	*NS*	*NS*	*NS*	*NS*	3000	*NS*	*NS*
106	DOWN - D(4)	*NS*	*NS*	*NS*	*NS*	*NS*	656	*NS*	*NS*
116	DOWN - D(1)	<10.0	50.8	510	2.1	8.9	1090	*NS*	*NS*
116	DOWN - D(2)	*NS*	*NS*	*NS*	*NS*	*NS*	45.2	*NS*	*NS*
116	DOWN - D(3)	*NS*	*NS*	*NS*	*NS*	*NS*	69.3	*NS*	*NS*
116	DOWN - D(4)	*NS*	*NS*	*NS*	*NS*	*NS*	45.5	*NS*	*NS*
601	DOWN - D(2)	*NS*	*NS*	*NS*	*NS*	*NS*	10200	*NS*	*NS*
601	DOWN - D(3)	*NS*	*NS*	*NS*	*NS*	*NS*	7000	*NS*	*NS*
601	DOWN - D(4)	*NS*	*NS*	*NS*	*NS*	*NS*	310	*NS*	*NS*
605	DOWN - D(1)	<10.0	<10.0	< 200	<1.0	<5.0	1540	*NS*	*NS*
605	DOWN - D(2)	*NS*	*NS*	*NS*	*NS*	*NS*	6.50	*NS*	*NS*
605	DOWN - D(3)	*NS*	*NS*	*NS*	*NS*	*NS*	9.50	*NS*	*NS*
605	DOWN - D(4)	*NS*	*NS*	*NS*	*NS*	*NS*	10.0	*NS*	*NS*
801	DOWN - D(1)	<10.0	<10.0	130	0.24	<5.0	9.10	*NS*	*NS*
802	DOWN - D(1)	<10.0	<10.0	380	<1.0	<5.0	69.3	*NS*	*NS*
803	DOWN - D(1)	19.5	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
804	DOWN - D(1)	<10.0	<10.0	< 200	<1.0	<5.0	62.7	*NS*	*NS*

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 11 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
502	DOWN - C(1)	<3.0	<0.20	120	<5.0	<10.0	4.70	*NS*	13.0	<20.0
502	DOWN - C(2)	<3.0	0.13	50.0	<5.0	<5.00	*NS*	*NS*	<50.0	<20.0
502	DOWN - C(3)	<3.0	<0.20	32.0	<5.0	<5.00	*NS*	*NS*	<50.0	<20.0
502	DOWN - C(4)	1.3	<0.20	37.0	<5.0	<5.00	*NS*	*NS*	<50.0	<20.0
602	DOWN - C(1)	85	<0.20	109	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
604	DOWN - C(1)	4.2	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
8605	DOWN - C(1)	<3.0	*NS*	<40.0	<5.0	<10.0	9.90	<100	2.20	<20.0
8605	DOWN - C(2)	*NS*	0.08	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
8607	DOWN - C(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
8609	DOWN - C(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
105	DOWN - D(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
106	DOWN - D (1)	17	<0.20	276	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
106	DOWN - D(2)	*NS*	*NS*	346	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
106	DOWN - D(3)	*NS*	*NS*	659	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
106	DOWN - D(4)	*NS*	*NS*	277	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
116	DOWN - D(1)	73	<0.20	491	<5.0	29.0	<10.0	*NS*	*NS*	*NS*
116	DOWN - D(2)	*NS*	*NS*	127	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
116	DOWN - D(3)	*NS*	*NS*	249	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
116	DOWN - D(4)	*NS*	*NS*	143	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
601	DOWN - D(2)	*NS*	*NS*	589	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
601	DOWN - D(3)	*NS*	*NS*	865	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
601	DOWN - D(4)	*NS*	*NS*	398	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
605	DOWN - D(1)	5.2	<0.20	284	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
605	DOWN - D(2)	*NS*	*NS*	14.0	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
605	DOWN - D(3)	*NS*	*NS*	43.8	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
605	DOWN - D(4)	*NS*	*NS*	81.4	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
801	DOWN - D(1)	<3.0	<0.20	14.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
802	DOWN - D(1)	<3.0	<0.20	43.3	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
803	DOWN - D(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
804	DOWN - D(1)	7.3	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 11 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
8603	DOWN - D(1)	<10.0	<10.0	330	<1.0	<5.0	<10.0	*NS*	*NS*
8604	DOWN - D(1)	<10.0	<10.0	300	0.26	<5.0	3.80	*NS*	*NS*
8612	DOWN - D(1)	<10.0	<10.0	245	<1.0	<5.0	<10.0	*NS*	*NS*
Till-Sand									
302	UP(1)	<10.0	<10.0	562	<1.0	<5.0	<10.0	*NS*	*NS*
Unweathered Lavery Till									
110	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
704	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
707	DOWN - B(1)	<10.0	12.2	< 200	1.3	<5.0	157	*NS*	*NS*
107	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	27.0	*NS*	*NS*
108	DOWN - C(1)	<10.0	<10.0	221	<1.0	<5.0	17.8	*NS*	*NS*
910	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
Weathered Lavery Till									
908	UP(1)	<10.0	<10.0	< 200	<1.0	<5.0	15.1	*NS*	*NS*
1005	UP(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
1008C	UP(1)	<10.0	<10.0	229	<1.0	<5.0	31.1	*NS*	*NS*
906	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
1006	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
NDATR	DOWN - C(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	<50.0	<25.0
NDATR	DOWN - C(2)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	<50.0	<25.0
NDATR	DOWN - C(3)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	<50.0	<25.0
NDATR	DOWN - C(4)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	<50.0	<25.0
909	DOWN - C(1)	<10.0	14.4	< 200	<1.0	<5.0	<10.0	<50.0	26.8

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 11 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
8603	DOWN - D(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
8604	DOWN - D(1)	<3.0	<0.20	13.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
8612	DOWN - D(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
Till-Sand										
302	UP(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
Unweathered Lavery Till										
110	DOWN - B(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
704	DOWN - B(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
707	DOWN - B(1)	15	<0.20	119	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
107	DOWN - C(1)	5.8	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
108	DOWN - C(1)	11	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
910	DOWN - C(1)	5.2	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
Weathered Lavery Till										
908	UP(1)	7.0	<0.20	<40.0	<5.00	<10.0	<10.0	*NS*	*NS*	*NS*
1005	UP(1)	<3.0	<0.20	<40.0	<5.00	<10.0	<10.0	*NS*	*NS*	*NS*
1008C	UP(1)	<3.0	<0.20	<40.0	<5.00	<10.0	<10.0	*NS*	*NS*	*NS*
906	DOWN - B(1)	<3.0	<0.20	<40.0	<5.00	<10.0	<10.0	*NS*	*NS*	*NS*
1006	DOWN - B(1)	<3.0	<0.20	<40.0	<5.00	<10.0	<10.0	*NS*	*NS*	*NS*
NDATR	DOWN - C(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	28.8
NDATR	DOWN - C(2)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	<20.0
NDATR	DOWN - C(3)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	<20.0
NDATR	DOWN - C(4)	5.8	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	83.1
909	DOWN - C(1)	9.1	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	125

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.
NS - Not sampled

Table E - 11 *(concluded)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Kent Recessional Sequence									
901	UP(1)	<10.0	<10.0	671	<1.0	<5.0	<10.0	*NS*	*NS*
902	UP(1)	<10.0	<10.0	770	<1.0	<5.0	<10.0	<50.0	<25.0
902	UP(3)	<10.0	<10.0	774	<1.0	<5.0	<10.0	<50.0	<25.0
1008B	UP(1)	<10.0	<10.0	713	<1.0	<5.0	<10.0	*NS*	*NS*
903	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	<5.0	<10.0	*NS*	*NS*
8611	DOWN - B(1)	<10.0	<10.0	< 200	<1.0	5.2	<10.0	*NS*	*NS*

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Kent Recessional Sequence										
901	UP(1)	5.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
902	UP(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	<20.0
902	UP(3)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	<3000	<50.0	75.5
1008B	UP(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
903	DOWN - B(1)	<3.0	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*
8611	DOWN - B(1)	9.3	<0.20	<40.0	<5.0	<10.0	<10.0	*NS*	*NS*	*NS*

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 12

Sampling Parameters at Early Warning Monitoring Wells (μg/L)

Location Code	Sample Round	Aluminum *Total*	Iron *Total*	Manganese *Total*
502	(1)	72	35,000	49
	(2)	150	4,500	94
	(2)	230	3,400	69
	(3)	<200	2,000	72
	(4)	91	3,000	17

Note: These parameters were sampled in addition to routine monitoring parameters in 1997.

Table E - 13
1997 Alpha- Beta- and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	C-14	K-40	Co-60	I-129	Cs-137
Sand and Gravel						
401	A(2)	0.73±2.24E-08	0.00±2.74E-07	0.00±1.96E-08	0.33±1.01E-09	0.00±1.77E-08
406	C(2)	1.49±2.26E-08	0.00±2.02E-07	0.00±3.19E-08	2.70±6.33E-10	0.00±1.83E-08
408	C(2)	-1.56±1.28E-08	1.06±5.88E-08	0.46±2.39E-09	0.37±1.93E-09	1.94±3.88E-09
Weathered Till						
NDATR	C(1)	-8.25±9.86E-09	0.00±2.04E-07	0.00±1.75E-08	2.37±8.71E-10	0.00±1.47E-08
NDATR	C(3)	0.71±1.44E-08	0.00±2.25E-07	0.00±1.75E-08	0.93±1.52E-09	0.00±1.40E-08
909	C(1)	-0.33±1.02E-08	0.00±2.02E-07	0.00±1.43E-08	9.51±2.40E-09	0.00±1.36E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 13 (concluded)
1997 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	A(2)	5.88±2.13E-09	-1.22±0.97E-09	9.23±4.63E-10	-4.29±5.38E-10	0.34±3.33E-10
111	C(2)	1.41±0.03E-06	*NS*	*NS*	*NS*	*NS*
406	C(2)	2.88±1.83E-09	3.65±1.12E-09	4.93±3.56E-10	-9.68±3.46E-10	-1.00±3.76E-11
408	C(2)	1.93±0.00E-04	2.01±0.21E-08	5.22±3.41E-10	-0.46±7.63E-09	1.47±1.33E-11
501	C(2)	8.98±0.03E-05	*NS*	*NS*	*NS*	*NS*
502	C(2)	6.93±0.02E-05	*NS*	*NS*	*NS*	*NS*
602	C(1)	3.03±0.47E-08	*NS*	*NS*	*NS*	*NS*
602	C(3)	2.87±0.45E-08	*NS*	*NS*	*NS*	*NS*
8605	C(2)	7.76±0.08E-06	*NS*	*NS*	*NS*	*NS*
8609	C(1)	1.85±0.11E-07	*NS*	*NS*	*NS*	*NS*
8609	C(3)	2.18±0.11E-07	*NS*	*NS*	*NS*	*NS*
116	D(1)	7.13±0.62E-08	*NS*	*NS*	*NS*	*NS*
116	D(3)	4.35±0.50E-08	*NS*	*NS*	*NS*	*NS*
605	D(1)	4.24±0.54E-08	*NS*	*NS*	*NS*	*NS*
605	D(3)	4.56±0.54E-08	*NS*	*NS*	*NS*	*NS*
801	D(1)	3.47±0.05E-06	*NS*	*NS*	*NS*	*NS*
801	D(2)	3.62±0.05E-06	*NS*	*NS*	*NS*	*NS*
801	D(3)	3.29±0.05E-06	*NS*	*NS*	*NS*	*NS*
801	D(4)	3.17±0.05E-06	*NS*	*NS*	*NS*	*NS*
8603	D(1)	1.54±0.03E-06	*NS*	*NS*	*NS*	*NS*
8603	D(3)	2.45±0.03E-06	*NS*	*NS*	*NS*	*NS*
Weathered Lavery Till						
NDATR	C(1)	3.52±0.50E-08	-1.39±1.93E-09	5.50±3.80E-10	3.91±0.53E-09	8.26±6.71E-11
NDATR	C(3)	3.51±0.49E-08	-3.30±1.61E-09	4.06±3.44E-10	7.37±3.52E-09	1.80±9.95E-11
NDATR	C(4)	*NS*	*NS*	*NS*	1.46±3.50E-09	*NS*
909	C(1)	1.47±0.09E-07	1.12±0.59E-08	3.36±2.95E-10	1.74±0.46E-09	2.35±1.83E-10

		U-233/234	U-235/236	U-238	Total U (µg/mL)
Sand and Gravel					
401	A(2)	5.03±3.83E-11	1.00±1.84E-11	4.36±3.11E-11	1.62±0.74E-04
406	C(2)	1.63±0.52E-10	0.80±2.12E-11	1.37±0.48E-10	0.00±9.50E-04
408	C(2)	3.35±0.76E-10	2.55±1.94E-11	1.78±0.53E-10	6.04±0.09E-04
Weathered Lavery Till					
NDATR	C(1)	1.27±0.16E-09	0.26±1.20E-10	7.80±0.33E-10	3.89±0.07E-04
NDATR	C(3)	7.00±2.41E-10	1.26±1.22E-10	4.97±2.09E-10	1.76±0.07E-03
909	C(1)	5.36±0.34E-09	2.40±0.63E-10	1.21±0.13E-09	1.90±0.03E-03

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 14

Modified Practical Quantitation Limits (PQLs) in µg/L for Appendix IX Parameters

COMPOUND	PQL	COMPOUND	PQL
Appendix IX Volatiles		*Appendix IX 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	1,2-Dichloroethylene (total)	5
Isobutyl alcohol	100		
Metals		*Metals*	
Aluminum	200	Manganese	15
Antimony*	10	Lead*	3
Arsenic*	10	Mercury*	0.2
Barium*	200	Nickel*	5 or 40**
Beryllium*	1	Selenium*	5
Cadmium*	5	Silver*	10
Chromium*	5 or 10**	Thallium*	10
Cobalt	50	Tin	3000
Copper	25	Vanadium	50
Iron	100	Zinc	20

** These parameters comprise the WVDP sampling list for metals from RCRA Part 264, Appendix IX, Hazardous Constituents List.*

*** Ni and Cr - Lower PQL per WVDP-266, Field Data Collection Plan (West Valley Nuclear Services Co., Inc. and Dames & Moore December 1996)*

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 14 (*continued*)

Modified Practical Quantitation Limits (PQLs) in μg/L for Appendix IX Parameters

COMPOUND	PQL
Appendix IX 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
Bis(2-chloro-1- methylethyl) ether	10
4-Bromophenyl phenyl ether	10
Butyl benzyl phthalate	10
Carbazole	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

COMPOUND	PQL
Appendix IX Semivolatiles	
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
Diphenylamine	10
Ethyl methanesulfonate	10
Famphur	10
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	10
Hexachloroethane	10
Hexachlorophene	10
Hexachloropropene	10
Indeno(1,2,3,-cd)pyrene	10
Isodrin	10
Isophorone	10
Isosafrole	10
Kepone	10
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	50
N-Nitrosodi-n-butylamine	10
N-Nitrosodiethylamine	10
N-Nitrosodipropylamine	10
N-Nitroso-di-N-phenylamine	10
N-Nitrosodimethylamine	10
N-Nitrosodipropylamine	10
N-Nitrosodiphenylamine	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

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 14 (concluded)

Modified Practical Quantitation Limits (PQLs) in µg/L for Appendix IX Parameters

COMPOUND	PQL
Appendix IX Semivolatiles	
p-(Dimethylamino)azobenzene	10
p-Chloroaniline	10
p-Chloro-m-cresol	10
p-Cresol	10
p-Dichlorobenzene	10
p-Nitroaniline	25
p-Nitrophenol	25
p-Phenylenediamine	10
Parathion	10
Pentachlorobenzene	10
Pentachloronitrobenzene	10
Pentachlorophenol	25
Phenacetin	10
Phenanthrene	10
Phenol	10
Pronamide	10
Pyrene	10
Safrole	10
1,2,4,5-Tetrachlorobenzene	10

COMPOUND	PQL
Appendix IX 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	10
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.

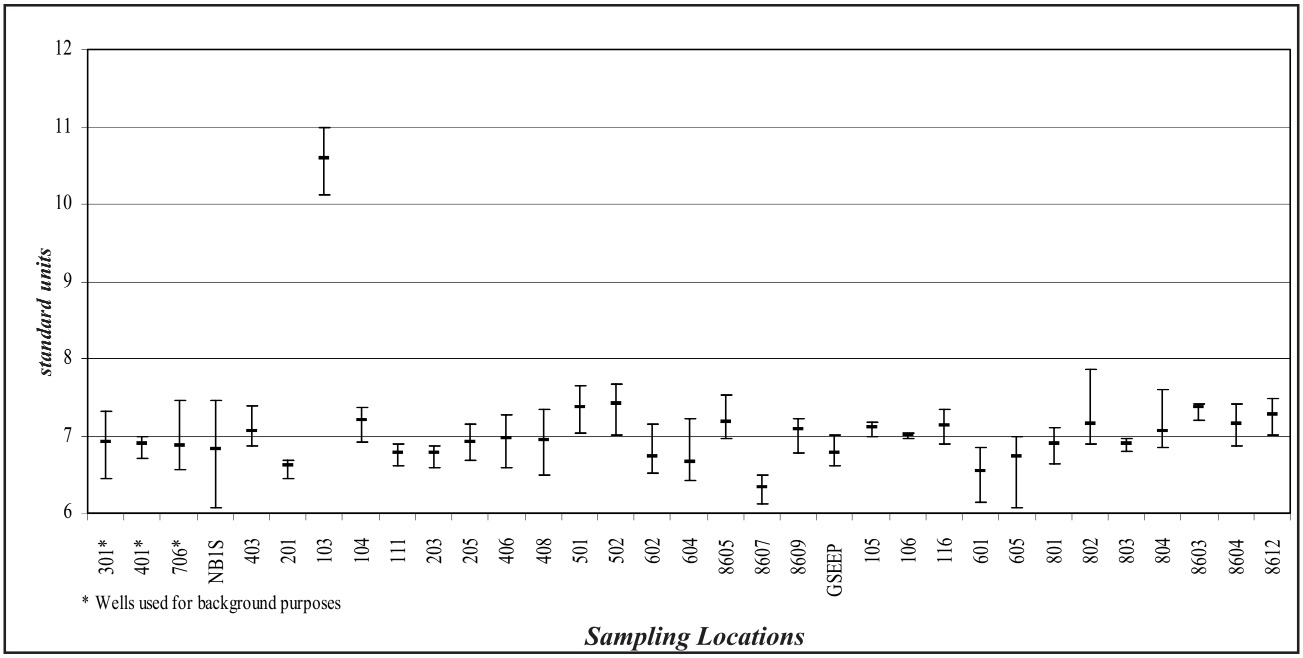


Figure E-1. pH in Groundwater Samples from the Sand and Gravel Unit

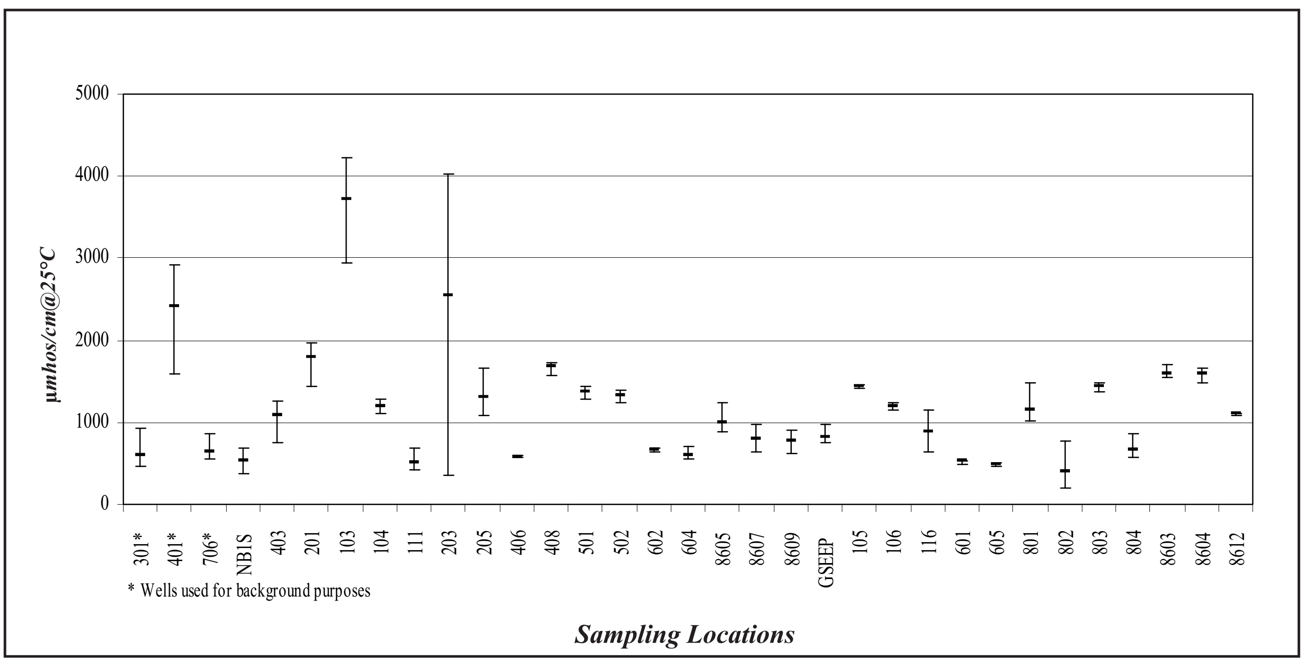


Figure E-2. Conductivity (µmhos/cm@25°C) in Groundwater Samples from the Sand and Gravel Unit

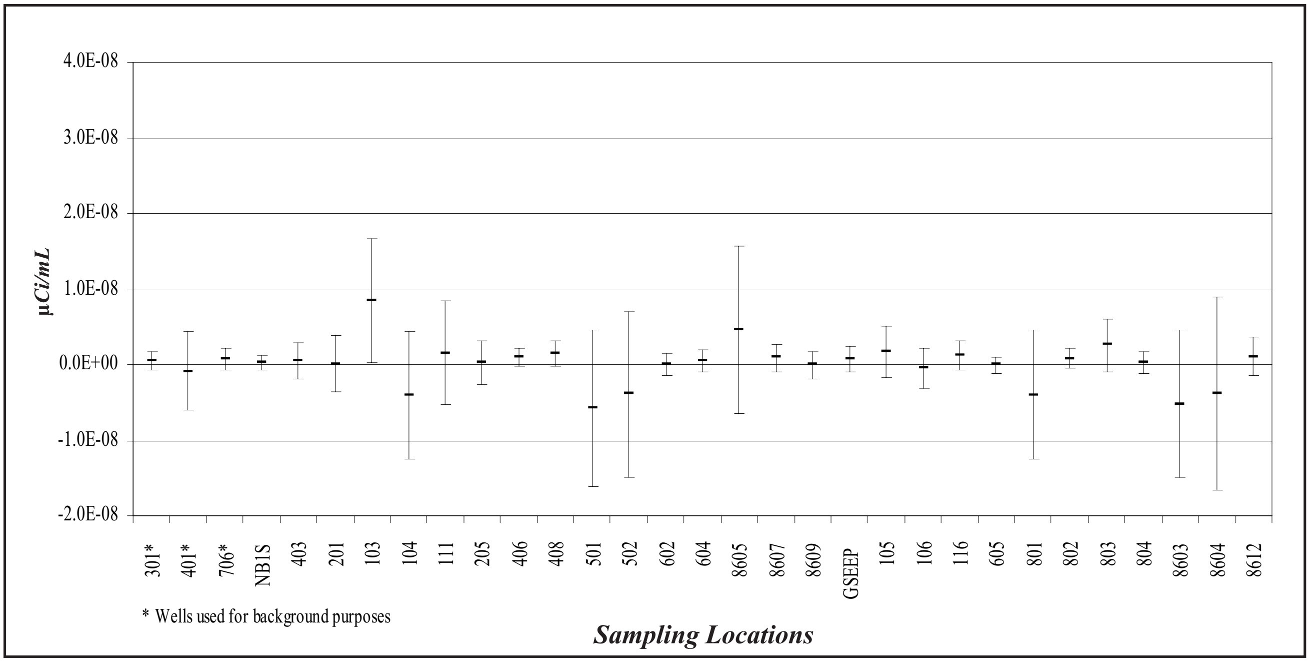


Figure E-3. Gross Alpha (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit

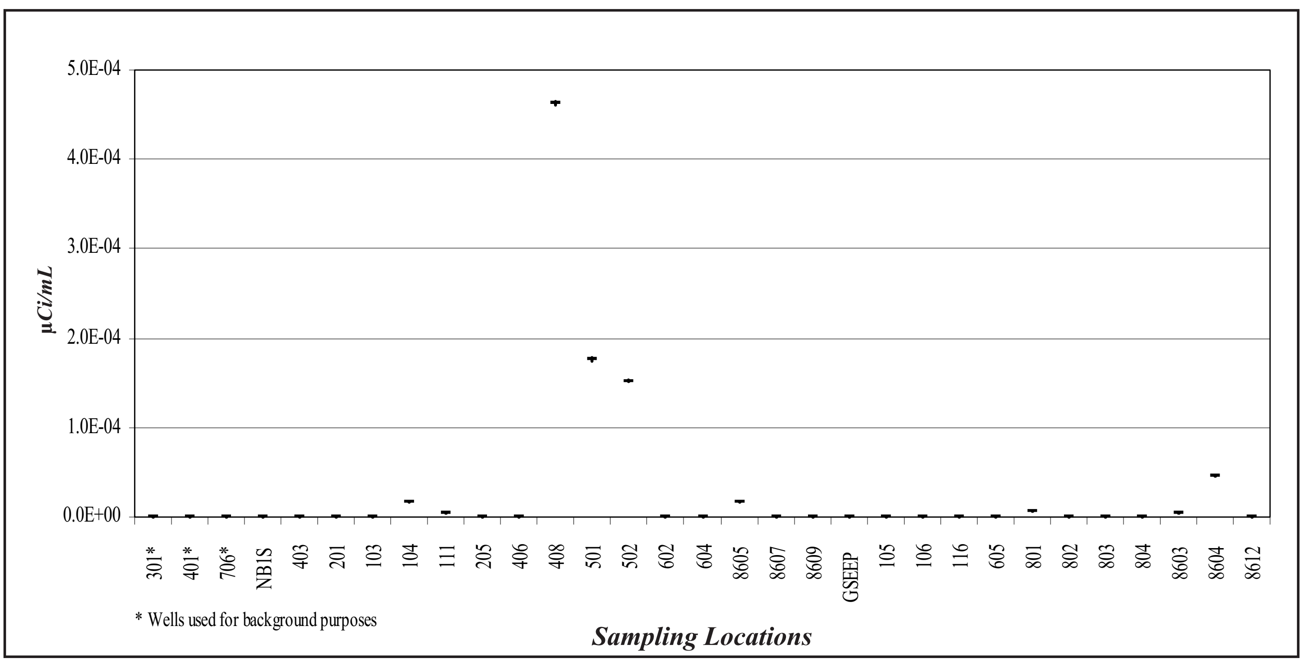


Figure E-4. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit
(Figs. E-4a and E-4b follow with magnified scales.)

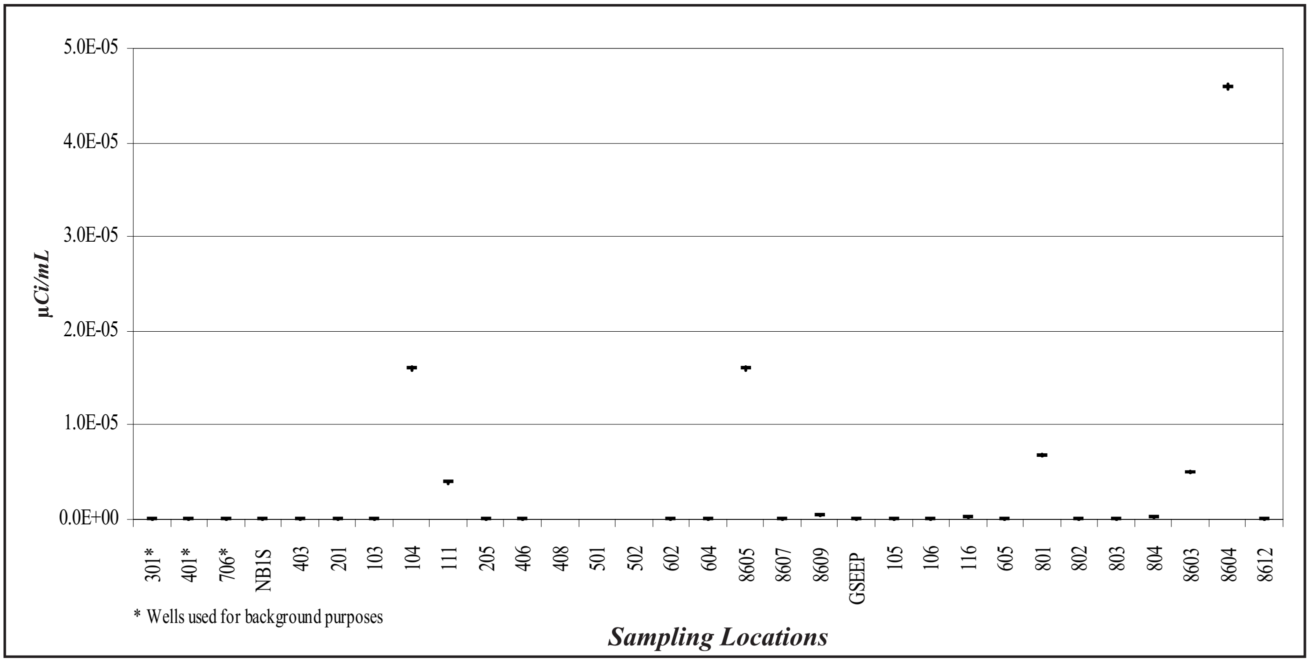


Figure E-4a. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. E-4)

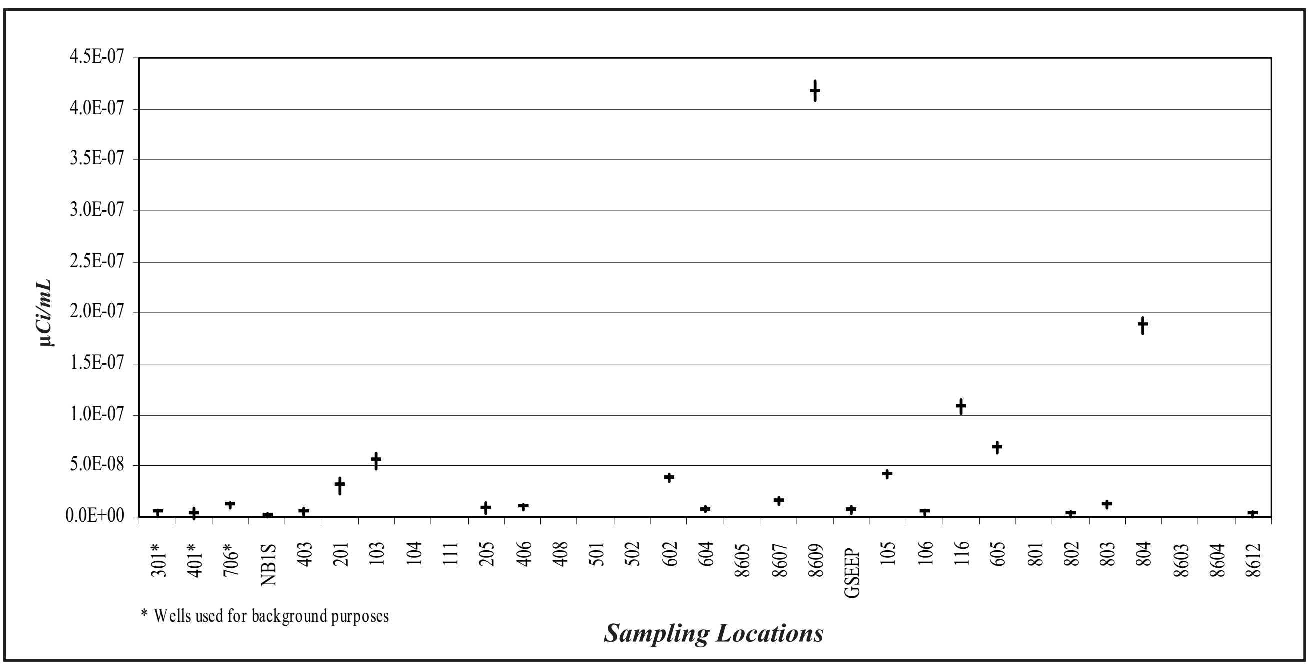


Figure E-4b. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. E-4a)

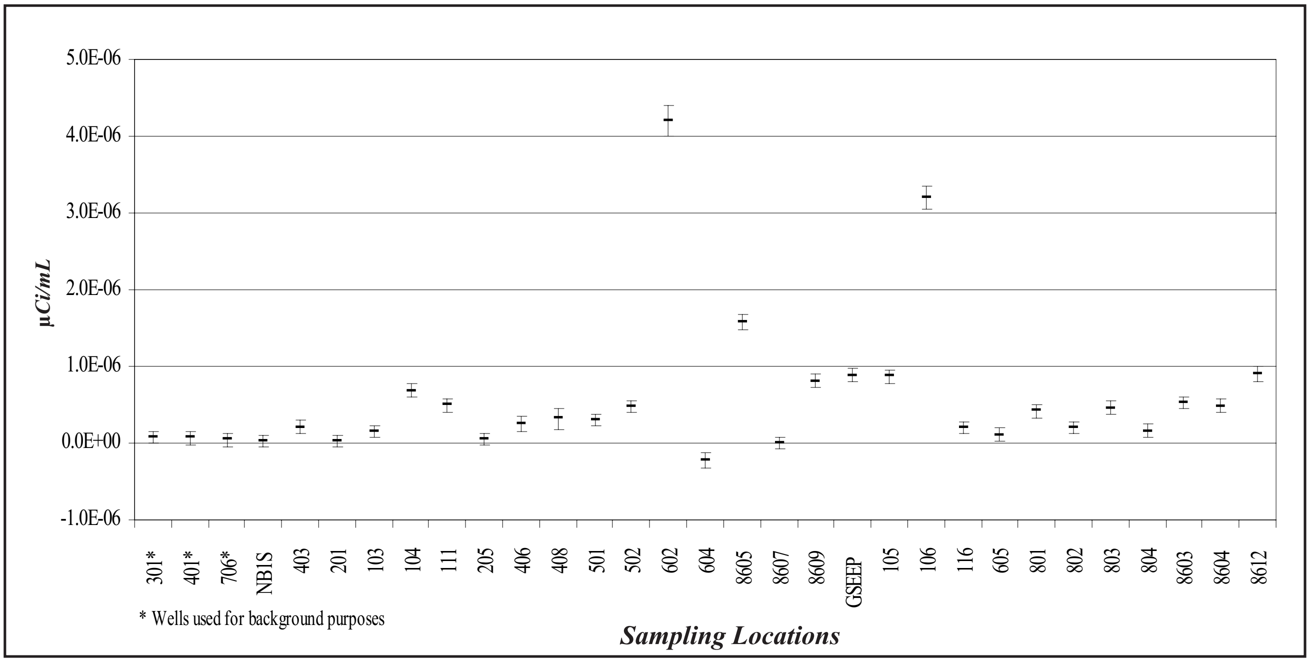


Figure E-5. Tritium Activity (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (Fig. E-5a follows with magnified scale.)

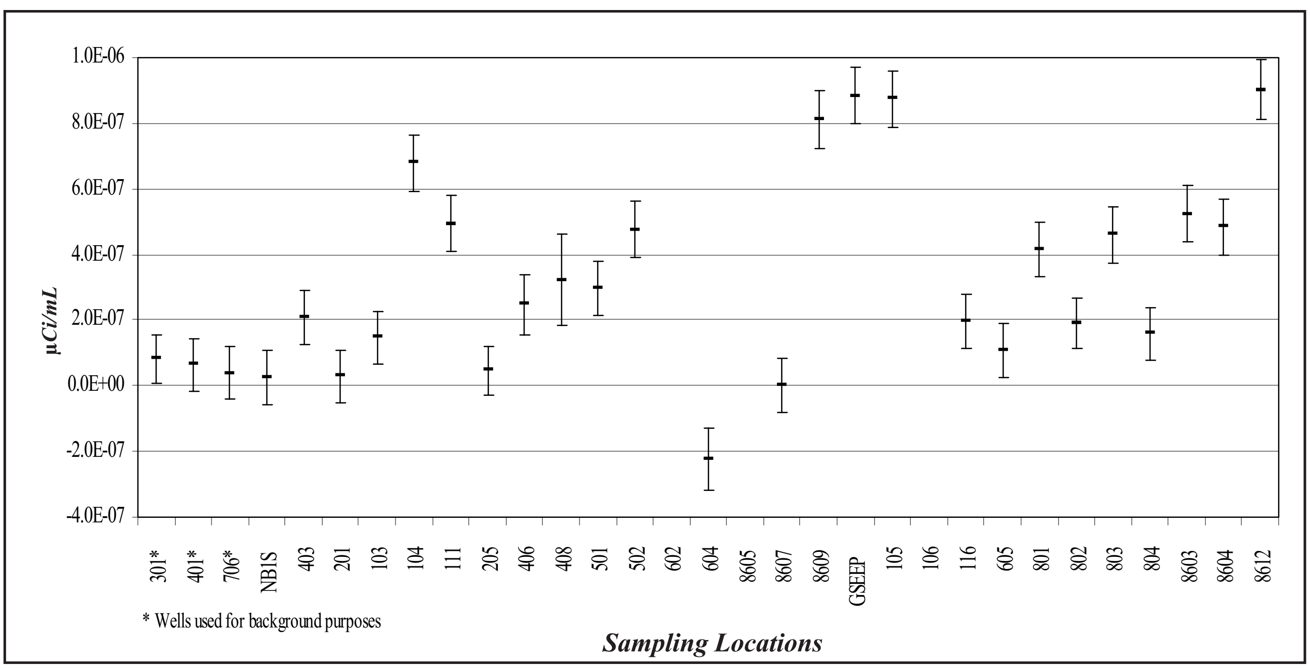


Figure E-5a. Tritium Activity (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. E-5)

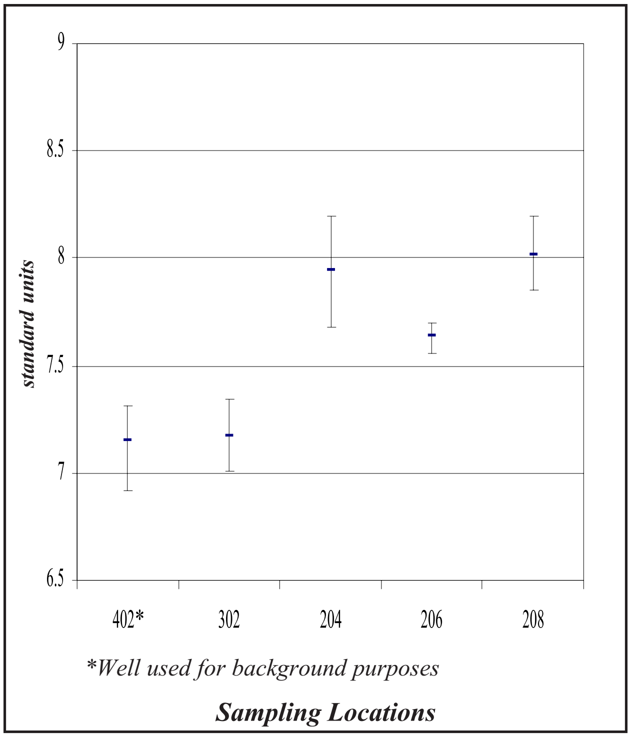


Figure E-6. pH of Groundwater Samples from the Till-Sand Unit

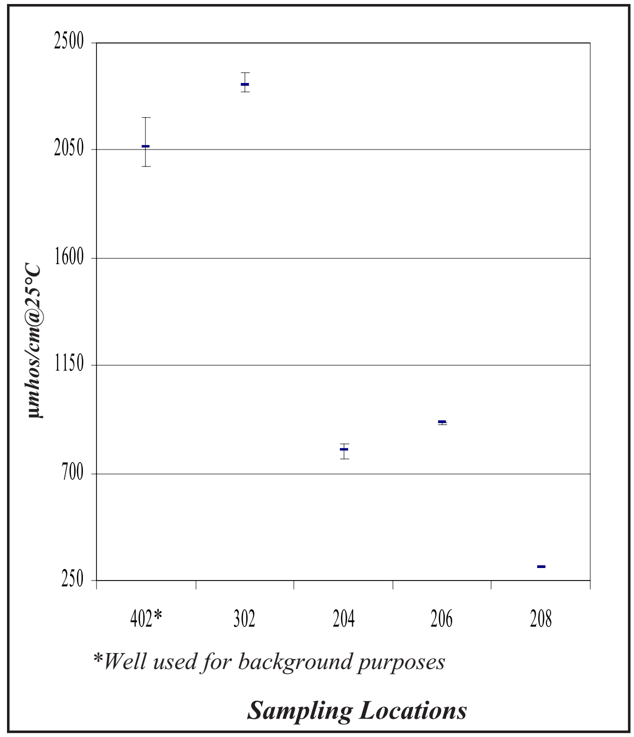


Figure E-7. Conductivity (µmhos/cm@25°C) of Groundwater Samples from the Till-Sand Unit

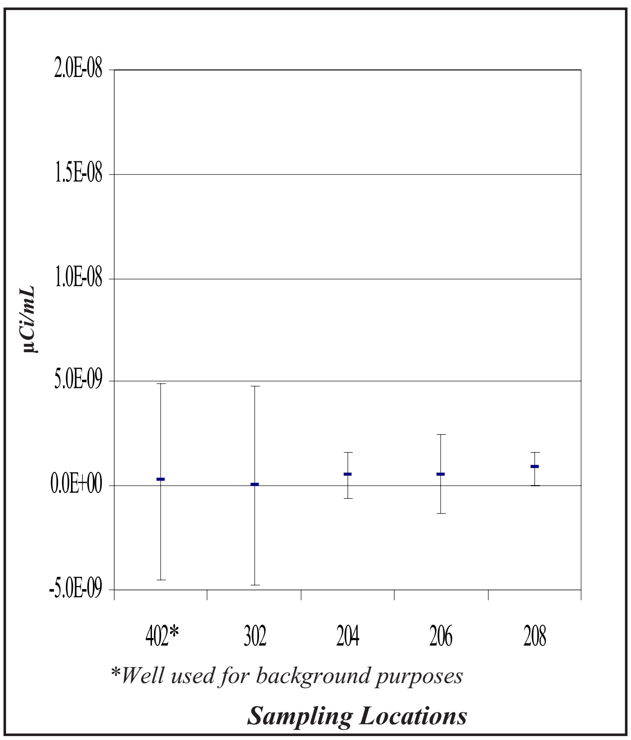


Figure E-8. Gross Alpha (µCi/mL) in Groundwater Samples from the Till-Sand Unit

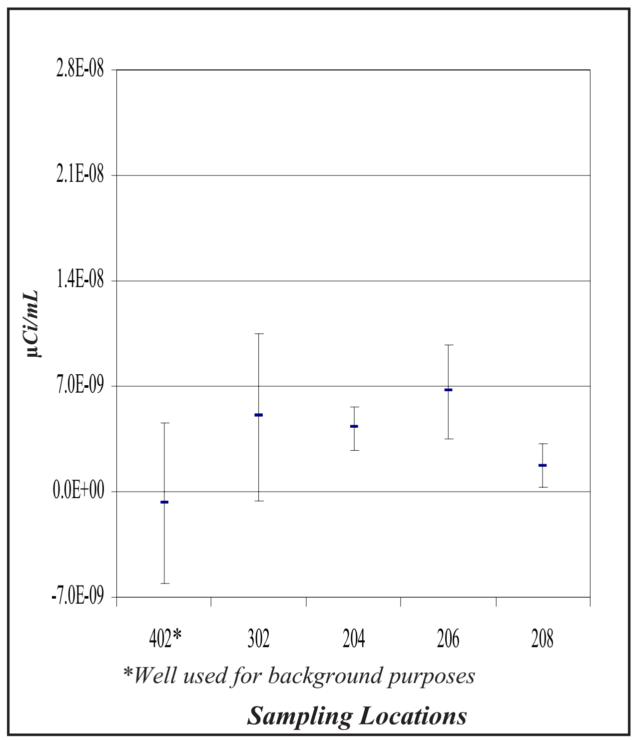


Figure E-9. Gross Beta (µCi/mL) in Groundwater Samples from the Till-Sand Unit

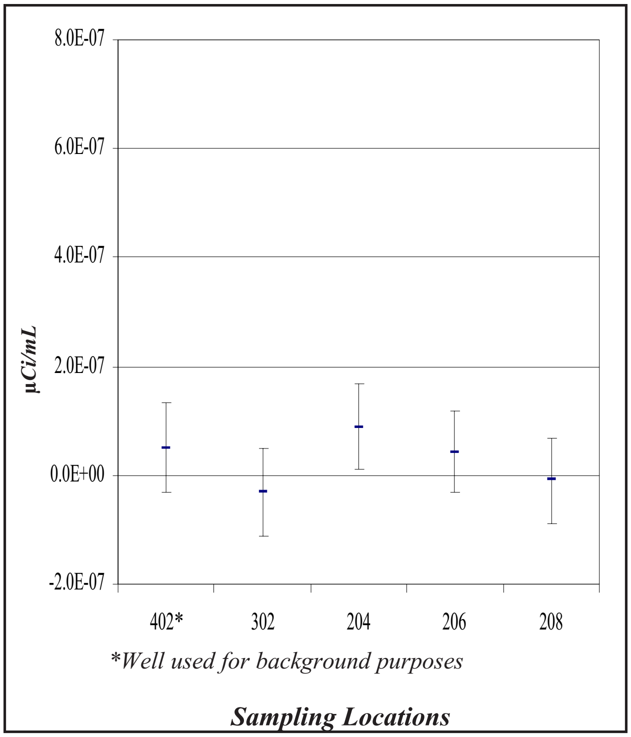


Figure E-10. Tritium Activity (µCi/mL) in Groundwater Samples from the Till-Sand Unit

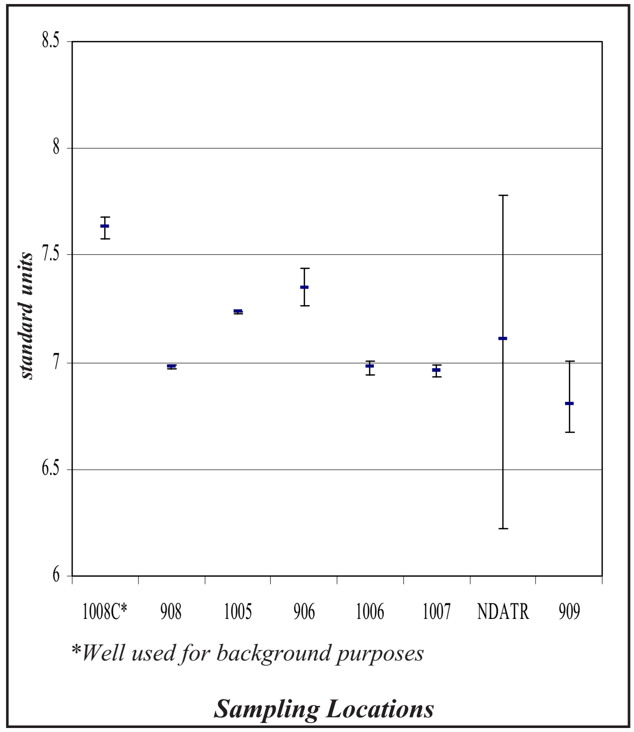


Figure E-11. pH of Groundwater Samples from the Weathered Lavery Till Unit

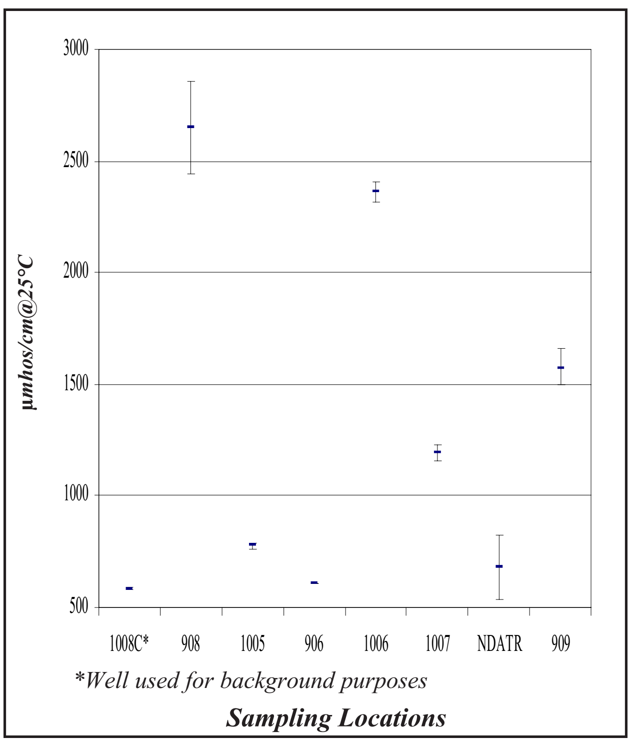


Figure E-12. Conductivity (µmhos/cm@25°C) of Groundwater Samples from the Weathered Lavery Till Unit

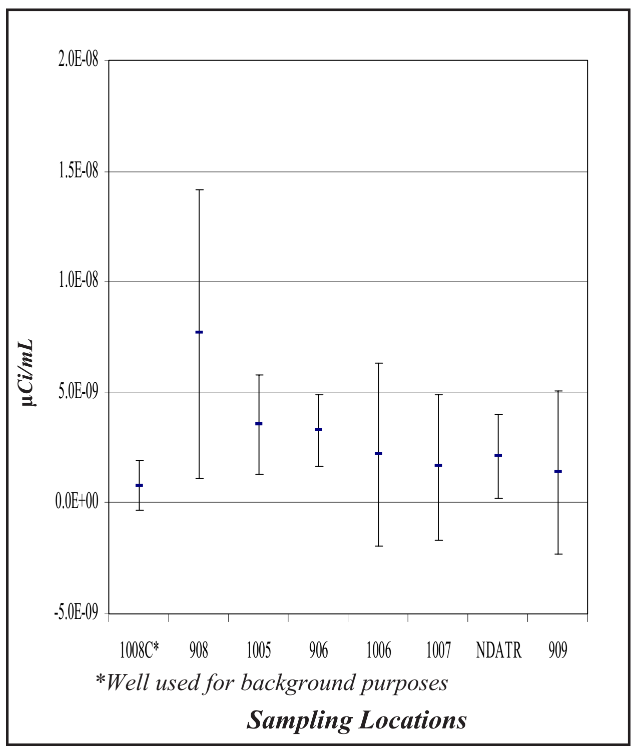


Figure E-13. Gross Alpha (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

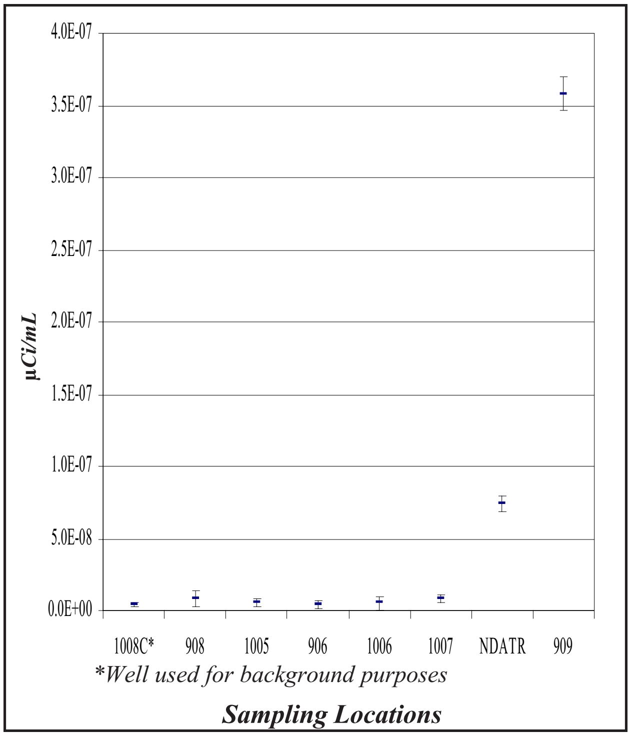


Figure E-14. Gross Beta (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit (Fig. E-14a follows with magnified scale)

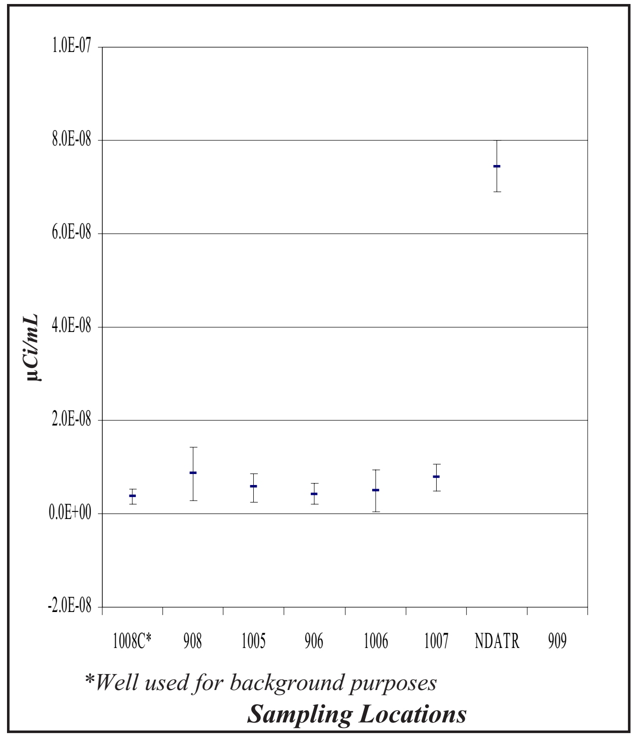


Figure E-14a. Gross Beta (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit (magnified scale of Fig. E-14)

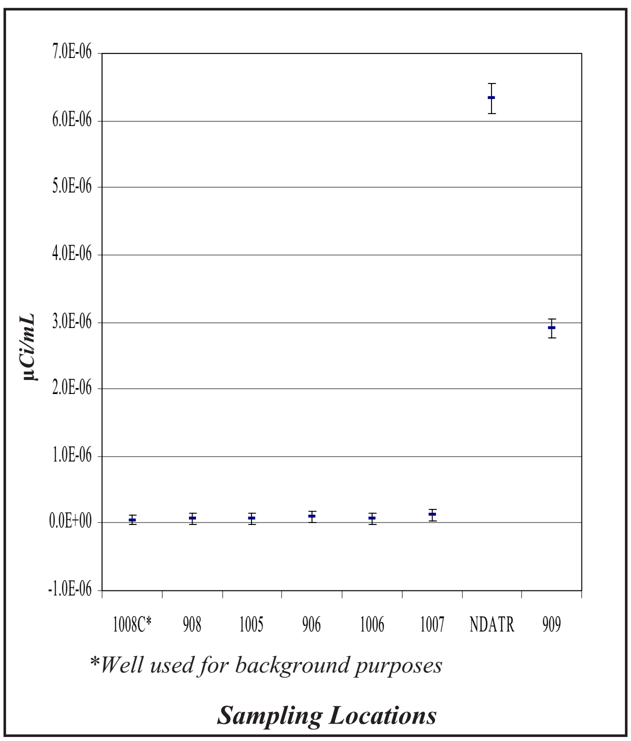


Figure E-15. Tritium Activity (µCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

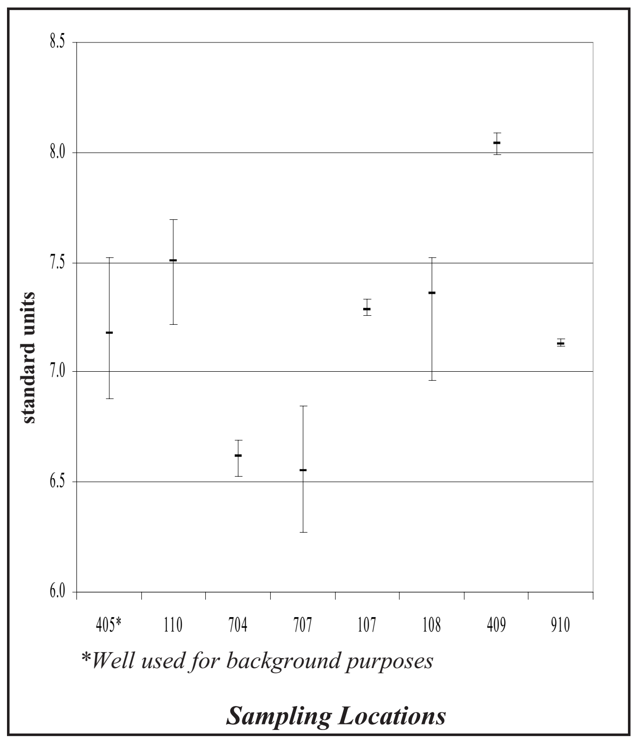


Figure E-16. pH of Groundwater Samples from the Unweathered Lavery Till Unit

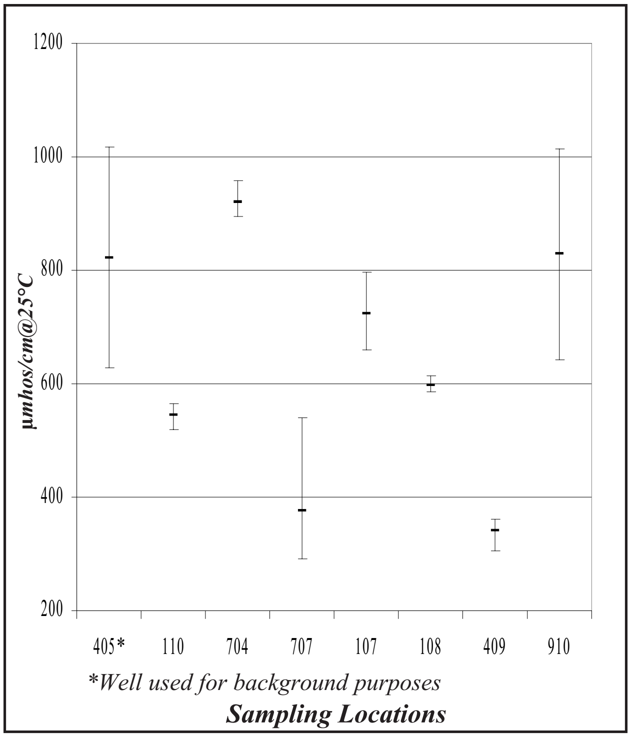


Figure E-17. Conductivity (µmhos/cm@25°C) of Groundwater Samples from the Unweathered Lavery Till Unit

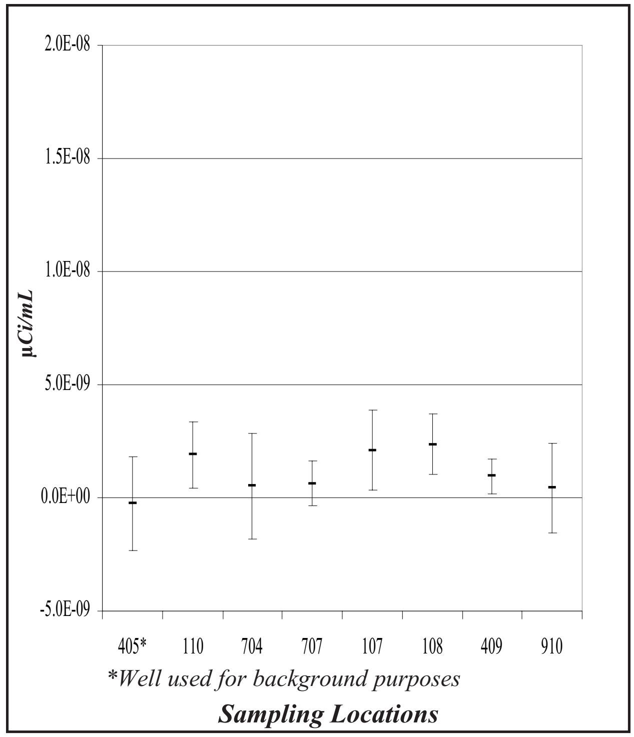


Figure E-18. Gross Alpha (µCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

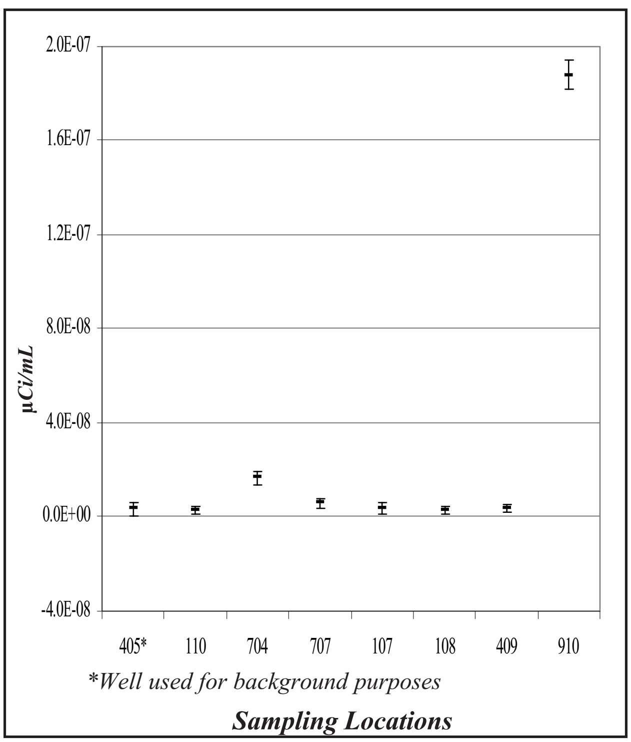


Figure E-19. Gross Beta (µCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit (Fig. E-19a follows with magnified scale)

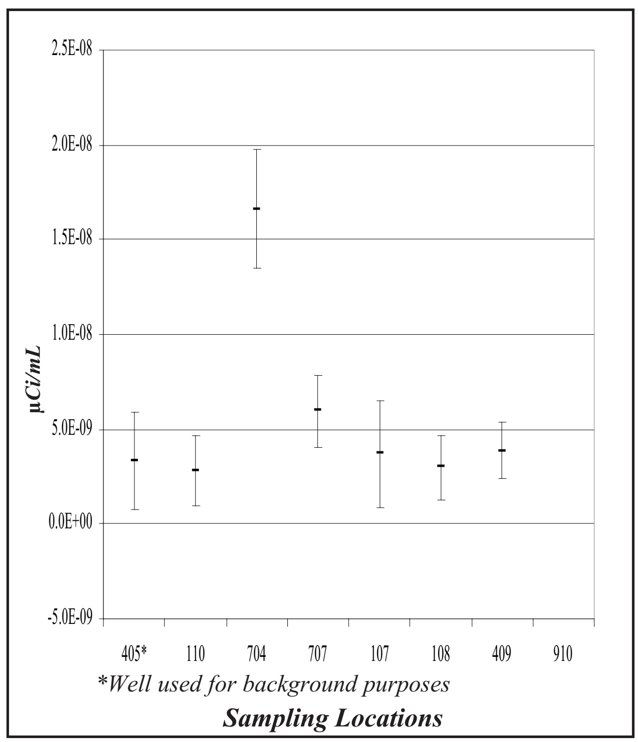


Figure E-19a. Gross Beta (µCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit (magnified scale of Fig. E-19)

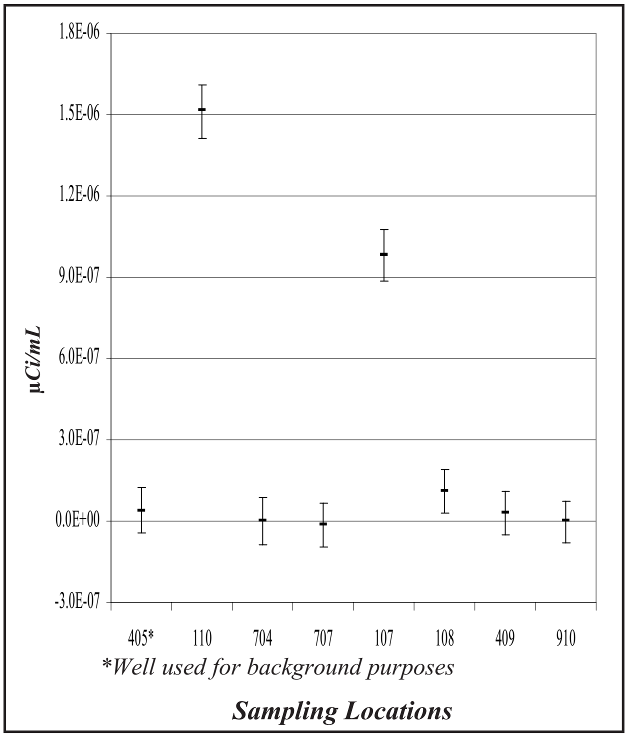


Figure E-20. Tritium Activity (µCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

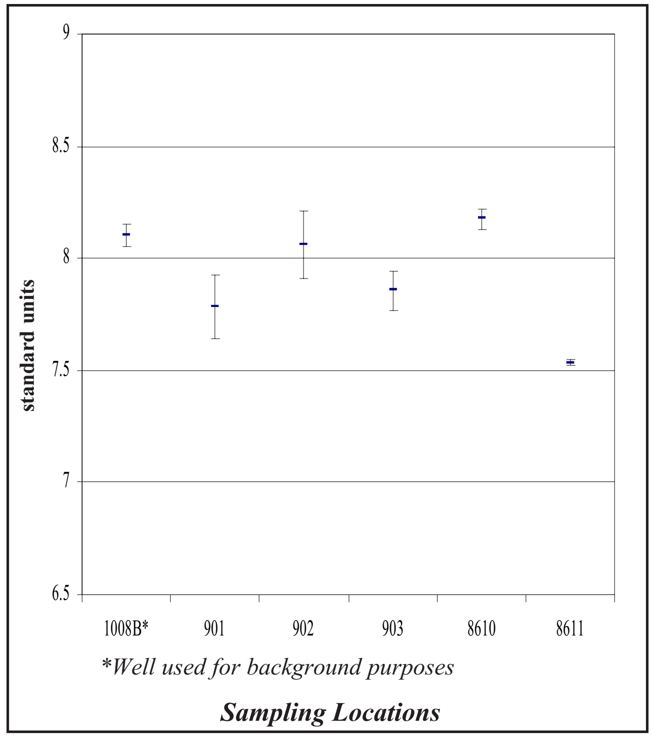


Figure E-21. pH of Groundwater Samples from the Kent Recessional Sequence

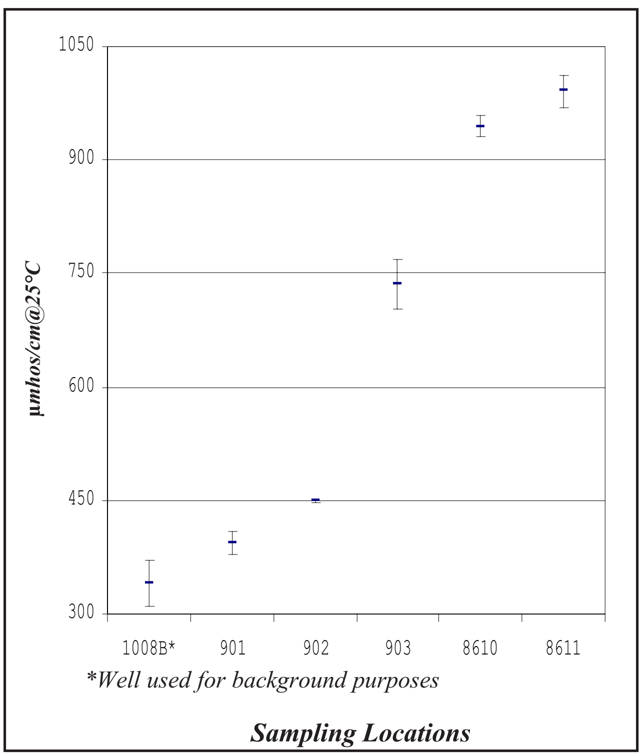


Figure E-22. Conductivity (µmhos/cm@25°C) of Groundwater Samples from the Kent Recessional Sequence

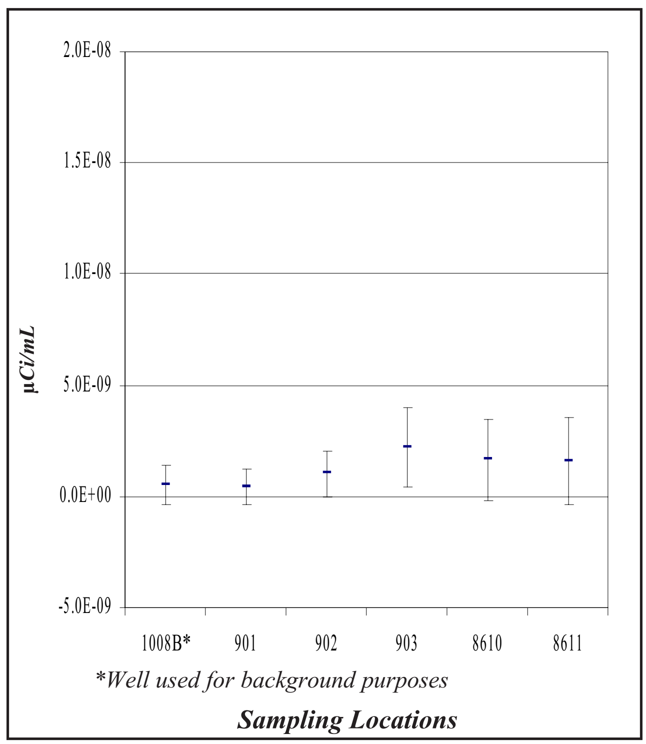


Figure E-23. Gross Alpha (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

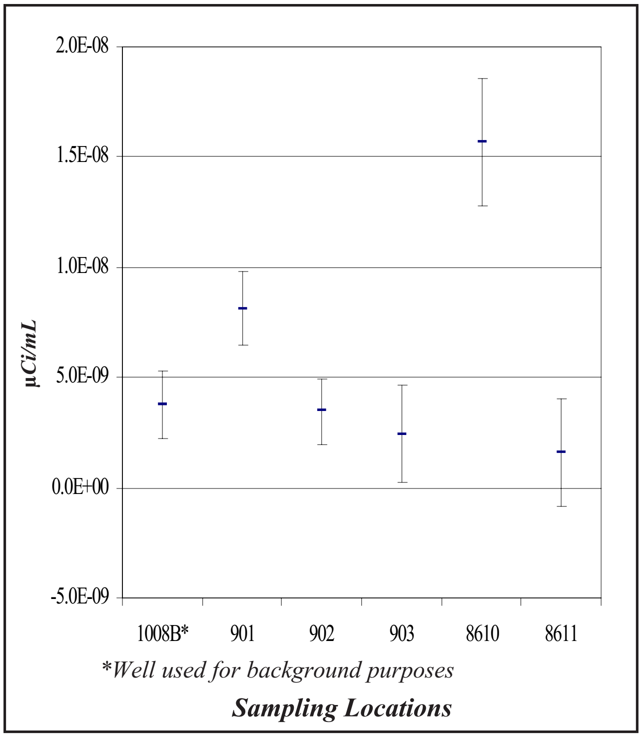


Figure E-24. Gross Beta (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

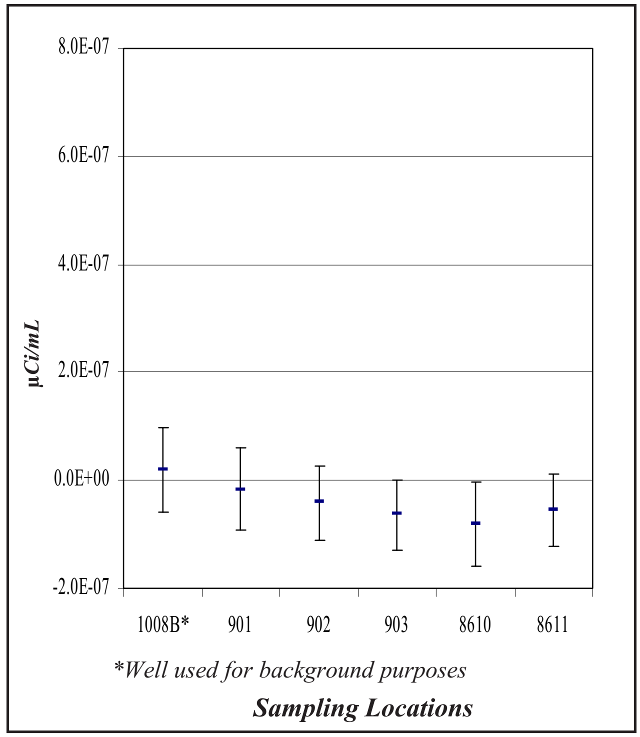
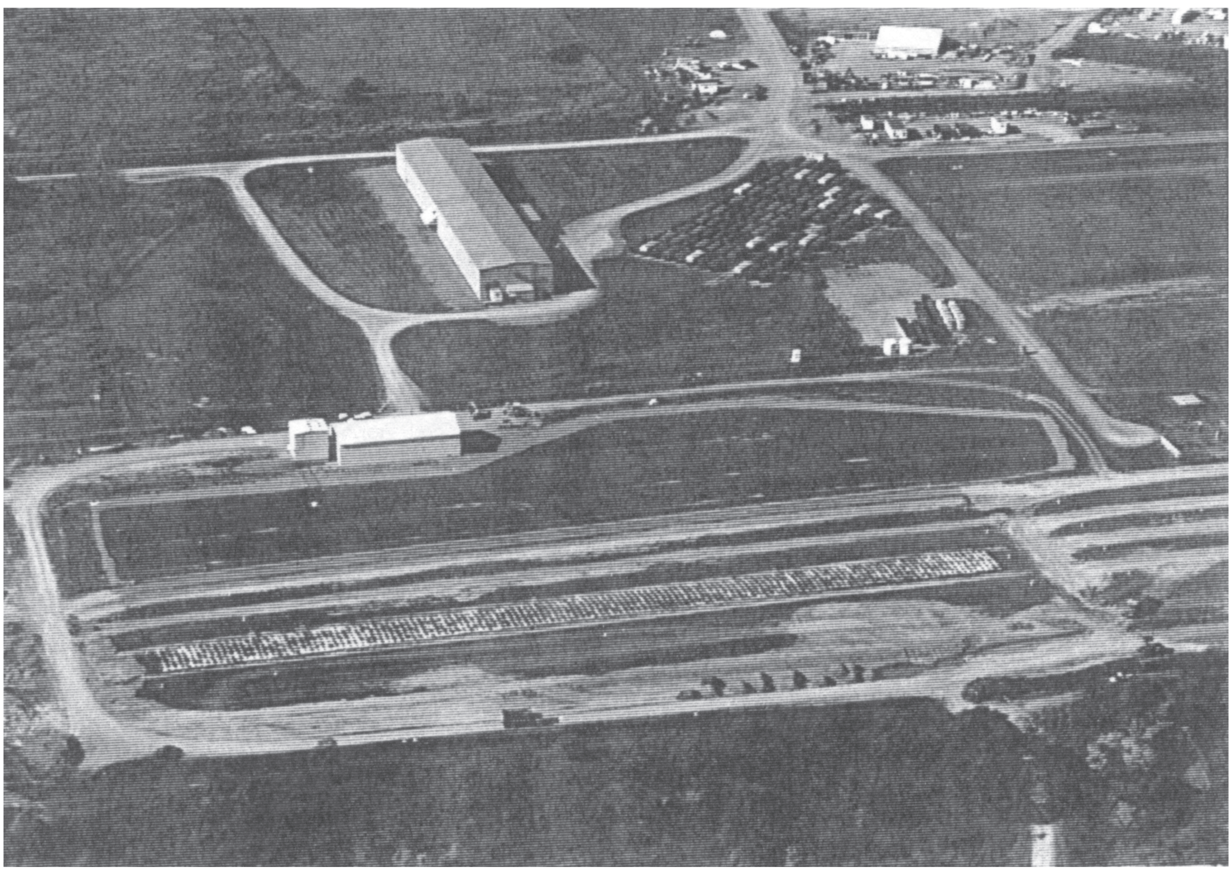


Figure E-25. Tritium Activity (µCi/mL) in Groundwater Samples from the Kent Recessional Sequence

Appendix F

Summary of NYSERDA Groundwater Monitoring Data



An Aerial View of the New York State-licensed Disposal Area

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Table F - 1

1997 Contamination Indicator Results at SDA Monitoring Wells

Sample Location	Date	Conductivity (µmhos/cm@25°C)	pH (standard units)	Temperature (°C)	Turbidity (NTU)
WNW1101A	6/4/97	590	7.80	12.7	1.89
WNW1101A	12/3/97	600	7.25	10.7	4.35
WNW1101B	6/4/97	680	7.80	11.9	1.47
WNW1101B	12/3/97	683	7.48	9.5	4.81
WNW1101C	6/4/97	377	8.00	13.7	213.00
WNW1101C	12/3/97	580	7.40	9.7	281.00
WNW1102A	6/4/97	691	7.70	12.1	2.00
WNW1102A	12/3/97	686	7.04	10.6	5.21
WNW1102B	6/4/97	586	7.60	12.4	3.20
WNW1102B	12/3/97	578	6.80	9.2	20.20
WNW1103A	6/3/97	859	7.35	9.9	1.83
WNW1103A	12/2/97	935	6.98	9.9	211.00
WNW1103B	6/3/97	710	7.45	11.3	1.54
WNW1103B	12/2/97	697	6.81	9.0	2.93
WNW1104A	6/3/97	701	7.73	10.6	0.80
WNW1104A	12/2/97	640	7.46	10.6	3.63
WNW1104B	6/3/97	615	7.62	11.3	0.70
WNW1104B	12/2/97	600	7.12	9.6	1.65
WNW1105A	6/5/97	716	6.79	10.3	142.00
WNW1105A	12/4/97	670	7.37	8.6	965.00
WNW1105B	6/5/97	741	7.25	10.6	175.00
WNW1105B	12/4/97	542	7.42	7.4	124.00
WNW1106A	6/6/97	708	6.76	12.3	0.81
WNW1106A	12/3/97	732	7.45	10.8	2.97
WNW1106B	6/6/97	847	6.75	11.8	4.01
WNW1106B	12/3/97	766	7.22	10.6	281.00
WNW1107A	6/6/97	2120	6.34	12.3	0.67
WNW1107A	12/4/97	1839	5.01	11.3	2.66
WNW1108A	6/3/97	1014	7.55	10.9	95.10

Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 1 (concluded)

1997 Contamination Indicator Results at SDA Monitoring Wells

Sample Location	Date	Conductivity (µmhos/cm@25°C)	pH (standard units)	Temperature (°C)	Turbidity (NTU)
WNW1109A	6/5/97	617	7.22	11.2	1.13
WNW1109A	12/3/97	589	7.20	10.9	4.71
WNW1109B	6/6/97	490	6.98	11.0	1.42
WNW1109B	12/4/97	479	7.44	9.9	9.09
WNW1110A	6/3/97	*NA*	7.83	*NA*	*NA*
WNW1111A	6/5/97	1030	6.97	13.3	1.75
WNW1111A	6/5/97	1030	6.97	13.3	1.75
WNW1111A	12/4/97	978	6.88	10.8	1.87
WNW1111A	12/4/97	978	6.88	10.8	1.87

NA - Not available.
Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 2

1997 Radiological Indicator Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Gross Alpha	Gross Beta	H-3
WNW1101A	6/4/97	1.1E-09±2.2E-09	5.0E-10±2.1E-09	1.3E-07±5.8E-08
WNW1101A	12/3/97	1.8E-09±2.0E-09	7.0E-10±2.0E-09	8.3E-08±5.9E-08
WNW1101B	6/4/97	6.3E-09±3.4E-09	2.5E-09±2.4E-09	3.0E-09±5.1E-08
WNW1101B	12/3/97	5.1E-09±3.4E-09	2.5E-09±2.6E-09	-2.9E-08±5.1E-08
WNW1101C	6/4/97	1.9E-09±1.5E-09	8.0E-10±1.3E-09	-3.0E-08±4.7E-08
WNW1101C	12/3/97	-6.1E-10±9.1E-10	1.7E-09±1.4E-09	2.3E-08±5.5E-08
WNW1102A	6/4/97	8.0E-10±2.3E-09	2.5E-09±2.6E-09	4.1E-07±7.4E-08
WNW1102A	12/3/97	3.4E-09±2.8E-09	1.7E-09±2.2E-09	3.6E-07±7.6E-08
WNW1102B	6/4/97	-3.4E-10±1.0E-09	2.3E-09±1.4E-09	1.1E-08±5.1E-08
WNW1102B	12/3/97	1.0E-09±1.6E-09	2.2E-09±1.5E-09	-2.9E-08±5.3E-08
WNW1103A	6/3/97	5.8E-09±4.7E-09	-2.8E-09±3.8E-09	5.4E-07±8.2E-08
WNW1103A	12/2/97	5.9E-09±3.8E-09	1.0E-08±3.0E-09	6.1E-07±9.1E-08
WNW1103B	6/3/97	1.8E-09±2.8E-09	9.0E-10±2.4E-09	-4.1E-08±4.7E-08
WNW1103B	12/2/97	3.8E-09±2.5E-09	3.0E-09±1.8E-09	-3.2E-08±5.1E-08
WNW1103C	6/2/97	*NA*	*NA*	-7.0E-09±4.9E-08
WNW1103C	12/1/97	4.0E-10±1.7E-09	8.1E-09±2.3E-09	-1.7E-08±5.3E-08
WNW1104A	6/3/97	1.3E-09±2.4E-09	1.8E-09±2.6E-09	2.5E-07±6.6E-08
WNW1104A	12/2/97	3.3E-09±2.4E-09	2.5E-09±1.7E-09	1.8E-07±6.6E-08
WNW1104B	6/3/97	8.0E-10±2.2E-09	2.2E-09±2.2E-09	3.0E-09±5.0E-08
WNW1104B	12/2/97	2.2E-09±1.9E-09	2.7E-09±1.6E-09	5.0E-09±5.5E-08
WNW1104C	6/2/97	*NA*	*NA*	-4.0E-09±4.9E-08
WNW1104C	6/6/97	7.0E-09±1.1E-08	1.2E-08±1.1E-08	*NA*
WNW1104C	12/1/97	2.0E-09±9.4E-09	3.4E-09±9.7E-09	2.1E-08±6.0E-08
WNW1105A	6/5/97	7.6E-09±3.3E-09	1.1E-09±1.9E-09	1.5E-07±5.9E-08
WNW1105A	12/4/97	3.7E-09±2.1E-09	3.0E-09±1.5E-09	1.5E-07±6.4E-08
WNW1105B	6/5/97	4.3E-09±3.0E-09	3.6E-09±2.2E-09	-5.0E-09±5.0E-08
WNW1105B	12/4/97	3.4E-09±2.8E-09	1.6E-09±2.2E-09	-4.6E-08±5.1E-08
WNW1106A	6/6/97	2.6E-09±2.5E-09	2.6E-09±2.1E-09	7.6E-07±9.6E-08
WNW1106A	12/3/97	3.2E-09±3.0E-09	6.3E-09±3.2E-09	8.6E-07±1.0E-07
WNW1106B	6/6/97	8.0E-10±2.2E-09	3.2E-09±2.2E-09	9.0E-09±5.0E-08
WNW1106B	12/3/97	9.0E-10±2.7E-09	1.1E-09±2.9E-09	7.0E-09±5.5E-08

NA - Not available.
Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 2 (concluded)

1997 Radiological Indicator Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Gross Alpha	Gross Beta	H-3
WNW1107A	6/6/97	6.8E-09±8.4E-09	3.0E-08±7.8E-09	1.6E-05±1.0E-06
WNW1107A	12/4/97	3.0E-09±7.2E-09	1.9E-08±8.1E-09	1.5E-05±1.0E-06
WNW1108A	6/3/97	1.1E+08±4.4E-09	3.8E-09±2.5E-09	1.4E-07±5.9E-08
WNW1108A	12/2/97	9.5E-09±4.8E-09	4.4E-09±3.4E-09	1.2E-07±6.2E-08
WNW1109A	6/5/97	2.4E-09±2.5E-09	2.2E-09±2.4E-09	4.5E-07±7.8E-08
WNW1109A	12/3/97	3.2E-09±2.7E-09	2.7E-09±2.1E-09	4.6E-07±8.3E-08
WNW1109B	6/6/97	8.0E-10±1.3E-09	1.4E-09±1.4E-09	6.1E-07±8.8E-08
WNW1109B	12/4/97	-3.0E-10±1.4E-09	1.3E-09±1.7E-09	6.5E-07±9.3E-08
WNW1110A	6/3/97	1.1E-08±6.3E-09	9.8E-09±4.8E-09	9.7E-08±5.7E-08
WNW1110A	12/2/97	1.5E-08±7.0E-09	6.7E-09±5.1E-09	1.3E-07±6.2E-08
WNW1111A	6/5/97	7.8E-09±5.0E-09	4.8E-09±3.3E-09	2.3E-07±6.5E-08
WNW1111A	6/5/97	4.8E-09±3.6E-09	5.6E-09±4.3E-09	3.2E-07±8.8E-08
WNW1111A	12/4/97	6.3E-09±4.7E-09	4.6E-09±3.9E-09	2.9E-07±7.2E-08
WNW1111A	12/4/97	4.5E-09±4.8E-09	2.8E-09±4.2E-09	2.6E-07±7.0E-08

NA - Not available.
Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 3

1997 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample Location	Date	Actinium-228	Bismuth-214	Carbon-14	Cesium-134
WNW1101A	6/4/97	1.6E-08±2.8E-08	-9E-09±1.2E-08	-2.2E-09±5.3E-09	-3.6E-09±3.7E-09
WNW1101B	6/4/97	1E-08±2.6E-08	1E-09±1.5E-08	-6E-10±5.3E-09	-1.6E-09±5.4E-09
WNW1101C	6/4/97	-6E-09±2.7E-08	-7E-09±1.1E-08	-4E-10±5.2E-09	-2.8E-09±4.7E-09
WNW1102A	6/4/97	1.9E-09±9.5E-09	-2E-10±6.6E-09	-3.6E-09±5.1E-09	-1.3E-09±1.3E-09
WNW1102B	6/4/97	6E-09±1.1E-08	-1.6E-09±6.4E-09	-2.6E-09±5.0E-09	7.0E-10±2.0E-09
WNW1103A	6/3/97	-4.6E-09±9.2E-09	3.9E-09±6.9E-09	-1.5E-09±5.1E-09	-8.0E-10±1.9E-09
WNW1103B	6/3/97	1.5E-08±3.0E-08	4E-09±1.7E-08	-2.4E-09±5.2E-09	2.2E-09±4.4E-09
WNW1103C	6/16/97	*NA*	*NA*	-1.6E-09±5.1E-09	*NA*
WNW1104A	6/3/97	-3.1E-09±7.1E-09	4.1E-09±7.1E-09	-2.7E-09±5.0E-09	-1.1E-09±1.9E-09
WNW1104B	6/3/97	-5E-09±2.8E-08	8E-09±1.6E-08	-5E-09±5.1E-09	-5.8E-09±4.2E-09
WNW1104C	6/6/97	-6.3E-08±4.7E-08	2.1E-08±4.7E-08	-3.3E-09±4.9E-09	-7.3E-09±9.5E-09
WNW1105A	6/5/97	-1.8E-08±2.6E-08	-5E-09±2.2E-08	-1.7E-09±5.1E-09	-7E-10±6.2E-09
WNW1105B	6/5/97	-2.2E-09±1.0E-08	-1.1E-09±6.1E-09	-3.9E-09±5.1E-09	-1E-10±1.7E-09
WNW1106A	6/6/97	3E-10±9.1E-09	1.4E-09±6.3E-09	-3.7E-09±5.0E-09	1.2E-09±2.2E-09
WNW1106B	6/6/97	1.7E-08±3.2E-08	3E-08±2.0E-08	-2.8E-09±4.9E-09	-9E-10±4.1E-09
WNW1107A	6/6/97	-2.3E-08±2.0E-08	2.1E-08±1.8E-08	-7E-10±5.1E-09	-5E-10±4.7E-09
WNW1108A	6/3/97	2.1E-09±9.5E-09	6.2E-09±7.1E-09	-2E-10±5.2E-09	-6E-10±1.2E-09
WNW1109A	6/5/97	6E-09±2.9E-08	1E-09±1.6E-08	8E-10±5.4E-09	-1.3E-09±3.9E-09
WNW1109B	6/6/97	-2.9E-08±2.9E-08	5E-09±1.1E-08	00E+00±5.2E-09	1.3E-09±4.6E-09
WNW1110A	6/3/97	-1.5E-08±2.0E-08	1E-09±1.5E-08	-4.3E-09±5.0E-09	5E-10±4.9E-09
WNW1111A	6/5/97	-1E-09±2.5E-08	1.7E-08±1.8E-08	9E-10±5.1E-09	3E-10±4.4E-09
WNW1111A	6/5/97	3.3E-09±1.0E-08	7.4E-09±6.9E-09	9E-10±5.1E-09	-1.5E-09±1.3E-09

NA - Not available.
Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 3 (continued)

1997 Radioisotopic Results at SDA Monitoring Wells (μCi/mL)

Sample	Date Location	Cesium-137	Cobalt-57	Cobalt-60	Iodine-129
WNW1101A	6/4/97	-5.7E-09±5.4E-09	2.9E-09±3.8E-09	-9.0E-10±4.7E-09	-9.0E-10±1.1E-09
WNW1101B	6/4/97	-3.4E-09±3.6E-09	-1.4E-09±2.7E-09	2.5E-09±4.5E-09	-2.4E-09±2.1E-09
WNW1101C	6/4/97	1.3E-09±7.9E-09	1.0E-10±3.9E-09	0.0E+00±0.0E+00	-5.0E-10±1.1E-09
WNW1102A	6/4/97	-1.3E-09±1.6E-09	0.0E+00±2.2E-09	-4.0E-10±1.6E-09	-2.0E-10±2.3E-09
WNW1102B	6/4/97	-2.3E-09±2.2E-09	6.0E-10±2.1E-09	-1.4E-09±1.6E-09	-7.0E-10±1.9E-09
WNW1103A	6/3/97	9.0E-10±3.1E-09	-6.0E-10±2.2E-09	-8.0E-10±1.7E-09	-1.5E-09±1.3E-09
WNW1103B	6/3/97	2.0E-09±9.2E-09	-1.1E-09±3.7E-09	5.0E-10±5.1E-09	-1.2E-09±1.1E-09
WNW1103C	12/1/97	3.0E-10±9.0E-09	-2.2E-09±6.6E-09	-1.0E-09±6.9E-09	*NA*
WNW1104A	6/3/97	2.0E-09±3.0E-09	-9.0E-10±2.2E-09	-5.0E-10±1.8E-09	1.3E-09±6.9E-09
WNW1104B	6/3/97	5.7E-09±9.1E-09	1.3E-09±4.3E-09	3.7E-09±4.0E-09	-7.0E-10±1.1E-09
WNW1104C	6/6/97	4.0E-09±2.6E-08	2.0E-09±1.2E-08	-6.0E-09±1.5E-08	*NA*
WNW1105A	6/5/97	2.0E-09±1.1E-08	-3.4E-09±3.2E-09	4.0E-09±6.1E-09	-9.0E-10±1.6E-09
WNW1105B	6/5/97	1.0E-10±2.9E-09	-1.8E-09±2.2E-09	1.4E-09±1.8E-09	-2.1E-09±2.5E-09
WNW1106A	6/6/97	-1.9E-09±2.1E-09	1.2E-09±2.0E-09	4.0E-10±1.7E-09	-1.0E-10±1.2E-09
WNW1106B	6/6/97	-6.0E-10±8.3E-09	2.2E-09±3.3E-09	-4.0E-10±4.0E-09	-4.0E-10±2.1E-09
WNW1107A	6/6/97	-2.7E-09±6.1E-09	-4.0E-10±3.0E-09	-2.0E-09±3.9E-09	-9.9E-10±1.0E-09
WNW1108A	6/3/97	1.2E-09±2.7E-09	6.0E-10±2.2E-09	-1.4E-09±1.1E-09	-1.6E-09±2.2E-09
WNW1109A	6/5/97	-2.5E-09±4.0E-09	2.6E-09±3.9E-09	2.2E-09±4.0E-09	-1.3E-09±1.1E-09
WNW1109B	6/6/97	4.0E-10±9.2E-09	-3.0E-10±3.7E-09	3.3E-09±4.7E-09	1.0E-10±2.2E-09
WNW1110A	6/3/97	-1.3E-09±5.8E-09	-1.1E-09±3.6E-09	7.0E-10±4.8E-09	-7.0E-10±2.4E-09
WNW1111A	6/5/97	-1.0E-09±1.6E-09	-1.6E-09±2.7E-09	-6.0E-10±4.7E-09	2.1E-09±2.3E-09
WNW1111A	6/5/97	5.5E-09±9.4E-09	1.8E-09±2.4E-09	4.0E-10±1.6E-09	-1.4E-09±1.2E-09

NA - Not available.
Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 3 (continued)

1997 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Lead-212	Lead-214	Potassium-40	Strontium-90
WNW1101A	6/4/97	-2.0E-09±1.3E-08	1.3E-08±1.4E-08	-3.1E-08±8.8E-08	-6.0E-11±2.0E-10
WNW1101B	6/4/97	1.2E-08±1.2E-08	-9.0E-09±8.3E-09	-2.2E-08±8.2E-08	-2.0E-11±2.1E-10
WNW1101C	6/4/97	-3.0E-09±1.2E-08	2.0E-09±1.3E-08	-2.0E-08±8.4E-08	-1.5E-10±2.1E-10
WNW1102A	6/4/97	4.3E-09±6.3E-09	2.4E-09±6.3E-09	-8.0E-09±3.5E-08	-1.9E-10±2.4E-10
WNW1102B	6/4/97	5.5E-09±6.3E-09	-3.6E-09±5.2E-09	1.5E-08±3.1E-08	7.0E-11±1.9E-10
WNW1103A	6/3/97	-1.3E-09±6.0E-09	2.5E-09±6.4E-09	9.0E-09±3.6E-08	1.0E-11±2.0E-10
WNW1103B	6/3/97	-4.0E-09±1.1E-08	2.0E-09±1.1E-08	-2.0E-08±7.7E-08	1.0E-11±1.9E-10
WNW1104A	6/3/97	-3.0E-10±6.0E-09	-1.4E-09±5.6E-09	9.0E-09±3.3E-08	-8.0E-11±1.9E-10
WNW1104B	6/3/97	0.0E+00±1.3E-08	-8.3E-09±7.5E-09	-3.3E-08±1.7E-08	-8.0E-11±1.8E-10
WNW1104C	6/6/97	-1.8E-08±3.6E-08	0.0E+00±4.2E-08	-3.0E-08±2.5E-07	*NA*
WNW1105A	6/5/97	-1.0E-09±1.7E-08	4.0E-09±1.9E-08	3.0E-08±1.2E-07	-3.0E-11±4.0E-10
WNW1105B	6/5/97	-1.1E-09±6.1E-09	4.0E-10±5.9E-09	1.2E-08±3.8E-08	3.0E-11±2.0E-10
WNW1106A	6/6/97	-3.9E-09±6.3E-09	4.3E-09±6.2E-09	1.0E-09±3.3E-08	-1.3E-10±2.1E-10
WNW1106B	6/6/97	-1.0E-09±1.3E-08	1.4E-08±1.5E-08	-9.0E-09±8.1E-08	-2.7E-10±2.0E-10
WNW1107A	6/6/97	5.0E-09±1.3E-08	6.0E-09±1.5E-08	5.3E-08±1.0E-07	9.6E-09±7.4E-10
WNW1108A	6/3/97	9.0E-10±6.3E-09	2.1E-09±6.3E-09	4.0E-09±3.5E-08	-4.0E-11±2.3E-10
WNW1109A	6/5/97	-5.0E-09±1.2E-08	-7.4E-09±3.1E-09	2.0E-09±9.1E-08	-6.0E-11±2.0E-10
WNW1109B	6/6/97	7.0E-09±1.2E-08	3.0E-09±1.4E-08	-5.3E-08±1.9E-08	4.0E-11±2.2E-10
WNW1110A	6/3/97	3.0E-09±1.3E-08	2.0E-09±1.4E-08	1.3E-08±9.4E-08	-6.0E-11±1.9E-10
WNW1111A	6/5/97	1.6E-09±6.1E-09	-4.5E-09±3.8E-09	2.1E-08±9.5E-08	-1.8E-10±2.2E-10
WNW1111A	6/5/97	-1.0E-09±1.2E-08	8.0E-09±1.5E-08	1.2E-08±3.5E-08	-7.0E-11±3.3E-10

NA - Not available.

Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

Table F - 3 *(concluded)*

1997 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Technetium-99	Thallium-208	Thorium-234	Uranium-235
WNW1101A	6/4/97	2.9E-09±2.5E-09	-1.7E-09±8.4E-09	-1.0E-08±1.6E-07	2.7E-08±3.5E-08
WNW1101B	6/4/97	1.6E-09±2.5E-09	-6.0E-10±8.0E-09	2.0E-08±1.5E-07	1.2E-08±3.4E-08
WNW1101C	6/4/97	-3.0E-10±2.2E-09	-1.0E-09±8.5E-09	-2.1E-08±9.4E-08	-1.2E-08±1.4E-08
WNW1102A	6/4/97	1.2E-09±2.4E-09	2.0E-09±3.6E-09	0.0E+00±6.3E-08	5.0E-09±2.0E-08
WNW1102B	6/4/97	-2.0E-10±2.4E-09	0.0E+00±3.7E-09	-6.0E-09±6.1E-08	4.0E-09±2.0E-08
WNW1103A	6/3/97	6.0E-10±2.5E-09	2.0E-10±3.4E-09	-1.0E-08±6.4E-08	2.0E-08±1.9E-08
WNW1103B	6/3/97	-7.0E-10±2.4E-09	3.5E-09±9.0E-09	1.0E-08±9.5E-08	-1.0E-09±3.3E-08
WNW1104A	6/3/97	1.1E-09±2.5E-09	-1.3E-09±3.3E-09	-9.0E-09±6.0E-08	-1.1E-08±1.2E-08
WNW1104B	6/3/97	1.3E-09±2.3E-09	-2.3E-09±8.8E-09	-2.0E-09±8.9E-08	-3.1E-09±2.5E-08
WNW1104C	6/6/97	3.5E-09±2.6E-09	-2.0E-09±2.4E-08	-2.0E-08±2.3E-07	7.0E-09±9.9E-08
WNW1105A	6/5/97	*NA*	1.0E-09±1.1E-08	4.0E-08±1.2E-07	-1.1E-09±4.5E-08
WNW1105B	6/5/97	4.0E-10±2.3E-09	-2.8E-09±2.4E-09	-2.0E-09±6.1E-08	-6.5E-09±7.7E-09
WNW1106A	6/6/97	6.0E-10±2.4E-09	3.2E-09±3.5E-09	-1.0E-09±6.3E-08	7.0E-09±2.1E-08
WNW1106B	6/6/97	6.0E-10±2.4E-09	4.1E-09±9.4E-09	4.0E-08±1.5E-07	5.0E-09±3.6E-08
WNW1107A	6/6/97	3.3E-09±2.7E-09	-6.2E-09±5.0E-09	3.7E-08±9.3E-08	1.0E-08±3.3E-08
WNW1108A	6/3/97	2.2E-09±2.5E-09	2.7E-09±3.7E-09	2.0E-08±1.5E-07	5.0E-09±2.0E-08
WNW1109A	6/5/97	4.0E-10±2.4E-09	-4.0E-09±5.5E-09	-3.6E-08±9.5E-08	-9.0E-09±3.1E-08
WNW1109B	6/6/97	-4.0E-10±2.4E-09	-2.5E-09±8.8E-09	-3.0E-08±1.6E-07	-5.0E-09±3.2E-08
WNW1110A	6/3/97	1.6E-09±2.5E-09	-4.0E-10±8.6E-09	-2.4E-08±9.0E-08	2.2E-08±3.6E-08
WNW1111A	6/5/97	9.0E-10±2.4E-09	-9.0E-10±3.4E-09	1.0E-08±1.5E-07	5.0E-09±2.0E-08
WNW1111A	6/5/97	9.0E-10±2.2E-09	-3.2E-09±9.4E-09	-1.0E-08±1.5E-07	-2.6E-08±2.3E-08

NA - Not available.

Note: All data in Tables F-1 through F-3 have been provided by NYSERDA.

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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.

ANION. A negatively charged ion. An ion that would migrate toward a positively charged electrode during electrolysis.

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.

CATION. A positively charged ion. An ion that would move toward a negatively charged electrode during electrolysis.

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.

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 B-1 in Appendix B.)

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.

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 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 that are often requested include 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.

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.

INTERIM STATUS. Any facility in existence on the effective date of statutory or regulatory amendments under RCRA that render the facility subject to the requirement to have a RCRA permit. An interim status facility shall be treated as having been issued a permit (Title 6 New York Code of Rules and Regulations [**NYCRR**] Part 373.

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 bayron family with a mass of 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 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.

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.

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

AEA. Atomic Energy Act

ALARA. As Low As Reasonably Achievable

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

CEQ. (President's) Council on Environmental Quality

CERCLA. Comprehensive Environmental Response, Compensation, and Liability Act

CFR. Code of Federal Regulations

CO. Certificate-to-Operate

CSPF. Container Sorting and Packaging Facility

CPC. Chemical Process Cell

CSRF. Contact Size-reduction Facility

CSS. Cement Solidification System

CWA. Clean Water Act

CX. Categorical Exclusion

CY. Calendar Year

DCG. Derived Concentration Guide

DE. Dose Equivalent

DMR. Discharge Monitoring Report

DOE. (U.S.) Department of Energy

DOE-EM. (U.S.) 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

DOE-WV. Department of Energy, West Valley Demonstration Project

EA. Environmental Assessment

EDE. Effective Dose Equivalent

Acronyms

EE. Environmental Evaluation

EHS. Extremely Hazardous Substance

EID. Environmental Information Document

EIS. Environmental Impact Statement

ELAP. Environmental Laboratory Approval Program

EML. Environmental Measurements Laboratory

EPA. (U.S.) Environmental Protection Agency

EPI. Environmental Physics, Inc.

EPCRA. Emergency Planning and Community Right-to-Know Act

ESQA&LO. Environmental Safety, Quality Assurance, and Laboratory Operations

ESR. (WVDP) Effluent Summary Report

FFC Act. Federal Facility Compliance Act

FONSI. Finding of No Significant Impact

FSFCA. Federal and State Facility Compliance Agreement

FY. Fiscal Year

HEPA. High-efficiency Particulate Air (filter)

HLW. High-level (radioactive) Waste

HPIC. High-pressure Ion Chamber

HVAC. Heating, Ventilation, and Air Conditioning

ICRP. International Commission on Radiological Protection

INEEL. Idaho National Environmental Engineering Laboratory

IRTS. Integrated Radwaste Treatment System

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

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 Emissions Standards for Hazardous Air Pollutants

NFS. Nuclear Fuel Services, Inc.

NIST. National Institute of Standards and Technology

NOI. Notice of Intent

NPOC. Nonpurgeable Organic Carbon

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

NYSERDA. New York State Energy Research and Development Authority

NYSGS. New York State Geological Survey

ODIS. On-site Discharge Information System Report

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

PVU. Portable Ventilation Unit

QA. Quality Assurance

QAP. Quality Assessment Program (also Quality Assurance Program)

QC. Quality Control

QEMDR. Quarterly Environmental Monitoring Data Report

RCRA. Resource Conservation and Recovery Act

RFI. RCRA Facility Investigation

RMW. Radioactive Mixed Waste

Acronyms

RTS. Radwaste Treatment System

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)

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

TCL. Target Compound List

TIC. Tentatively Identified Compound

TLD. Thermoluminescent Dosimetry

TOC. Total Organic Carbon

TOX. Total Organic Halogens

TRI. Toxic Release Inventory

TSCA. Toxic Substances and Control Act

TSDF. Treatment, Storage, and Disposal Facility

USGS. U.S. Geological Survey

VOC. Volatile Organic Compound

WNYNSC. Western New York Nuclear Service Center

WVDP. West Valley Demonstration Project

WVNS. West Valley Nuclear Services Company, Inc.

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)

Area

Symbol	Name
ha	hectare (10,000 m^2)

Concentration

Symbol	Name
µCi/mL	microcuries per milliliter
mL/L	milliliter per liter
µCi/g	microcuries per gram
mg/L	milligrams per liter
µg/mL	micrograms per milliliter

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

Unit Prefixes

centi	1/100 = 1×10^{-2} = 0.01 = E-02
milli	1/1,000 = 1×10^{-3} = 0.001 = E-03
micro	1/1,000,000 = 1×10^{-6} = 0.000001 = E-06
nano	1/1,000,000,000 = 1×10^{-9} = 0.000000001 = E-09
pico	1/1,000,000,000,000 = 1×10^{-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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