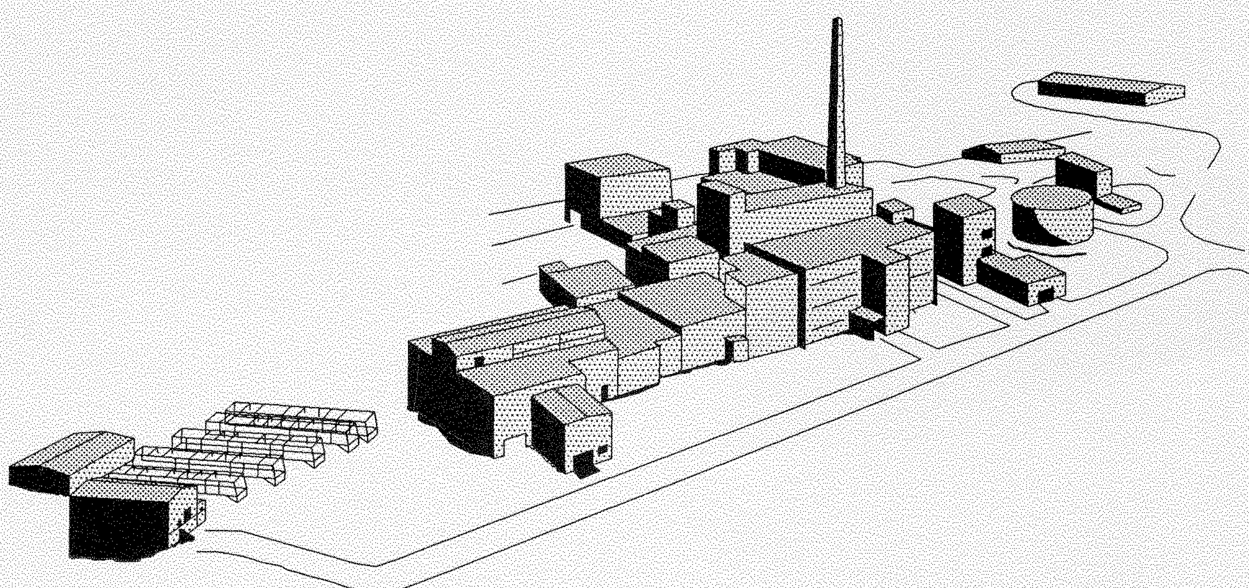
WEST VALLEY DEMONSTRATION PROJECT
SITE ENVIRONMENTAL REPORT
FOR CALENDAR YEAR 1991



May 1992

West Valley Nuclear Services, Inc.

Rock Springs Road
West Valley, New York 14171

PREPARED FOR:
U. S. Department of Energy
Idaho Field Office
West Valley Project Office
Under Contract DE-AC07-81NE44139

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West Valley Demonstration Project Site Environmental Report

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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 site and the quality of the air and water discharged by the Project.

This report represents a single, comprehensive source of off-site and on-site environmental monitoring data collected during 1991 by WVNS environmental monitoring personnel. The data are found in the appendices following this report. Appendix A is a summary of the site environmental monitoring schedule. Appendix B lists the environmental permits and regulations pertaining to the West Valley Demonstration Project. Appendices C through E contain summaries of all data obtained during 1991 and are intended for those interested in more detail than is provided in the main body of the report.

Requests for additional copies of the 1991 SITE ENVIRONMENTAL REPORT *and questions regarding the report should be referred to the WVDP Community Relations Department, P.O. Box 191, Rock Springs Road, West Valley, New York 14171 (716-942-4610).*

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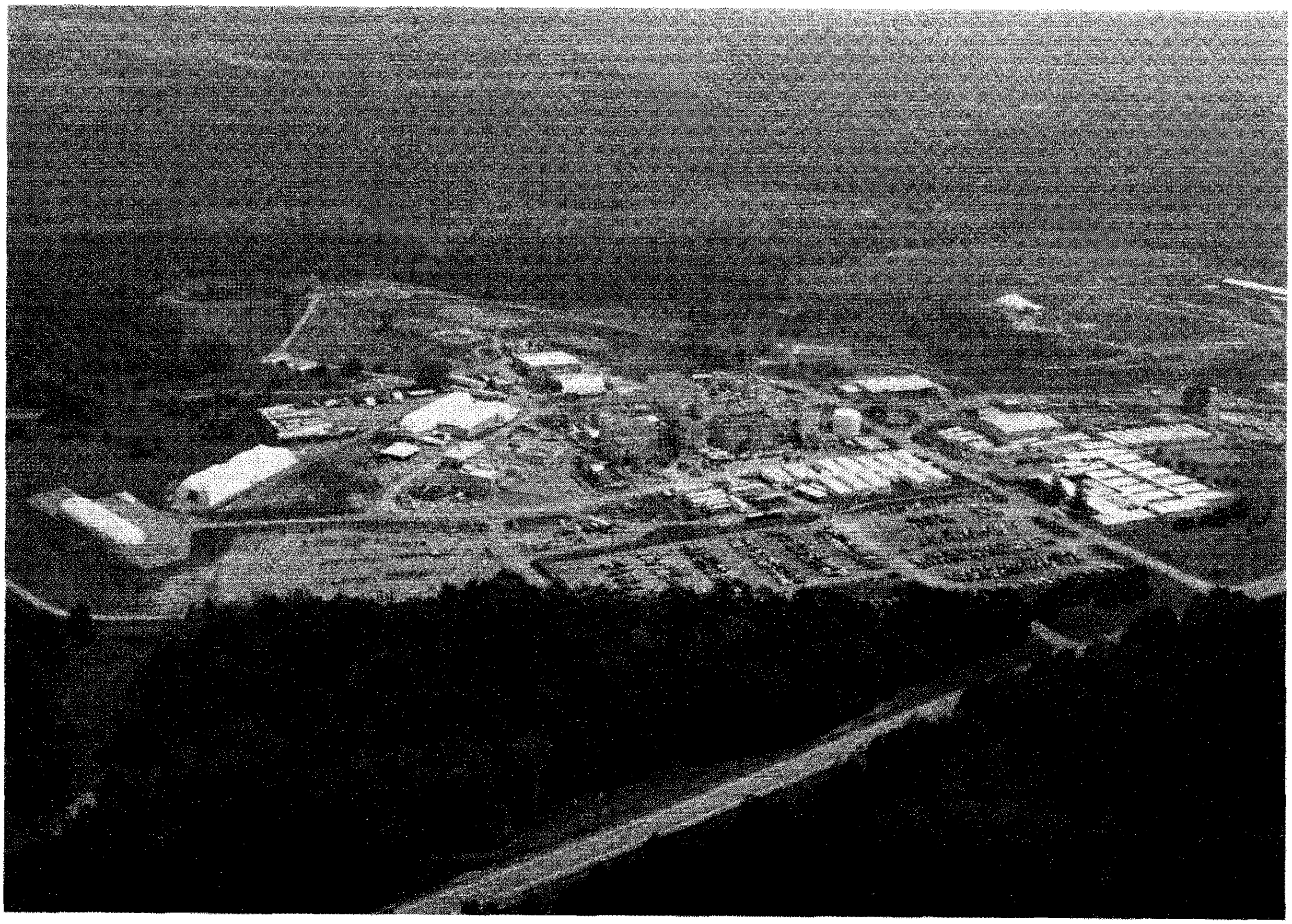


The West Valley Demonstration Project Site

Executive Summary

The West Valley Demonstration Project (WVDP) conducts a comprehensive environmental monitoring program that fulfills U.S. Department of Energy (DOE) Orders and directives and the regulatory requirements of the United States Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). The results of this program show that public health, safety, and the environment are being protected with respect to activities on the site and the waste materials stored there.

This annual report, published to meet the requirements of DOE Orders 5400.1 and 5400.5, summarizes the environmental monitoring data collected during 1991. On-site and off-site radiological and nonradiological monitoring in 1991 confirm that site activities, with few exceptions, were conducted well within state and federal regulatory limits. (A description of regulatory issues is found in the *Environmental Compliance Summary:Calendar Year 1991.)* The exceptions noted have resulted in no significant effects upon public health or the environment.

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 under which the Atomic Energy Commission encouraged 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 3,345 acres near West Valley, New York and established the Western New York Nuclear Service Center (WNYNSC). The Davison Chemical Co., co-licensed with the New York State Atomic Research and Development Authority, which later became the New York State Energy Research and Development Authority (NYSERDA), formed Nuclear Fuel Services, Inc. (NFS) to construct and operate a nuclear fuel reprocessing plant. NFS leased the Western New York Nuclear Service Center and began operations in 1966 to recycle fuel from both commercial and federally owned reactors.

In 1972, while the plant was closed for modifications and expansion, more rigorous federal and state safety regulations were imposed. Most of the changes were aimed at the disposal of high-level radioactive liquid waste and at preventing earthquake damage to the facilities. Compliance with the new regulations was deemed 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 to the passage of Public Law 96-368, which authorized the Department of Energy to demonstrate a method for solidifying the 2.5 million liters (660,000 gals.) of liquid high-level waste that remained at the West Valley site. The technologies developed at West Valley would be used at other facilities throughout the United States. West Valley Nuclear Services Co. (WVNS), a subsidiary of Westinghouse Electric, was chosen by the Department of Energy to be the management and operations contractor for the West Valley Demonstration Project.

The purpose of the West Valley Demonstration Project 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 transport 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 an underground storage tank and had settled into two layers — a liquid supernatant and a precipitate sludge. West Valley Nuclear Services, as prime contractor to DOE, secured environmental approval and constructed various subsystems that made possible the successful start-up in May 1988 of the integrated radwaste treatment system (IRTS). The system stripped radioactivity from the liquid supernatant. Treatment of the supernatant liquid from the high-level waste tanks through the IRTS was completed in 1990. The resulting 10,393 drums of low-level treated liquid were solidified in a special cement mixture and stored on-site in an engineered above-ground vault.

The next step in the process, washing the remaining sludge with water to remove soluble constituents, began in late 1991. (See Chapter 1, *Environmental Monitoring Program Information* for a more detailed description.)

Compliance

The West Valley Demonstration Project operates within the radiological guidelines of Department of Energy Orders for protection of human health, safety, and the environment. Limits on radioactivity concentrations and individual doses are specified in the DOE Orders. The Project did not exceed or approach any of the limits on radioactivity or radiation doses in 1991, including the emission standards promulgated by the EPA and incorporated in DOE Orders.

Nonradiological plant effluents are regulated by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA). New York State inspects nonradiological air emission points periodically although nonradiological air effluent monitoring is not currently required because discharges resulting from site activities are very limited. Surface effluent water quality, regulated by NYSDEC, is tested for pH, biochemical oxygen demand, and other chemical factors.

The State Pollutant Discharge Elimination System (SPDES) permit identifies discharge water quality limits. On three occasions in 1991 the concentration of total iron in water exceeded permitted levels. These deviations resulted from flow-weighting formulas in the site's SPDES permit that did not adequately compensate for variations in the high natural iron present in the Project's raw intake water. In each case, appropriate actions were taken to notify NYSDEC in accordance with permit requirements. These deviations resulted in no significant effect on the environment. Evaluations of alternative methods continued in order to determine the best way to prevent recurrence. There were no excursions attributable to the sewage treatment plant in 1991. (See the *Environmental Compliance Summary: Calendar Year 1991* for a more detailed description.)

Effects of Project activities upon site groundwaters are regulated by NYSDEC and the EPA. Groundwater sampling and analyses confirm that on-site groundwater quality has been and continues to be affected both radiologically and nonradiologically by past facility operations. Increased well sampling in 1991 added to the understanding of these effects. Although definite radiological and nonradiological effects upon localized on-site groundwaters can be seen, these do not affect public health or the off-site environment.

Effluent and Environmental Monitoring Program

The 1991 environmental monitoring program provided radiological and nonradiological measurements of site effluent discharges and of related on-site and off-site samples. Air and surface water samples were collected to monitor the two major pathways by which radioactive material could migrate off-site.

Analysis of animal, soil, and vegetation samples from the facility environs also provided data from which the risk of exposure to radioactivity through ingestion pathways could be determined. Control, or background, samples were taken to compare with on- or near-site samples.

The flying insects that had been the subject of a special investigation in 1990 were not present in 1991. The control measures used to prevent recurring insect hatches appeared to be effective, and radioactivity was not detected in the very limited insect samples available.

Air Pathway Monitoring

Airborne particulate radioactivity was sampled continuously at five WNYNSC perimeter locations (see Fig. 2-2 in Chapter 2, *Environnmental Monitoring*) and four remote locations during 1991. Sample filters were collected weekly and analyzed for gross alpha and beta radioactivity. Airborne gross activity around the site boundary was, in all cases, indistinguishable from background concentrations measured at the remote locations. The specific alpha and beta-gamma isotopes measured in the ventilation exhausts were well below the Department of Energy limits. (See *Appendix B*.)

Direct monitoring of airborne effluents at the main plant stack and other permitted release points showed all discharges to be well below DOE or EPA effluent limitations. Special testing for naturally occurring radon and thoron of the main stack exhaust air showed that radon and thoron are detectable below DOE effluent dose limits.

Surface Water Pathway Monitoring

Six automatic samplers collected surface water at locations along site drainage channels. Samples were analyzed for gross alpha, gross beta and gamma activity, and for tritium and strontium-90. Analyses for carbon-14, iodine-129, uranium and plutonium isotopes, and americium-241 are also program requirements at several collection points. As a result of past site activities and continuing releases of treated liquids, gross radioactivity concentrations remained slightly higher in Buttermilk Creek below the West Valley Project site than at the upstream background sample point. Yearly average concentrations in water below the Project site in Cattaraugus Creek during 1991 were indistinguishable from background concentrations measured in Buttermilk Creek upstream of the Project facilities. All Cattaraugus Creek concentrations observed are well below regulatory limits. Concentrations of cesium-137 and other gamma emitters, strontium-90 and other beta emitters, uranium and plutonium isotopes, and tritium were below DOE guidelines at all locations, including Frank's Creek at the inner site security fence more than three miles upstream of Cattaraugus Creek.

The low-level liquid waste treatment facility (LLWTF) contributes most of the activity released from the site in liquid discharges. The 1991 annual average liquid effluent concentrations of radionuclides were below DOE release guidelines at the point of discharge.

Food Pathway Monitoring

Radioactivity that could pass through the food chain was measured by sampling milk, beef, hay, corn, apples, beans, fish, and venison. Available results were not very different from 1989 and 1990 samples and corroborated the low doses calculated from the measured concentrations in site effluents.

Direct Environmental Monitoring

Direct environmental radiation was measured continuously during each quarter in 1991 using thermoluminescent dosimeters (TLDs) at forty-one points distributed around the site perimeter and access road, at the waste management units, at the inner facility fence, and at various background locations. No significant differences were noted among exposure rates measured at background stations and the WNYNSC perimeter locations. Some TLD data were also collected within the restricted area boundary to monitor the exposure from nearby radioactive waste handling and storage facilities.

Nonradiological Monitoring

Nonradiological discharges from the site are regulated by NYSDEC; however, no special monitoring and reporting of nonradiological airborne effluents are required.

Nonradiological liquid discharges are monitored as a requirement of the State Pollutant Discharge Elimination System (SPDES). Liquid is discharged at permitted outfalls to surface waters. Project effluents are monitored for biochemical oxygen demand (BOD), suspended solids, ammonia, iron, pH, oil and grease, and other water quality indicators. Although there were three iron excursions, monitoring indicated that nonradiological liquid discharges had no effect on the off-site environment.

Groundwater Monitoring

The WVDP is underlain directly by layers of glacial sand, clay and rock, and/or by layers of deposited lake and stream materials. The underlying bedrock is primarily Devonian shales and sandstones. As the material deposited across the site is not uniformly distributed, groundwater flow and seepage rates are uneven.

The 1991 monitoring network included both on-site wells for surveillance of solid waste management units and off-site wells to monitor drinking water. In 1991 ninety-six on-site groundwater monitoring wells were added to the thirteen existing monitoring points. The additional on-site wells were sampled at an increased frequency and for more parameters.

These wells provided upgradient and downgradient monitoring of the low-level liquid waste treatment facility (LLWTF) lagoons, the high-level waste tank complex, the NRC-licensed disposal area (NDA), and other solid waste management units. Wells in the groundwater monitoring network were each sampled during 1991. The range of analyses performed was determined by regulatory requirements and site-specific characterization needs.

Wells are grouped by geologic unit in the description of groundwater monitoring results in Chapter 3, *Groundwater Monitoring*. Data from groundwater monitoring of the sand and gravel unit around the LLWTF lagoons indicate that radionuclides from past plant operations have affected groundwater quality. Compared to background, both tritium and gross beta concentrations are elevated in groundwater surrounding the lagoon system. However, the level of tritium contamination has declined steadily since 1982, as indicated by measurements at the french drain outfall. Gross beta activity that previously had increased leveled off or declined in 1991 at LLWTF monitoring points WNSP008, WNW8605, and WNW8603. Gross beta increased in well WNW8604 in 1991.

Data from monitoring wells around the high-level waste tanks do not suggest any effect of the stored high-level radioactive waste on the groundwater. However, significant radiological differences between upgradient and downgradient wells do indicate that previous site activities have affected groundwater in this area. Most notable are elevated levels of gross beta and tritium in well WNW0408, WNW0501, and WNW0502, downgradient of the main process plant facilities.

Other measured parameters such as pH and conductivity have shown significant differences between upgradient and downgradient locations. Well WNW0103 demonstrated a high sodium and hydroxide ion level in 1991 samples. This well is located in the vicinity of a spill of sodium hydroxide solution that occurred because of a transfer pipe failure in 1984. The till-sand well WNW0202 also shows an elevated pH. This higher pH is of unknown origin.

Greater-than-detectable concentrations of 1,1-dichloroethane at wells WNW8609 and WNW8612 continued to be found in 1991. At the WNGSEEP location 1,1,1-trichloroethane remained detectable but at lower levels than in 1990.

Groundwater monitoring around the NRC-licensed disposal area (NDA) indicates no discernible effects on the deeper unweathered Lavery till deposits in the area, as indicated primarily by measurements for tritium. However, one shallow well (in the weathered Lavery till) in the vicinity of the SDA (WNW1107A) has shown elevated tritium levels slightly above the New York State groundwater quality standard. Although other SDA wells in the shallow geologic units have shown detectable tritium, elevated tritium has not been observed in the monitoring wells in the deeper lacustrine unit.

Ongoing environmental characterization and facility investigations are assessing the groundwater in greater detail.

Migration of contaminants from the NDA was not detected in 1991 by the interceptor trench. This control and remediation effort within the NDA includes monitoring the water collected in a gravel back-filled trench downgradient of the known kerosene-contaminated soils. No solvent was found in the water collected from the trench in 1991.

In addition to the on-site measurements the potential effect of Project activities on near-site groundwater is monitored by annual sampling of designated private drinking water wells. Monitoring of these wells continues to demonstrate that the site has had no effect on residential drinking water supplies.

Radiological Dose Assessment

Potential radiation doses to the public from airborne and liquid effluent releases of radioactivity from the site during 1991 were estimated via computer models. Potential radiation doses from ingestion of locally produced foods were also calculated and compared to results derived from the computer models.

The EPA-approved computer program CAP88-PC was used to calculate hypothetical radiation doses from airborne effluents. The highest annual effective dose equivalent (EDE) to a nearby resident was estimated to be 4.9 x 10^{-4} mrem, which is 0.005% of the 10 mrem EPA standard. The collective dose to all persons within a 50-mile radius was estimated to be 4.7 x 10^{-3} person-rem effective dose equivalent (EDE).

Computer modeling was also used to estimate a hypothetical maximum annual radiation dose from liquid effluents. The highest EDE to an individual was estimated to be 5.5 x 10^{-2} mrem, which is 0.055% of the DOE limit. Overall, the annual EDE from air and liquid discharges to the people within an 80-kilometer (50-mi) radius of the site was calculated to be 1.6 x10^{-2} person-rem.

Radiation doses estimated from maximum consumption rates of locally produced foods are lower than the values reported in previous years.

The hypothetical calculated doses presented above should be considered in relation to an average dose of 300 mrem per year to a U.S. resident from natural background radiation. The dose assessment described in Chapter 4, *Radiological Dose Assessment*, predicts an insignificant effect on the public's health as a result of radiological releases from the WVDP.

Quality Assurance

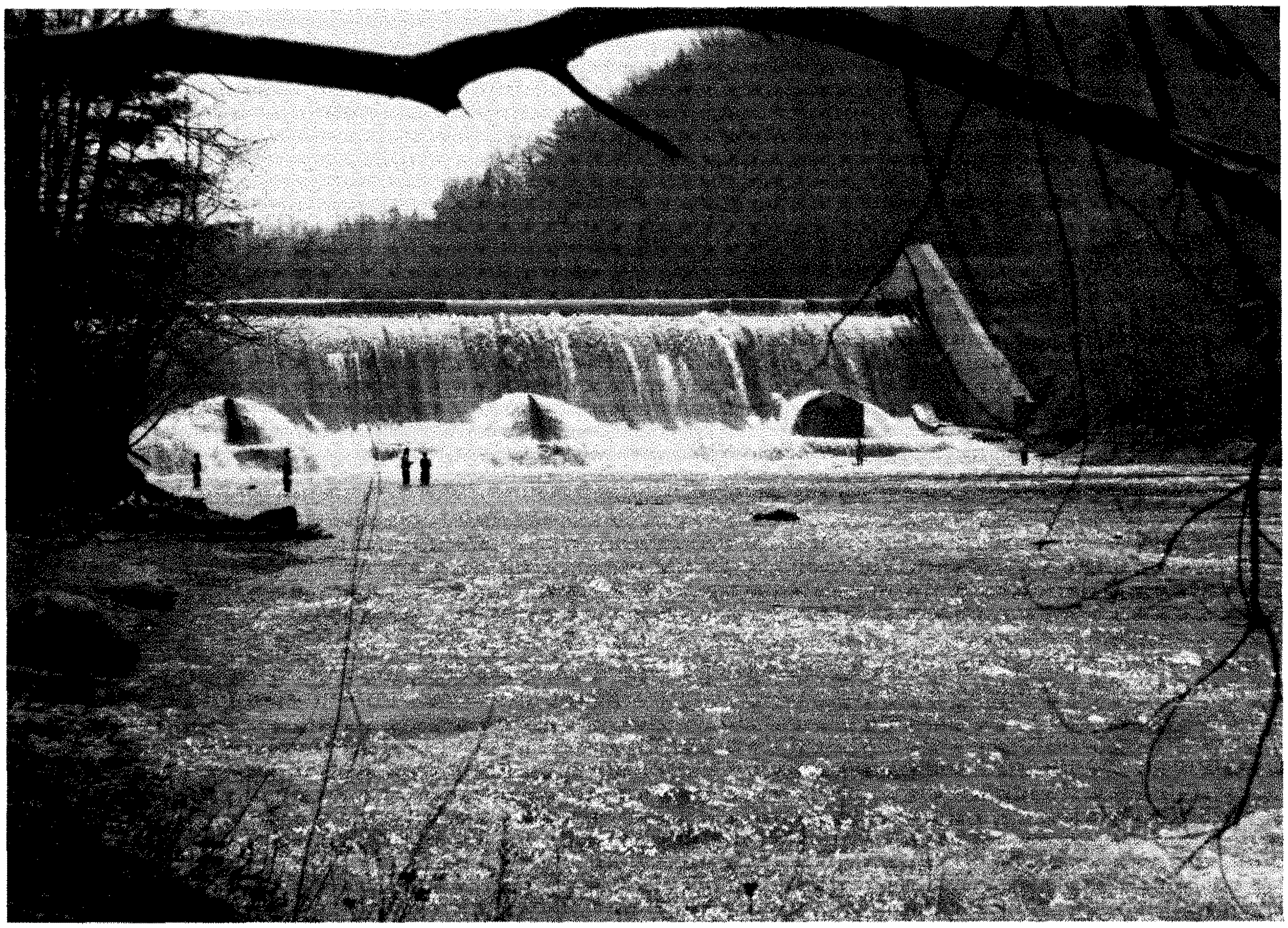
The quality assurance (QA) program overseeing environmental monitoring activities includes the evaluation and control of data from both on-site and off-site sources. Commercial contract laboratories and their internal quality assurance programs are routinely reviewed by site personnel. In addition, commercial laboratories must perform blind analyses of standard or duplicate samples submitted by the WVDP Environmental Laboratory.

WVDP monitoring activities are subject to quality control checks from the time of sample collection through sample analysis and data reduction. Each analytical test of the samples analyzed in the on-site environmental laboratory is reviewed in detail. Specific quality checks include external review of sampling procedures, accurate calibrations using primary standard materials, participation in formal laboratory crosscheck programs (for example, with the EPA and DOE), and outside auditing by organizations that include the U.S. Nuclear Regulatory Commission (NRC), the Department of Energy, and Westinghouse Electric Corporation.

Environmental sample sharing and co-location of measurement points with the New York State Department of Health (NYSDOH) and the Nuclear Regulatory Commission continued in 1991, ensuring that selected samples and locations were routinely measured by two or more independent organizations.

Crosscheck program participation coupled with other internal quality control procedures and external laboratory checks verified the overall high quality of data gathered in 1991. General program adequacy and specific issues of quality assurance were audited by the WVNS quality assurance department in 1991. Quarterly self-assessments, conducted by an independent team of environmental monitoring staff, identified areas needing improvement and tracked the actions taken to achieve the high quality standards that the environmental monitoring program represents.

The major auditing activity in 1991 was a visit by the DOE Office of Environmental Audit in July and August. Overall, the environmental monitoring program was found to be satisfactory. (See the *Environmental Compliance Summary: Calendar Year 1991* for a more complete discussion.)



Springville Dam on Cattaraugus Creek

Introduction

The West Valley Demonstration Project (WVDP) site is located about 50 kilometers (30 mi) south of Buffalo, New York (Fig.1-1). The Project occupies about 89 hectares (220 acres) within the 1,354-hectare (3,345-acre) Western New York Nuclear Service Center (WNYNSC). The Project site includes a security-fenced area of about 63 hectares (156 acres) that contains the plant facilities.

Activities at the West Valley Demonstration Project are directed towards decontaminating and decommissioning the Western New York Nuclear Service Center. This report on the environmental monitoring program at the WVDP provides information about the radioactive and chemical constituents on and around the WNYNSC and the effect, if any, of Project activities on the environment.

The geography, economy, climate, biology, 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

The WVDP is located on New York State's western 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 neither hunting, fishing, public access to the site, nor human habitation on the WNYNSC are permitted.

Economy

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek is used locally for swimming, canoeing, and fishing. Although limited irrigation water for 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.

Climate

Although there are recorded extremes of 37°C (98.6°F) and - 42°C (- 43.6°F) in the region, the Western New York climate is moderate, with an average annual temperature of 7.2°C (45.0°F). Rainfall is relatively high, averaging about 104 centimeters (41 in.) per year, although the 33 inches of precipitation in 1991 marked a relatively dry year. 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 were predominantly from the west and south at about 4 m/sec (9 mph) during 1991.

Biology

The Western New York Nuclear Service Center 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 endangered species on the federal endangered species list are known to be present on the WNYNSC.

Geology and Groundwater Hydrology

The site is underlain by five geologic units with varying degrees of permeability. The glacial deposits occupy an older valley that is cut into the sedimentary rocks under-

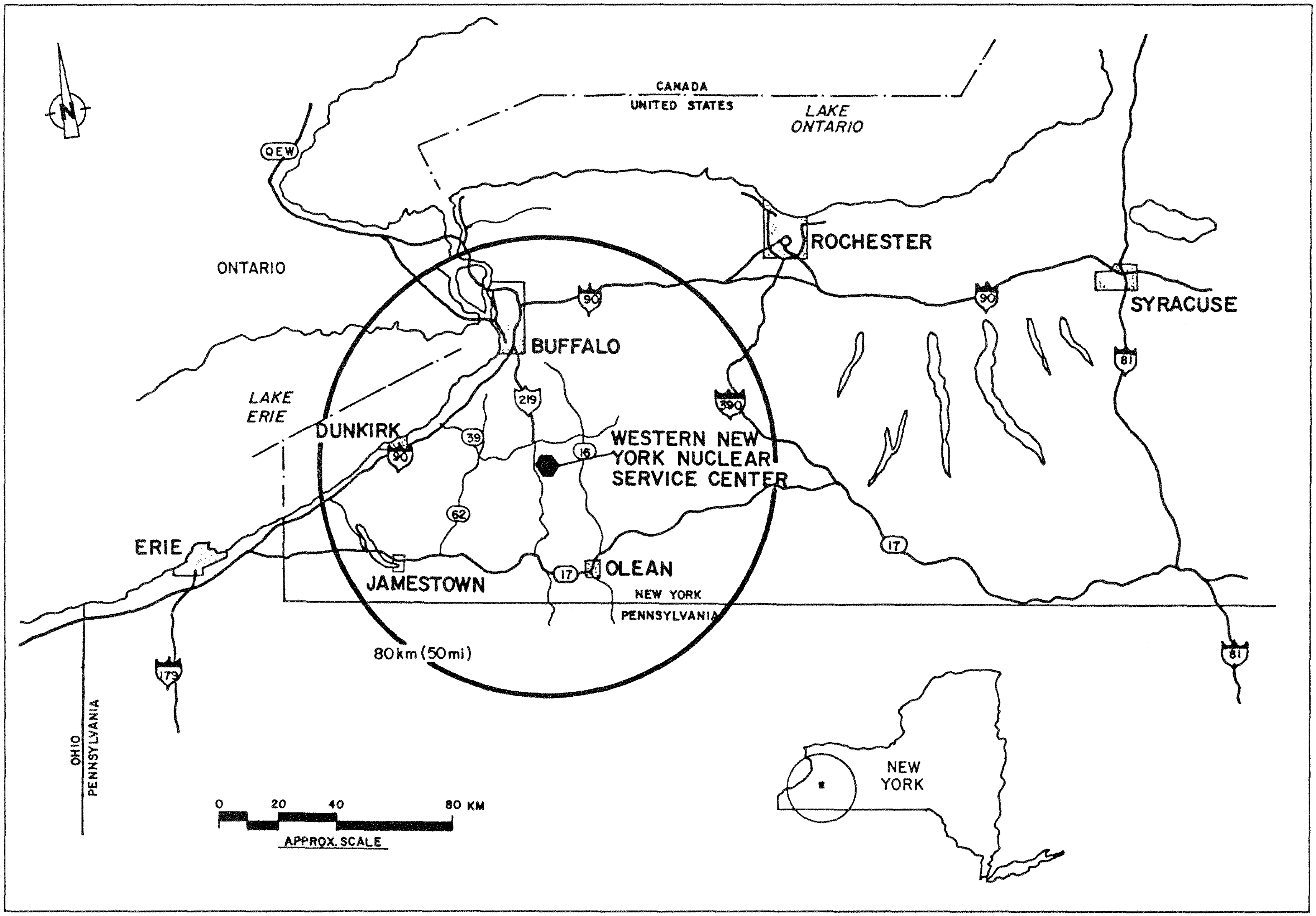


Figure 1-1. Location of the Western New York Nuclear Service Center

lying the entire region. These rocks are exposed in the upper drainage channels on the hillsides.

The soil is mainly silty till consisting of unconsolidated rock fragments, pebbles, sand, and clays. The uppermost till unit is the Lavery, a very dense, compact, gray, silty clay. Below the Lavery till is a more granular zone, the lacustrine unit, which is made up of silts, sands, and, in some places, gravels that overlie a layered clay. The lacustrine unit, in turn, is underlain by an older glacial till, the Kent till, which is quite similar to the Lavery.

There are two aquifers in the site area but neither is considered highly permeable. The topmost aquifer is a transient water table aquifer in the upper 6 meters (20 ft) of weathered Lavery till and alluvial gravels concentrated near the western edge of the site. High ground to the west of the WVDP and Buttermilk Creek valley to the east each intersect this aquifer, precluding off-site migration of groundwater. Several shallow, isolated, water-transmitting strata also occur at various other locations within the site boundary but do not appear to be continuous enough to provide avenues for the movement of groundwater from on-site to off-site areas.

The uppermost bedrock is another aquifer consisting of decomposed shale and rubble that ranges in depth from 2 meters (6 ft) underground on the hillsides to 170 meters (560 ft) deep just east of the Project's fenced area. The groundwater flow patterns are related to the recharge and downgradient movement for the two aquifers. Groundwater in the surficial unit tends to move east or northeast, away from Rock Springs Road. Most of this groundwater empties into Frank's Creek. Groundwater from the lower aquifer tends to move east toward the lowest point of the valley, about 300-350 meters west of Buttermilk Creek, and may emerge to flow north-northwest as surface water. All surface drainage from the WNYNSC is to Buttermilk Creek, which flows into Cattaraugus Creek and ultimately into Lake Erie.

Environmental Monitoring Program

The environmental monitoring program for the West Valley Demonstration Project began in February 1982. The program has been developed to detect any 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 produced by the processing of high-level waste; possible routes that radiological and non-radiological contaminants could follow into the environment; geologic, hydrologic, and meteorological 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 program, additional monitoring points are selected for sampling.

Monitoring and Sampling

The environmental monitoring program consists of on-site effluent monitoring and on-site and off-site environmental surveillance in which samples are measured for both radiological and non-radiological components. It includes both the continuous recording of data and the collecting of soil, sediment, water, air, and other samples at various times.

Monitoring and sampling of environmental media provide two ways of assessing the effects of on-site radioactive waste processing. Monitoring is a continuous process that allows rapid detection of any potential effects on the environment from site activities. Sampling is slower than monitoring because it must be followed by laboratory analysis of the collected material, but it allows smaller quantities of radioactivity to be detected through the analysis.

Information in this Report

Individual chapters in this report include information on compliance with regulations, general information about the monitoring program and significant activities in 1991, summaries of the results of radiological and non-radiological monitoring, and calculations of doses to the population. Where possible, graphs and tables are included to illustrate important trends and concepts. The bulk of the data, however, is furnished in the appendices following the text.

Appendix A summarizes the 1991 environmental monitoring schedule at both on-site 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.)* *Appendix A* lists the kinds of samples taken, the frequency of collection, the parameters analyzed, and the location of the sample points.

Appendix B provides a partial list of the radiation protection standards set by the Department of Energy. It also lists federal and state regulations that affect the WVDP and regulatory permits held by the site.

Appendix C summarizes analytical data from air, water, sediment, and biological samples (meat, milk, food crops, and fish) as well as direct radiation measurements and meteorological monitoring.

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

Appendix E summarizes the data collected from groundwater monitoring. Tables and graphs report concentrations at various locations for parameters such as gross alpha and beta, tritium, cesium, and dissolved metals.

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, and DOE Regulatory Guide DOE/EH-0173T.

The West Valley Demonstration Project also participates in the State Pollutant Discharge Elimination System (SPDES) as required by the New York State Department of Environmental Conservation (NYSDEC), which regulates discharges of liquid effluents containing nonradiological pollutants. The SPDES permit identifies the outfalls where liquid effluents are released to site drainage and specifies the sampling and analytical requirements for each outfall.

In addition, the site operates under state-issued air discharge permits for nonradiological plant effluents. Radiological air discharges must also comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAPs).

For more information see the ENVIRONMENTAL COMPLIANCE SUMMARY: CALENDAR YEAR 1991. Permits are listed in Appendix B.

Exposure Pathways Monitored at the West Valley Demonstration Project

The major pathways for potential movement of radionuclides 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 at locations from which small amounts of radioactivity are normally released or might possibly be released. Such locations include plant ventilation stacks as well as various water effluent points and surface water drainage locations. Samples of air, water, soils, and biota from the environment surrounding the site indicate any radioactivity that might reach the public from site releases.

Water and Sediment Pathways

Effluent water is collected regularly or, in the case of lagoon 3, when the lagoon water is released, and is analyzed for various parameters, including gross alpha and gross beta, tritium, pH, conductivity, strontium-90, and gamma isotopes. Additional analyses of composite samples determine metals content, biochemical oxygen demand, organic chemicals, and specific isotopic radioactivity.

On-site groundwater and surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and beta, tritium, and pH. Selected samples are scheduled for analysis for conductivity, chlorides, phenols, heavy 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 beta, tritium, gamma isotopes, pH, and conductivity.

Off-site surface waters, primarily from Cattaraugus Creek and Buttermilk Creek, are sampled both upstream of the Project for background radioactivity and downstream to measure possible Project contributions. Sediments deposited downstream of the facility are collected semiannually and analyzed for gross alpha, gross beta, and specific radionuclides. (See *Appendix C-1* for water and sediment data summaries).

Air Pathways

Effluent air emissions on-site are continuously monitored for alpha and beta activity with remote alarms that indicate any unusual rise in radioactivity. Air particulate filters, which are retrieved and analyzed weekly for gross radioactivity, are also composited quarterly and analyzed for strontium-90, isotopic gamma, and specific alpha-emitting nuclides.

Iodine-129 and tritium also are measured in effluent ventilation air. At two locations silica gel-filled columns are used to extract water vapor that is then distilled from the desiccant and analyzed for tritium. Four samplers contain activated charcoal adsorbent that is analyzed for radioiodine. The silica gel columns are analyzed weekly; 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 population centers.

Air is continuously sampled at nine locations. Background samplers are located in Great Valley and Dunkirk, New York. Nearby community samplers are in Springville and West Valley, New York. Five samplers are located on the perimeter of the Western New York Nuclear Service Center. These samples are analyzed for parameters similar to the effluent air samples. (See *Appendix C-2* for air monitoring data summaries.)

Atmospheric Fallout

An important contributor to environmental radioactivity is atmospheric fallout. Sources of fallout materials include earlier atmospheric testing of atomic explosives and residual radioactivity from the Chernobyl nuclear power plant accident. Four site perimeter locations currently are sampled for fallout using pot-type samplers that are collected every month. An on-site fallout pot sampler was added to the program in 1990. Long-term fallout is determined by analyzing soil collected annually at each of the nine perimeter and off-site air samplers. (See *Appendix C-2* for fallout data summaries and *Appendix C-1* for soil data summaries.)

Food Pathways

Another potentially significant pathway is through domesticated farm animals and produce raised near the WVDP and through game animals and fish that include the WVDP in their range. Appropriate animal and fish samples 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. Beef, milk, hay, and produce are collected at nearby farms and at selected locations well away from any possible WVDP influence. (See *Appendix C-3* for biological data summaries.)

Direct Radiation Monitoring

Direct penetrating radiation is continuously monitored using thermoluminescent dosimeters (TLDs) located on- and off-site. Monitoring points within the site are placed at waste management units and the inner security fence. Other monitoring stations are situated around the site perimeter and access road and at background locations remote from the WVDP. Forty-one monitoring points were used in 1991. The TLDs are retrieved quarterly and analyzed on-site to obtain the integrated gamma exposure. (See *Appendix C- 4* for direct radiation data summaries.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded on-site. Wind speed and direction, barometric changes, temperature, and rainfall are all measured. Such data are valuable in evaluating long-term trends and in developing dispersion models. In the event of an emergency immediate access to the most recent data is indispensable for predicting the path and concentration of any materials that become airborne. (See *Appendix C-6* for meteorological data summaries.)

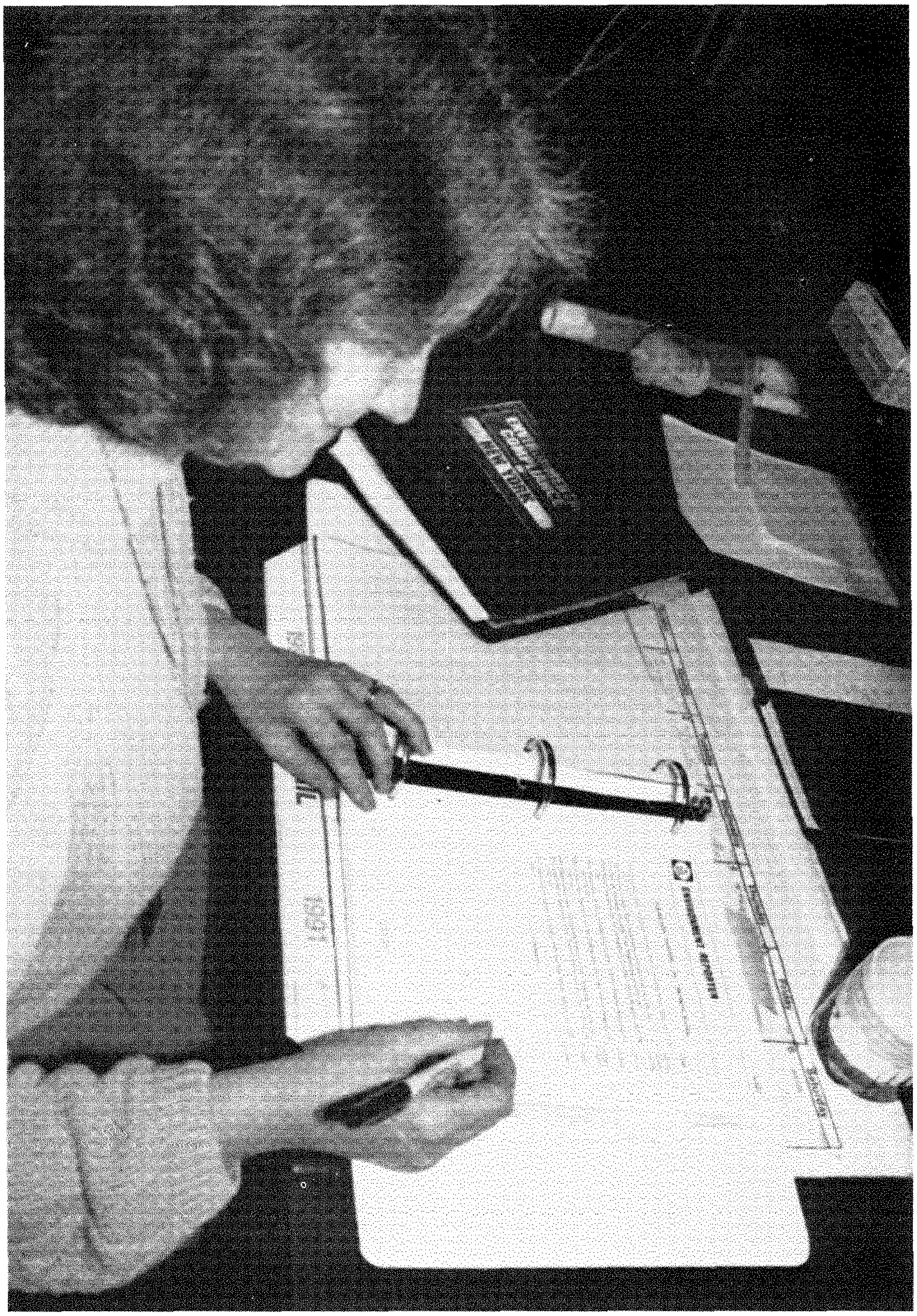
Quality Assurance and Control

The work performed by and through the on-site environmental laboratory is regularly reviewed by several agencies for accuracy and compliance with applicable regulations. Audits 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.

In 1991 the Department of Energy's Office of Environmental Audit reviewed the environmental monitoring program reported in this annual site report. No major deficiencies were identified. (See the *Environmental Compliance Summary: Calendar Year 1991*, for a summary of this audit.)

The Environmental Laboratory also participates in several quality assurance crosscheck programs administered by federal or state agencies. Outside laboratories contracted to perform analyses for the WVDP also are regularly subjected to performance audits. (See *Appendix D* for a summary of crosscheck performance.)

Environmental monitoring management continued to strengthen its formal self-assessment program, developing new strategies and procedures for ensuring high data quality despite more restrictive regulations and a burgeoning sample load. Experienced senior scientists and specialists in varying disciplines follow an annual schedule of quarterly internal appraisals, produce a formal report with recommended corrective actions, and track the planned actions for their implementation. These internal reports are made available to external auditing agencies to provide a history of the monitoring program development and direction.



Review of Regulatory Technical Requirements for Recent Changes

Environmental Compliance Summary

Calendar Year 1991

Introduction: Compliance Status

Environmental compliance activities during 1991 at the West Valley Demonstration Project (WVDP) successfully addressed the full range of environmental laws and regulations, including the management of radioactive mixed wastes under the Resource Conservation and Recovery Act (RCRA). The WVDP presently is negotiating a Federal and State Facilities Compliance Agreement (FSFCA) to address compliance issues relating to radioactive mixed waste management. (See **Current Issues and Actions** below.)

All inspections and audits conducted by external agencies indicated full compliance. The audit conducted by the Department of Energy's Office of Environmental Audit noted significant improvements since the DOE Tiger Team's 1989 audit.

Management at the WVDP continues to provide strong support for environmental compliance issues, ensuring that all state and federal statutes and regulations, as well as Department of Energy (DOE) Orders, are integrated into the compliance program at the Project.

Clean Air Act (CAA)

The Clean Air Act establishes a comprehensive federal and state framework that regulates air emissions from both stationary and mobile sources: any emission sources of a CAA-regulated substance may require a permit or be subject to registration or notification requirements. Emission sources regulated by the CAA may include stacks, ventilators, ventilation ducts, wall fans, open burning, and dust piles.

Nonradiological emissions are regulated by the New York State Department of Environmental Conservation (NYSDEC). In 1991 NYSDEC approved the operation of a tank vent, a source-capture welding system, a paint booth, and laboratory equipment. Approval was also given to continue fire brigade training exercises under the conditions contained in a Restricted Burning Permit.

The WVDP operated under twenty active air permits in 1991. (See Table B-3 in *Appendix B*.) Of the twenty permits, six are for radiological emissions and therefore are regulated under the U.S. Environmental Protection Agency's (EPA) National Emissions Standards for Hazardous Air Pollutants (NESHAPs) program.

The annual NESHAPs inspection in May indicated no noncompliance episodes or notices of violation. Calculations to demonstrate compliance with NESHAPs standards showed 1991 doses to be less than $6x10^{-3}$% (0.006%) of the 10 millirem standard.

The 10 millirem standard includes a *de minimis* value for which permit applications were not required to be submitted to the EPA. The WVDP modeled possible emissions and releases from four radiological release points to determine the need for monitoring and permitting: the contact size-reduction facility; the supernatant treatment system, ventilation of tank 8D-4; and the IRTS evaporator. None needed permit modifications.

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

The purposes of EPCRA are to provide local governments and the public with information concerning potential chemical hazards in their communities and to encourage and support emergency planning efforts at the state and local levels.

The EPCRA program requires the WVDP to submit reports to various off-site state and local emergency response organizations giving information about the quantities, locations, and any associated hazards of chemicals used and stored on-site. Additionally, the WVDP is required to submit an annual report to the Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) on toxic chemical emissions from the site.

All required reports were submitted to the appropriate organizations by the required deadlines. In compliance with the waste minimization and pollution prevention directives from the EPA and NYSDEC, the number of reportable chemicals used on-site during the 1991 reporting period were reduced from twenty-five to twenty-one.

The annual emissions report was submitted as required and noted a reduction from three toxic chemical emissions in 1990 to a single toxic chemical emission in 1991. The only reportable toxic chemical emission from the site was a nitric acid emission from venting of the storage tanks, conservatively calculated to be less than two pounds.

The WVDP also submits updates of the chemical site inventory every quarter to NYSDEC and the State and Local Community Emergency Planning Center. The update ensures that the public and emergency organizations have the most recent information about site conditions and operations.

Clean Water Act (CWA)

The Clean Water Act is the primary statute governing water pollution control programs in the United States. It controls discharges to surface water and groundwater by establishing a National Pollutant Discharge Elimination System (NPDES) permit program that requires permits to be issued specifying discharge standards and monitoring and reporting requirements. Authorized states are allowed to issue equivalent State Pollutant Discharge Elimination System (SPDES) permits.

SPDES-permitted Outfalls

All WVDP point source discharges to surface waters are permitted through the New York SPDES program.

The WVDP has three permitted outfalls:

- Outfall 001 discharges the effluent from the low-level radioactive wastewater treatment facility (LLWTF).
- Outfall 007 discharges the combined effluent from the site's sewage treatment plant and various non-radioactive industrial and potable water treatment systems.
- Outfall 008 directs groundwater flow from the northeast side of the site's LLWTF lagoon system through a french drain.

In 1991 treated water from the low-level waste treatment facility was discharged in six batches that averaged 5.7 million liters (1.5 million gals) each. The annual average concentration of radioactivity at the point of release was 26.2% of the DOE's derived concentration guides (DCGs). None of the individual releases exceeded the DCGs. (See the *Glossary* and Table B-1 in *Appendix B*.)

There were three instances in which the SPDES permit level for iron, 0.31 mg/L, was exceeded. The first excursion occurred in April when the flow-weighted iron concentration from outfalls 001, 007, and 008 was calculated to be 0.55 mg/L. The second and third occurred in August, when the flow-weighted concentrations were calculated to be 0.39 mg/L and 1.10 mg/L.

The level of naturally occurring iron in the raw water used by the WVDP was determined to be a contributing cause of the excursions. Precipitated iron in the site's discharge basins remains to be satisfactorily addressed. It is possible that natural sediments may become resuspended in the water column during batch discharge, thus causing an elevated iron level that is not directly due to the LLWTF effluent. The discharge pipe in the basin was elevated to limit contact of the treated water with the sediments. The limited data available appear to indicate a positive effect. Other remedial measures are currently being investigated.

There were no excursions attributable to the sewage treatment plant in 1991. A proposal for the expansion of the sewage treatment plant into a wastewater treatment facility has been forwarded to NYSDEC and is awaiting approval. Construction can begin following receipt of the permit approval application and National Environmental Policy Act (NEPA) documentation.

The New York State Department of Environmental Conservation (NYSDEC) did not conduct a formal SPDES inspection in 1991.

Stormwater Permit Application

Stormwater from municipal or industrial facilities may contain a variety of pollutants. To protect aquatic resources and the public health, new regulations require that facilities such as the WVDP must obtain permits specifying discharge limits.

The WVDP must submit a stormwater discharge permit application to NYSDEC by October 1, 1992. In preparation for the permit application, the WVDP obtained site-specific data through extensive sampling in 1991. Analytical results will be included on the application. Detailed maps describing site drainage patterns and the location of various process units and buildings will also be included in the permit application.

Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act states 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. The drinking water quality program in the state of New York is administered by the New York State Department of Health (NYSDOH) through county health departments.

The WVDP obtains its drinking water from surface water reservoirs on the WNYNSC site and is considered a nontransient, noncommunity public water supplier, (i.e., it does not serve residents of the community outside the workplace but does regularly serve at least the same twenty-five people for six months of the year). As an operator of a drinking water supply system, the WVDP must sample the water and report the results of the analyses to the Cattaraugus County Health Department, which also collects independent samples periodically.

The water is purified by settling, filtration, and chlorination before it is distributed on-site. Monitoring results in 1991 indicated that the Project drinking water met NYSDOH drinking water quality standards. There were no violations of the drinking water program during 1991.

On August 19, 1991, representatives of the Cattaraugus County Health Department inspected the drinking water treatment facilities. No problems were noted.

Medical Waste Tracking

The WVDP transported two pounds of untreated, regulated medical wastes to Bertrand Chaffee Memorial Hospital, a licensed medical waste disposal facility, for incineration. The shipments consisted of medical dressings and inoculation needles.

Petroleum Product Spill Reporting

Under an agreement with the New York State Department of Environmental Conservation, the WVDP reports on-site spills of petroleum products of ten gallons or less onto an impervious surface (such as blacktop) in a monthly log. Spills that are greater than ten gallons that do not affect ground- or surface water or enter a drainage system must be reported to NYSDEC within twenty-four hours and entered on the monthly log. Spills of any amount that do affect waters of the state (groundwater, surface water, drainage systems) must be reported immediately to the NYSDEC spill hotline and also are entered in the monthly log.

There were forty-eight minor spills of petroleum products in 1991 totaling approximately 100 liters (26.4 gals). These spills were typically associated with the heavy industrial construction equipment currently on-site.

Of the forty-eight spills, only seven, totaling 71.3 liters(18.8 gals) required immediate notification of NYSDEC under the reporting protocol. All spills were cleaned up in a timely fashion in accordance with the WVDP Spill Prevention, Control, and Countermeasures Plan. None of the spills resulted in any discernible adverse environmental effect.

Resource Conservation and Recovery Act (RCRA)

Hazardous Waste

During 1991 the WVDP disposed of 0.24 tons of nonradioactive hazardous waste off-site, using permitted transportation and disposal services.

Sources of these materials ranged from expired laboratory chemicals to maintenance shop wastes. The WVDP also reclaimed, recycled, or rendered nonhazardous by neutralization 1.60 tons of material as part of its waste minimization and reduction program.

Radioactive Mixed Waste (RMW) Management Program

Radioactive mixed waste is waste that contains both a radioactive constituent, which is regulated by the Atomic Energy Act (AEA), and a hazardous waste component, regulated under RCRA. The WVDP has been operating under RCRA interim status for treatment and storage of radioactive mixed waste since June 1990. In April 1991 the WVDP amended its RCRA interim status application to allow for limited storage of nonradioactive hazardous waste.

Potential conflicts between RMW regulations under the Atomic Energy Act and under RCRA regulations led to the WVDP's initiation of discussions with the regulatory agencies to resolve these conflicts through a Federal and State Facilities Compliance Agreement (FSFCA). Negotiations on the FSFCA and a RCRA 3008(h) Administrative Order on Consent continued during 1991. These agreements will provide the means whereby the WVDP can comply with RCRA regulations and with the requirements of the AEA. (See **Current Issues and Actions** below.)

National Environmental Policy Act (NEPA)

The National Environmental Policy Act establishes the nation's policies for the protection of the environment. Its goals are to prevent or eliminate damage to the environment and to restore the environment where necessary. The President's Council on Environmental Quality, established by the National Environmental Policy Act, carries out this policy. Its regulations are found in the Code of Federal Regulations, Title 40, Parts 1500-1508 (40 CFR 1500-1508).

Since 1990, the Department of Energy has been revising its NEPA-compliance program. The latest draft of these proposed regulations was made available for review and comment August 22, 1991. The new rule has been approved by the President's Council on Environmental Quality and is being reviewed by the Office of Management and Budget. When made final, the Department of Energy's NEPA compliance regulations will be codified in 10 CFR 1021.

1991 NEPA Activities

NEPA requires that any activity of a federal agency that might affect the environment be reviewed through preparation of detailed documents such as an environmental impact statement (EIS) or an environmental assessment (EA), thus ensuring that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

Activities at the West Valley Demonstration Project that are subject to NEPA review are either ongoing activities to support solidification of the high-level waste (Phase I), or activities to support preparation of the environmental impact statement that will assess the effect of Project completion activities (Phase II).

Phase I

Phase I activities generally are small-scale activities typical of facility operation and maintenance. During 1991, fifteen proposed WVDP actions were submitted to DOE as categorical exclusions, recommending that because of their insignificant environmental impact no further NEPA review be required.

In addition to the categorical exclusions a draft environmental assessment for a proposed expansion to the WVDP sewage treatment plant continued in the DOE review and approval process during 1991. When completed, the environmental assessment will conclude in either a finding of no significant impact (FONSI) or the preparation of an environmental impact statement if the potential for significant environmental effects is established.

Phase II

Phase II site characterization activities continued in 1991. The baseline data collected through this characterization will provide the technical supporting information needed for the environmental impact statement for completion of the West Valley Demonstration Project and closure of the WNYNSC. Basic research continued in several primary areas of investigation: geology, seismology, hydrology, soil characterization, water quality, a radiological survey, and solid waste management unit assessment.

Current Issues and Actions

Resource Conservation and Recovery Act (RCRA)

The WVDP continued negotiations with the EPA and NYSDEC for a Federal and State Facilities Compliance Agreement regarding compliance with RCRA regulations pertaining to radioactive mixed waste management. The focus of these negotiations in 1991 was a RCRA 3008(h) Administrative Order on Consent.

The Administrative Order on Consent is an agreement between NYSDEC, the EPA, NYSERDA, and the DOE about the kind and extent of the work needed to identify and evaluate any hazardous waste constituent that may be at the WVDP site. The Order provides a framework for compliance with RCRA that is consistent with the environmental impact statement site characterization work for completion of the Project.

Negotiating the approach and requirements of the Consent Order was the primary focus in 1991. The data-gathering activities required by the Consent Order will continue to be integrated with the data-gathering work that has been under way for the EIS. Tasks were identified and schedules defined for activities that will take place in 1992 and 1993. (See **Current Issues and Actions**, *Environmental Compliance Summary: First Quarter 1992*.)

Hazardous Materials Transportation

A Department of Energy moratorium on shipments of hazardous/toxic wastes to commercial disposal facilities was declared in May 1991 after it was reported that shipments of hazardous waste from another DOE facility to a commercial disposal facility in Louisiana were allegedly radioactively contaminated.

In response, the Department of Energy published a PERFORMANCE OBJECTIVE FOR CERTIFICATION OF NON-RADIOACTIVE HAZARDOUS WASTE. The goal of the procedures and actions initiated by this document was to ensure that hazardous/toxic wastes shipped from DOE facilities to commercial treatment, storage, or disposal facilities "contain no measurable increase in radioactivity resulting from DOE operations" and comply with "DOE Order 5400.5 criteria for surface contamination."

All Department of Energy sites were required to examine and document hazardous and/or toxic waste shipments from 1981 to the present and to compare records against new DOE guidelines to ascertain whether any radioactively contaminated hazardous wastes had been shipped off-site.

Further, in order to resume shipping of hazardous/toxic waste, all DOE sites were required to identify and implement this objective in their hazardous/toxic waste management and transportation procedures and provide DOE Headquarters with documentation of the implementation, including the schedule for incorporating the objective into procedures.

The West Valley Demonstration Project submitted the historical data on waste shipments in September 1991 to DOE Headquarters. According to the stringent criteria set forth in the PERFORMANCE OBJECTIVE, no hazardous or toxic wastes shipped from the WVDP to commercial disposal facilities were radioactively contaminated. The data were reviewed by DOE Headquarters and accepted.

In August 1991 the WVDP submitted the necessary documentation of its plan for meeting the performance objective. Comments were received in September 1991 and were resolved by November 1991.

Department of Energy Environmental Audit

A comprehensive review of environmental monitoring, compliance, and management at the WVDP was conducted by a team of twelve auditors from the Department of Energy Headquarters Office of Environmental Audit from July 29, 1991 through August 16, 1991. Of the thirty-seven items identified by the team, more than half had been previously noted by WVDP management for correction or improvement. No deficiences were found that represented conditions or actions posing a significant threat to public health or the environment.

In addition, the forty-one action items identified during the 1989 Tiger Team audit, which were formally closed out by the WVDP in February 1991, were reviewed by the audit team to verify completion.

In the judgment of the audit team, six of the items were not completed satisfactorily. These concerns were incorporated into the 1991 audit and WVDP Action Plan.

The 1989 Tiger Team action items were formally closed by this action.

The draft audit team report was prepared and received by the WVDP in August 1991. A draft WVDP Action Plan Response was submitted to DOE in September 1991 and made final in April 1992. (See **Current Isssues and Actions,** *Environmental Compliance Summary: First Quarter 1992*.)

Summary of Permits

Environmental permits in effect at the Project during 1991 are listed in Table B-3 of *Appendix B*.

Environmental Compliance Summary

First Quarter 1992

Introduction: Compliance Status

The compliance status of the West Valley Demonstration Project's major environmental programs through the first quarter of 1992 is noted below. Primary compliance inspections thus far in 1992 were by the New York State Department of Environmental Conservation (NYSDEC), which inspected the Project with regard to Resource Conservation and Recovery Act requirements and the Water Pollution Control Act and found the WVDP to be in full compliance.

Clean Air Act (CAA)

The WVDP has been involved in an ongoing review of proposed rulemaking associated with the 1990 CAA Amendments. The majority of the rules involve the protection of stratospheric ozone and reduction of hazardous air pollutants. The WVDP has provided comments to aid in developing the rulemaking process.

A proposed method for demonstrating compliance with periodic monitoring requirements for radionuclide emissions from DOE facilities (40 CFR 61.63) has been submitted to the EPA. The WVDP has been working with the EPA to develop additional compliance procedures.

The New York State Department of Environmental Conservation inspected the WVDP's air programs in January 1992 and found all areas inspected to be in regulatory compliance. The WVDP has received three permits to construct air emission sources associated with the vitrification cold chemical facility.

Clean Water Act (CWA)

The WVDP is preparing a final draft of its stormwater discharge permit application to be submitted to NYSDEC. It is expected to be submitted well in advance of the October 1, 1992 regulatory deadline.

The WVDP submitted an application to NYSDEC for renewal and modification of its State Pollutant Discharge Elimination System (SPDES) permit in May 1990. A draft SPDES permit was received in March 1992 with new and more stringent monitoring requirements, compared to the last permit. The WVDP submitted comments to NYSDEC on the draft permit.

A formal inspection of SPDES monitoring at the WVDP conducted by NYSDEC in March 1992 found no violations.

Safe Drinking Water Act (SDWA)

The WVDP was required in 1991 to monitor volatile organic chemicals from its potable water treatment plant every quarter. The last of four monitoring results was received in February 1992 and indicated that the Project is in compliance with SDWA regulations. Quarterly monitoring can now be reduced to once every five-year period. This schedule will be maintained as long as monitoring results remain within specified limits.

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

Emergency and Hazardous Chemical Inventory (Tier II) reports for the 1991 reporting period were transmitted to the state and local emergency response organizations by the March 1, 1992 deadline.

Resource Conservation and Recovery Act (RCRA)

The WVDP's hazardous waste and radioactive mixed waste programs were inspected by the New York State Department of Environmental Conservation on March 17, 1992. There were no findings or notices of noncompliance.

The annual Hazardous Waste Generator/Waste Minimization Report was submitted to the New York State Department of Environmental Conservation by the March 1,1992 deadline.

Hazardous Materials Transportation

The moratorium on hazardous/toxic waste shipments was lifted for the WVDP in January 1992 in accordance with the documentation and action plan that had been submitted by the WVDP in November 1991.

The WVDP was one of the first DOE sites approved to resume shipments of hazardous/toxic waste to permitted, commercial disposal facilities.

Medical Waste Tracking

The WVDP generates very small quantities of regulated medical wastes consisting of medical dressings and inoculation needles. The disposal facility that has been used in the past has been closed. Other options for medical waste disposal are being evaluated.

Department of Energy Environmental Audit

A final report by the Department of Energy Headquarters Office of Environmental Audit on the 1991 environmental audit was received by the WVDP in March 1992. The WVDP completed its final Action Plan and resubmitted it to DOE Headquarters in April 1992. More than 70% of the identified action items have already been resolved.

Current Issues and Actions

Resource Conservation and Recovery Act

The Department of Energy, the New York State Energy Research and Development Authority, the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation completed negotiations concerning the RCRA 3008(h) Administrative Order on Consent. The effective date of the Order was March 15, 1992.

The work under the Consent Order requires detailed evaluations of solid waste management units to ascertain the potential for release of hazardous constituents; documentation of the interim measures that have been taken at the NDA interceptor trench project ; documentation of the investigation of 1,1,1-trichloroethane, a volatile organic that had been detected in a groundwater seepage point; and potential additional interim measures or corrective measures studies, if necessary.

Detailed plans and schedules for all deliverables have been prepared and are being closely monitored. All commitments are currently on or ahead of schedule.

Negotiations also are continuing for a Federal and State Facilities Compliance Agreement between the EPA, NYSDEC, DOE, and NYSERDA. As noted in the *Environmental Compliance Summary: Calendar Year 1991*, this agreement addresses compliance issues resulting from dual regulation of radioactive mixed waste under the Resource Conservation and Recovery Act and the Atomic Energy Act.

Among other issues concerning radioactive mixed waste the FSFCA addresses compliance with RCRA land disposal restrictions that prohibit the storage of mixed waste if treatment and disposal facilities are not available. Realizing that many facilities lacked the capacity to treat radioactive mixed waste, the EPA granted a two-year variance from its prohibitions. The variance expired on May 8, 1992. Since treatment capacity remains limited, the WVDP has determined that all operations with the potential for generating radioactive mixed waste will be discontinued until an appropriate capacity variance is obtained or other relief is granted by the EPA. Only those activities necessary for safety or for protection of human health or the environment will continue. These activites would include those associated with compliance with operational safety requirements, regulatory release limits, and emergency response.

Electroshock Fishing for Background Samples
with the New York State Department of Environmental Conservation

Environmental Monitoring Program Information

Introduction

The high-level waste (HLW) presently stored at the West Valley Demonstration Project is the by-product 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 is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity associated with the Project's high-level waste treatment operations and the residual effects of NFS, Inc. operations. The following information about the operations at the Project and about radiation and radioactivity may be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

High-level Waste Treatment

Most of the waste from NFS operations had been stored in one of four underground tanks (tank 8D-2). Within the tank the waste 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 two-stage process of pretreatment and vitrification.

Pretreatment

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.

The supernatant was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total fission products in the supernatant.

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 that needed pretreatment 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 constituents.
- The resulting liquid, containing sodium and sulfur compounds, 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 271-liter (71-gal) steel drums.
- Finally, the steel drums were stored in an on-site aboveground vault, the drum cell.

Processing of the supernatant was completed in 1990. Eighty percent of the radioactivity in the liquid was removed and 10,393 drums of cemented waste produced.

The sludge that remains is composed mostly of iron hydroxide. Strontium-90 accounts for most of the radioactivity in the sludge.

Pretreatment of the sludge began in 1991. (See **1991 Activities at the West Valley Demonstration Project** below.)

Vitrification

The second stage of the high-level waste treatment process, solidification into glass (vitrification), is scheduled to begin in 1996. The high-level waste mixture of sludge and zeolite from the ion-exchange process will be combined with glass-forming chemicals, fed to a ceramic melter, heated to approximately 2,000°F, and poured into stainless steel canisters. Approximately 300 stainless steel canisters 10 ft by 2 ft (diameter) will be filled with a uniform high-level waste glass that will be suitable for eventual shipment to a federal repository. Vitrification is scheduled to be completed in 1998.

Radiation and Radioactivity

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

Radiation is the energy released as atomic nuclei decay. By emitting energy the nucleus moves toward a less energetic, more stable state. The energy that is released takes three main forms: alpha or beta particles, and gamma rays.

■ *Alpha Particles*

An alpha particle is a fragment of a much larger nucleus. It consists of two protons and two neutrons and is positively charged. Alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation thus 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 a small amount of tissue.

■ *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 an inch or so thick. If beta particles are released inside the body they do much less damage than alpha particles because they are smaller and faster and have less of a charge.

■ *Gamma Rays*

Gamma rays are high-energy "packets" of electromagnetic radiation called photons. 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 available, the excess energy may be emitted as gamma rays. If the released energy is high a very penetrating gamma ray is produced that can only be effectively reduced by several inches of a heavy element such as lead. Although large amounts of gamma

IONIZING RADIATION

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock loose electrons from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes a previously 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.

radiation are dangerous, gamma rays are also used in many lifesaving medical procedures.

Measurement of Radioactivity

The rate at which radiation is emitted from a decaying nucleus can be described by the number of 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). One becquerel equals one decay per second. One curie equals 37 billion nuclear disintegrations per second (3.7 x 10^{10}d/s). Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-trillionth (10^{-12}) of a curie.

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.

Alpha, beta, and gamma radiation affect the body to different degrees. Dose equivalent, or dose, is a unit of measurement used to compare the effects of different kinds of radiation. Each type of radiation is given a quality factor that indicates the extent of 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, and so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of one.

The unit of dose measurement is the rem. Rems are equal to the number of rads multiplied by the quality factor of the kind of radiation. Dose can also be measured 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 West Valley Demonstration Project all three pathways are monitored, but air and surface water pathways are the two major means by which radioactive material can move off-site.

The geology of the site (kinds and structures of rock and soil), the hydrogeology (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 West Valley Demonstration Project includes measuring the concentration of total 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 in several samples, which can be done within a matter of hours, produces a comprehensive picture of current on-site and off-site radiation levels from all sources. In a facility such as the West Valley Demonstration Project, 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 detected 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 methods, so these must be analyzed separately with instruments having greater sensitivity. Heavy elements such as uranium require special analysis to be detected because in comparison to background they exist at such low levels at the WVDP.

The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in the air and water effluents. Because 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 1/1000 of the original radioactivity remaining. (See *Appendix A* for a schedule of samples and radionuclides measured and *Appendix B* for related Department of Energy protection standards.)

Data Reporting

Because any two samples are never exactly the same, statistical methods are used to decide how a particular measurement compares with other measurements of similar samples. The term *confidence level* is used to describe how certain a measurement is of being a "true"

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person 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 others. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in 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. An instantaneous dose of 100-200 rem (1-2 Sv) might cause temporary effects such as vomiting, but usually would have no long-lasting side effects. At 50 rem (0.5 Sv) a single instantaneous dose might cause a reduction in white blood cell count.

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.

The West Valley Demonstration Project workforce is limited to 0.1 rem (1 mSv) for individual daily work exposures, and to 1 rem (10 mSv) per calendar quarter. At such low exposures no clinically observable effects have ever been seen. The calculated doses from Project operations during 1991 for the maximally exposed off-site individual are about 0.23 mrem (2.3×10^{-3} mSv) for all of 1991.

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 300 mrem (3 mSv), comes from natural sources. The rest comes from medical procedures and from consumer products.

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.

value. The WVDP environmental monitoring program uses the 95% confidence level, which means that 95% of the measurements (19 out of 20) are within the statistical "uncertainty" range.

The uncertainty range is the expected range of values that account for random nuclear decay and small measurement process variations. The uncertainty range of a measurement is the plus-or-minus (±) value following the measurement (e.g., 5.30 ± 3.6E-09 µCi/mL). Within this range a measurement will be "true" 95% of the time. For example, a value that falls within 5.30 ± 3.6E-09 means that 95% of the time the "true" value will be found between 1.7 µCi/mL to 8.9E-09 µCi/mL. If the uncertainty range is greater than the value itself, the measurement is below the detection limit, which means that at least 95% of the time the "true" value is somewhere below the detection limit value. (In general, the detection limit is the minimum amount of constituent that can be picked up by an instrument or method and distinguished from background and intrument noise. Thus, the detection limit is the lowest value at which a sample measurement shows a statistically positive difference from a measurement in which no constituent is present.)

1991 Activities at the West Valley Demonstration Project

High-level Waste Processing

Sludge Pretreatment

Pretreatment of the sludge layer in the high-level waste tank 8D-2 began in 1991. Five specially designed 50-ft 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 sodium salts and sulfates. After mixing, the sludge will be allowed to settle. The water used to wash the sludge will be processed through the integrated radwaste treatment system. Radioactive constituents removed from the washwater will be solidified in glass later on. The remaining washwater will be stablized in cement.

The sludge is scheduled to be washed three more times during the next two years. Following sludge pretreatment, the ion-exchange zeolite used in the liquid processing to trap radioactivity will be blended with the sludge in the glass-forming feed mixture.

Low-level Waste Processing

Aqueous Waste

Water containing added radioactive material from site cleanup operations is collected and treated in the low-level liquid waste treatment facility. (Sanitary water, 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 1991 33.5 million liters (8.85 million gal.) of water were treated in the low-level waste treatment system and released.

The discharge waters contained an estimated 39 millicuries (mCi) of gross alpha plus gross beta radioactivity. Comparable releases during the previous six years averaged about 44 millicuries per year. The 1991 release was about 11% below this average.

The 1.09 curies of tritium also released in 1991 was about half of the previous five-year average.

Solid Waste

Low-level waste at the WVDP consists of various materials generated through site maintenance and cleanup activities. It is stored in aboveground facilities. Metal piping and tanks are cut up and packaged in a special size-reduction facility and dry compressible materials such as paper and plastic are compacted to reduce waste volume. In 1991 waste volume was reduced from 1990 levels by about 717 m^3 (25,300 ft^3).

Two weatherproof storage structures, completed in 1991, provide an additional 300,000 ft^3 of controlled storage space for low-level waste.

Hazardous Wastes

(See *Environmental Compliance Summary: Calendar Year 1991.*)

Waste Minimization Program

A waste minimization plan that includes long-range planning for waste storage and processing facilities, manpower, funding, and waste minimization at the Project was approved and issued in 1991.

A major goal of the plan was achieved in 1991 when the amount of hazardous, radioactive, and mixed waste generated by Project activities was reduced by 5% from anticipated levels. The WVDP's goal is to reduce waste generation by 25% over the next five years.

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 the right-to-know communications program and new employee orientation that provides information about the WVDP's INDUSTRIAL HYGIENCE AND SAFETY MANUAL, environmental pollution control procedures, and the HAZARDOUS WASTE MANAGEMENT PLAN.

In 1991 hazardous waste operations training programs and radiation worker/hazardous waste requalification programs were modified to include information regarding pollution prevention goals and progress. In addition, three articles on pollution prevention topics were carried in the WVDP's monthly employee newsletter.

The WVDP's goal is to make all employees aware of the importance of pollution prevention both at work and at home.

1991 NEPA Activities

As a federal agency the Department of Energy is required to consider the environmental effects of its proposed actions. 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 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 an effect on the environment. Environmental assessments evaluate whether the proposed action will significantly 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.

Phase I NEPA Activities

Phase I NEPA activities at the WVDP generally involve facility maintenance and minor projects that support high-level waste vitrification. Most of these projects are documented and submitted for approval as categorical exclusions.

Fifteen proposed activities were submitted in 1991 as having been previously approved within existing NEPA documents or as categorically excluded from further NEPA review.

In addition, a draft environmental assessment for a proposed expansion to the WVDP sewage treatment plant continued in the DOE review and approval process during 1991. This assessment will conclude in either a finding of no significant impact (FONSI) and approval to proceed or in the preparation of an environmental impact statement if the potential for significant effects is established.

Phase II NEPA Activities

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the West Valley Demonstration Project and closure of the WNYNSC. The EIS will describe the potential environmental effects associated with various site closure alternatives. Completion and closure are Phase II activities.

In order to assess potential effects associated with alternative closure actions, an extensive multidisciplinary characterization of the site was necessary. Characterization activities began in 1989, but require data collection for several years. Site characterization studies include investigations in geomorphology, soils, geohydrology, surface water hydrology, geochemistry, water quality, air quality, seismology, demography, cultural resources, botany, and terrestrial and aquatic ecology.

1991 Changes in the Environmental Monitoring Program

Minor updates in the 1991 monitoring program met several regulatory additions and supported current site characterization activities.

The changes were limited to adding specific points where isotopic or chemical species had not been well-defined previously. Three stormwater locations also were defined although they had been included in the routine monitoring program.

A number of redundant or supporting sample locations were cut back or eliminated after extensive evaluation of historical data and a review of the current rationale for sampling: Water or media from standing bodies of waters (ponds or pools) were reduced by half, and one redundant soil sample location was eliminated. One water sampling location was reduced from weekly to monthly sampling.

The most significant effect on the 1991 monitoring program was the gradual initiation of the full sampling regimen for the 109 groundwater sampling locations. Although all the wells were initially sampled in 1990, the full set of analyses and replicates in 1991 increased the sample work load and data evaluation by an order of magnitude beyond the 1989 program.

Appendix A summarizes the program changes and lists the sample points and parameters measured in 1991.

RCRA Reports

WVNS has developed a hazardous waste management plan that ensures proper management of all hazardous waste from the point of generation to final disposition. The plan's basic requisites include properly designating and packaging all hazardous waste generated at the facility; obtaining appropriate samples and characterizing wastes according to hazardous wastes regulations; maintaining required records and reports; stocking and maintaining spill control materials and equipment and ensuring that the appropriate employees are trained in emergency response; and determining nonradioactive hazardous waste release reporting and notification requirements and, when required, making appropriate notifications.

Toxic Chemical Inventory

Under the Superfund Amendments and Reauthorization Act (SARA) Title III requirements, also known as the Emergency Preparedness and Community Right-to-Know Act (EPCRA), hazardous chemical inventories on-site must be reported to the EPA. During the 1991 reporting period the WVDP produced quarterly updates of the inventory of hazardous chemicals used on-site and sent them to local and state emergency management agencies. The chemicals, quantities stored on-site, and on-site use in 1991 included:

ammonia (380 lbs), used in the laboratories and for sewage treatment

cement (70,000 lbs), used in the solidification of low-level radioactive waste

chlorine (600 lbs), used to disinfect potable water

diesel fuel #2 (7000 lbs), used for back-up power for generators

ferrous sulfate (32,000 lbs), used in wastewater treatment

gasoline (16,500 lbs), used for on-site vehicles

fuel oil # 2 (7,000 lbs), used for back-up power for boilers and other equipment

hydrogen peroxide (1,100 lbs), used in the nitrous oxides off-gas system

lithium hydroxide (2,600 lbs), used in vitrification

nitric acid (1,200 lbs), used in vitrification testing and for pH control

oil (9,000 lbs), used to lubricate various equipment

propane (500 lbs), used for fuel

silicon dioxide (17,100 lbs), used in vitrification

sodium hydroxide (12,400 lbs), used in water treatment and high-level waste sludge washing

sulfuric acid (33,000 lbs), used in water treatment

zinc bromide (13,500 lbs), used for radiation shielding in viewing windows.

On-site Environmental Training

The safety of personnel who are involved in hazardous waste operations falls under the Occupational Safety and Health Act (OSHA). This act is a comprehensive law governing diverse occupational hazards such as protection from fire and electrical safety as well as the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy working environment for employees.

Training for hazardous waste operations at the West Valley Demonstration Project is job-specific and takes the mixed waste characteristics of the Project into consideration.

OSHA 29 CFR 1910.120 (hazardous waste operations) requires that employees at treatment, storage, and disposal facilities, which are regulated by the Resource Conservation and Recovery Act, who may be exposed to health and safety hazards during hazardous waste operations, receive twenty-four hours of initial training and eight hours of annual refresher training.

The Project's training program identifies employees who are eligible for OSHA instruction and provides an initial twenty-four hour training program and an eight-hour refresher course and documents the instruction.

Initially offered in 1990, the program provides detailed information on hazardous materials management procedures, focusing on lessons learned in the field. A total of 987 employees have participated in this program.

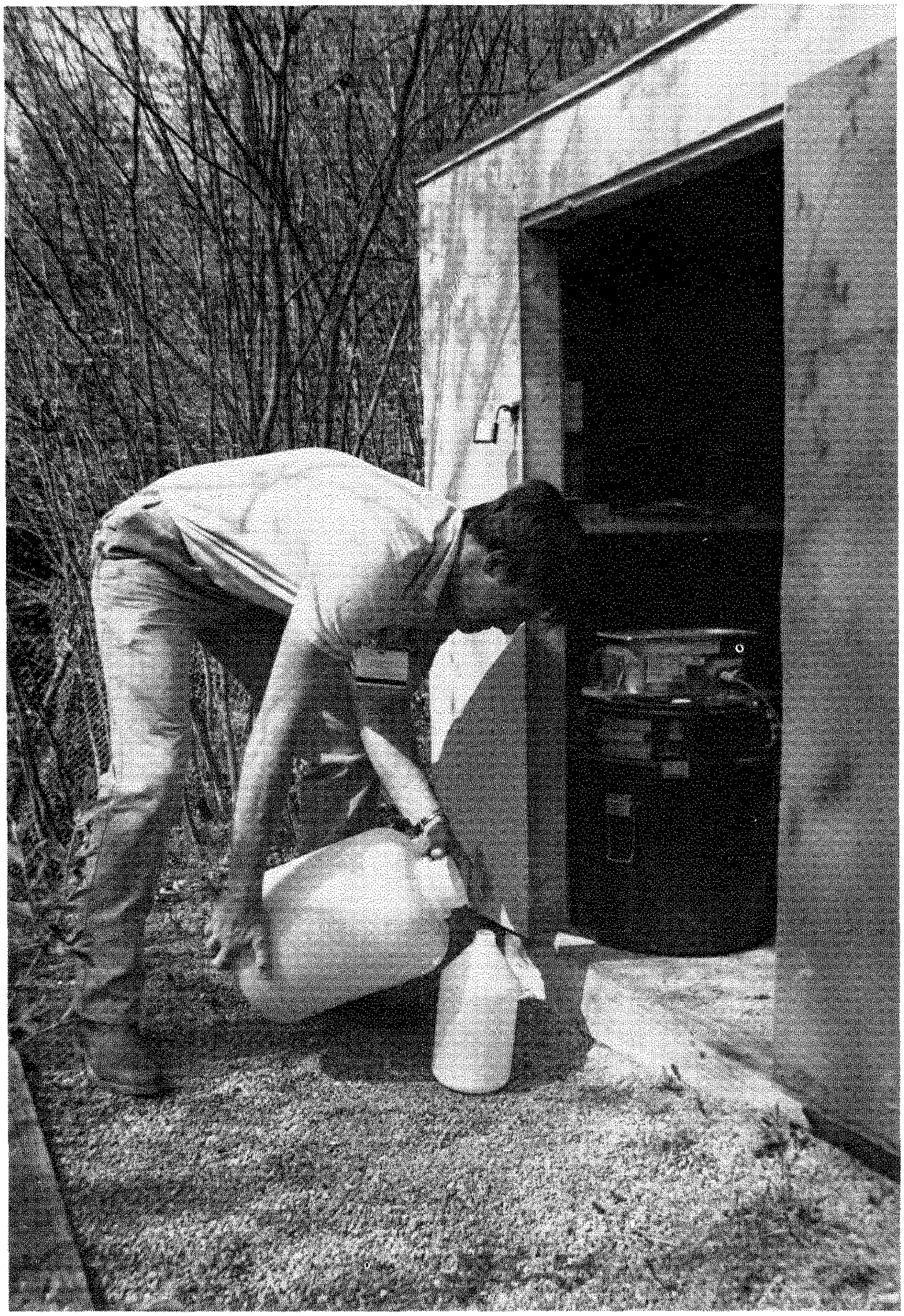
OSHA 29 CFR 1910.120 also requires training in proper response to on-site spills of hazardous materials or wastes. To date, sixty-five employees have been fully trained as a hazardous materials response team.

An eight-hour course for supervisors covers how to determine site hazards, how to assess risk, on-the-job training, and incident command. Sixty-three employees have completed this course.

In addition, each visitor or nonworker at the site must receive a site-specific briefing on safety and emergency procedures before being admitted to the site. Currently, each visitor views an information tape that explains site safety policies and emergency evacuation procedures.

Self-assessment

Assessments concerning environmental compliance and regulations are summarized in the *Environmental Compliance Summary: Calendar Year 1991*. See also Chapter 5, *Quality Assurance*, for additional information.



Collecting a Composite Water Sample at the Project Boundary

Environmental Monitoring

Pathway Monitoring

The effluent and environmental monitoring program provides data on 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 facility to the public. Both radiological and nonradiological parameters are monitored in order to ascertain the effect of Project activities.

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

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

Air and Liquid Effluent Pathways

Air and liquid effluents are monitored on-site by collecting samples at locations where small amounts of radioactivity or other regulated substances are normally released or might be released, such as plant ventilation stacks or various water effluent outfalls or weirs.

Surface Water Pathways

Surface water samples are collected from the creeks that flow through the 3,345-acre WNYNSC (tributaries of Cattaraugus Creek) and from drainage channels within the site. Surface water is also sampled at the on-site water supply reservoirs and low-level waste treatment lagoons.

Both air and water samples are also collected at remote locations as well in order to provide background concentration data and at perimeter locations where the highest concentrations of transported radionuclides might be found.

Sampling Codes

The complete monitoring schedule is detailed in *Appendix A*. 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 also is found in *Appendix A*.

These codes are used throughout this report for ease of reference. For example, a sample location code such as AFGRVAL indicates an air sample (A), off-site (F), at the Great Valley (GRVAL) sampling station.

Air Sampler Location and Operation

Air samplers are located at points remote from the West Valley Demonstration Project site, at the perimeter of the site, and on the site itself. Figure 2-1 shows the locations of the on-site air samplers; Figure 2-2 shows the location of the perimeter and remote air samplers.

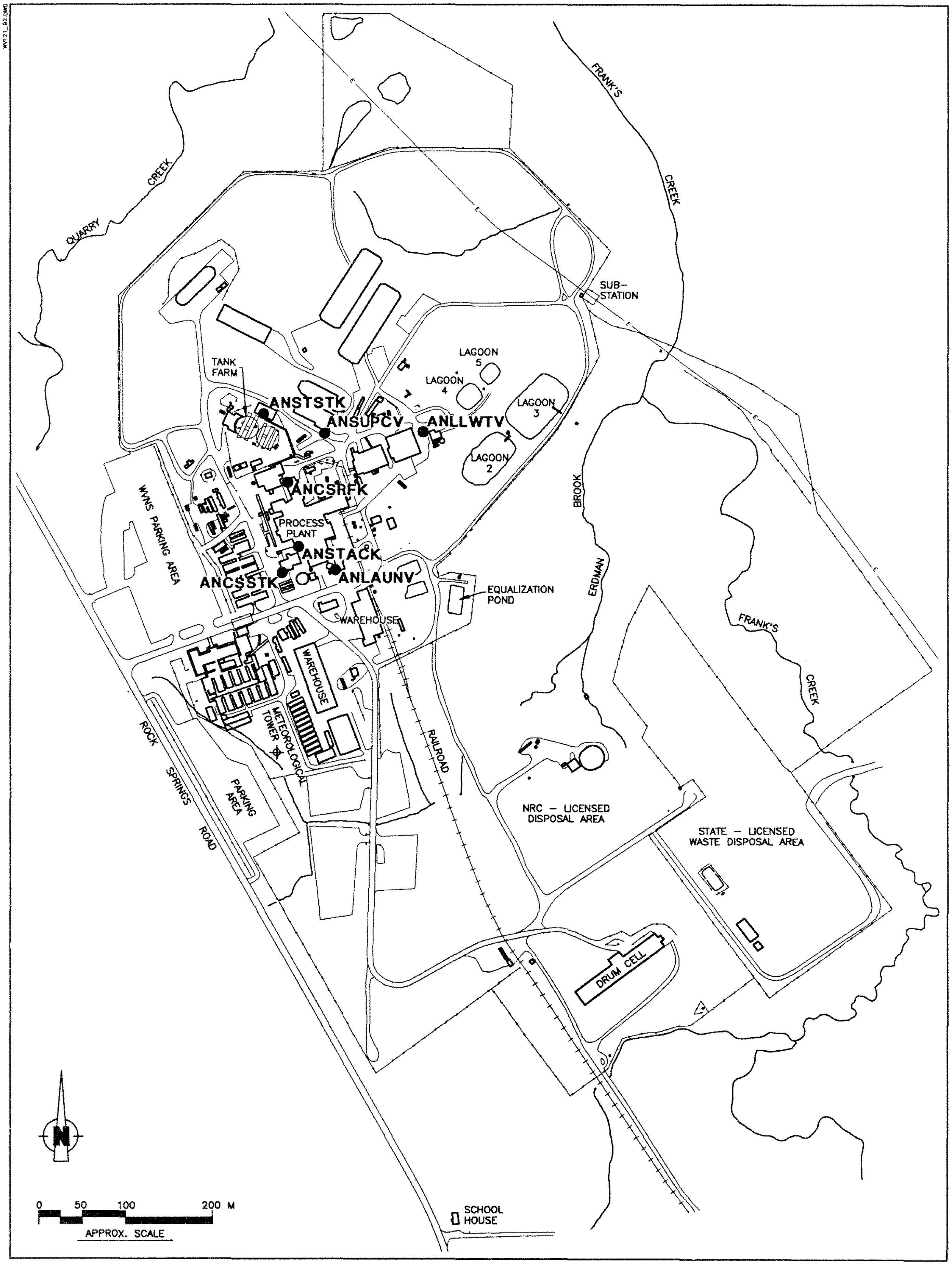


Figure 2-1. Location of On-Site Air Effluent Points.

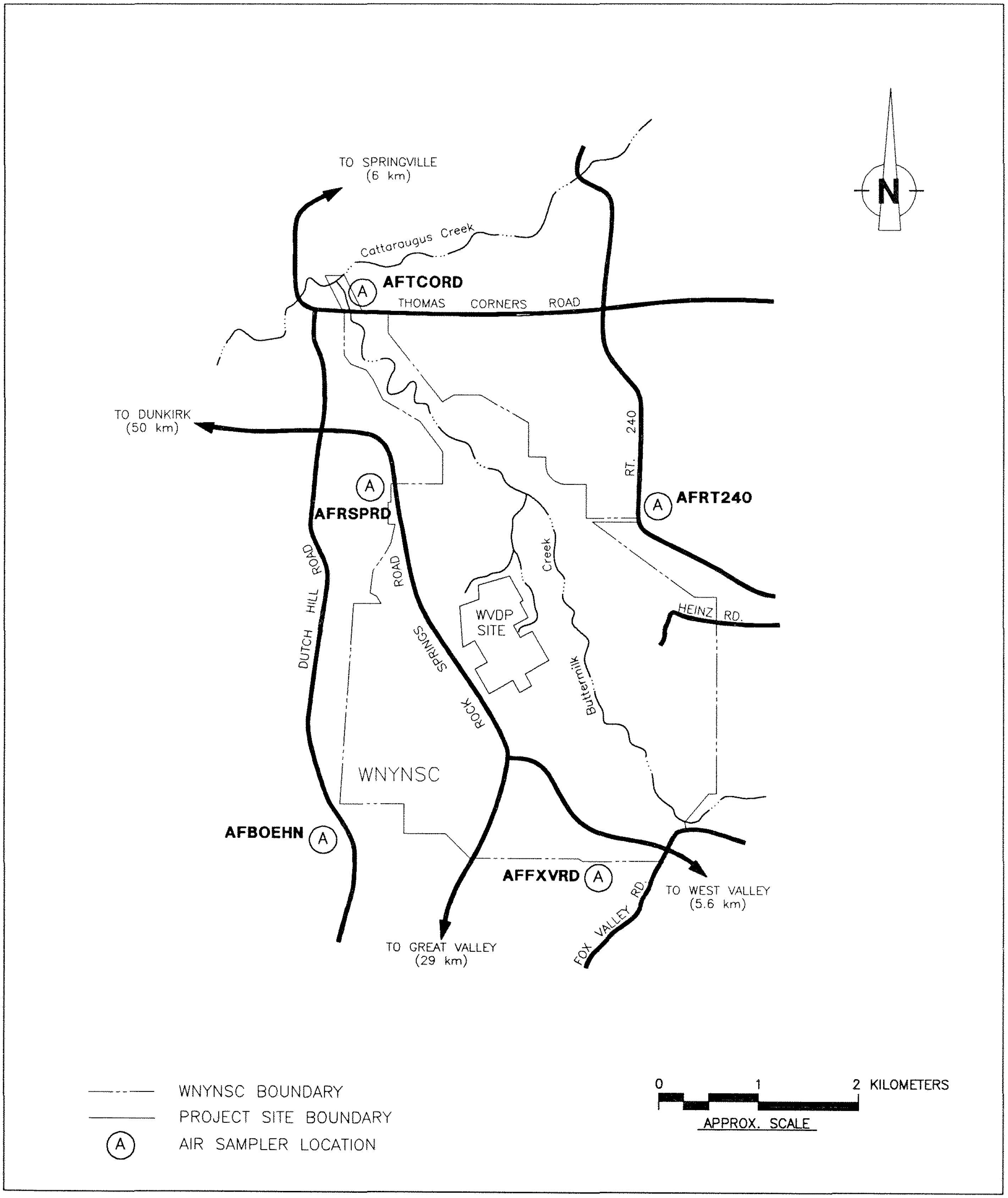


Figure 2-2. Location of Perimeter Air Samplers.

Air samples are collected by drawing air through a very fine filter with a vacuum pump. The total volume of air drawn through the sampler is measured and recorded. The filter traps particles of dust that are then tested in the laboratory for radioactivity. At the Rock Springs Road and Great Valley locations samples are also collected for iodine-129 analysis using activated carbon cartridges. (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. Figure 2-3 shows the location of the on-site surface water monitoring points; Figure 2-4 shows the location of the off-site surface water monitoring points. (On-site locations are WNSP006, WNNDADR, and WNSW74A. Off-site locations are WFBCTCB, WFFELBR, and the background location, WFBCBKG.)

Water samplers draw water through a tube extending to an intake below the stream surface. An electronically controlled battery-powered pump first blows air through the sample line to clear any debris. The pump then reverses to collect a sample, reverses again to clear the line, then resets itself. The pump and sample container are housed in an insulated and heated shed to allow sampling throughout the year. (A more detailed description of the water sampling program follows below.)

Radiological Monitoring

Air Monitoring

On-site Ventilation Systems

Permits obtained from state and federal agencies allow air to be released from plant ventilation stacks during normal operations. The air released must meet certain federal and state criteria that ensure that the environment and the public's health and safety are not adversely affected by these releases.

Parameters measured include gross alpha and gross beta, tritium, and various isotopes such as cesium-137 and strontium-90. To provide conservatively high values, alpha and beta radioactivity is assumed to come from americium-241 (alpha radiation) and strontium-90 (beta radiation), as the derived concentration guides (DCGs) for these isotopes are the most stringent. (Department of Energy standards and DCGs for radionuclides of interest at the West Valley Demonstration Project are found in *Appendix B*.)

The exhaust from each permitted fixed ventilation system serving the site's facilities 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 measure the radioactivity on these filters and provide remote readouts of alpha and beta radioactivity levels to monitored display panels.

The air released must meet federal and state criteria that ensure that the environment and the public's health and safety are not adversely affected.

A separate sampling unit on the ventilation stack of each system contains another filter that is removed every week and tested in the laboratory. This sampling system also may contain an activated carbon cartridge used to collect a sample that is analyzed for iodine-129.

In addition to these samples, water vapor from the main plant ventilation stack (ANSTACK) is collected by trapping moisture on 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.

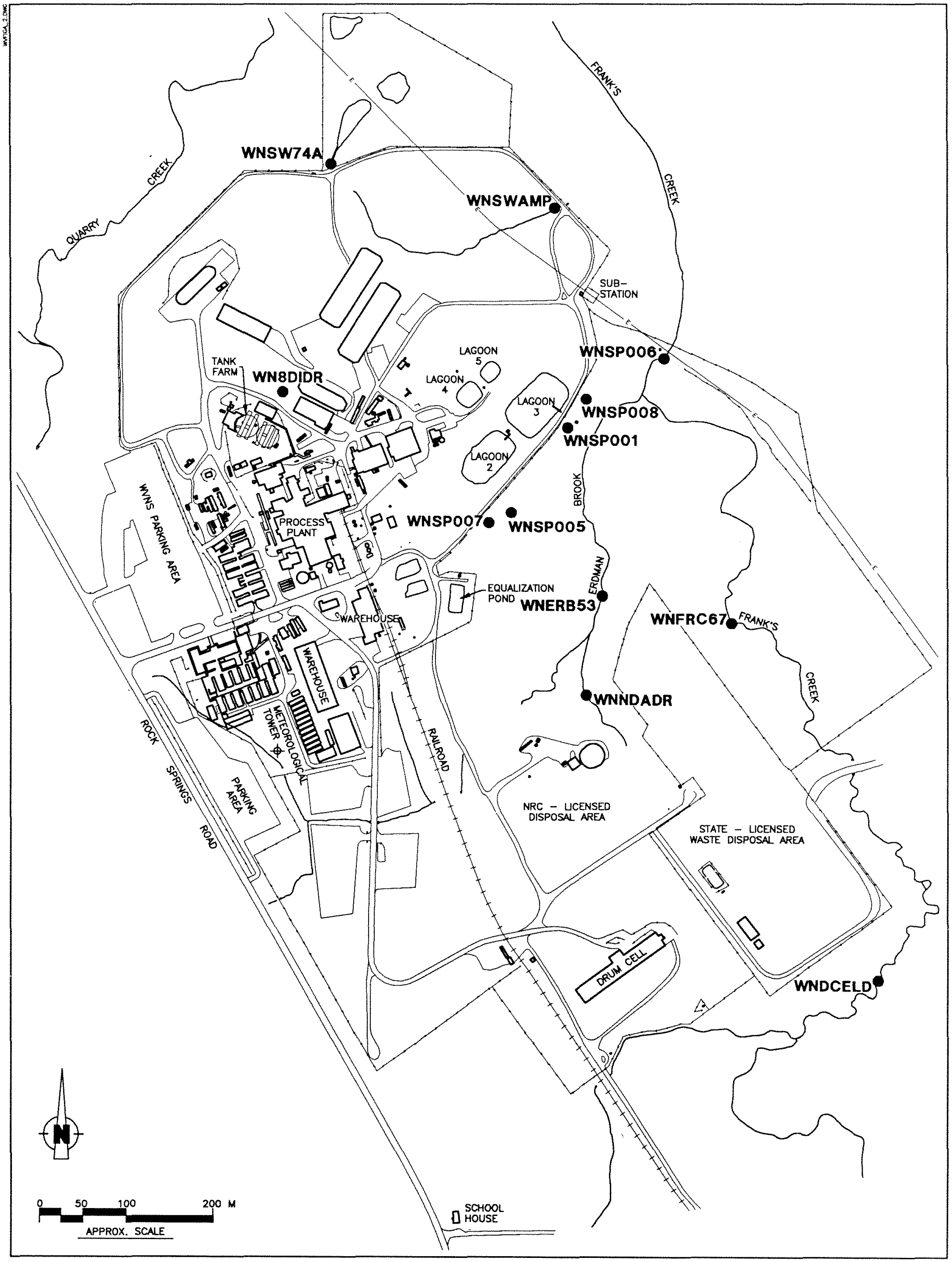


Figure 2-3. Sampling Locations for On-Site Surface Water.

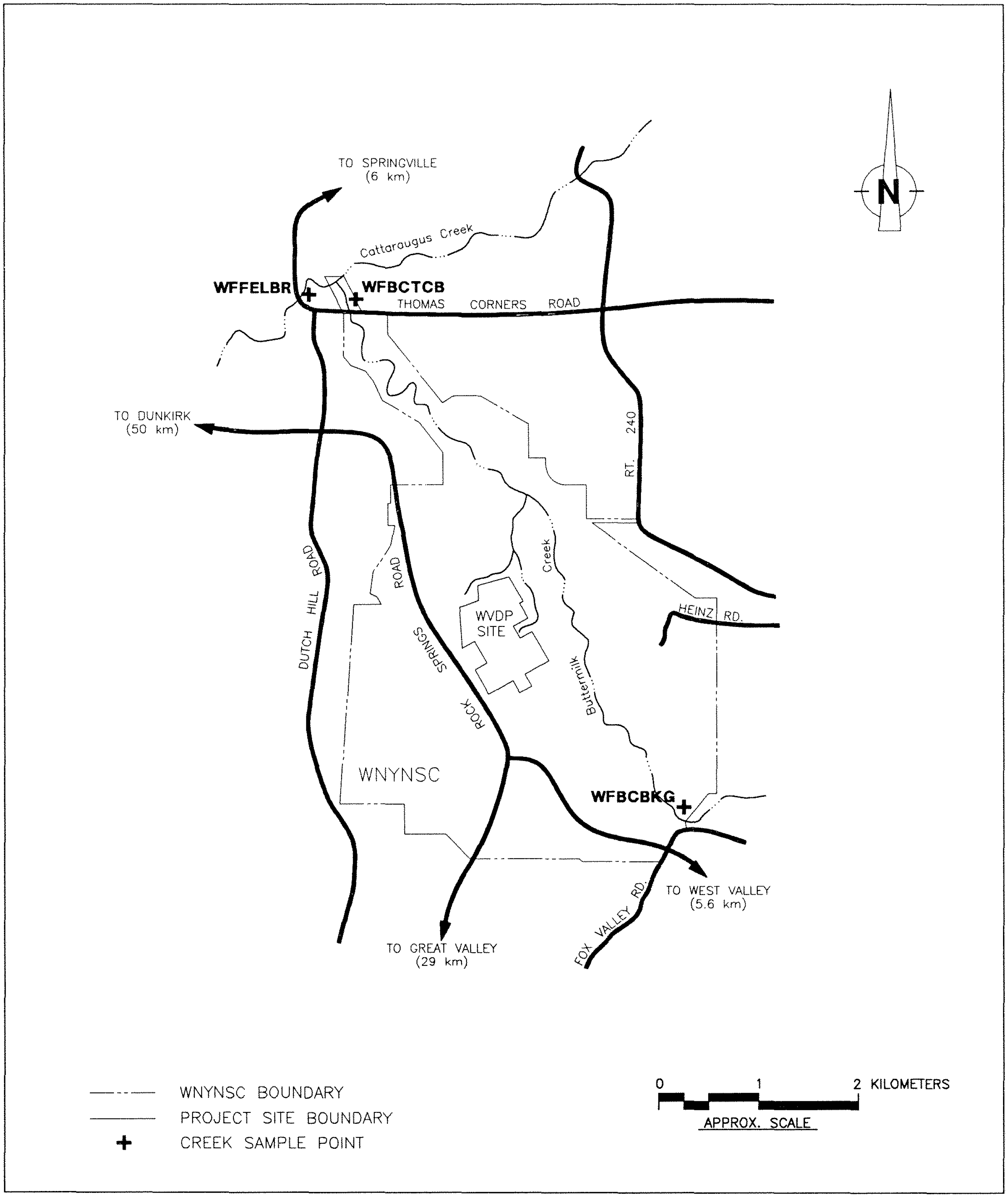


Figure 2-4. Location of Off-Site Surface Water Samplers.

- The Main Plant Ventilation Stack (ANSTACK)

The main ventilation stack (ANSTACK) sampling system is the most significant airborne effluent point. A high sample collection flow rate through multiple intake nozzles ensures a representative sample for both the weekly filter sample and the on-line monitoring system. The total quantity of gross alpha, gross beta, and tritium released each month from the main stack, based on weekly filter measurements, is shown in *Appendix C-2*, Table C-2.1.

Analyses of specific radionuclides in the four quarterly composites of the main stack effluent samples are listed in Table C-2.2. A comparison of the average concentrations of these measured isotopes with Department of Energy derived concentration guides (DCGs) in Table C-2.3 shows that at the point of discharge, average radioactivity levels were already below concentration guidelines for airborne radioactivity in an unrestricted environment. Further dilution from the stack to the site boundary reduces the concentration by an average factor of about 200,000.

At the point of discharge, average radioactivity levels were already below concentration guidelines for airborne radioactivity.

- Other On-site Sampling Systems

Sampling systems similar to those of the main stack monitor airborne effluents from the cement solidification system ventilation stack (ANCSSTK), the contact size-reduction facility ventilation stack (ANCSRFK), and the supernatant treatment system ventilation stack (ANSTSTK). The 1991 samples showed detectable gross radioactivity, including specific beta- and alpha-emitting isotopes, but did not approach any Department of Energy effluent limitations. Tables C-2.4 through C-2.9 in *Appendix C-2* show monthly totals of gross alpha and beta radioactivity and concentrations of specific radionuclides for each of these sampling locations.

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

Perimeter and Remote Air Sampling

As in previous years, airborne particulate radioactive samples were collected continuously at five locations around the perimeter of the site and at four remote locations at Great Valley, West Valley, Springville, and at Dunkirk, New York. (See Fig. 2-2.)

Perimeter locations — on Fox Valley Road, Rock Springs Road, Route 240, Thomas Corners Road, and Dutch Hill Road — were chosen to provide historical continuity or because the location would probably provide the highest annual average airborne concentrations of radioactivity.

The remote locations provide data from nearby communities — West Valley and Springville — and from natural background areas. Concentrations measured at Great Valley (AFGRVAL, 29 km south of the site) and Dunkirk (AFDNKRK, 50 km west of the site) are considered representative of natural background radiation.

Three of the four perimeter samplers, mounted on towers 4 meters high, maintain an average flow of about 40 L/min (1.4 ft^3/min) through a 47-mm glass fiber filter. The remaining perimeter sampler and the four remote samplers operate with the same air flow rate as the three samplers mounted on towers, but the sampler head is set at 1.7 meters above the ground, the height of the average human breathing zone.

Perimeter locations provide historical continuity in the air sampling program.

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 radioactivity. Gross alpha and gross beta measurements of each filter are made using a low-background gas proportional counter.

In addition, quarterly composites consisting of thirteen weekly filters from each sample station are analyzed. Data from these samplers are provided in *Appendix C-2*, Tables C-2.12 through C-2.20.

Radioactivity Concentrations at On-site Air Sampling Locations

The total amount of radioactivity discharged from facilities other than the main ventilation stack is less than 1% of the airborne radioactivity released from the site and was not a significant factor in the airborne pathway in 1991.

Radioactivity Concentrations at Perimeter and Remote Air Sampling Locations

Air samples are measured weekly and the values averaged each month. The maximum and minimum monthly average values are presented as concentrations that reflect normal seasonal variations.

The average monthly concentrations at the perimeter and remote locations ranged from 1.51E-14 μCi/mL to 1.94E-14 μCi/mL (5.6E-04 Bq/m^3 to 7.2E-04 Bq/m^3) of beta activity and from 9.43E-16 μCi/mL to 1.71E-15 μCi/mL (3.5E-05 Bq/m^3 to 6.3E-05 Bq/m^3) of alpha activity. In all cases, the measured monthly gross radioactivities were well below 3E-12μCi/mL (1.1E-1 Bq/m^3) beta and 2E-14 μCi/mL (7.4E-4 Bq/m^3) alpha, the most stringent acceptable limits or DCGs set by the Department of Energy for any of the isotopes present at the WVDP. Iodine-129 was not detected at either the Rock Springs Road location (AFRSPRD) or the Great Valley location (AFGRVAL). Tables C-2.13 and C-2.18 in *Appendix C-2* contain the data for these two samplers.

The 1991 data for the three samplers that have been in operation since 1982 — Fox Valley, Thomas Corners, and Route 240 — averaged about 1.73E-14 μCi/mL (6.4E-04 Bq/m^3) of gross beta activity in air. This average is comparable to 1990 data. The average gross beta concentration at the Great Valley background station was 1.64E-14 μCi/mL (6.1E-04 Bq/m^3) in 1990, and in 1991 averaged 1.63E-14 μCi/mL (6.0E-04 Bq/m^3).

Global Fallout Sampling

Global fallout is also sampled at four of the perimeter air sampler locations and at the base of the on-site meteorological tower. Precipitation from all of the locations is collected and analyzed every month. Results from these measurements are reported in nCi/m2 per month for gross alpha and gross beta and in mCi/mL for tritium. (The 1991 data from these analyses are found in Appendix C-2, Table C-2.21. Table C-2.22 contains precipitation pH measurement data.)

Fallout pot data indicate short-term effects; the reporting units for gross alpha and gross beta indicate a rate of deposition rather than the actual concentration of activity within the collected water. Long-term deposition is measured by surface soil samples collected annually near each sampling station. Soil sample data are found in Table C-1.11 of Appendix C-1.

Surface Water and Sediment Monitoring

On-site Surface Water Sampling: the Low-level Waste Treatment Facility

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility (LLWTF) through the lagoon 3 weir (WNSP001, Fig. 2-3) into Erdman Brook, a tributary of Frank's Creek. There were six batch releases totaling about 33.5 million liters (8.85 million gals) in 1991. In addition to composite samples collected near the beginning and end of each discharge, forty-eight daily effluent grab samples were collected and analyzed.

Off-site Surface Water Sampling

An off-site sampler (WFFELBR) is located on Cattaraugus Creek at Felton Bridge just downstream of Cattaraugus Creek's confluence with Buttermilk Creek, which is the major surface drainage from the Western New York Nuclear Service Center. (See Fig. 2-4.) The sampler periodically collects an aliquot (a small volume of water, approximately 100 mL/hr) from the creek. 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 based on relative stream discharge. The samples are analyzed for gross alpha, gross beta, and tritium each week, and the composite is analyzed for strontium-90 and gamma-emitting isotopes.

In addition to the Cattaraugus Creek sampler, two surface water monitoring stations are located on Buttermilk Creek both upstream and downstream of the WVDP. 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 plant and upstream of Buttermilk Creek's confluence with Cattaraugus Creek (WFBCTCB).

The samplers collect a 25-mL aliquot every half-hour. Samples are retrieved biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite of the biweekly samples is analyzed for gamma-emitting isotopes and strontium-90. (Table C-1.3 shows monthly and quarterly radioactivity totals upstream of the site at Fox Valley; Table C-1.4 shows monthly and quarterly radioactivity totals downstream of the site at Thomas Corners.)

The fourth station (WNSP006) is located on Frank's Creek where Project site drainage leaves the security area. (See Fig. 2-3). This sampler collects a 50-mL aliquot every half-hour. Samples are retrieved weekly and composited both monthly and quarterly. Weekly samples are analyzed for tritium and gross alpha and beta radioactivity. The monthly composite is analyzed for strontium-90 and gamma-emitting isotopes. (See Table C-1.5.) A quarterly composite is analyzed for carbon-14, iodine-129, and alpha-emitting isotopes. (See Table C-1.6.)

Radioactivity Concentrations at the Low-level Waste Treatment Facility

The total amounts of radioactivity from specific radionuclides in the lagoon 3 effluent are listed in Table C-1.1. During 1991 approximately 494,000 liters (130,000 gals) of lagoon 3 effluent originated in the New York State-licensed disposal area (SDA) rather than from current or previous Project operations. This represents about 1.5% of the total liquid effluent.

The annual average concentrations from the lagoon 3 effluent discharge weir, including all measured isotope fractions, were less than 30% of the DCGs (Table C-1.2 in *Appendix C-1*).

Radioactivity Concentrations at Off-site Surface Water Sampling Locations

Radiological concentration data from these sample points show that average gross radioactivity concentrations generally tend to be higher in Buttermilk Creek below the WVDP site, presumably because small amounts of radioactivity from the site enter Buttermilk Creek via Frank's Creek. The range of gross beta activity, for example, was from 2.2E-09 to 7.5E-09 µCi/mL (8.1E-02 to 2.8E-01 Bq/L) upstream in Buttermilk Creek at Fox Valley (WFBCBKG), and from 4.2E-09 to 3.6E-08 µCi/mL (1.6E-01 to 1.3E+00 Bq/L) in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB).

These data show that concentrations downstream of the site are only marginally higher than background concentrations upstream of the site. To establish a perspective on these data, note that if the maximum beta concentration in Buttermilk Creek downstream of the Project at Thomas Corners Bridge, to which dairy cattle have access, were assumed to be entirely from iodine-129, which is the most restrictive beta-emitting isotope, then the radioactivity would represent 7.1% of the Department of Energy's derived concentration guide (DCG) for unrestricted use.

At sampling location WNSP006 at the Project security fence (see Fig. 2-3) more than 4 kilometers from the nearest public access point, the most significant beta-emitting radionuclides were measured at 3.62E-08µCi/mL(1.3E+00Bq/L) for cesium-137 and 6.91E-08 µCi/mL(2.6E+00Bq/L) for strontium-90 during the month of highest concentration. This corresponds to 1.2% of the DCG for cesium-137 and 6.9% of the DCG for strontium-90.

At WNSP006 the annual average concentration of cesium was 0.8% of the DCGs and 2.4% of the strontium DCG. Tritium, at an annual average of 1.50E-06 µCi/mL (5.6E+01 Bq/L), was 0.1% of the DCG value. Of the fifty-two samples collected and analyzed for gross alpha during 1991, six were above the detection limit. The annual average was 1.33E-09 µCi/mL or 4.4% of the DCG for americium-241.

The highest concentrations in monthly composite water samples from Cattaraugus Creek during 1991 show strontium-90 to be less than 0.7% of the DCGs for drinking water. No gamma-emitting fuel cycle isotopes were detected in Cattaraugus Creek during 1991. (See Table C-1.7.) Yearly averages for Cattaraugus Creek at Felton Bridge are not significantly higher statistically than background levels.

Sediment Sampling

Sediments are grab-sampled semiannually at or near the water sampling locations. 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 locations are Buttermilk Creek at Fox Valley Road (SFBCSED) and Cattaraugus Creek at Bigelow Bridge (SFBISED).

A comparison of annual averaged 1986-1991 cesium-137 concentrations for these five sampling locations is found in Figure 2-5. As the figure indicates, cesium-137 concentrations are decreasing or staying constant with time for the locations downstream of the Project

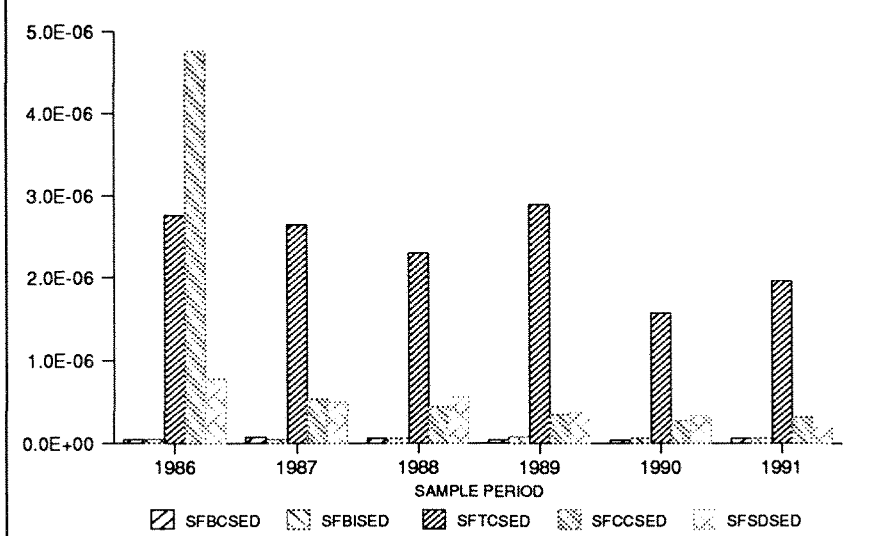


Figure 2-5. Annual Averages of Cs-137 (µCi/g) in Stream Sediment for Two Locations Upstream and Three Locations Downstream of the WVDP.

(SFTCSED, SFCCSED, and SFSDSED). Concentrations of cesium-137 at the upstream locations (SFBCSED and SFBISED) have remained consistent throughout the time period.

A comparison of cesium-137 to naturally occurring potassium-40 (Fig. 2-6) 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. Results of sediment sampling upstream and downstream of the Project are tabulated in Appendix C-1, Table C-1.9.

Radioactivity in the Food Chain

Each year food samples are collected both near the site and from remote locations. 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 grazing near the site and at remote locations. Hay, corn, apples, and beans are collected at the time of harvest.

Fish

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

Ten fish were collected from this section of the stream during one annual collection period in 1991 and the strontium-90 content and gamma-emitting isotopes (cesium-134,-137, and strontium-90) in flesh were determined. (See Table C-3.4 in *Appendix C-3.)*

A similar number of fish are taken from waters that are not influenced by site runoff (BFFCTRL) and their edible portions are analyzed for the same isotopes. These control samples, containing only natural background radiation, provide comparisons with the concentrations found in fish taken from site-influenced waters. The control samples are representative of the species collected in Cattaraugus Creek downstream from the WVDP. Ten fish were collected during each semiannual collection period in 1991.

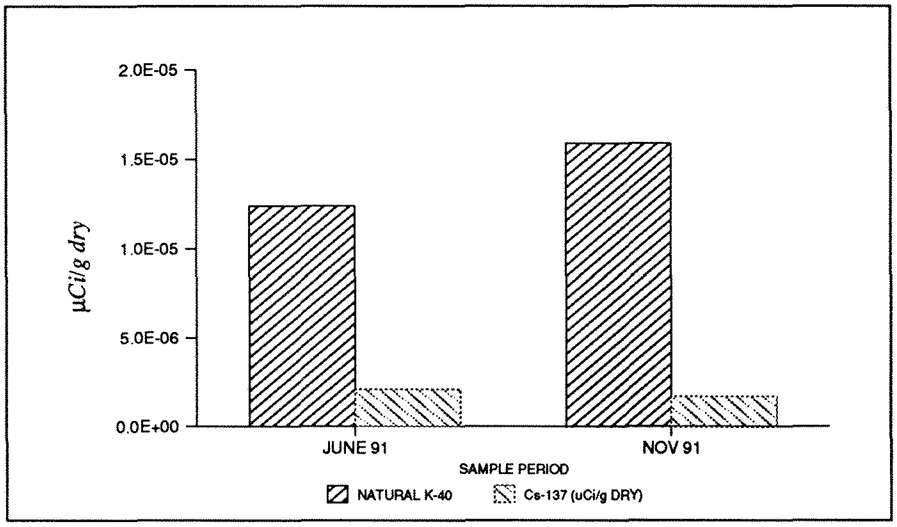


Figure 2-6. Comparison of Cs-137 with Naturally Occurring K-40 Concentrations at Downstream Sampling Location SFTCSED.

Radioactivity Concentrations in Fish Samples

Detectable strontium-90 in fish collected downstream of the Project in Cattaraugus Creek was slightly above the median values seen in the previous six years. Strontium-90 concentrations in fish samples from the first half of 1991 were higher than the concentrations in samples from the second half. However, within the range of variations for analytical methods and sample population statistics, no upward trend of strontium-90 in fish was indicated.

As in previous years, no detectable concentrations of cesium-134 or cesium-137 were found, using isotopic gamma analyses of the edible fish flesh. Strontium-90 levels in fish taken below the first upstream barrier from Lake Erie on Cattaraugus Creek were at or below background levels. No cesium-134 or cesium-137 isotopes were found in these below-dam downstream fish in 1991.

Venison

Specimens from an on-site deer herd also are analyzed for radioactive components. Historically, concentrations of radioactivity in deer flesh have been very low and site activities have not been shown to affect the local herd.

Radioactivity Concentrations in Venison

Venison from three deer taken from a resident herd on the WNYNSC were analyzed and the data compared with data on deer collected near Olean, New York, which is 65 kilometers southeast of the WNYNSC. The low levels of radioactivity for both near-site and control samples appear to be the same or slightly lower than the 1990 levels. There is no apparent difference in radioactivity concentrations between the control deer and the near-site deer.

Meat and Milk

Beef samples taken semiannually from near-site and remote locations are analyzed for strontium-90 and gamma-emitting isotopes such as cesium-137 and 134.

The concentration of strontium-90 in beef from the near-site sample appeared to be similar to the control (background) samples.

Radioactivity Concentrations in Beef Samples

Cesium analysis of both near-site and control samples yielded near detection limit values (see Glossary). Positive cesium-137 values were detected in two background beef samples and one near-site sample. The concentrations were approximately the same for all three samples. The positive values, however, were lower than the 1990 detection limit values for the same locations. Historically, very little difference in isotope concentration has been observed between near-site and control herds.

Milk samples were taken in 1991 from dairy farms near the site (Fig. 2-7) and from control farms at some distance from the site. Besides the quarterly composite of monthly samples from the maximally exposed herd to the north (BFMREED), a quarterly composite of milk also was taken from a nearby herd to the northwest (BFMCOBO). Single annual samples were taken from

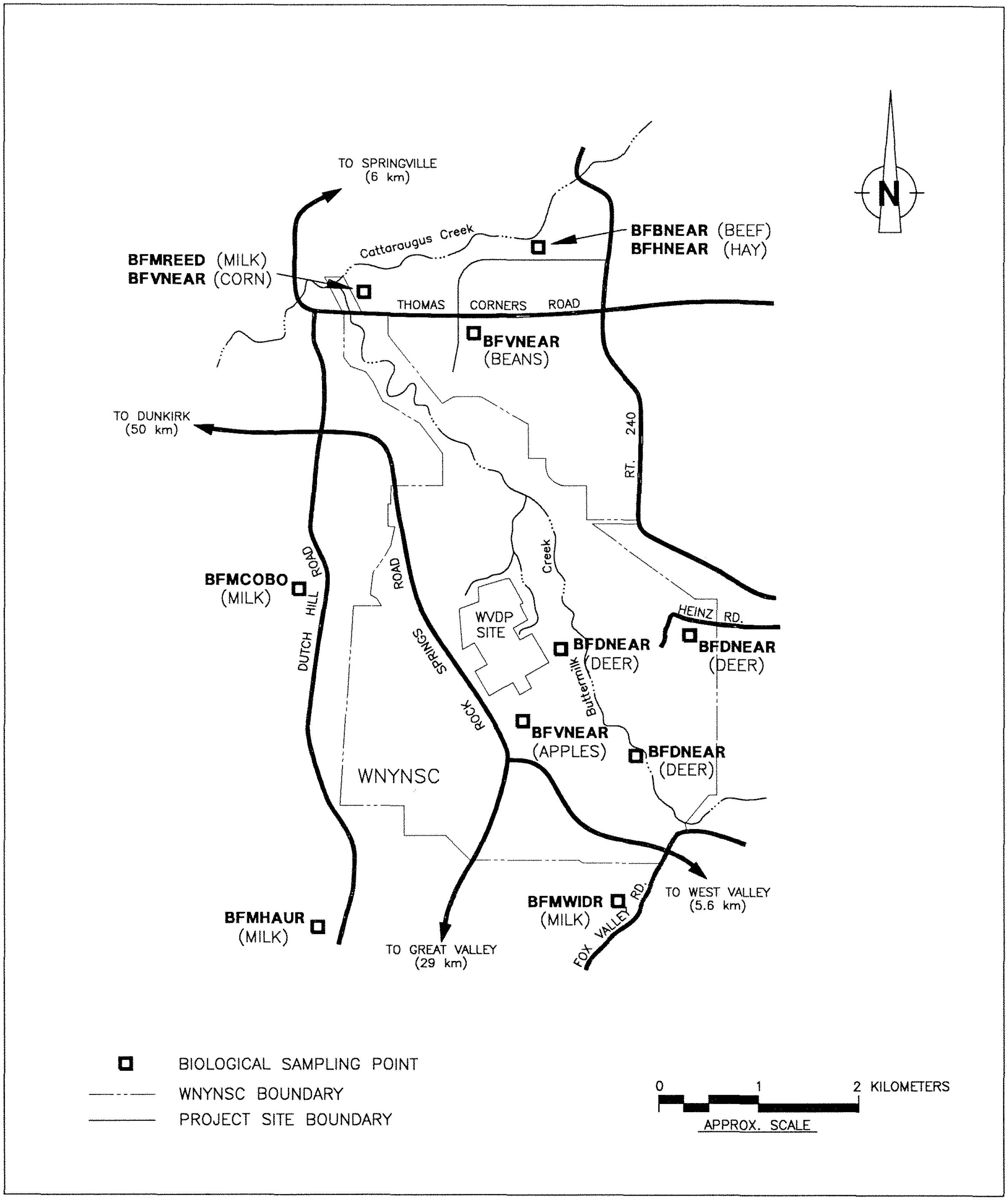


Figure 2-7. Near–Site Biological Sampling Points – 1991.

herds to the south (BFMWIDR) and the southwest (BFMHAUR). Monthly samples from control herds (BFMCTLN and BFMCTLS) were also collected as quarterly composites.

Radioactivity Concentrations in Milk Samples

Each sample or composite was analyzed for strontium-90, tritium, iodine-129, and gamma-emitting isotopes (cesium-137 and 134). Strontium-90 in samples from near the site ranged from 2.1E-10 to 7.9E-09 μCi/mL (7.6E-03 to 2.9E-1 Bq/L). Iodine was detected at 4.8E-10 μCi/mL(1.8E-02 Bq/L)in only one near-site sample. This value is very near the detection limit of 4.73E-10μCi/mL (1.76E-02 Bq/L). In all cases the iodine concentrations were lower than the 1990 detection limit of 9.9E-10 μCi/mL (3.7E-02 Bq/L). This may be because the laboratory used a more refined analytical technique. Although tritium values above detection limits were observed in milk samples taken from near-site farms in 1990, higher values were observed in samples taken from distant control locations. (See Table C-3.1.)

Fruit and Vegetables

Data from samples analyzed in 1991 (Table C-3.3) indicated no consistent differences in the concentration of tritium, strontium-90, or gamma-emitting isotopes in corn, beans, or apples grown either near the site or at remote locations.

Direct Environmental Radiation Monitoring

The current monitoring year, 1991, was the eighth full year in which direct penetrating radiation was monitored at the West Valley Demonstration Project using TL-700 lithium fluoride (LiF) thermoluminescent dosimeters (TLDs).

The dosimeters are processed on-site and are used solely for environmental monitoring, apart from the occupational dosimetry TLDs. The environmental TLD package consists of five TLD chips laminated on a thick card bearing the location identification and other information. These cards are placed at each monitoring location for one calendar quarter (three months) and are then processed to obtain the integrated gamma radiation exposure.

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. (See Figs. 2-8 and 2-9 below and Fig. A-9 in Appendix A.) The TLDs are numbered in order of their installation. The monitoring locations are as follows:

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

THE PERIMETER OF THE WVDP SITE -SECURITY FENCE: TLDs #24, 26-29, 32-34

THE POINT OF CLOSEST PUBLIC ACCESS ON THE WVDP PERIMETER: TLD #25

ON-SITE SOURCES OR SOLID WASTE MANAGEMENT UNITS: TLDs #18 and #32-36 (RTS drum cell); #18 and 19 (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 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); #23 (Great Valley); #37 (Dunkirk); #41 (Sardinia)

The statistical uncertainty of individual results and averages was acceptable and measured exposure rates were comparable to those of 1990. There were no significant differences between the data collected from the background TLDs (#17, 23, 37, and 41) and from those on the WNYNSC perimeter for the 1991 reporting period.

Appendix C - 4 provides a summary of the results for each of the environmental monitoring locations by calendar quarter along with averages for comparison.

The quarterly averages and individual location results show very slight differences due to seasonal variation. The data obtained for all four calendar quarters compared favorably to the respective quarterly data in 1990 with no unusual situations observed. The quarterly average of the seventeen perimeter TLDs was 20.1 milliroentgen (19.3 mrem) in 1991.

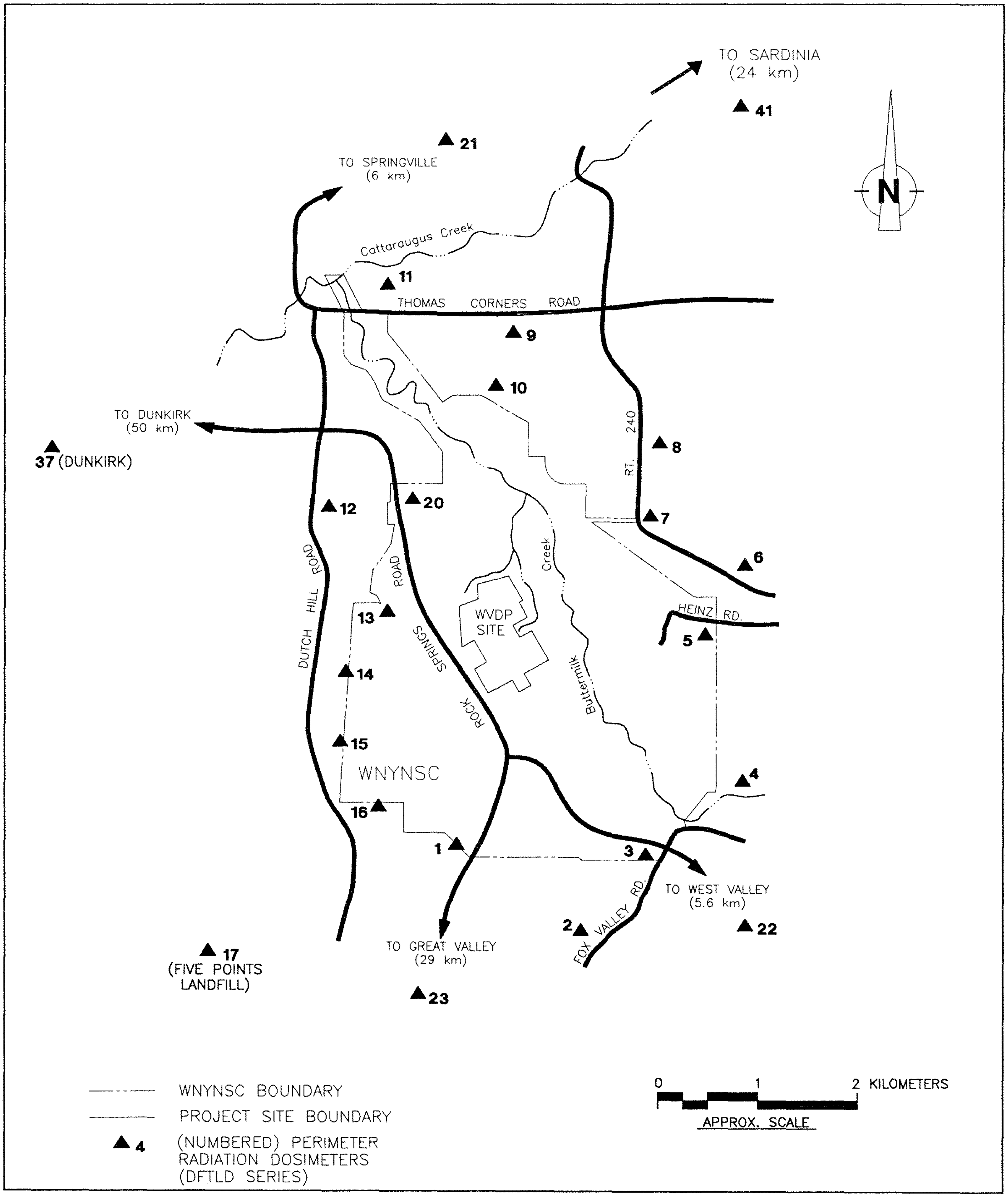


Figure 2-8. Location of Off-Site Thermoluminescent Dosimetry (TLD).

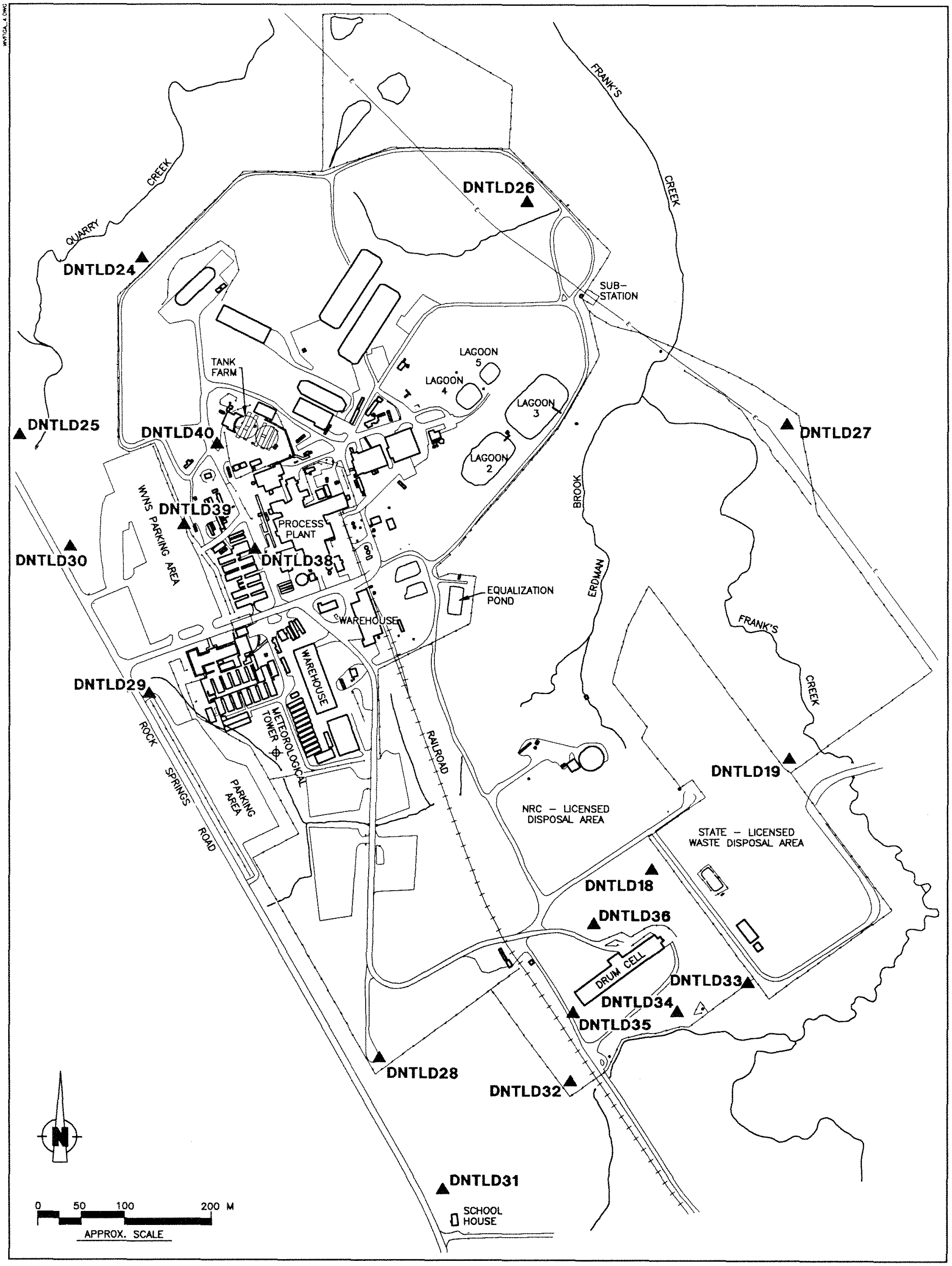


Figure 2-9. Location of On-Site Thermoluminescent Dosimetry (TLD).

On-site Radiation Monitoring

Certain locations show slight changes in radiation levels. Presumably because of its proximity to the low-level waste disposal area, the dosimeter at location #19 showed a small elevation in radiation exposure compared to the WNYNSC perimeter locations. Although above background, the readings are relatively stable from year to year. Location # 25, on the public access road through the site north of the facility, also showed a small elevation above background because decontamination wastes are stored near location #24 within the inner facility fence. (See *Appendix C - 4*, Table C-4.1.)

Location #24 on the north inner facility fence, like location #19, is not included in the off-site environmental monitoring program; however, it is a co-location site for one NRC TLD. (See *Appendix D*, Table D-7). This point received an average exposure of 0.57 milliroentgens (mR) per hour during 1991, as opposed to 0.63 mR/hr in 1990 and 0.67 mR/hr in 1989. Sealed containers of radioactive components and debris from the plant decontamination work are stored nearby. The storage area is well within the WNYNSC boundary (as is location #19) and is not readily accessible by the public.

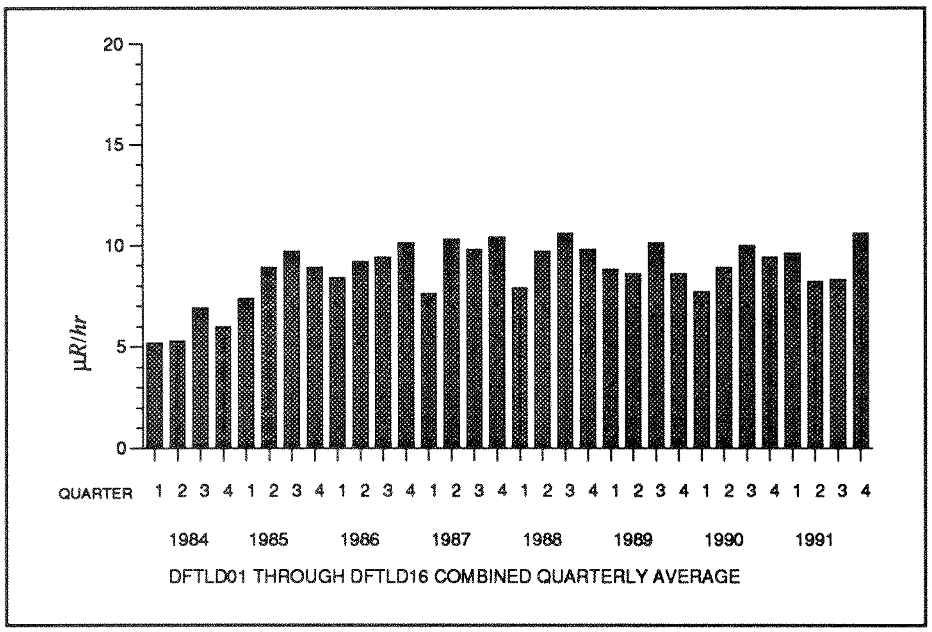


Figure 2-10. Trends of Environmental Radiation Levels (µR/hr)

Locations around the radwaste treatment storage (RTS) building — the drum cell — showed an increase in exposure rate. The average dose rate at these locations (TLDs #s18, 32, 33, 34, 35, and 36) was 0.026 mR/hr in 1991, compared to 0.022 mR/hr in 1990. This increase reflects 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 readily accessible by the public.

Perimeter and Off-site Radiation Monitoring

The perimeter TLDs (TLD#s 1-16 and 20) are located in the sixteen compass sectors around the facility near the WNYNSC boundary. The quarterly averages for these TLDs (Fig. 2-10) indicate no trends other than normal seasonal fluctuations. TLDs #s 17, 21-23, 37, and 41 monitor near-site community and background locations. The results from these monitoring points are statistically the same as the perimeter TLDs. Figure C-4.1 in *Appendix C-4* shows the average quarterly dose rate of each off-site TLD location. Figure C-4.2 shows the average quarterly dose rate of each on-site TLD.

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 to assess potential effects of routine and nonroutine releases of airborne radioactive materials and to calculate dispersion models for any releases that may exceed DOE effluent limits.

Since dispersive capabilities of the atmosphere are dependent upon wind speed, wind direction, and atmospheric stability, which is a function of the difference in temperature between the 10-meter and 60-meter elevations, these parameters are closely monitored at the WVDP and are available to the emergency assessment team at the WVDP.

The on-site 60-meter meteorological tower continuously monitors wind speed, wind direction, and temperatures at 60-meter and 10-meter elevations. In addition, an independent, remote 10-meter meteorological tower located approximately 5 kilometers south of the site on the top of Dutch Hill Road also continuously monitors wind speed and wind direction at the 10-meter elevation.

The two meteorological towers support the primary digital and analog data acquisition systems located within the Environmental Laboratory. All systems are run on line power with an uninterruptible power source battery backup in case of site power failure.

Figures C-6.1 and C-6.2 in *Appendix C-6* illustrate 1991 mean wind speed and wind direction at the 10-meter and 60-meter elecvations.

A chart-recording microbarograph, a digital barometric pressure sensor, and a digital, tipping-bucket heated precipitation gauge are also located near the site meteorological tower.

Cumulative total and weekly total precipitation data are illustrated in Figures C - 6.3 and C - 6.4 in *Appendix C-6*. Based upon the 30-year average for Western New York, the 1991 total of 32.66 inches of precipitation was 4.86 inches (12.9%) below normal levels.

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

Special Monitoring

Stormwater Monitoring

The New York State Department of Environmental Conservation currently is accepting permit applications for stormwater run-off discharges as mandated by the U.S. Environmental Protection Agency NPDES (National Pollutant Discharge Elimination System) program.

Three locations on-site would be the primary conduits for run-off water in a storm: Frank's Creek at the security fence (WNSP006), the north swamp drainage (WNSW74A), and the northeast swamp drainage WNSWAMP. During 1991 baseline grab samples and samples taken during a storm were analyzed for a number of chemical and radiological parameters. Analysis results were included in a permit application for stormwater discharges. The application will be filed with the New York State Department of Environmental Conservation in 1992.

Solvent Contamination Monitoring

Radioactively contaminated solvent was first discovered at the northern boundary of the NRC-licensed disposal area (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 solvent could migrate. To contain this subsurface solvent migration an interceptor trench and liquid pretreatment system (LPS) were built. The interceptor trench was designed to halt and collect subsurface water, which could be carrying solvent, in order to prevent it from entering the surface water drainage ditch and, subsequently, the surface water system (Erdman Brook) that drains the WNYNSC.

The LPS was designed to separate the solvent from the water and to treat the collected water before its transfer to the low-level waste treatment facility. Pretreatment would remove the solvent and reduce the concentration of iodine-129. The separated solvent would be stored for subsequent treatment and disposal.

As of the publication of this report, no water containing solvent has been encountered in the trench, and thus no water or solvent has been treated by the LPS or the low-level waste treatment facility.

Nonradiological Monitoring

Air Monitoring

Nonradiological emissions and plant effluents are controlled and permitted under New York State Department of Environmental Conservation and U.S. Environmental Protection Agency regulations. The regulations that apply to the WVDP are listed in Table B-2 in *Appendix B*. The individual air permits held by the WVDP are identified and described in Table B-3.

The nonradiological air permits are for minor sources of regulated pollutants that include particulates, nitric acid mist, oxides of nitrogen, and sulfur. However, because of their insignificant concentrations and small mass discharge, monitoring of these parameters currently is not required.

New permits obtained in 1991 cover sources such as fume hoods for welding and paint fumes, a fume hood for process and instrumentation effluents, and a fume hood vent for a nitric acid storage tank.

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. 2-11) and that specifies the sampling and analytical requirements for each outfall. This permit was modified in 1990 to include additional monitoring requirements at outfall WNSP001.

Three outfalls are identified in the permit:

- outfall WNSP001, discharge from the low-level waste treatment facility (LLWTF)
- outfall WNSP007, discharge from the sanitary and utility effluent mixing basin
- outfall WNSP008, groundwater effluent from the perimeter of the low-level waste treatment facility storage lagoons.

The conditions and requirements of the current SPDES permit are summarized in Table C-5.1 in *Appendix C-5*.

The most significant features of the SPDES permit are the requirements to report biochemical oxygen demand, iron, and ammonia data as flow-weighted concentrations and to apply a net discharge limit for iron. The net limit allows amounts of iron that are naturally present in the incoming water to be subtracted from the Project's effluent. The flow-weighted limits apply to the total discharge of Project effluents but allow the more dilute waste streams to have a maximum effect in determining compliance with effluent concentration limits specified in the permit.

Semiannual grab sampling 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) was added to the surface water environmental monitoring program in 1991. These samples are screened for organic constituents and selected anions, cations, and metals. Results of these measurements for WNSP006 and WFBCBKG are found in Table C-1.2 in *Appendix C-1*.

The SPDES monitoring data for 1991 are graphically displayed in Figures C-5.2 through C-5.37 in *Appendix C-5*. The WVDP reported a total of three noncompliance episodes in 1991 (Table C-5.2). These are described above in the *Environmental Compliance Summary: Calendar Year 1991*.

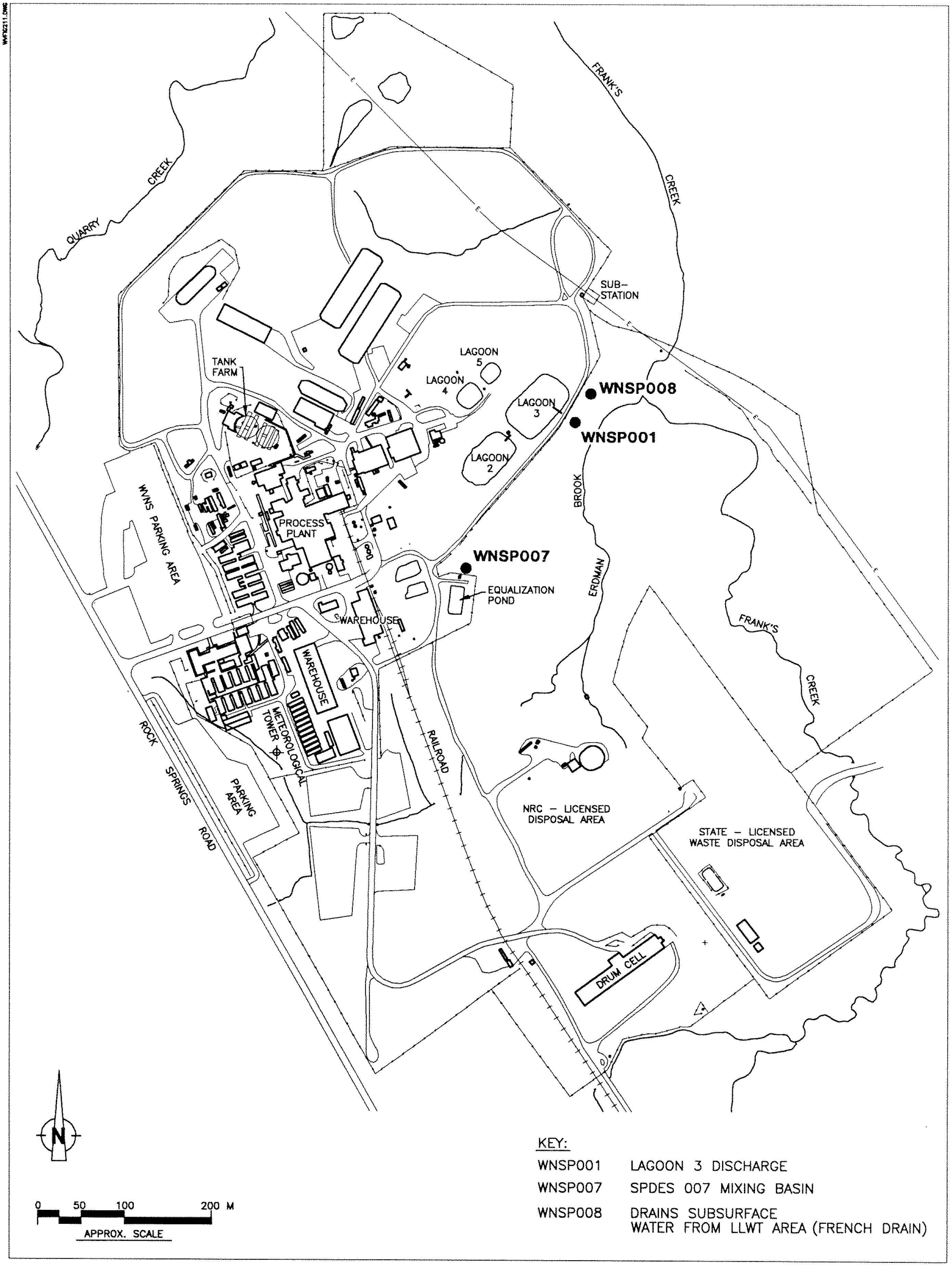
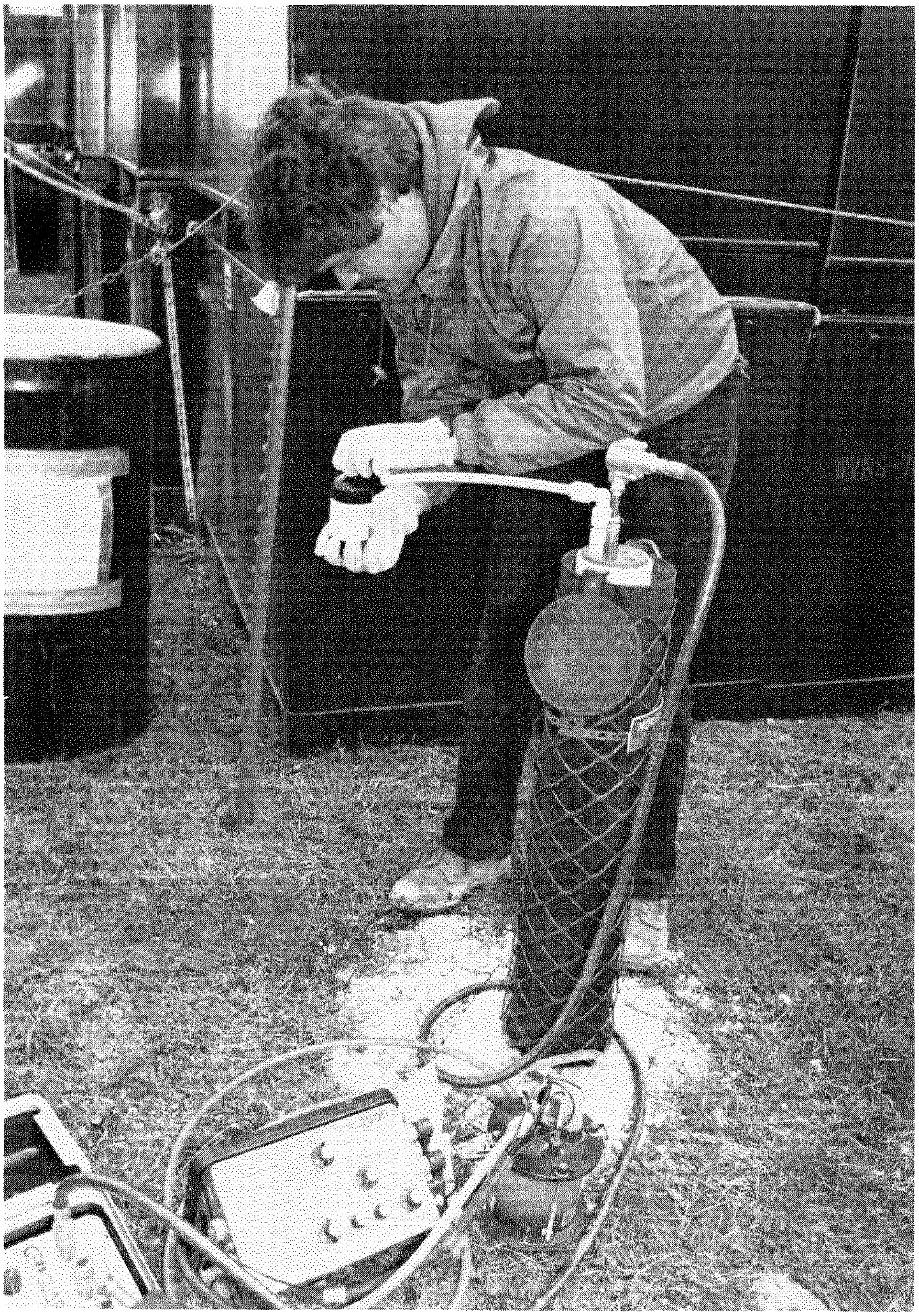


Figure 2-11. SPDES Monitoring Points.



Sampling with a Dedicated Bladder Pump
Installed in an On-site Groundwater Monitoring Well

Groundwater Monitoring

Geologic History of the West Valley Site

The West Valley Demonstration Project is located on the dissected and glaciated Allegheny Plateau at the northern border of Cattaraugus County in southwestern New York. The area is drained by Cattaraugus Creek, which is part of the Great Lakes-St. Lawrence watershed (Tesmer 1975). Geologic conditions encountered at the site are the result of geologically recent events in the earth's history, including repeated glaciation during the Pleistocene epoch, 1.6 million to ten thousand years ago.

The WVDP site rests immediately on a thick sequence of glacial deposits that ranges up to 150 meters in thickness. These glacial deposits are underlain by a bedrock valley eroded into the upper Devonian shales and siltstones of the Canadaway and Conneaut Groups, which dip southward at about 5 m/km (Rickard 1975). Total relief in the area is approximately 400 meters (1,300 ft.), with summits reaching 732 meters (2,400 ft.) above sea level.

Oscillations of the Laurentide ice sheet during the ice ages include four major stages of ice advance and retreat. The last of these, and the one of greatest concern here, was the Wisconsinan glaciation (Broughton et al. 1966).

The most widespread glacial unit in the site area is the Kent till, deposited between 15,500 and 24,000 years ago toward the end of the Wisconsinan glaciation. 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, more material was released and deposited to form the lacustrine and kame delta deposits that presently overlie 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).

About 15,000 years ago the ice began its last advance (Albanese et al. 1984). Material from this advance covered the kame delta and lacustrine 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, with a thickness of about 24 meters (80 ft.) at the waste burial areas. The retreat of the Lavery ice left behind another proglacial lake that ultimately drained, allowing modern Buttermilk Creek to flow northward to Cattaraugus Creek. The modern Buttermilk Creek has cut the modern valley since the final retreat of the Wisconsinan glacier. Post-Lavery outwash and alluvial fans, including the fan that underlies the northern part of the WVDP, were deposited on the Lavery till between 15,000 and 14,200 years ago (LaFleur 1979).

Hydrogeology of the West Valley Site

The site can be divided into two regions: the north plateau, on which the plant and its associated facilities reside, and the south plateau, which contains the NRC-licensed disposal area (NDA) and the state-licensed disposal area (SDA) that were previously used to dispose of waste. (See Fig.3-1, a geological cross section of the north plateau, and Fig.3-2, a geological cross section of the south plateau.)

South Plateau

The uppermost geologic unit on the south plateau is the Lavery till, a very compact, gray silty clay with scattered pods of silt to fine sand. Below this is a sequence of more permeable lacustrine silt and sand, which in turn overlies the less permeable Kent till.

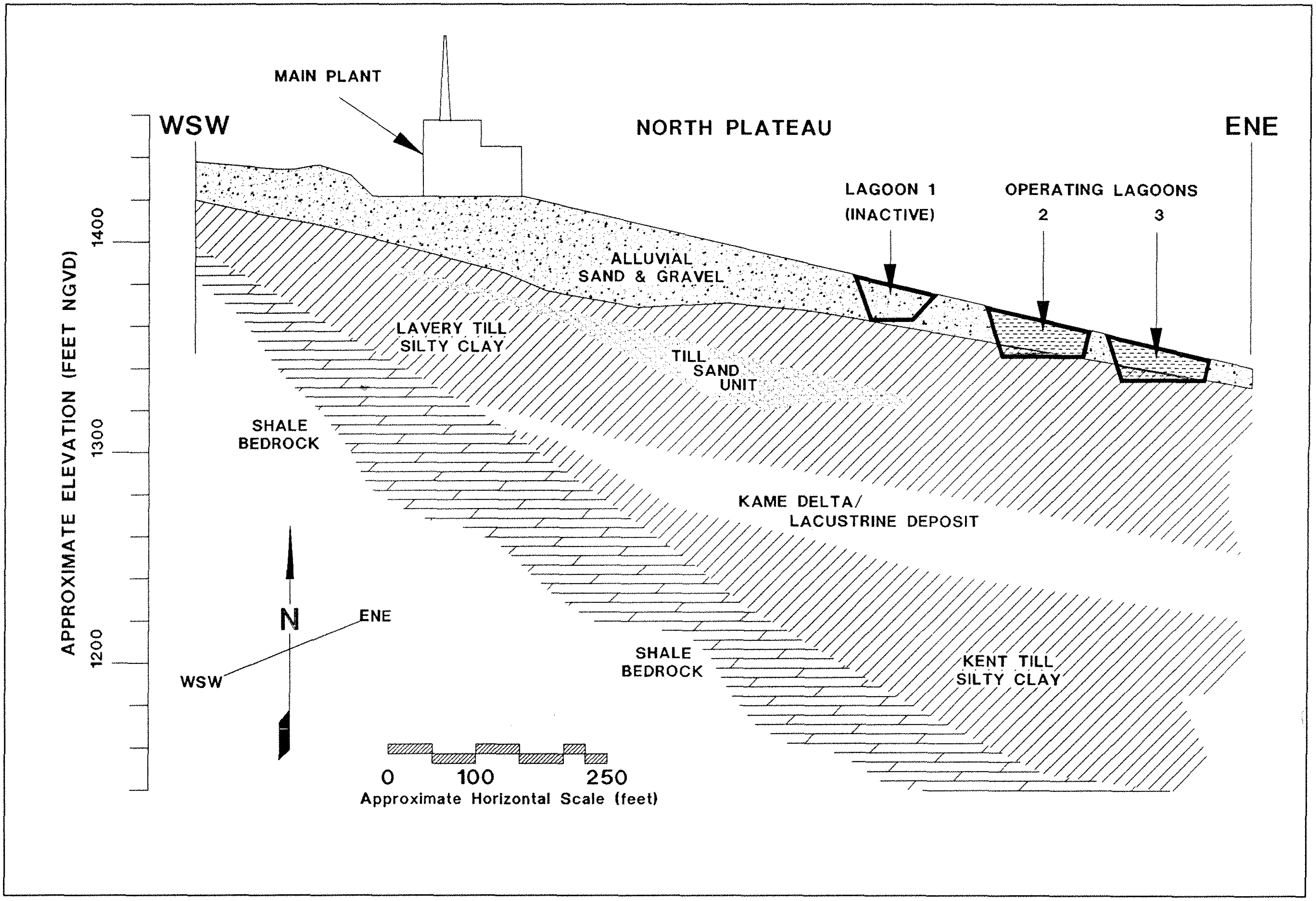


Figure 3-1. Geologic Cross Section Through the North Plateau

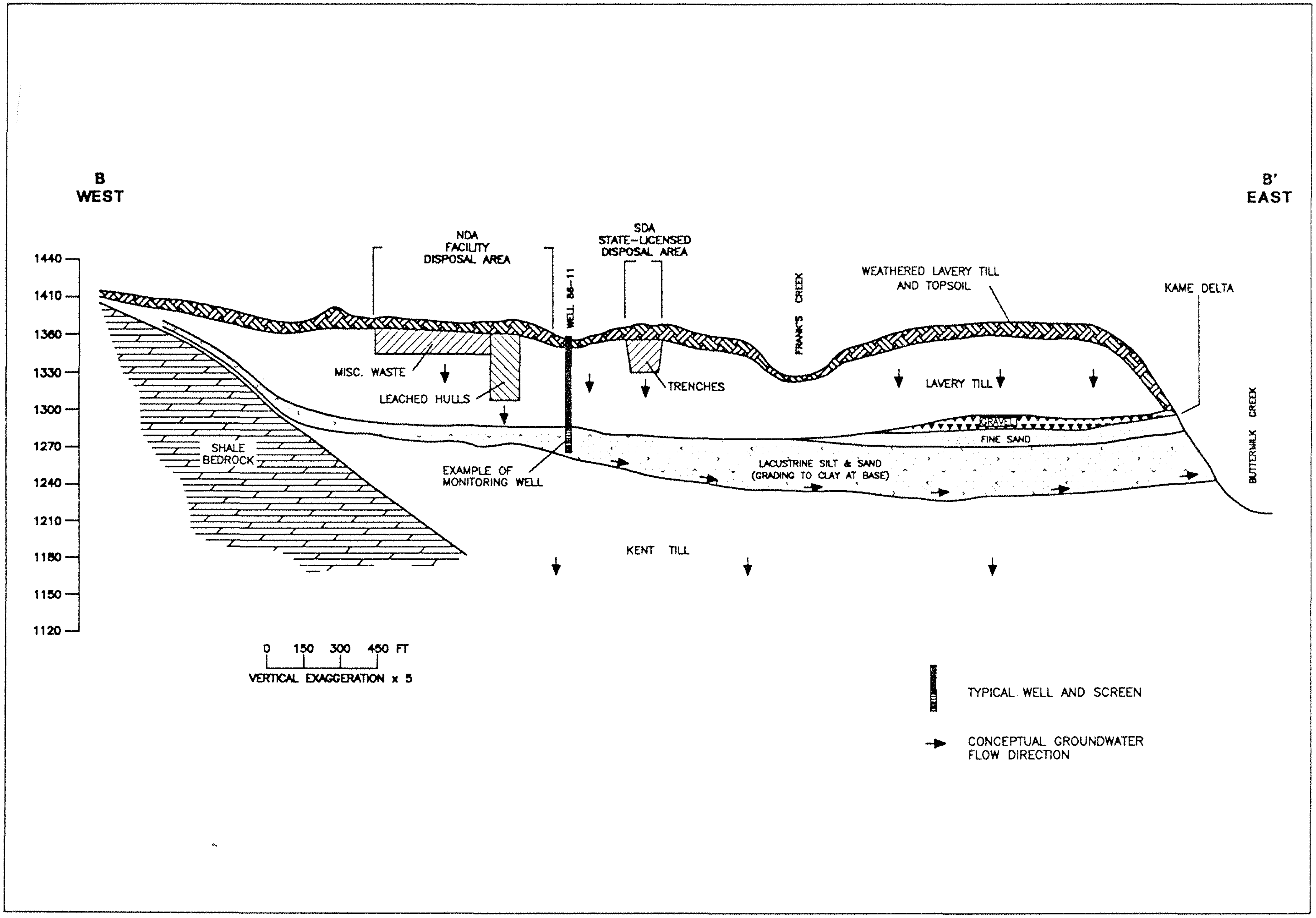


Figure 3-2. Geological Cross Section Through the South Plateau.

The water table beneath the south plateau occurs in the upper 4.5 meters (0 ft. to 15 ft.) of the Lavery till. Groundwater flow in this unit, for the most part, is vertical to the lacustrine unit. The upper, weathered portion of the Lavery till exhibits a horizontal flow, which enables groundwater to move laterally before moving downward or discharging to nearby land-surface depressions or stream channels. (Bergeron and Bugliosi 1988). Some laterally moving water eventually percolates downward into the underlying unweathered till. Values of vertical and horizontal hydraulic conductivity obtained from laboratory analysis of undisturbed cores and from field analyses of piezometer recovery tests suggest that the till is virtually isotropic. The hydraulic conductivity of the fresh, unweathered till averages 2.92 x 10^{-8} cm/sec. On a field scale, the hydraulic conductivity of the fractured unweathered till is five times greater than that of the fresh, unweathered till, and the hydraulic conductivity of the fractured weathered till is ten times greater than that of the fresh, unweathered till.

The lacustrine sequence at the WVDP acts as a semiconfined unit that is recharged primarily from the bedrock to the west. Water levels in piezometers completed in this unit indicate a northeastward lateral flow under a gradient of 0.023. Minor recharge also occurs from the overlying Lavery till, making this unit a possible conduit of Lavery discharge to Buttermilk Creek. The lacustrine unit is underlain by the relatively impermeable Kent till (LaFleur 1979).

North Plateau

The north plateau differs from the south plateau in that it is mantled by a sequence of alluvial sand and gravel up to 10 meters thick that is immediately underlain by the Lavery till.

The depth to the groundwater on the north plateau varies from 0 meters to 5 meters (0 ft. to 16 ft.), being deepest at the process building and intersecting the surface farther north towards the security fence. Most of the groundwater beneath the north plateau moves horizontally through the alluvial sand and gravel unit from an area southwest of the process building to the northeast, southeast, and east; a small percentage percolates downward into the underlying Lavery till (Yager 1987). Groundwater discharge from the north plateau occurs at seepage points along the banks of Frank's Creek, Erdman Brook, Quarry Creek, and at the wetlands near the northern perimeter of the security fence. The geometric mean of the hydraulic conductivity of the alluvial sand and gravel unit is 4.6 x 10^{-3} cm/sec (Bergeron et al. 1987). Recent on-site investigations (1989-1990) identified a sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the north plateau. This unit, called the till-sand, was not specifically identified in previous studies as a hydrologic unit.

Groundwater Monitoring Program Overview

An expanded groundwater monitoring program was phased in during 1991. Ninety-six new wells were added to thirteen pre-existing monitoring points to form the expanded network. These 109 groundwater monitoring points provide radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs) and of general site-wide conditions. On-site groundwater monitoring point locations are shown on Fig. 3-3.

Monitoring includes the five different geologic units discussed above: the sand and gravel unit, the weathered Lavery till, the unweathered Lavery till, the till-sand unit, and the lacustrine unit. Table 3-1 lists the twelve super solid waste management units, the well position within the waste management unit, the geologic unit monitored, and the depth of each well. Figure 3-4 shows the outline of the twelve identified super solid waste management units at the West Valley Demonstration Project. (Twenty-one of the wells are in the state-licensed disposal area [SDA] and are the responsibility of NYSERDA. Although the state-licensed disposal area is a closed radioactive waste landfill contiguous to the Project premises, the WVDP is not responsible for the facilities or activities relating to it. Under a joint agreement with the New York State Energy Research and Development Authority (NYSERDA), however, the Project provides specifically requested technical support to NYSERDA in SDA-related matters.)

Groundwater monitoring fulfills multiple technical and regulatory requirements, which are summarized in the site's ENVIRONMENTAL MONITORING PROGRAM PLAN, WVDP-098 (WVNS 1991), the draft SAMPLING AND ANALYSIS PLAN FOR THE GROUNDWATER MONITORING NETWORK (WVNS 1990), the annual site GROUNDWATER PROTECTION MANAGEMENT PROGRAM PLAN, WVDP-091 (WVNS 1990), and the draft RCRA FACILITY INVESTIGATION WORKPLAN, WVDP-113 (WVNS 1991).

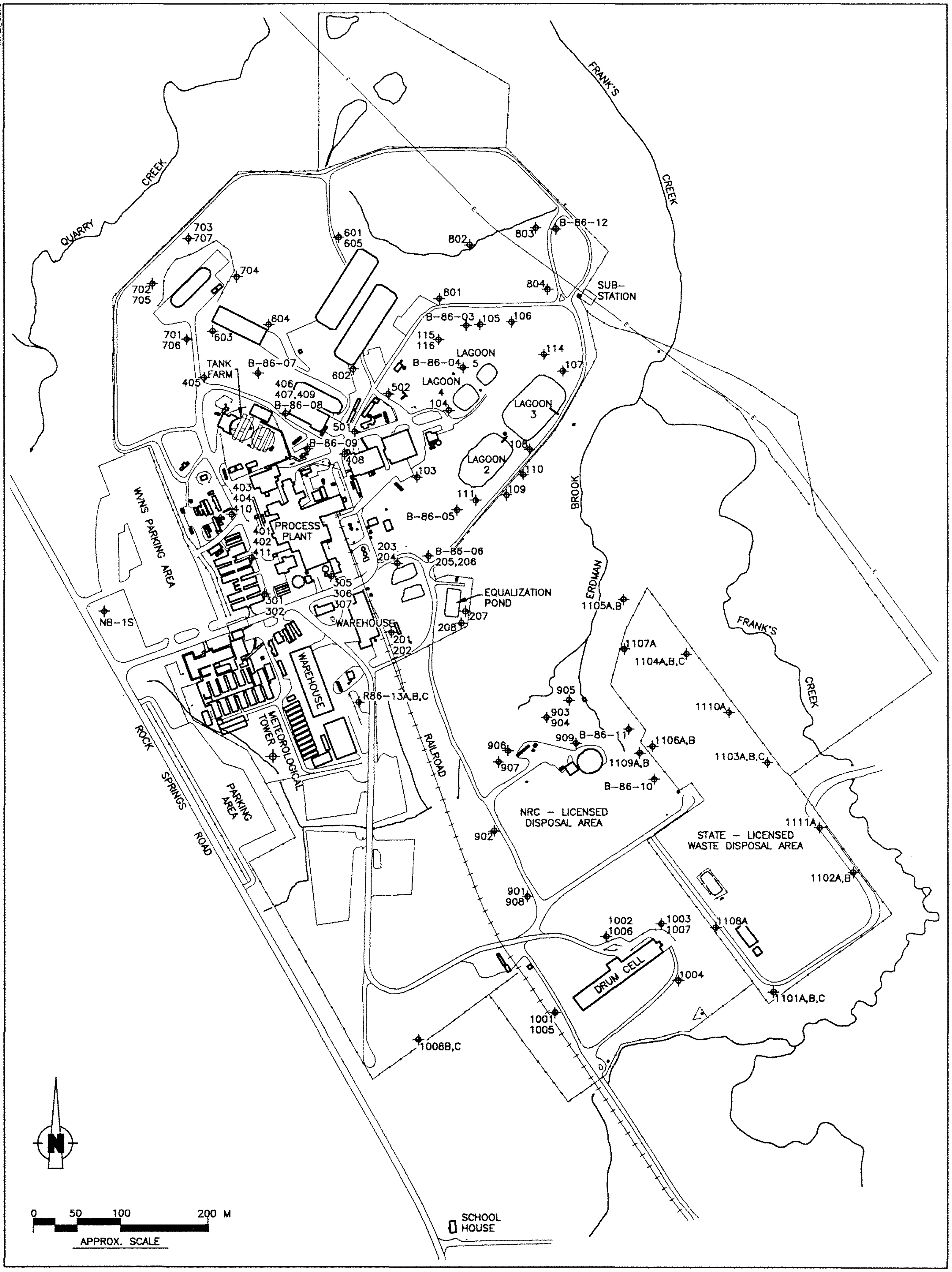


Figure 3-3. Location of On-Site Groundwater Network Wells.

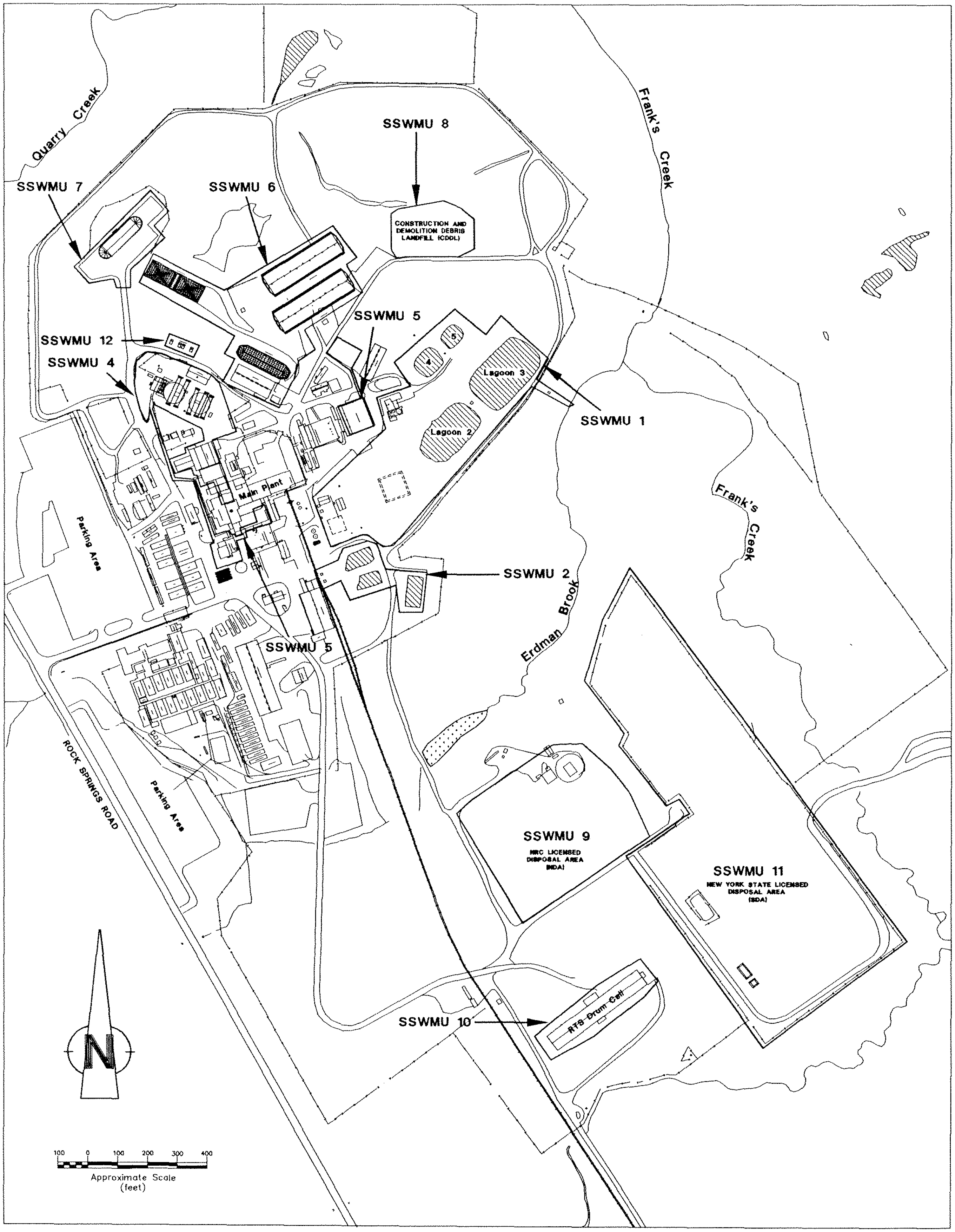


Figure 3-4. Location of Super Solid Waste Management Units (SSWMUs)

TABLE 3-1

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position	Depth(ft) Belowgrade
SSWMU No. 1 - Low-Level Waste Treatment Facilities:				
	WNW-0103	S	U	21.00
• Former Lagoon 1	WNW-0104	S	U	23.00
• LLWTF Lagoons	WNW-0105	S	D	28.00
• LLWTF Building	WNW-0106	S	D	14.50
• Interceptors	WNW-0107	U	D	28.00
• Neutralizer Pit	WNW-0108	U	D	33.00
	WNW-0109	U	D	33.00
	WNW-0110	U	D	33.00
	WNW-0111	S	D	11.00
	WNW-0114	U	D	29.00
	WNW-0115	U	D*	28.00
	WNW-0116	S	D*	11.00
	WNW-86-03	S	D*	25.42
	WNW-86-04	S	D*	23.00
	WNW-86-05	S	D*	13.00
	WNSP008	Groundwater French Drain Monitoring Point		
SSWMU No. 2 - Miscellaneous Small Units:				
	WNW-0201	S	U	20.00
• Sludge Ponds	WNW-0202	TS	U	38.00
• Solvent Dike	WNW-0203	S	U	18.00
• Effluent Mixing Basin	WNW-0204	TS	U	43.00
• Paper Incinerator	WNW-0205	S	D	11.00
	WNW-0206	TS	D	37.80
	WNW-0207	S,U	D	11.00
	WNW-0208	TS	D	23.00
	WNW-86-06	S	D	13.00
SSWMU No. 3 - Liquid Waste Treatment System:				
	WNW-0301	S	U	16.00
• Liquid Waste	WNW-0302	TS	U	28.00
Treatment System	WNW-0305	S	D*	31.00
• Cement Solidification System	WNW-0306	L	D*	81.00
• Main Process Bldg. (Specific Areas)	WNW-0307	S	D*	16.00
• Background (North Plateau)	WNW-NB1S	S,W	B	13.00

Key:

* Position to be further evaluated

Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient

Geologic Unit: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand

TABLE 3-1 (continued)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position	Depth (ft) Belowgrade
SSWMU No. 4 - HLW Storage and Processing Area:				
	WNW-0401	S,U	U	16.00
• Vitrification Facility	WNW-0402	TS	U	29.00
• Vitrification Test Tanks	WNW-0403	S	U	13.00
• HLW Tanks	WNW-0404	TS	U	36.50
• Supernatant Treatment System	WNW-0405	U	D	12.50
	WNW-0406	S	D	16.80
	WNW-0407	U,L	D	75.50
	WNW-0408	S	D	38.00
	WNW-0409	U	D	55.00
	WNW-0410	L	U	78.00
	WNW-0411	U,L	U	65.50
	WNW-86-07	S	D	18.75
	WNW-86-08	S	D	19.00
	WNW-86-09	S	D	25.00
SSWMU No. 5 - Maintenance Shop Leach Field:				
	WNW-0501	S	U	33.00
• Maintenance Shop Leach Field	WNW-0502	S	D	18.00
SSWMU No. 6 - Low-Level Waste Storage Area:				
	WNW-0601	S	D	6.00
• Hardstands (Old & New)	WNW-0602	S	D	13.00
• Lag Storage	WNW-0603	S	U	13.00
• Lag Storage Additions	WNW-0604	S	D	11.00
	WNW-0605	S,U	D	11.00
	WNW-86-07	S	U	18.75
	WNW-86-08	S	U	19.00
SSWMU No. 7 - CPC Waste Storage Area:				
	WNW-0701	S,TS	U	28.00
• CPC Waste Storage Area	WNW-0702	TS	D	38.00
	WNW-0703	U	D	21.00
	WNW-0704	U	D	15.50
	WNW-0705	U	D	21.00
	WNW-0706	S	U	11.00
	WNW-0707	W,U	D	11.00

Key:

* *Position to be further evaluated*

Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient

Geologic Unit: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand

TABLE 3-1 (continued)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position	Depth (ft) Belowgrade
SSWMU No. 8 - Construction and Demolition Debris Landfill:				
	WNW-0801	S	U	17.50
• Former Construction and Demolition Debris Landfill	WNW-0802	S,U	D	11.00
	WNW-0803	S	D	18.00
	WNW-0804	S	U	9.00
	WNGSEEP	Groundwater Seepage		
	WNDMPNE	Monitoring Points		
	WNW86-12	S	D	18.83
SSWMU No. 9 - NRC-Licensed Disposal Area:				
	WNW-0901	L,U	U	136.0
• NRC-Licensed Disposal Area	WNW-0902	L,U	U	128.0
• Container Storage Area	WNW-0903	L,U	D*	133.0
• Trench Interceptor Project	WNW-0904	U	D	26.00
	WNW-0905	TS	D	23.00
	WNW-0906	W	D*	10.00
	WNW-0907	W,U	D*	16.00
	WNW-0908	W,U	U	21.00
	WNW-0909	W,U	D	23.0
	WNW-86-10	L	D	114.0
	WNW-86-11	L	D	120.0
SSWMU No. 10 - IRTS Drum Cell:				
	WNW-1001	L,U	U	116.0
• IRTS Drum Cell	WNW-1002	L,U	D	113.0
	WNW-1003	L	D	138.0
	WNW-1004	L,U	D	108.0
	WNW-1005	W,U	U	19.00
	WNW-1006	W,U	D	20.00
	WNW-1007	W,U	D	23.00
• Background (South Plateau)	WNW-1008b	L,U	B	51.00
	WNW-1008c	W,U	B	18.00

Key:

* *Position to be further evaluated*

Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient

Geologic Unit: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand

TABLE 3-1 (concluded)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	*Well Identification Number*	*Geological Unit Monitored*	*Well Position*	*Depth (ft) Belowgrade*
SSWMU No. 11 - State-Licensed Disposal Area:				
	WNW-1101a	*W,U*	*U*	*16.00*
• *State-Licensed Disposal Area (SDA)*	*WNW-1101b*	*U*	*U*	*30.00*
	WNW-1001c	*L*	*U*	*110.0*
	WNW-1102a	*W,U*	*D*	*17.00*
	WNW-1102b	*U*	*D*	*31.00*
	WNW-1103a	*W,U*	*D*	*16.00*
	WNW-1103b	*U*	*D*	*26.00*
	WNW-1103c	*L*	*D*	*111.0*
	WNW-1104a	*W,U*	*D*	*19.00*
	WNW-1104b	*U*	*D*	*36.00*
	WNW-1104c	*L*	*D*	*114.0*
	WNW-1105a	*U*	*D*	*21.00*
	WNW-1105b	*U*	*D*	*36.00*
	WNW-1106a	*W,U*	*U*	*16.00*
	WNW-1106b	*U*	*U*	*31.00*
	WNW-1107a	*W,U*	*D*	*19.00*
	WNW-1108a	*W,U*	*U*	*16.00*
	WNW-1109a	*W,U*	*U*	*16.00*
	WNW-1109b	*U*	*U*	*31.00*
	WNW-1110	*W,U*	*D*	*20.00*
	WNW-1111	*U*	*D*	*21.00*
SSWMU #12 - Hazardous Waste Storage lockers	*(No wells installed for SSWMU #12)*			
	R86-13A	*S,U*	*C*	*8.00*
Motor Fuel Storage Area	*R86-13B*	*S*	*C*	*8.00*
(Monitors Underground Storage Tanks; not a SSWMU)	*R86-13C*	*S*	*D*	*6.50*

Key:

* *Position to be further evaluated*

Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient

Geologic Unit: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand

The data generated as part of the groundwater monitoring program will also be used to support preparation of an environmental impact statement (EIS) that will assess the effect of Project completion and site closure.

Four designations are often used to indicate a well's function within a groundwater monitoring program:

Upgradient well. A well installed hydraulically upgradient of the unit under study that is capable of yielding groundwater samples that are representative of local conditions and that are not affected by the unit in question.

Downgradient well. A well installed hydraulically downgradient of the unit that is capable of detecting the migration of contaminants from the unit under study.

Background well. A well installed hydraulically upgradient of all waste management units that is capable of yielding groundwater samples that are representative of natural conditions. In some cases upgradient wells may be downgradient of other units, which makes them unsuitable for use as true background wells. However, they are still useful in providing upgradient information about the unit under study.

Crossgradient well. A well installed to the side of the major downgradient flow path.

Table 3-1 identifies the position of a well relative to the waste management unit monitored. The wells monitoring a given geologic unit (e.g., sand and gravel, lacustrine) also may be arranged in a generalized upgradient to downgradient order based upon their location within the geologic unit. The hydraulic position of a well relative to a super solid waste management unit (i.e., upgradient or downgradient) does not necessarily match that same well's position within a geologic unit. For example, a well upgradient relative to a SSWMU may be located at any position within a geologic unit, depending on the geographic position of the SSWMU within the geologic unit. In general, the following text and graphics refer to the hydraulic position of monitoring wells within their respective geologic units, thus providing a site-wide geologic unit perspective.

Initial sampling of selected wells in the expanded network for a subset of the parameters listed in Table 3-2 began in 1990. Wells in the expanded monitoring network were gradually incorporated into the sampling schedule (Table 3-3).

Sampling at additional key wells began in January 1991, including wells monitoring SSWMUs #1,7, and 8, and wells from the former monitoring program. Samples were collected and analyzed for alpha, beta, tritium, pH, and conductivity. In addition, wells around the SDA were sampled and analyzed for alpha, beta, gamma isotopic, tritium, pH, and conductivity.

By May 1991 the expanded monitoring network locations had been sampled for indicator parameters. All points with adequate volume were sampled in May and June for the indicator and groundwater parameters listed in Table 3-2. The SDA wells were sampled for indicator, groundwater, and drinking water parameters. By October 1991 the full schedule had been initiated for all site groundwater monitoring points.

Groundwater Sampling Parameters

The three categories of groundwater sampling parameters, collected as noted in Table 3-2, are contamination indicator parameters, groundwater quality parameters, and EPA interim primary drinking water quality parameters. Table 3-3 indicates the way in which sampling for these parameters was incorporated into the program during 1991.

Contamination indicator parameters: Samples are collected eight times a year (four samples each semiannual period). Monitoring the contamination indicator parameters helps to identify more quickly any potential effect of past or present site operations.

Groundwater quality parameters: Samples are collected two times a year (one sample each semiannual period). The groundwater quality parameters selected provide information essential to migration modeling and to evaluating the indicator parameter results and the potential effect of a release.

EPA interim primary drinking water parameters: Samples are collected four times a year for one year only. These samples establish a baseline for water quality and are compared to the drinking water standards.

Sampling Methodology

Samples are collected from the monitoring wells using either Teflon well bailers or bladder pumps. Both of these methods meet all regulatory requirements for groundwater sample collection.

TABLE 3-2

SCHEDULE OF GROUNDWATER SAMPLING AND ANALYSIS

Contamination Indicator Parameters (Scheduled eight times per year)	*pH** *Total Organic Carbon* *Gross Alpha* *Gamma Scan* *Conductivity** *Total Organic Halogens* *Gross Beta* *Tritium* *Volatile Organic Analysis*
Groundwater Quality Parameters (Scheduled two times per year)	*Chloride* *Iron* *Sodium* *Manganese* *Phenols* *Sulfate* *Magnesium* *Nitrate + Nitrite-N* *Calcium* *Potassium* *Ammonia* *Bicarbonate/Carbonate*
EPA Interim Primary Drinking Water Standards (Scheduled four times per year, one year only)	*Arsenic* *Barium* *Cadmium* *Chromium* *Lead* *Mercury* *Selenium* *Silver* *Fluoride* *Endrin* *Methoxychlor* *2,4 D* *Radium* *Nitrate + Nitrite-N* *Lindane* *Toxaphene* *2,4,5-TP Silvex* *Turbidity **

** Field measurement*

TABLE 3-3

1991 PHASING-IN SCHEDULE FOR EXPANDED GROUNDWATER MONITORING NETWORK

Date	*Sample Rep*	*Contamination Indicator Parameters Scheduled and Collected*	*Groundwater Quality Parameters Scheduled and Collected*	*Drinking Water Quality Parameters Scheduled and Collected*
1/1/91 - 2/1/91	1	P	——-	——-
2/2/91 - 3/31/91	2	P	——-	——-
4/1/91 - 5/15/91	3	F	——-	——-
5/16/91 - 6/30/91	4	F	F	SDA
7/1/91 - 8/15/91	5	F	——-	——-
8/16/91 - 9/30/91	6	F	——-	SDA
10/1/91 - 11/15/91	7	F	——-	——-
11/16/91 - 12/31/91	8	F	F	F
Total samplings per well in 1991:		6-8	2	1-3

Key:

P = Phase-in: Selected wells sampled for selected parameters.

F = All wells sampled for full parameters.

SDA = SDA wells only sampled for full parameters

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

The Teflon bailer, a tube with a check valve at the bottom and the top, is lowered into the well until it reaches the desired point in the water column. The bailer is lowered slowly to ensure that the water column is not agitated 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 used exclusively for that well at all times.

Bladder pumps use compressed air to gently squeeze a Teflon bladder, encased in a stainless steel tube, that is located near the bottom of the well. The air forces water out of a sample line extending from the pump to the top 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 drive air is always kept separate 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 its individual well to reduce the likelihood of sample contamination from external materials or cross contamination. The compressor and air control box are used from well to well but do not contact the sample.

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-casing volumes cannot be removed because of limited recharge, purging the well to dryness achieves the same results. Conductivity and pH are measured before and after sampling to help determine whether the quality of the groundwater changed while samples were being collected.

Immediately after the samples are collected they are put into a cooler and returned to the Project's Environmental Laboratory. The samples are then either packaged for overnight delivery to an off-site contract laboratory or put into controlled storage to await on-site testing.

Ten off-site wells, sampled for radiological parameters, pH, and conductivity, were also part of the groundwater monitoring program during 1991. These wells are used by site neighbors as sources of drinking water (Fig. 3-5).

Groundwater Monitoring Results

Results of the 1991 groundwater monitoring program are summarized below. Complete data are found in *Appendix E.*

Unlike last year's report, which presented the groundwater monitoring data based on identified SSWMUs, this year's results are grouped and summarized based upon the five geologic units. The purpose of grouping results based on geologic units is two-fold: it presents the results of the groundwater monitoring program on a site-wide basis and it provides an initial overview of the results of the groundwater monitoring program that may form the basis for additional reports to follow. More detailed assessment of potential effects of SSWMUs on the environment will be prepared as part of the site's RFI WORKPLAN required by the RCRA 3008(h) Order on Consent.

There are many aspects to the successful implementation of the WVDP's groundwater monitoring program, all of which are integral to generating high quality results representative of the groundwater environment. Some of these aspects include the proper placement of groundwater monitoring wells, the use of appropriate methods to collect samples and to identify and track samples and analytical results, thorough review of analytical data and quality control information, and appropriate methods of presenting, summarizing, and evaluating the resulting data.

Presentation of Results in Tables

Appendix E contains tables showing individual results of sampling for the contamination indicator parameters (*Appendix E*, Tables E-1 through E-5) and the groundwater quality parameters (*Appendix E*, Tables E-6 through E-10) as listed in Table 3-1. Contamination indicator parameters and groundwater quality parameters are listed in Table 3-2.

The tables in *Appendix E* present the results of the groundwater monitoring program grouped according to the five different geologic units monitored: the sand and gravel unit, the till-sand unit, the unweathered lavery till unit, the lacustrine unit, and the weathered lavery till unit. Results of sampling for volatile organics are part of the contamination indicator parameter grouping and are reported only where confirmed positive values were obtained (*Appendix E*, Table E-11).

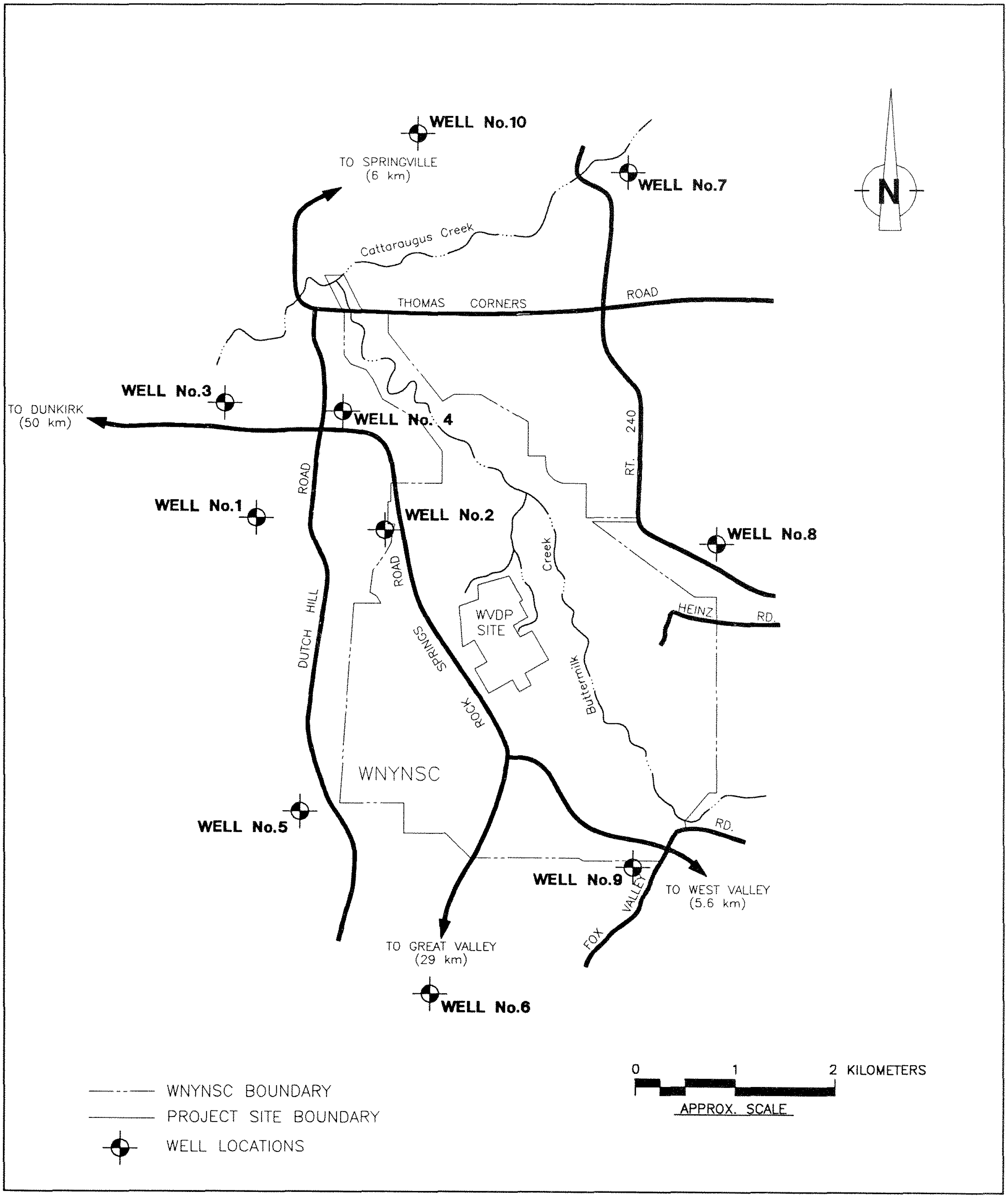


Figure 3-5. Off–Site Groundwater Monitoring Points.

Groundwater monitoring data to compare with EPA interim primary drinking water standards will be reviewed after the annual cycle of quarterly sampling and analysis now in progress is completed. These results will be reported in the 1992 SITE ENVIRONMENTAL REPORT.

The tables summarizing the contamination indicator parameters also include general information about each well's hydraulic position relative to other wells within the same geologic unit. These positions are identified by the terms "UP," which refers to either background or upgradient wells, and "DOWN - B," "DOWN - C," and "DOWN - D." Upgradient locations are designated "UP" because they are upgradient of all the other locations. Downgradient locations are designated B, C, or D to indicate their positions relative to each other. For example, wells denoted as "DOWN - C" in the sand and gravel unit are downgradient of "UP" and "DOWN - B" wells and upgradient to "DOWN - D" wells. These groupings have been used in order to provide a logical basis for presenting the groundwater monitoring data in the tables and graphics within this report.

The tables of contamination indicator data also give information about the sample collection period. The groundwater collection year is divided into two semiannual periods. Within each semiannual period four replicate samples, or "reps," may be collected from each well over evenly spaced six-week periods. Four of the reps may be collected during the period of January through June, and the remaining four reps may be collected during the period from July through December. Because the groundwater sampling program was phased in gradually during 1991 not all wells were sampled the same number of times during the year. (This is the primary reason for blank rows in some of the *Appendix E* contamination indicator parameter tables.) Table 3-3 summarizes the incorporation of all wells into the groundwater sampling program during 1991.

Presentation of Results in Graphs

A second way in which groundwater monitoring results are presented is through graphs to show trends in the data or to summarize large amounts of data into an interpretable format. Three different graphic aids are used in this report:

Multiple Box-and-Whisker Plots: The multiple-box-and-whisker plot is used to present contamination indicator data well-by-well for all wells grouped within the same geologic unit. All individual analytical results obtained for a selected parameter (pH, conductivity, total organic carbon, total organic halogens, gross alpha, gross beta, and tritium) were used to form the dimensions of the box-and-whisker diagram for each well within a given geologic unit. Box-and-whisker plots allow results of similar sample analyses for all wells within a geologic unit to be visually compared to each other.

Figure 3-6 is an example of a multiple box-and-whisker plot.

- The horizontal line within the box shows the median of the data set for a given well.
- The box outline itself shows the range of the middle 50% of the data for a given well (the upper and lower quartiles).
- The whisker extension shows the range of the data for a given well. (Values beyond 1.5 times the length of the box are plotted as individual points.)

The sample counting results for gross alpha, gross beta, and tritium, even if below the minimum detectable concentration, were used to generate the box-and-whisker plots. Thus, negative values sometimes were included.

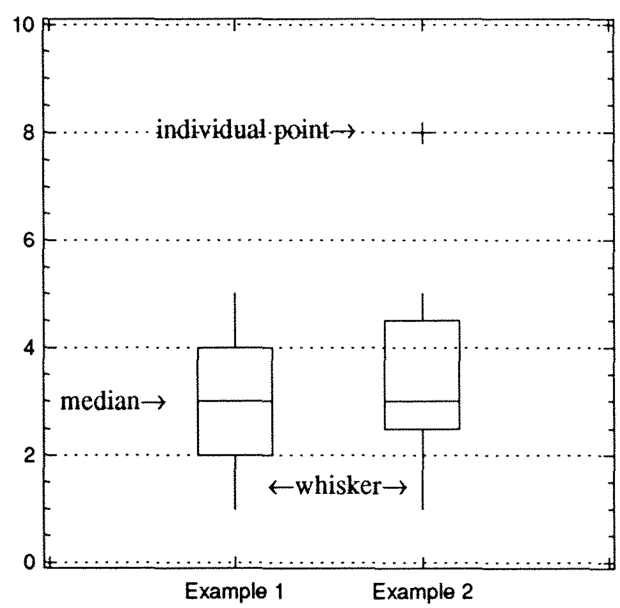


FIGURE 3 - 6. SAMPLE BOX-AND-WHISKER PLOT

This is most common for the gross alpha analyses, where sample radiological counting results are sometimes lower than the associated instrument background. In these cases, the sample results would be reported as "less than" values in the data tables in Appendix E.

All box-and-whisker plots shown in this section present the upgradient wells on the left side of the figure with the upgradient location code prefixed with the letter "A." Downgradient locations are plotted to the right and use the letters "B" through "D," as discussed above, to distinguish relative position within the downgradient flow regime.

Trend Plot: Trend plots or line plots can show how concentrations of a particular parameter change over time at selected monitoring locations. Results for the volatile organic compounds 1,1-dichloroethane (1,1-DCA) and 1,1,1-trichloroethane (1,1,1-TCA) are plotted using this format (see Fig. 3-42). Long-term trends of gross beta and tritium for selected groundwater monitoring locations are also shown in Fig. 3-43 and Fig. 3-44.

Pie Charts: Pie charts showing the major ion composition of groundwater for each well are found in *Appendix E*. These charts were constructed using averaged results of two samples collected for the major cations (calcium, magnesium, sodium, potassium) and anions (chloride, sulfate, bicarbonate and carbonate and, in some cases, hydroxide). The pie charts also indicate how the levels of cations and anions in the sample balance. Figure 3-6a is an example explanatory figure.

Results of Contamination Indicator Monitoring of the Sand and Gravel Unit

Figures 3-7 through 3-13a show box-and-whisker plots for selected contamination indicator parameters for forty-five wells monitoring the sand and gravel unit of the north plateau of the WVDP. Background site conditions are monitored by well WNWNB1S (coded ANB1S on the box-and-whisker plots), and upgradient monitoring is provided by wells WNW0301, WNW0401 and WNW0403 (coded A0301, A0401 and A0403, respectively, in the figures).

Downgradient conditions are monitored at forty-one locations within the sand and gravel unit. These locations are subdivided into three categories according to the well's general position within the groundwater flow regime. For example, downgradient wells prefixed with "B" in the figures are nearest to the background or upgradient wells (prefixed "A"), while wells prefixed with a "D" are farthest downgradient.

Wells monitoring downgradient conditions in the sand and gravel unit are part of the monitoring network for eight of the identified on-site SSWMUs and for the motor fuel storage area. The SSWMUs monitored by wells in the sand and gravel unit are: SSWMU #1 - the low-level waste treatment facility; SSWMU #2 - miscellaneous small units; SSWMU #3 - the liquid waste treatment system; SSWMU #4 - the high-level waste

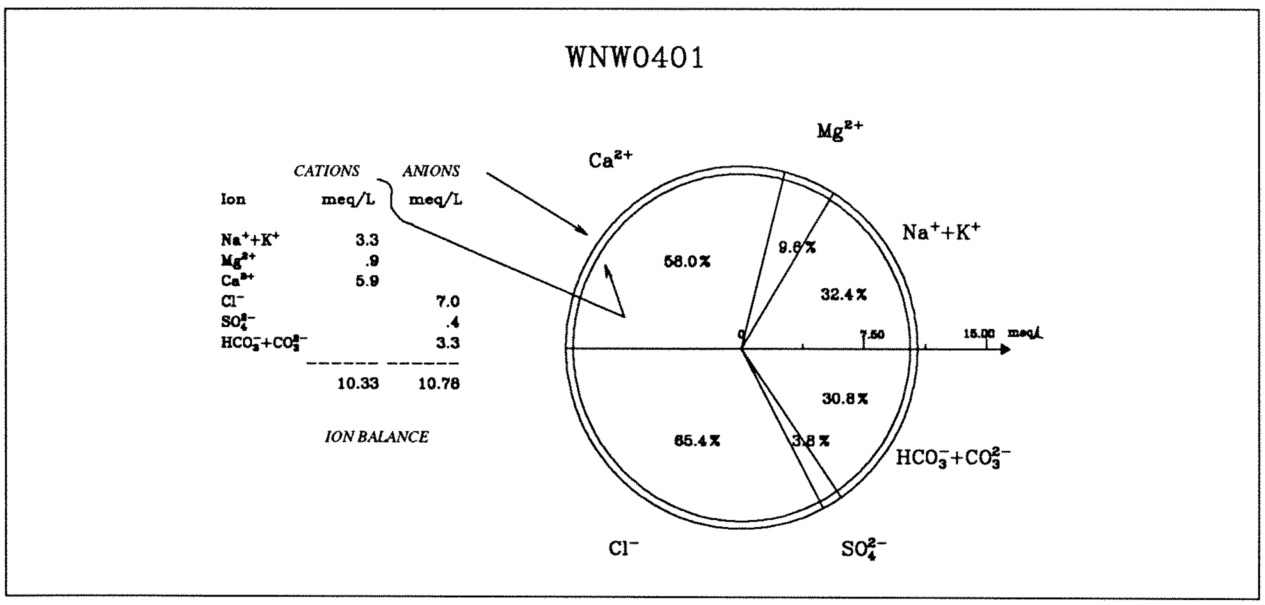


FIGURE 3 - 6A. SAMPLE PIE CHART

storage and processing area; SSWMU #5 - the maintenance shop leach fields; SSWMU #6 - the low-level waste storage area; SSWMU #7 - the chemical process cell waste storage area; and SSWMU #8 - the construction and demolition debris landfill. (See Table 3-1, which identifies the SSWMUs and associated individual SWMUs, the geological unit monitored, and the depth of each well.)

The box-and-whisker plots for the sand and gravel geologic unit show elevated levels of pH and conductivity and high levels of total organic carbon in well WNW0103 (coded C0103 in the figures). Note that only the lower whisker is visible in the plots for conductivity and total organic carbon. The central box is off-scale: this scaling was selected in order to adequately size the other data in the figures. Well WNW0103 is part of the monitoring network for the low-level waste treatment facility (SSWMU #1) and is located in the vicinity of a spill of caustic sodium hydroxide that occurred in 1984. Results of groundwater quality analyses of WNW0103 waters indicate high levels of sodium and hydroxide. (See *Appendix E*, Table E-6).

The pie plot for this well (*Appendix E*, Figure E-1, Groundwater Quality Plots for Sand and Gravel Wells) shows that sodium and hydroxide form the majority of the ionic make-up of WNW0103 waters. The pH levels for all other sand and gravel wells appear to rest within a normal environmental range. Several other wells show marginally elevated levels of conductivity, but none are elevated to the degree of WNW0103 and none show a corresponding shift in groundwater pH.

Results of radiological analyses of samples collected from wells monitoring the sand and gravel unit indicate various levels of gross beta and tritium activity across the sand and gravel unit. Results of gross alpha analyses, reflecting mostly below minimum detectable levels, do not indicate any migration of alpha activity. Gross beta results range from an average background level for well WNWNB1S of 3.1E-09 µCi/mL to a high of more than 1.5E-04 µCi/mL at well WNW0408, an approximate 50,000-fold change in concentration between background and downgradient groundwater monitoring locations.

Similarly, the concentrations of tritium (H-3) range from 1.0 E-07 µCi/mL at background locations to a high of approximately 2.5E-05 µCi/mL at location WNW0408. This represents a 250-fold change in concentration between background and downgradient locations. Thus, the highest levels of gross beta and tritium activity appear at well location WNW0408 and appear to decline as one moves north-northeast to locations WNW0501, WNW0502, WNW0602, and WNW0116. These latter locations are more distant from the main process plant.

Other monitoring locations with elevated levels of gross beta and tritium activity within the sand and gravel unit include points monitoring the low-level waste treatment facility: wells WNW0111, WNW8604, WNW8605, and the french drain, WNSP008. Additional wells show elevated levels of activity, although lower than the wells just noted, as indicated in Figures 3-12a and 3-13a, which show the same results as Figures 3-12 and 3-13 except that the scales have been expanded in order to adequately display lower concentration data.

The New York State groundwater quality standard for gross beta activity (1.0E-06 µCi/mL) was exceeded at well locations WNW0111, WNW0408, WNW0501, WNW0502, WNW8604, and WNW8605. The New York State groundwater quality standard for tritium (2.0E-05 µCi/mL) was exceeded for one measurement of a sample collected from well WNW0408.

Results of Contamination Indicator Monitoring of the Till-Sand Unit

Eight wells monitor groundwater in the till-sand unit. As noted in the discussion of hydrogeology, the till-sand unit was recently identified as a hydrologic unit of limited areal extent and variable thickness within the Lavery till. General upgradient conditions are monitored by wells WNW0302, WNW0402, and WNW0404 (denoted with the letter "A" in the box-and-whisker plots). Wells WNW0202, WNW0204, WNW0206, WNW0208, and WNW0905 monitor general downgradient conditions.

Figures 3-14 through 3-20 show the box-and-whisker plots for selected contamination indicator parameters for the till-sand unit. Well WNW0202, which is 38 feet belowgrade, shows elevated levels of pH and conductivity. The pH of water from well WNW0202 (11.5 - 12.5) indicates the presence of substantial hydroxide concentrations. However, this groundwater is much lower in overall ionic concentration than well WNW0103 and shows much lower levels of conductivity and sodium. The origin of the high pH levels at this well is unknown at this time.

Pie charts of major groundwater quality constituents for the till-sand unit are shown in *Appendix E*, Figure E-2.

The pie chart for well WNW0202 shows the influence of hydroxide ion on the overall anion balance of groundwater at this location. Groundwater monitoring of the surficial sand and gravel unit at the same location (WNW0201 at a depth of 20 feet) indicates normal pH and conductivity levels. (See Figs. 3-7 and 3-8.) Concentrations of total organic carbon, shown in Figure 3-16, are low for all wells in this geologic unit with the exception of WNW0905. Well WNW0905 is positioned downgradient of SSWMU #9, the NRC-licensed disposal area (NDA).

Concentrations of radiological constituents are low in all wells monitoring the till-sand unit and resemble near background concentrations. Marginally elevated levels of gross beta activity are indicated in well WNW0202, and marginally detectable tritium (greater than the minimum detectable level of 1E-07 µCi/mL) in well WNW0905. These values are well below the New York State groundwater quality standards for these constituents (1.0E-06 µCi/mL and 2.0E-05 µCi/mL, respectively).

Results of Contamination Indicator Monitoring of the Unweathered Lavery Till Unit

Twenty-four wells monitor the unweathered Lavery till unit, which extends across both the north and south plateaus of the WVDP. Site background conditions are monitored by well WNW1008C. Three additional wells, WNW0405, WNW0704, and WNW0707, are grouped together as being representative of general upgradient, although not necessarily true, background conditions.

Wells monitoring the unweathered Lavery till are part of the monitoring network for several SSWMUs: SSWMU #1 - the low-level waste treatment facility, SSWMU #4 - the high-level waste storage and processing area; SSWMU #7 - the chemical process cell waste storage area; SSWMU #9 - the NRC-licensed disposal area; SSWMU #10 - the IRTS drum cell; and SSWMU #11 - the state-licensed disposal area. Results of groundwater contamination indicator monitoring for this geologic unit are shown in box-and-whisker Figures 3-21 through 3-27.

There are no observable anomalies for pH and conductivity data for wells in this unit. Data for pH and conductivity are grouped fairly tightly for a given well, as indicated by the relatively narrow range associated with the individual box-and-whisker figures representing data for individual wells.

Concentrations of both total organic carbon (Fig.3-23) and total organic halogens (Fig.3-24) appear slightly elevated for well WNW0704, which extends 15.5 feet belowgrade and is part of the monitoring network associated with the chemical process cell waste storage area. Levels of gross beta are also slightly elevated at this location. However, the levels of gross beta activity are well below the New York State groundwater quality standard of 1.0E-06 µCi/mL. Six of the twenty-four wells associated with the unweathered Lavery till unit show median tritium concentrations above the minimum detectable level of 1.0E-07 µCi/mL. Five of these wells are associated with SSWMU #1, and one is associated with SSWMU #11. All levels of tritium are well below the New York State groundwater quality standard of 2.0E-05 µCi/mL.

Results of Contamination Indicator Monitoring of the Lacustrine Unit

Twelve wells monitor groundwater conditions within the lacustrine unit. These wells are all situated on the site's south plateau and represent the deepest groundwater monitoring points on-site.

Background conditions are monitored by well WNW1008B, which is 51 feet belowgrade. Three additional wells, WNW0901, WNW0902, and WNW1001, provide upgradient monitoring of the lacustrine unit. These wells range in depth from 116 to 136 feet belowgrade.

General downgradient monitoring is provided by eight wells ranging in depth from 108 to 138 feet.

The lacustrine unit is monitored as part of the groundwater monitoring program associated with SSWMU #9 - the NRC-licensed disposal area; SSWMU #10 - the IRTS drum cell; and SSWMU #11 - the state-licensed disposal area.

Results of contamination indicator monitoring of the lacustrine unit are seen in Figures 3-28 through 3-34. The pH and conductivity box-and-whisker plots (Figs. 3-28 and 3-29) show variations across well locations. These variations may reflect differences in groundwater geochemistry. Some of the wells in the lacustrine unit exhibit very low groundwater recharge rates, which limit the ability to collect enough sample for all analyses and can also impair the ability to thoroughly flush or purge the well before sampling. For example, SDA well WNW1103C exhibits very limited recharge, allowing only a limited set of analyses to be made.

Results of sampling for the remaining contamination indicator parameters suggest the lack of any direct site-induced effects on the waters of the lacustrine unit. For example, detection of tritium in groundwater would probably be the first indicator of contamination from tritium becoming incorporated into and moving with the groundwater. Figure 3-34 shows that all median values for all wells monitoring this unit are below the minimum detectable level of 1.0E-07µCi/mL.

Elevated levels of gross beta activity in SDA well WNW1103C are indicated. However, this well does not show a corroborating level of tritium activity. Further analysis of this beta component would be necessary to help identify its origin.

All levels of radioactivity measured within the lacustrine unit are below New York State groundwater quality standards.

Results of Contamination Indicator Monitoring of the Weathered Lavery Till Unit

Sixteen wells are used to monitor groundwater in the weathered Lavery till unit, which is the surficial geologic unit on the south plateau of the site. Three SSWMUs are monitored as part of groundwater monitoring in the weathered Lavery till: SSWMU #9 - the NRC-licensed disposal area; SSWMU #10 - the IRTS drum cell; and SSWMU #11 - the state-licensed disposal area.

Well WNW1008C monitors background conditions in the weathered Lavery till. Well WNW0908 and WNW1005 within the weathered Lavery till unit monitor general upgradient conditions. Wells monitoring this unit range in depth from 10 to 23 feet belowgrade.

The results of downgradient monitoring of pH (Fig.3-35) fall within a range of 6.5 to 7.5, with one SDA well, WNW1107A, falling between about 6.3 to 6.6. The range of conductivity values is relatively wide across this unit, with the variability within a given well generally small. Downgradient values for conductivity are within the range of the upgradient and background results as shown in Figure 3-36.

Median values for total organic carbon (Fig.3-37) and total organic halogens (Fig.3-38) indicate elevated levels of these constituents at the SDA well WNW1107A. Additional sampling and analysis followed up these apparently elevated levels of total organic carbon and total organic halogens. Additional samples for an expanded set of organic analyses were collected from both WNW1107A and WNW1101A in September 1991 and analyzed for semi-volatile organic compounds using method 8270 from *Test Methods for Evaluating Solid Waste, SW-846* (EPA 1986). Well WNW1101A acted as a control or background location since it showed low levels of both total organic carbon and total organic halogens. The results for all compounds were below the method quantitation limits for both locations sampled.

Gross alpha (Fig.3-39) and gross beta (Fig.3-40) show levels grouped within a range that may be considered near background levels. Several of the wells within the unit, e.g., WNW0906, WNW0907, WNW0908, and WNW1108A, are sometimes dry or have a reduced volume of water and very limited recharge. The variation in gross alpha levels indicated in Figure 3-39 for WNW0908 represents a range of below minimum detectable levels caused primarily by elevated levels of solids in the analytical process. These values thus indicate variations in the detection limit as opposed to true positive results. The apparently elevated levels of gross beta activity in upgradient well WNW0908 (1.18E-08 µCi/mL to 1.87E-08 µCi/mL), although representing positive values, may be related to the elevated solids discussed above for gross alpha activity and are well below the groundwater quality standard for gross beta activity of 1.0E-06 µCi/mL.

Several wells monitoring the SDA show detectable levels of tritium activity (Figs. 3-41 and 3-41a). Levels of tritium in well WNW1107A are slightly above the New York State groundwater quality standard of 2.0E-05 µCi/mL. Several other SDA wells (WNW1103A, WNW1106A, WNW1109A) consistently show much lower levels of tritium (see Fig. 3-41a) that are well below the groundwater quality standard.

Results of Monitoring of Site Groundwater for Volatile Organic Compounds

All groundwater wells that are part of the on-site groundwater monitoring program are monitored regularly for volatile organic compounds as part of the contamination indicator parameters. (See Table

3-3, which summarizes the 1991 sampling schedule. Samples collected for volatile organic compounds are analyzed by off-site contract laboratories according to method 8240 from *Test Methods for Evaluating Solid Waste, SW-846* (EPA 1986). Results of the analysis of these samples generate data on fifty-eight volatile organic compounds. Table E-11 lists the individual compounds and the typical practical quantitation limit (PQL) for each compound. The practical quantitation limit is the lowest concentration of the compound that can be reliably determined within the method-specified level of precision and accuracy under routine laboratory conditions. (Practical quantitation limits are roughly equivalent to method detection limits [MDLs]).This listing of volatile organic compounds originates from 40 CFR Part 264, referred to as the Appendix IX Groundwater Monitoring List. The volatile organic compounds are a sub-list of the entire Appendix IX listing.

The results of groundwater monitoring for volatile organic compounds continue to reveal very low levels of two different compounds. At wells WNW8609 and WNW8612, 1,1-dichloroethane continues to be detected and 1,1,1-trichloroethane continues to be detected at location WNGSEEP. Analytical results for these compounds for the above locations are shown in Table E-12. A two-year trend figure (Fig.3-42) shows how concentrations of these volatile organic compounds have varied over the two years. The results shown in Fig. 3-42 represent routine groundwater monitoring data from relatively evenly spaced sampling intervals (one through eight) for each year shown. The detection of 1,1,1-trichloroethane at WNGSEEP is the subject of a draft report being prepared to fulfill the RCRA 3008(h) Order on Consent (WVNS 1992).

Analysis of volatile organic compounds by method 8240 uses an instrument called a gas chromatograph/mass spectrometer (GC/MS). This instrument has the ability to qualitatively identify the presence of compounds below the method practical quantitation limits (PQLs) shown in Table E-11. Such detections, taken on an individual basis, must be viewed with caution because they may indicate false detections. However, when the same compound is detected repeatedly at levels below the PQL at the same groundwater location, it may indicate the actual presence of that compound, but at levels below that which the GC/MS can accurately measure.

The repeated detection of compounds below the associated PQL (5 μg/L for the compounds in question) has occurred at three groundwater monitoring locations:

- WNW8612. Repeated detections of 1,1,1-trichloroethane below the PQL of 5 μg/L have been observed. The possible presence of this compound at this location may or may not be related to 1,1,1-trichloroethane at location WNGSEEP. As noted above, WNW8612 shows positive levels of 1,1-dichloroethane.

- WNW0103 and WNW0202. Both wells have shown repeated detections below the PQL of 5 μg/L for toluene and xylene. These wells have both shown elevted levels of pH and hydroxide alkalinity. It is not known at this time if the volatile compounds are related to the high pH at these locations. A source for these volatile organic compounds also has not been identified.

Volatile organic compounds at wells WNW8613A, WNW8613B, and WNW8613C are monitored as a check on the integrity of the site's underground storage tanks used for petroleum fuels. Results of analysis for benzene, toluene, and xylene were all below method detection limits for samples collected in the vicinity of these tanks during 1991.

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

Trend graphs showing results of groundwater monitoring from 1986 through 1991 for gross beta (Fig. 3-43) and tritium (Fig. 3-44) were prepared for selected locations. These graphs show annual averaged results for these parameters over a six-year period. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations. These specific locations were selected for trending because they have shown elevated levels of these constituents (WNW8605) or have shown rising or falling trends over time.

The results for gross beta activity (Fig. 3-43) indicate a steadily rising trend for location WNW8604. Other locations show a general leveling off after what appears as several years of continual rise in some cases (e.g., locations WNSP008 and WNW8603).

The trend graph for tritium for the same locations as above shows a general leveling or falling trend for all locations since 1987. All locations presented are associated with monitoring of the sand and gravel geologic unit around SSWMU #1, the low-level waste treatment facility.

Groundwater Quality Parameters

Results of the two rounds of sampling for groundwater quality parameters are in *Appendix E*, Tables E-6 through E-10. The results for the major cations (calcium, magnesium, sodium, and potassium), and anions (chloride, sulfate, bicarbonate, carbonate, and, in some cases, hydroxide) are also summarized in pie charts as indicated above in Figures E-1 through E-5 in *Appendix E*. Compiling groundwater quality results in pie charts provides a convenient way to present data in a format that allows rapid comparison of results between different wells. These pie charts are very useful for identifying the major constituents of the groundwater, the relative percentages of these various constituents, the degree to which the cation and anions balance, and the overall ionic content of the groundwater. The pie charts (see *Appendix E*) are grouped by geologic unit, and the wells are presented in the same order as in the tables for contamination indicator parameters.

Off-site Groundwater Monitoring Program

During 1991 all of the off-site groundwater residential wells were sampled for radiological constituents, pH, and conductivity. Sampling and analysis indicated no evidence of contamination by the WVDP of these off-site water supplies. Analytical results are found in Table C-1.8 in *Appendix C-1*.

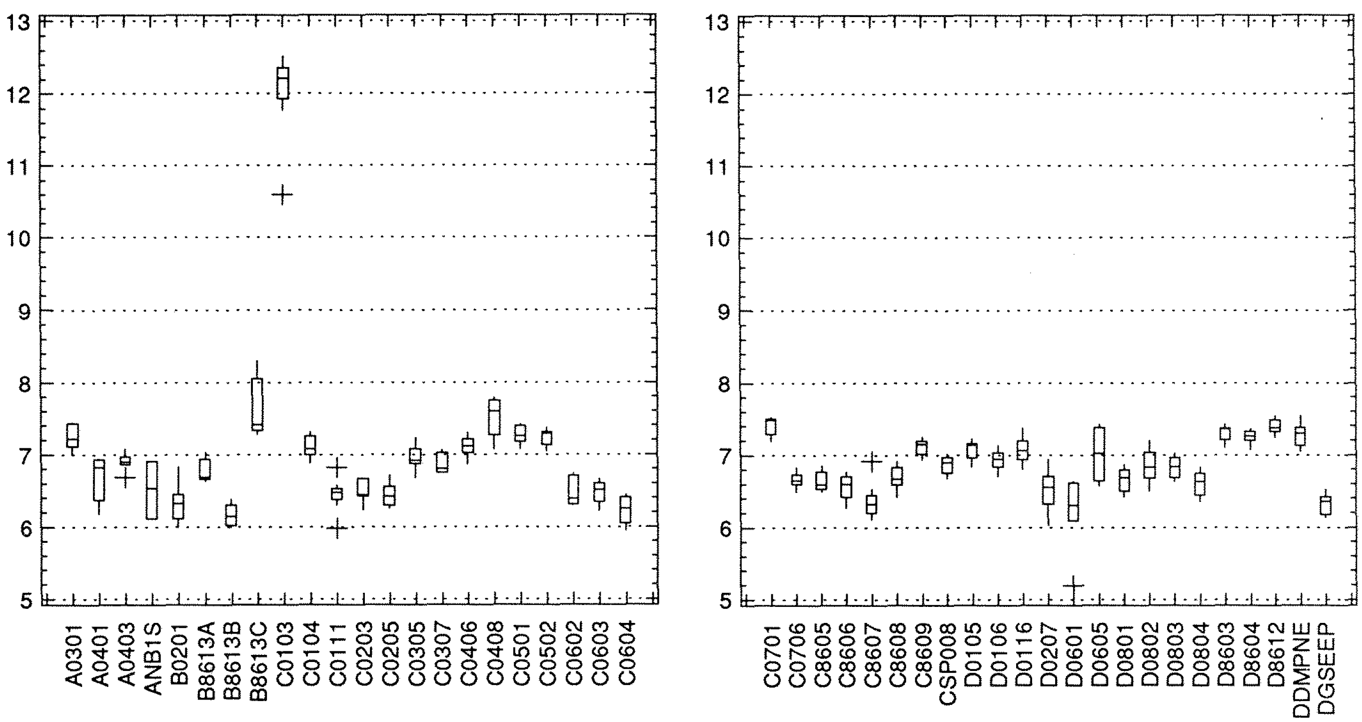


Figure 3-7. pH in Groundwater Samples from the Sand and Gravel Unit

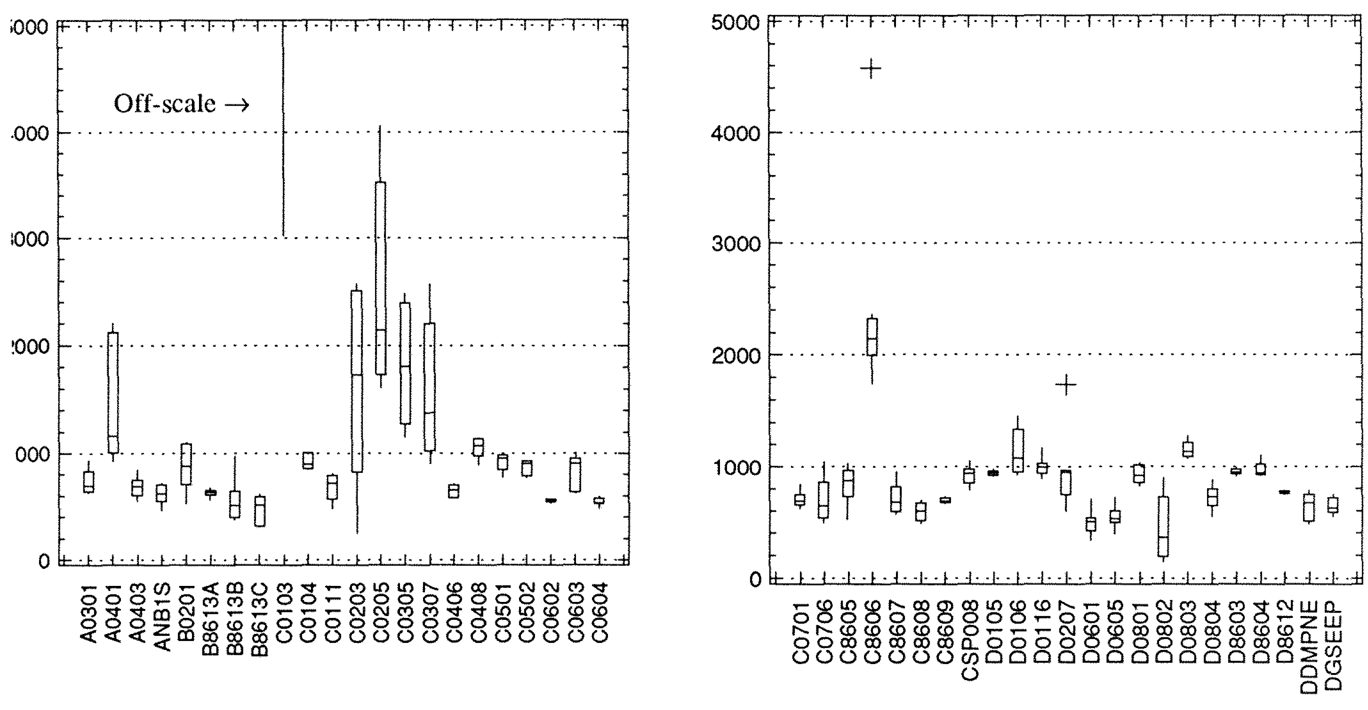


Figure 3-8. Conductivity (µmhos/cm@25°) from the Sand and Gravel Unit (Note: well WNW0103 is off-scale.)

Wells are arranged in general upgradient to downgradient order, reading from left to right.

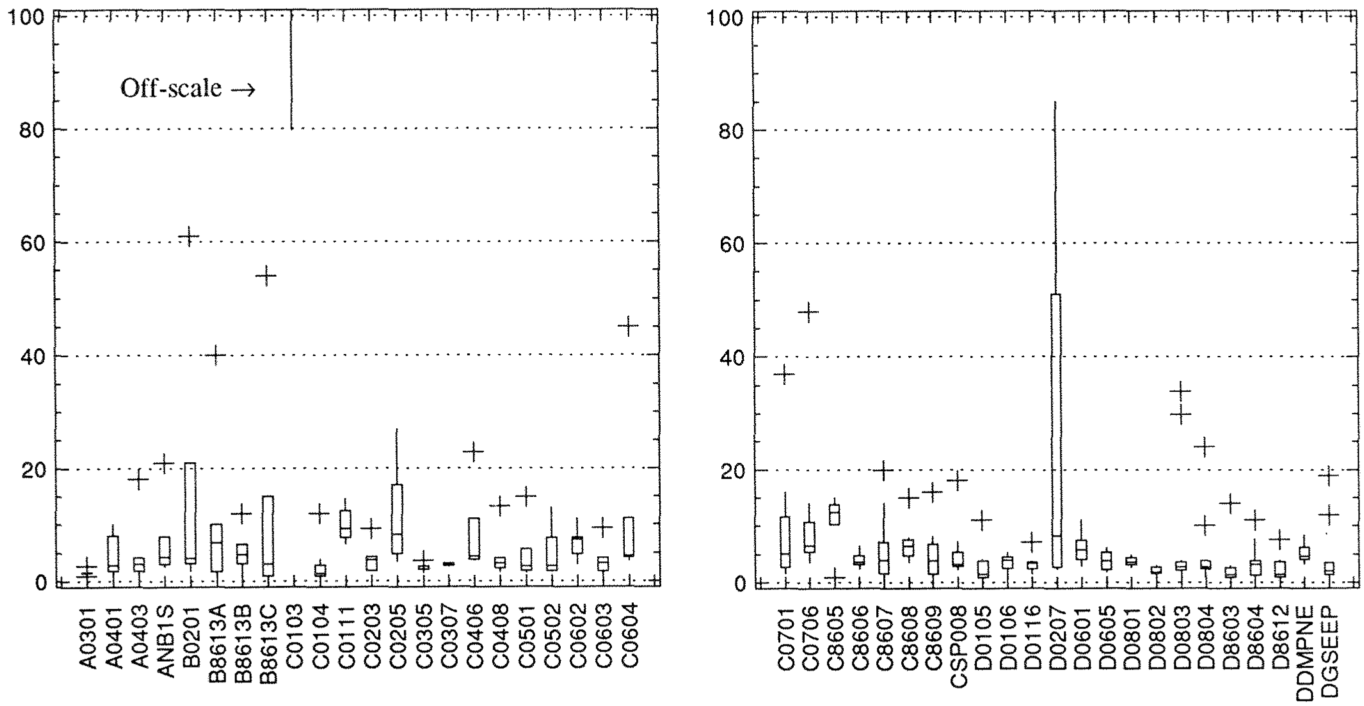


Figure 3-9. Total Organic Carbon (mg/L) in Groundwater Samples from the Sand and Gravel Unit

(Note: well WNW0103 is off-scale)

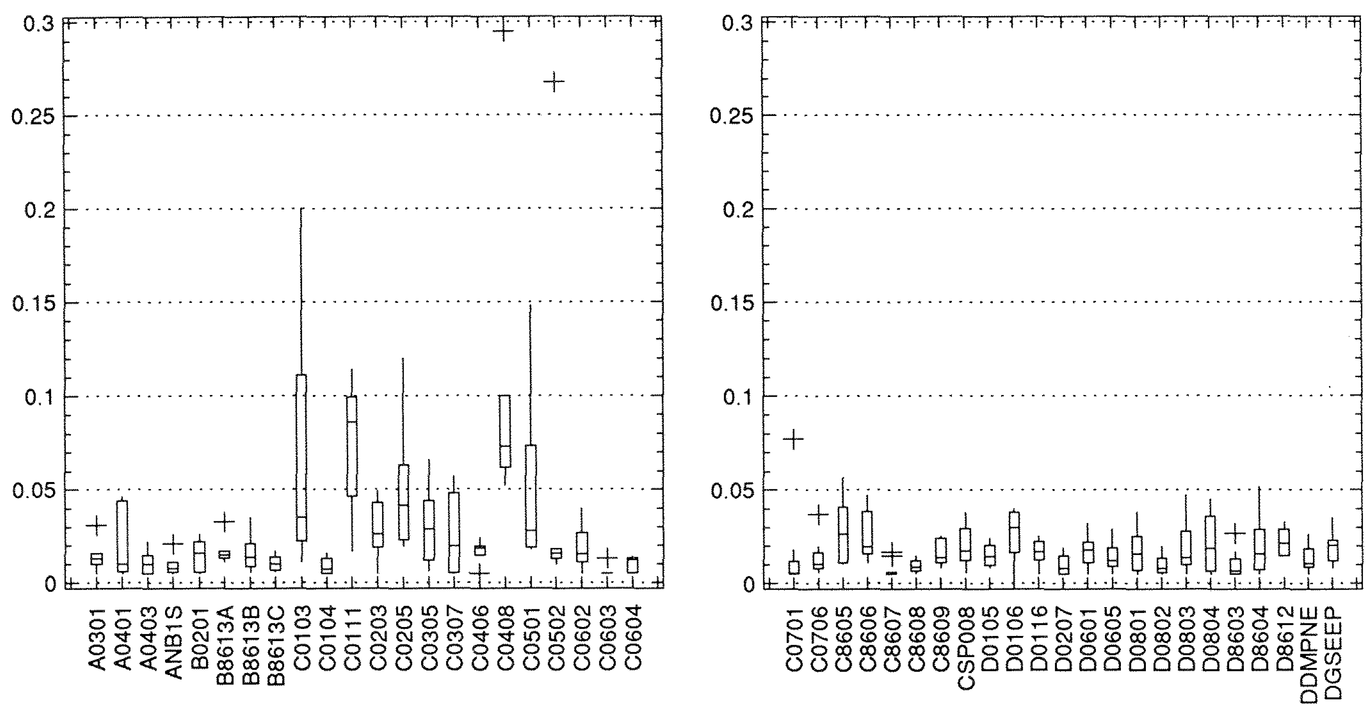


Figure 3-10. Total Organic Halogens (mg/L) in Groundwater Samples from the Sand and Gravel Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

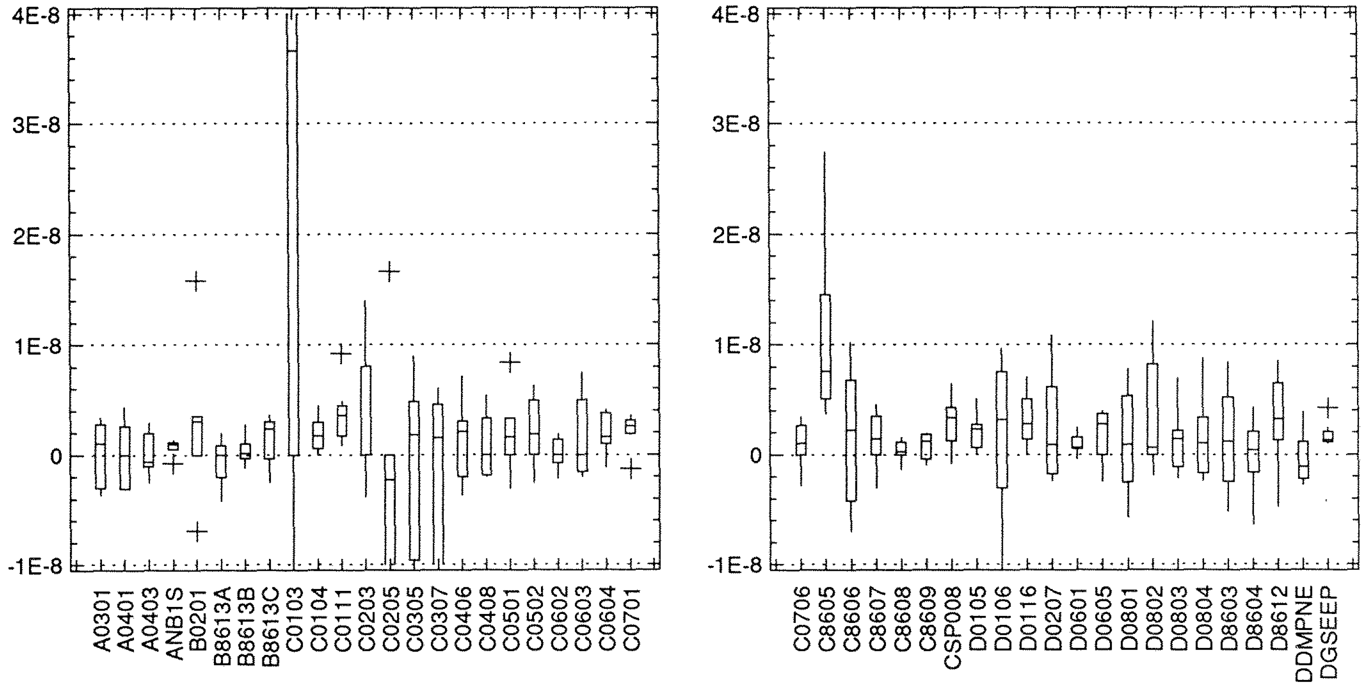


Figure 3-11. Gross Alpha (μCi/mL) in Groundwater Samples from the Sand and Gravel Unit

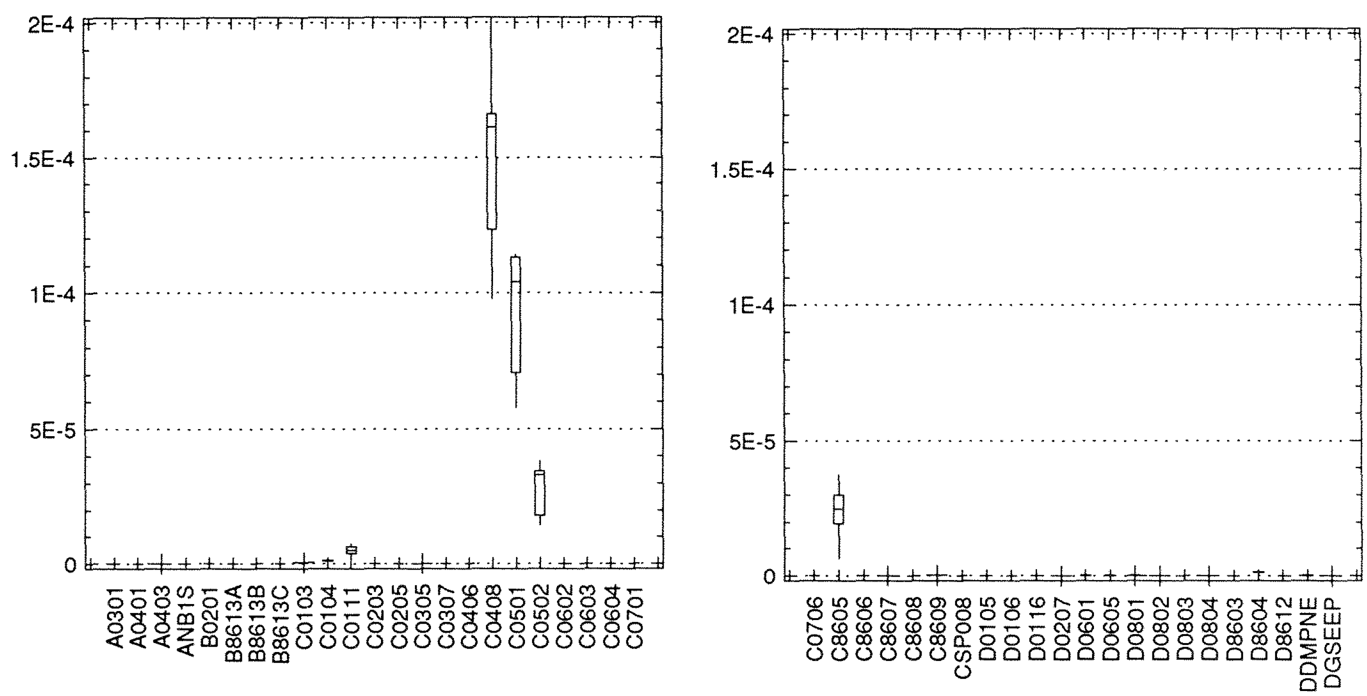


Figure 3-12. Gross Beta (μCi/mL) in Groundwater Samples from the Sand and Gravel Unit

Figure 3-12a follows with expanded scale

Wells are arranged in general upgradient to downgradient order, reading from left to right.

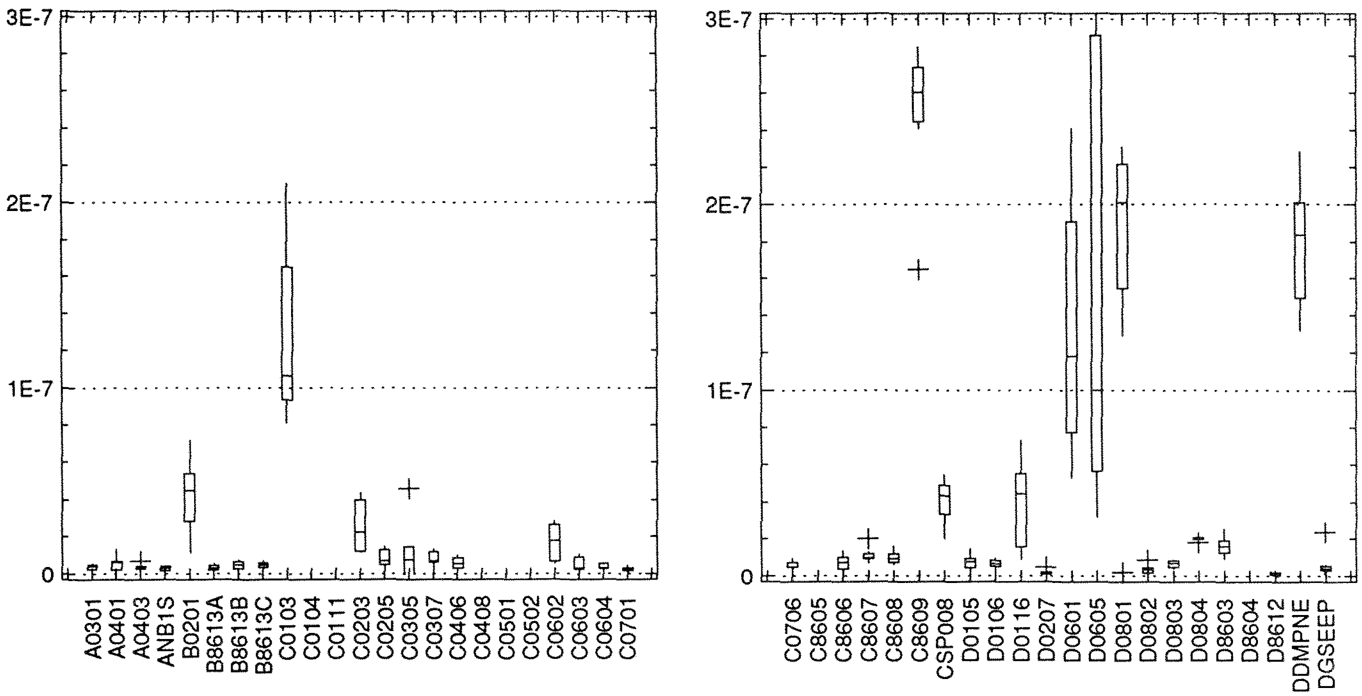


Figure 3-12a. Gross Beta (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit (expanded scale)

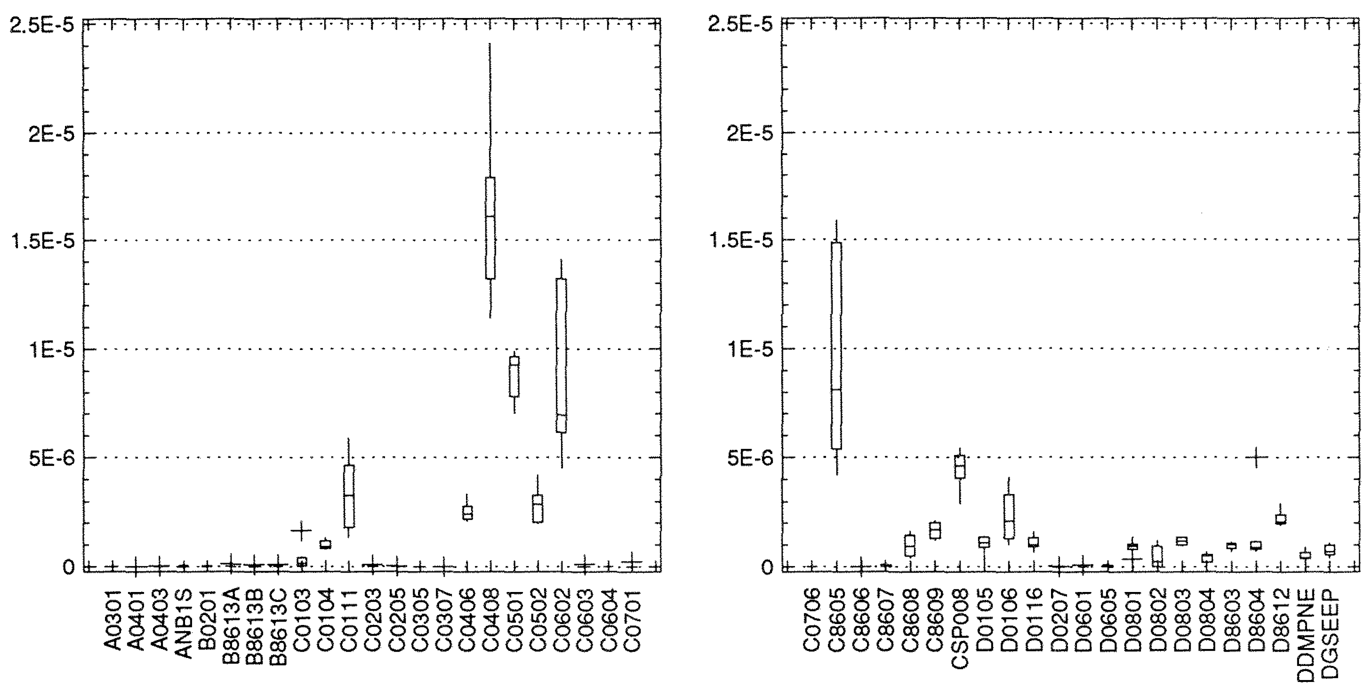


Figure 3-13. Tritium Activity (µCi/mL) in Groundwater Samples from the Sand and Gravel Unit

Figure 3-13a follows with expanded scale

Wells are arranged in general upgradient to downgradient order, reading from left to right.

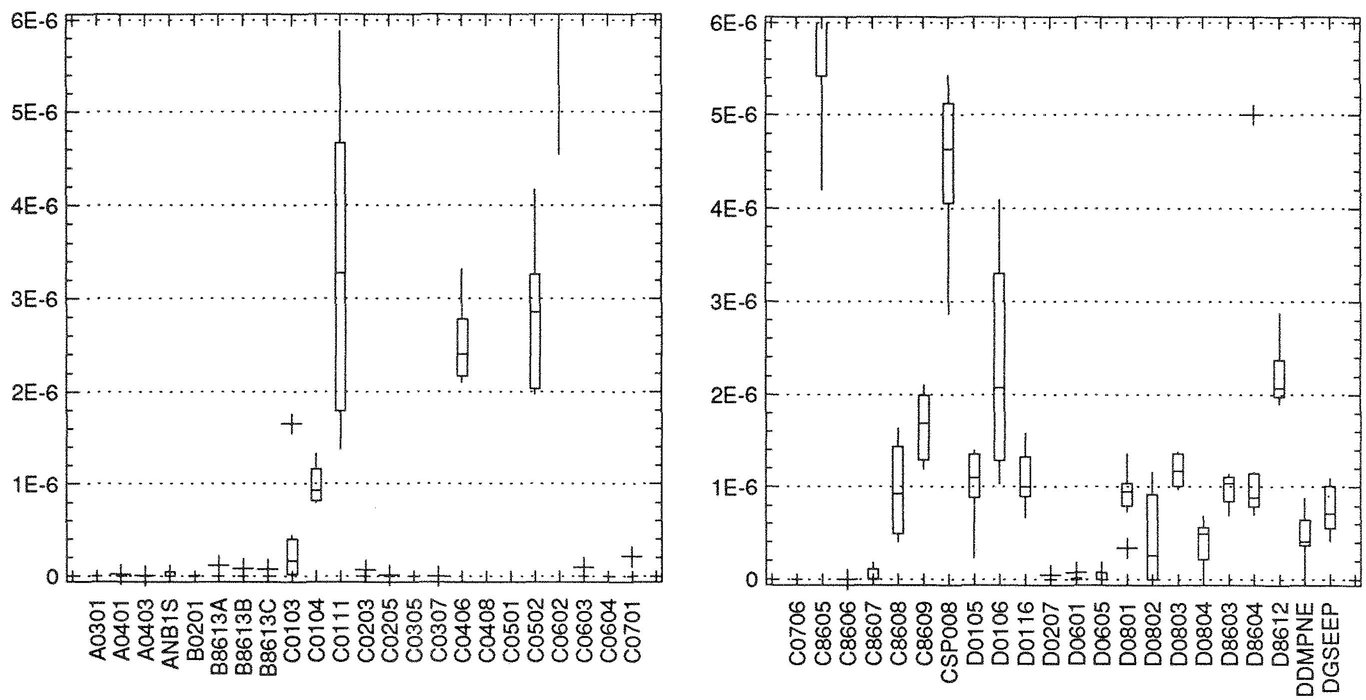


Figure 3-13a. Tritium Activity (μCi/mL) in Groundwater Samples from the Sand and Gravel Unit (expanded scale)

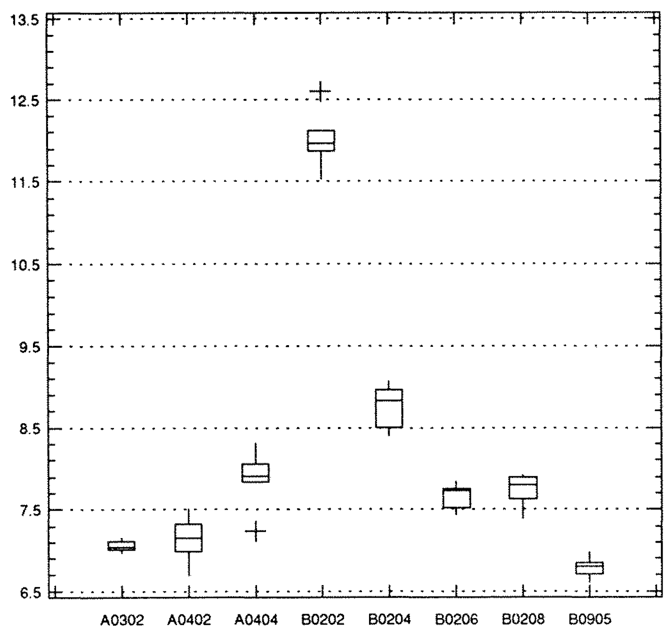


Figure 3-14. pH in Groundwater Samples from the Till-Sand Unit

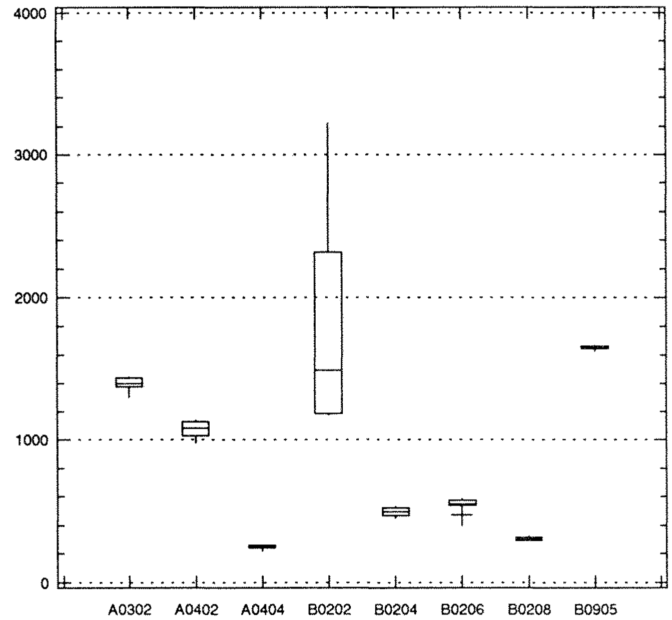


Figure 3-15. Conductivity (µmhos/cm@25°C) in Groundwater Samples from the Till-Sand Unit

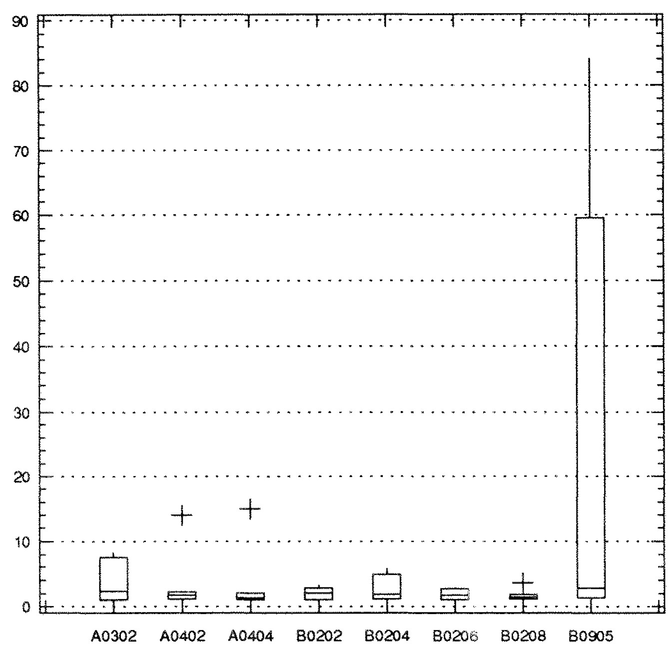


Figure 3-16. Total Organic Carbon (mg/L) in Groundwater Samples from the Till-Sand Unit

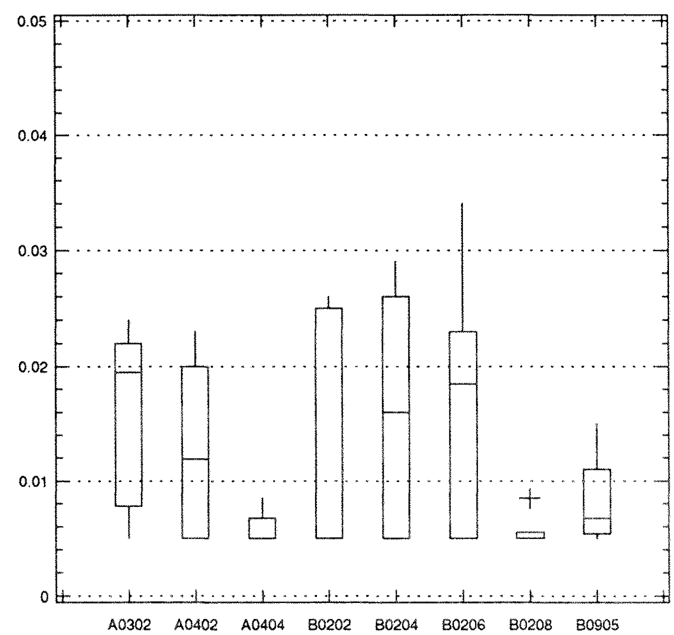


Figure 3-17. Total Organic Halogens (mg/L) in Groundwater Samples from the Till-Sand Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

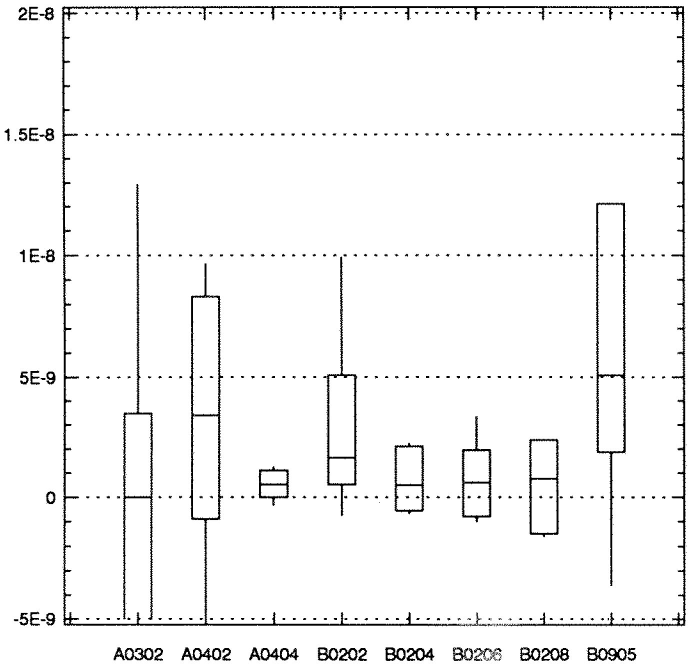


Figure 3-18. Gross Alpha (µCi/mL) in Groundwater Samples from the Till-Sand Unit

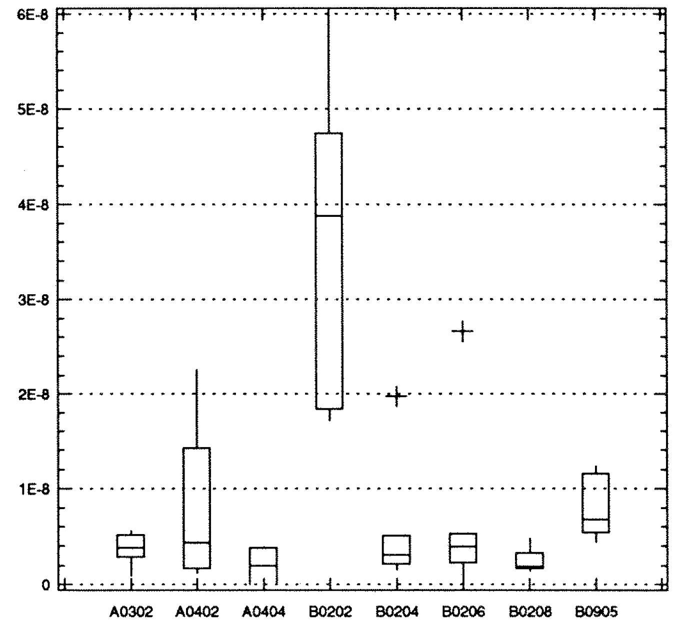


Figure 3-19. Gross Beta (µCi/mL) in Groundwater Samples from the Till-Sand Unit

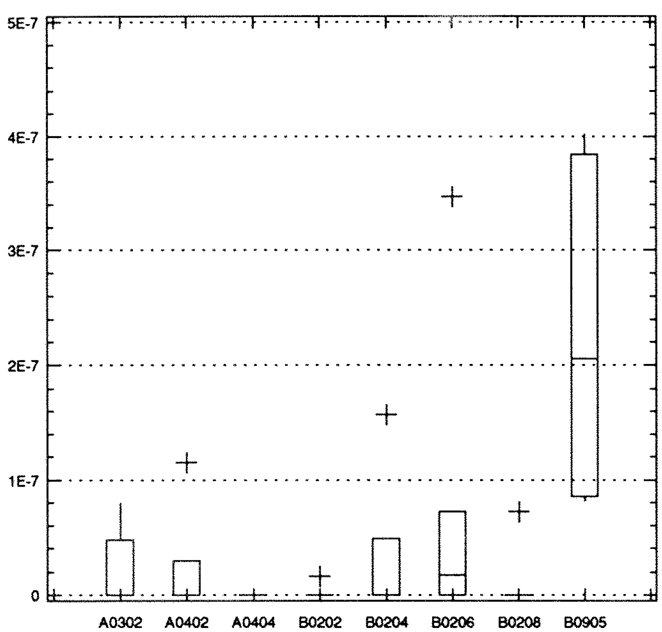


Figure 3-20. Tritium Activity (µCi/mL) in Groundwater Samples from the Till-Sand Unit

Wells are arranged in general upgradient to downgradient order from left to right.

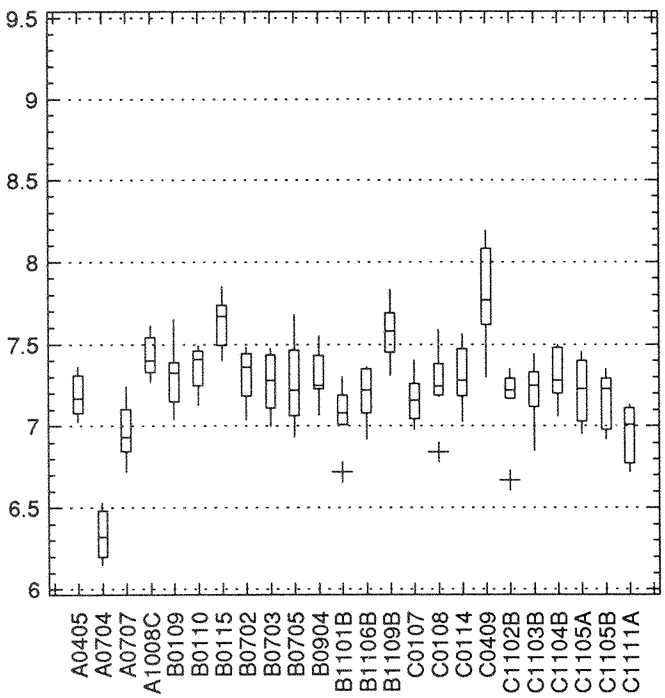


Figure 3-21. pH in Groundwater Samples from the Unweathered Lavery Till Unit

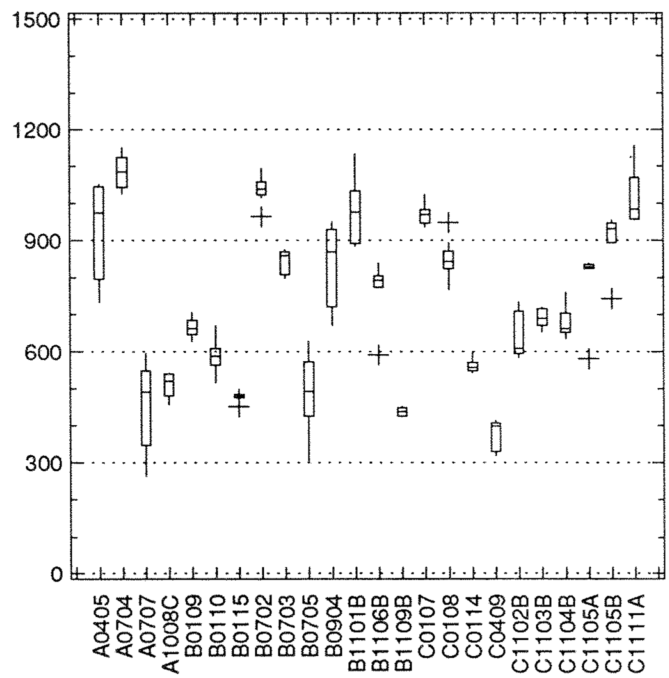


Figure 3-22. Conductivity (μmhos/cm@25°C) in Groundwater Samples from the Unweathered Lavery Till Unit

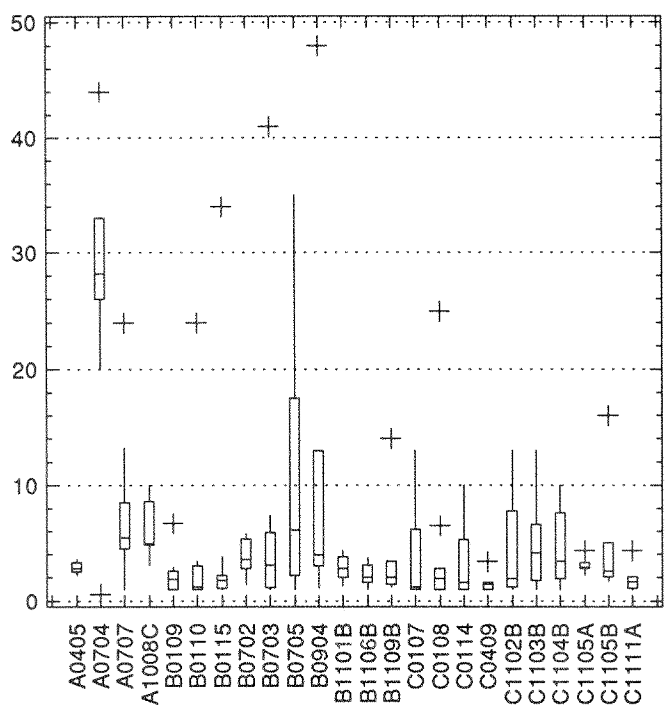


Figure 3-23. Total Organic Carbon (mg/L) in Groundwater Samples from the Unweathered Lavery Till Unit

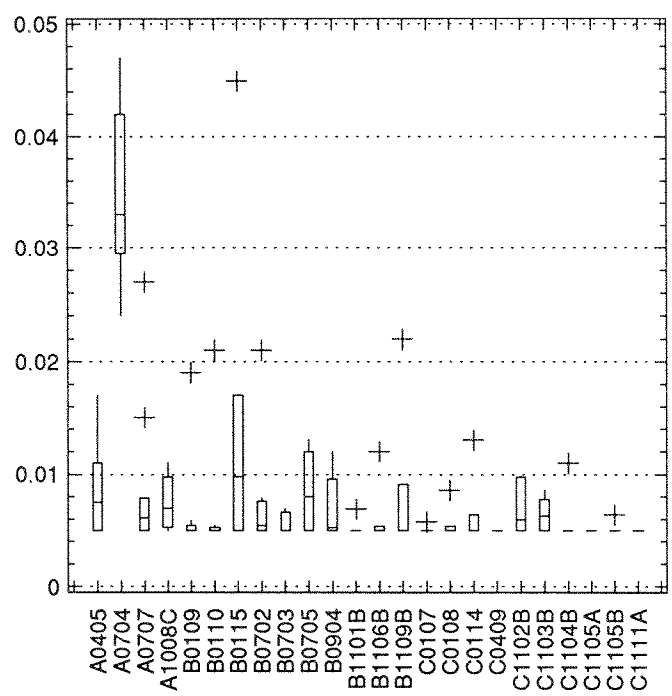


Figure 3 -24. Total Organic Halogens (mg/L) in Groundwater Samples from the Unweathered Lavery Till Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

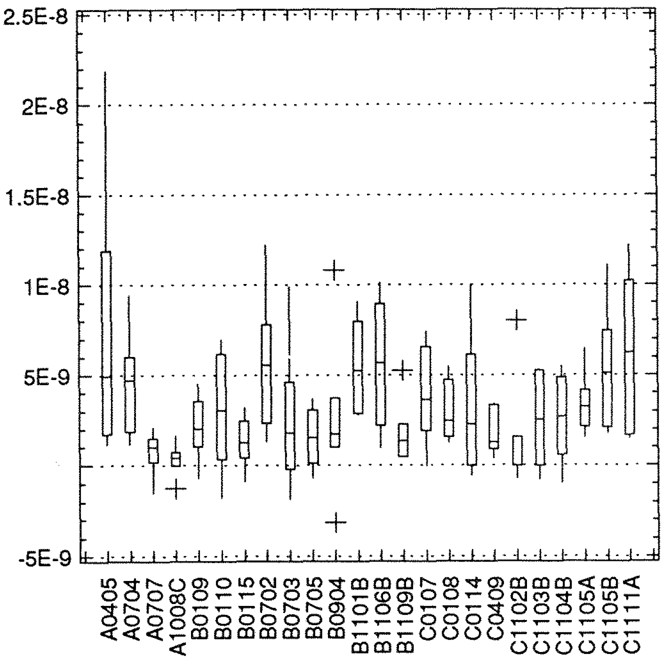


Figure 3-25. Gross Alpha (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

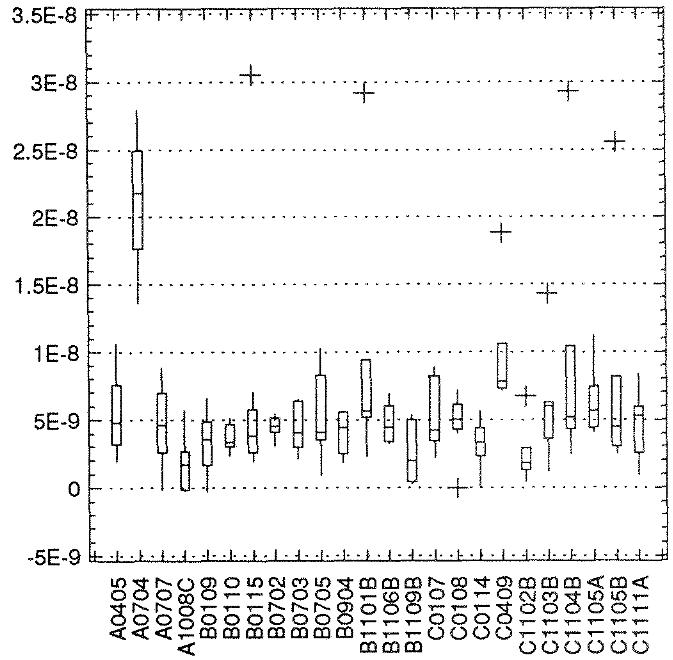


Figure 3-26. Gross Beta (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

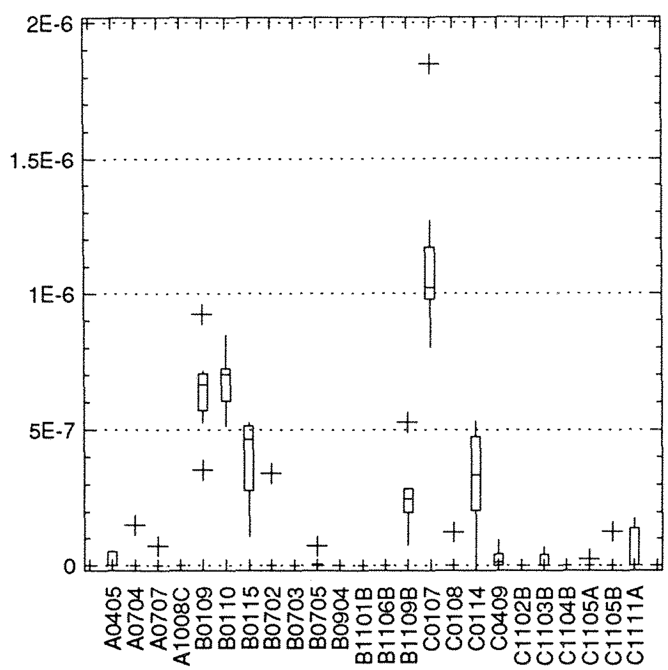


Figure 3-27. Tritium activity (μCi/mL) in Groundwater Samples from the Unweathered Lavery Till Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

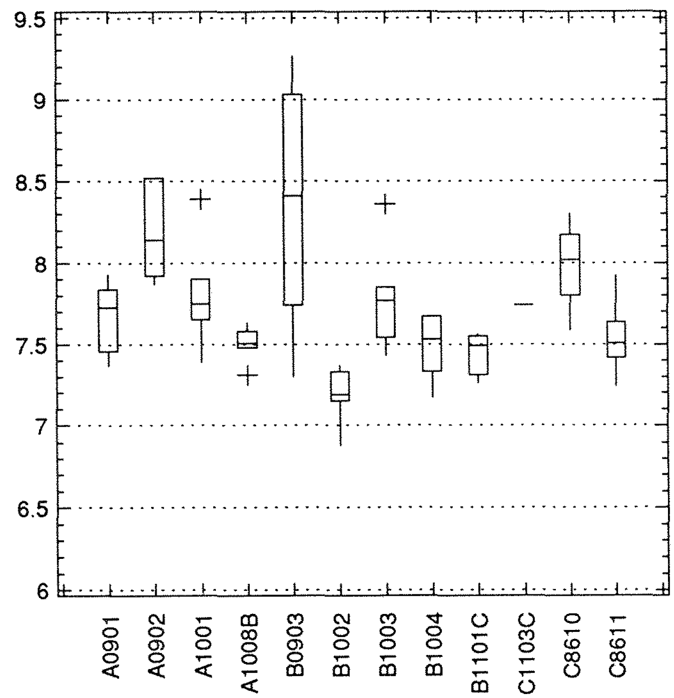


Figure 3-28. pH in Groundwater Samples from the Lacustrine Unit

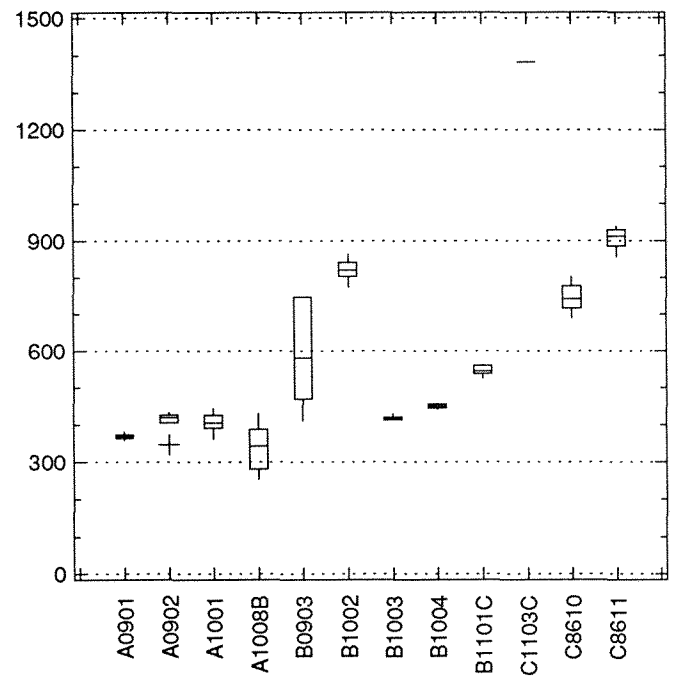


Figure 3-29. Conductivity (μmhos/cm@25°C) in Groundwater Samples from the Lacustrine Unit

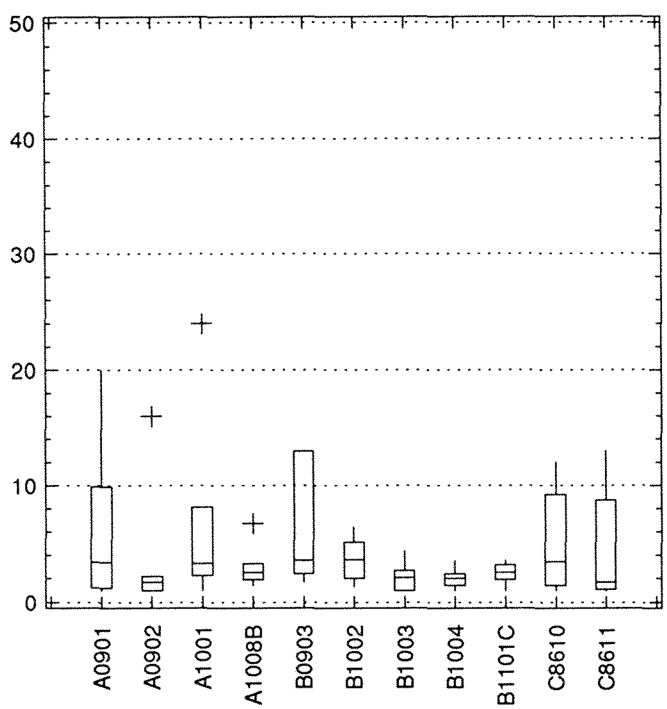


Figure 3-30. Total Organic Carbon (mg/L) in Groundwater Samples from the Lacustrine Unit

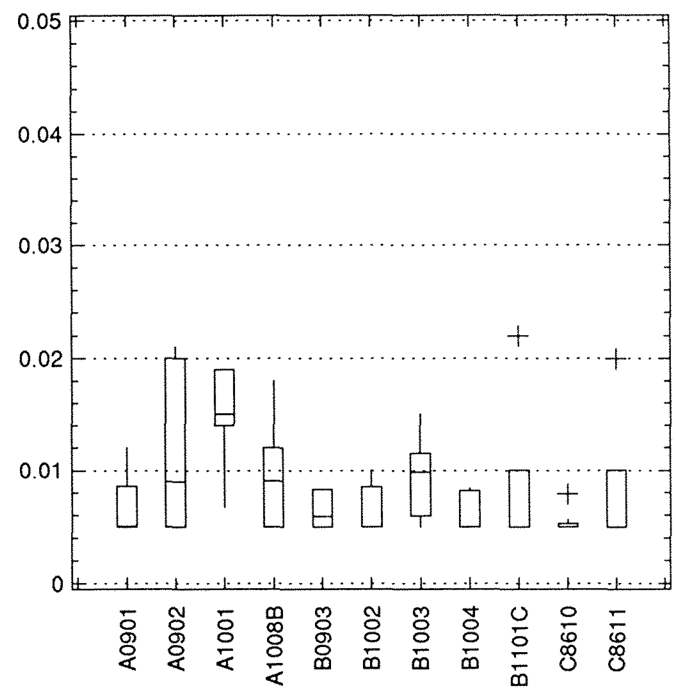


Figure 3 -31. Total Organic Halogens (mg/L) in Groundwater Samples from the Lacustrine Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

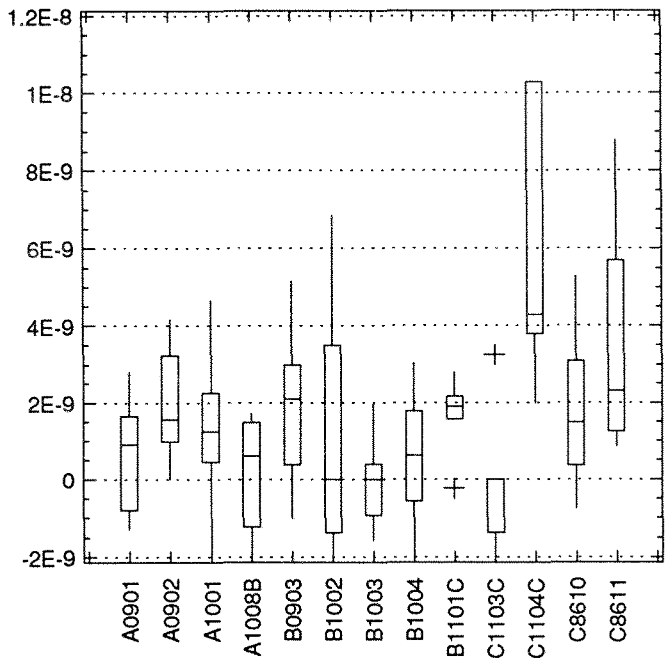


Figure 3-32. Gross Alpha (µCi/mL) in Groundwater Samples from the Lacustrine Unit

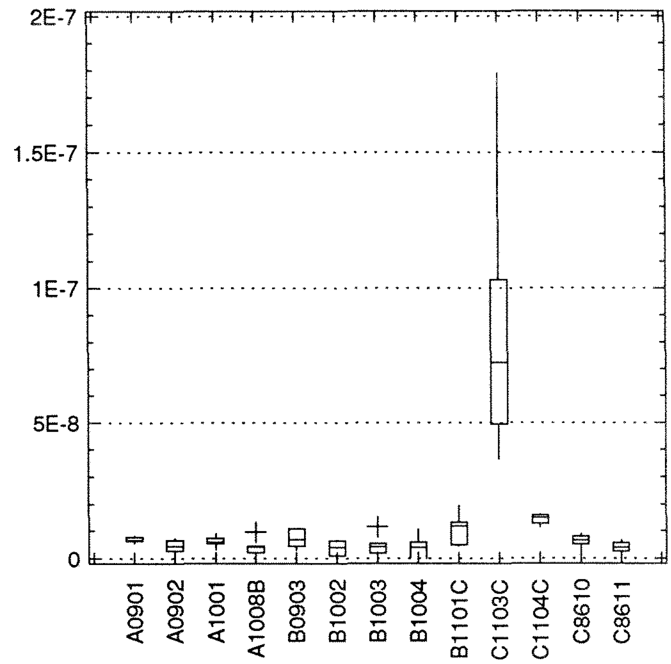


Figure 3-33. Gross Beta (µCi/mL) in Groundwater Samples from the Lacustrine Unit

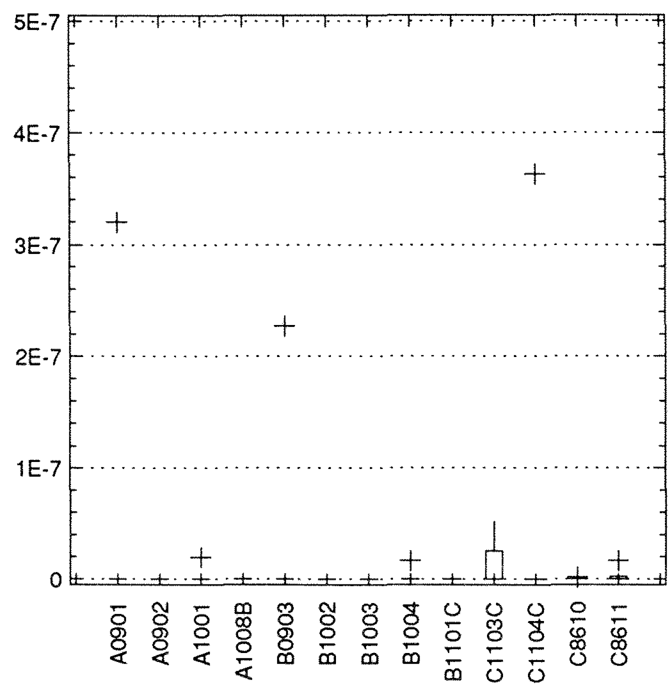


Figure 3-34. Tritium Activity (µCi/mL) in Groundwater Samples from the Lacustrine Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

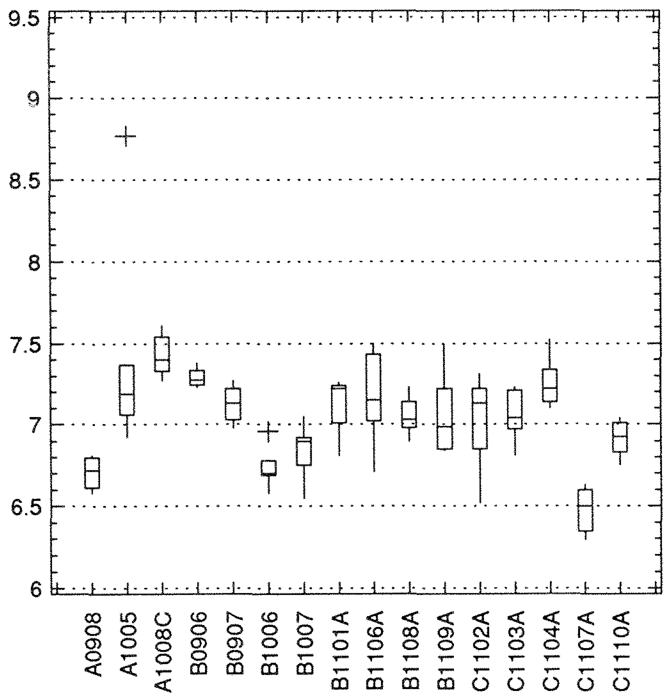


Figure 3-35. pH in Groundwater Samples from the Weathered Lavery Till Unit

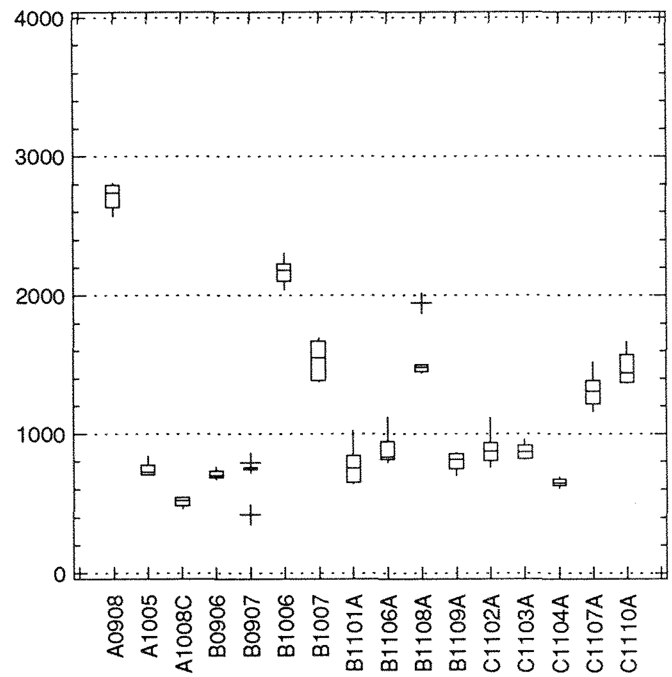


Figure 3-36. Conductivity (µmhos/cm@25°C) in Groundwater Samples from the Weathered Lavery Till Unit

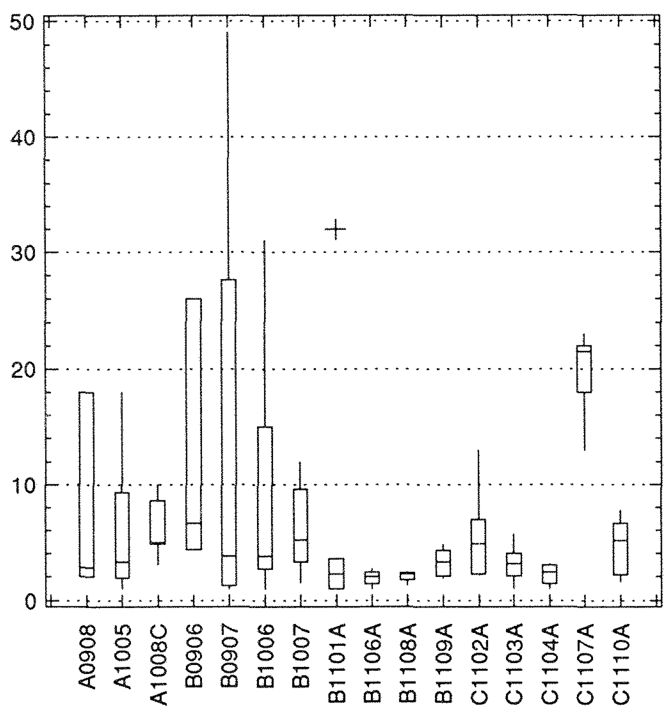


Figure 3-37. Total Organic Carbon (mg/L) in Groundwater Samples from the Weathered Lavery Till Unit

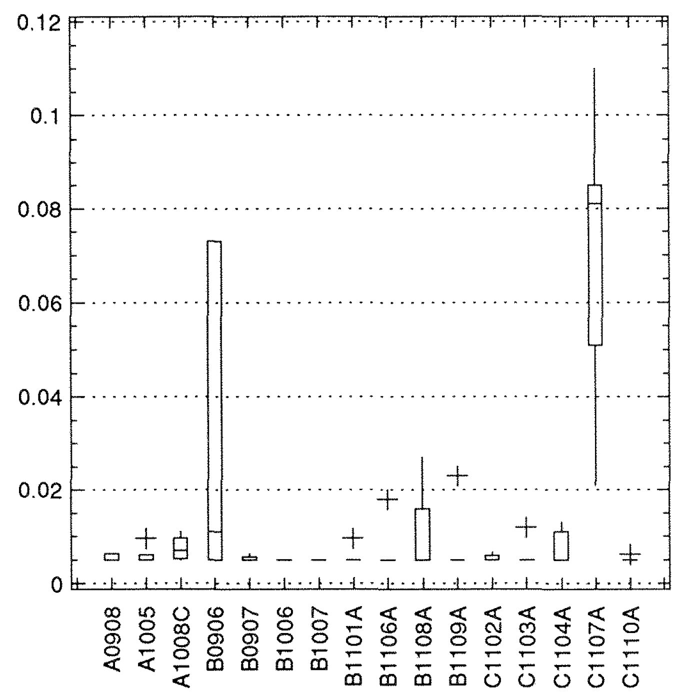


Figure 3 -38. Total Organic Halogens (mg/L) in Groundwater Samples from the Weathered Lavery Till Unit

Wells are arranged in general upgradient to downgradient order, reading from left to right.

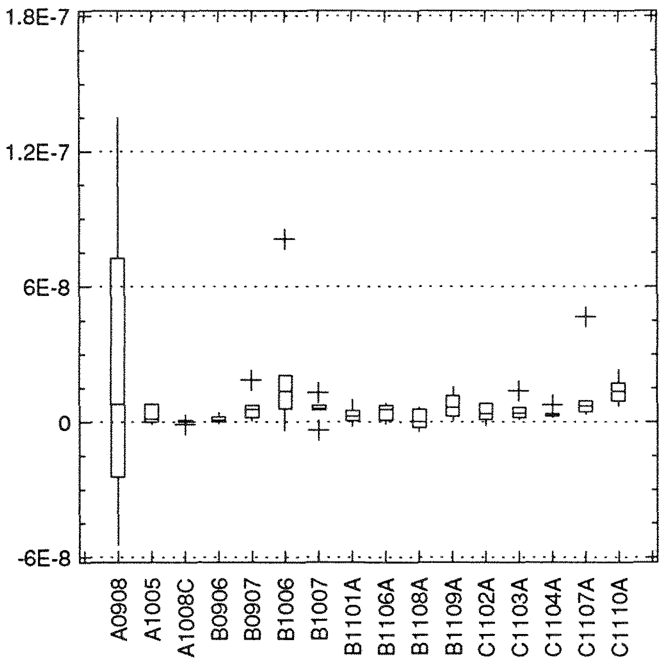


Figure 3-39. Gross Alpha (μCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

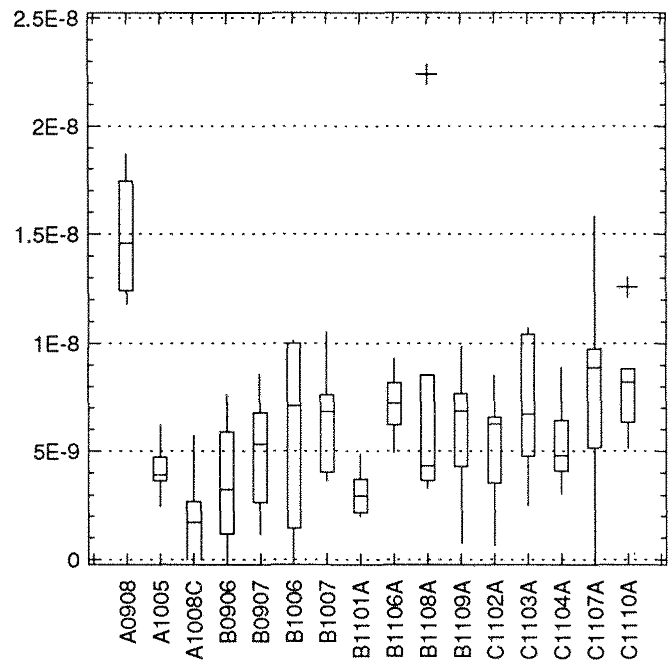


Figure 3-40. Gross Beta (μCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

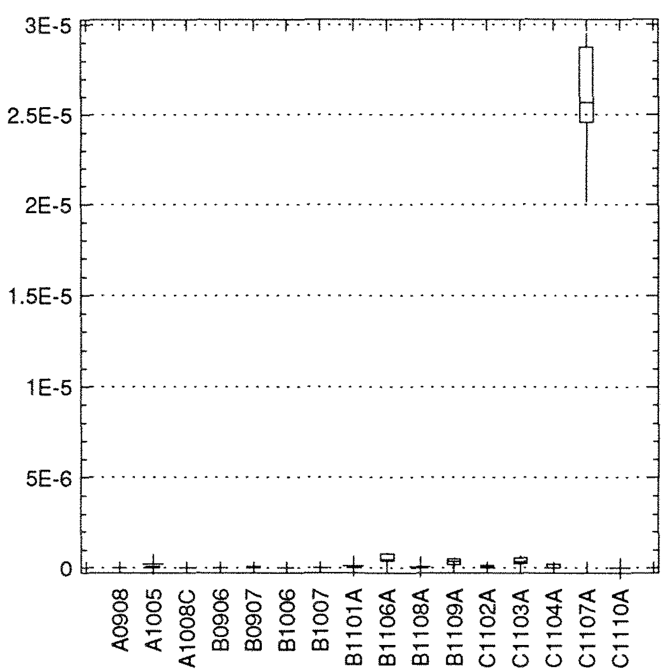


Figure 3-41. Tritium Activity (μCi/mL) in Groundwater Samples from the Weathered Lavery Till Unit

Figure 3-41a follows with expanded scale

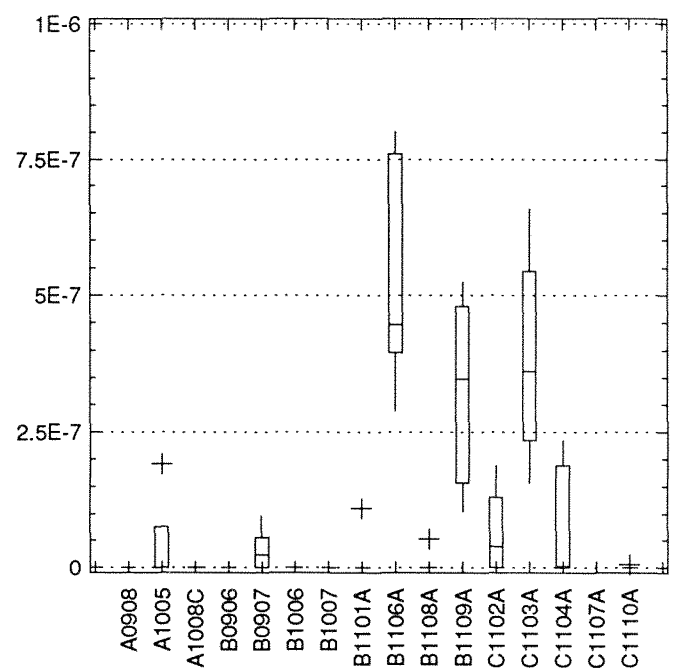


Figure 3-41a. Tritium Activity (μCi./mL) in Groundwater Samples from the Weathered Lavery Till Unit (expanded scale)

Wells are arranged in general upgradient to downgradient order, reading from left to right.

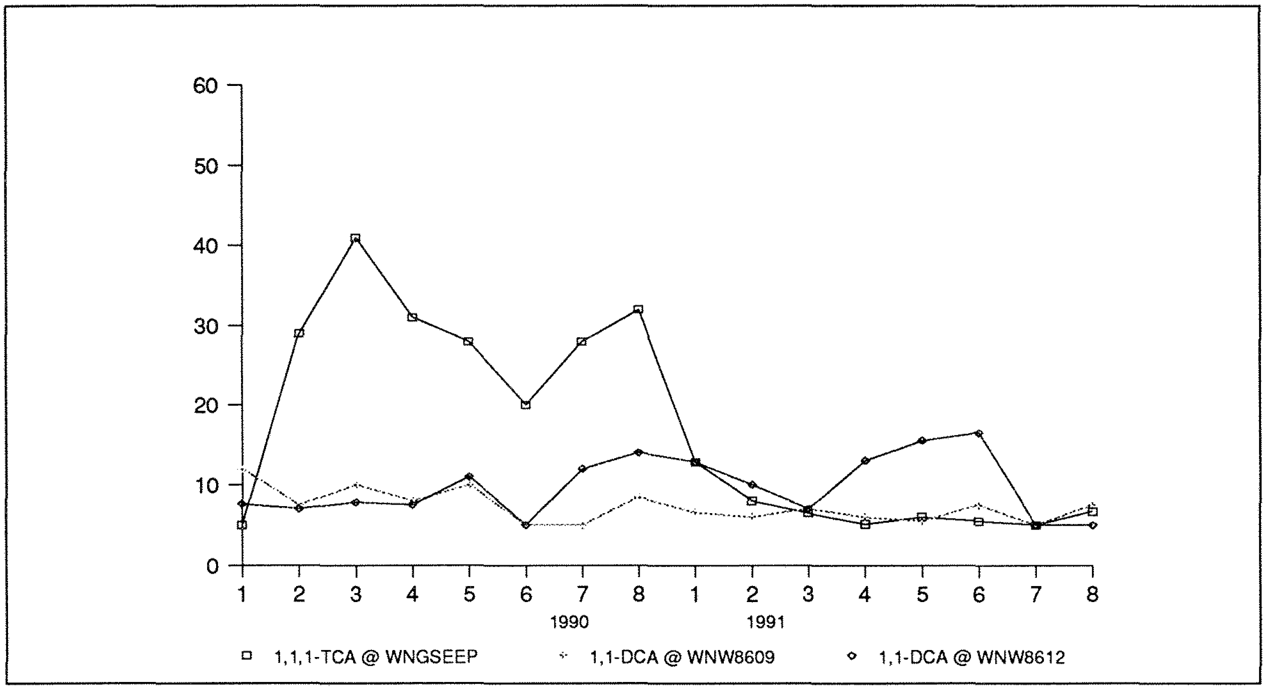


Figure 3-42. Two-year trends (1990 through 1991) of 1,1-DCA and 1,1,1-TCA (μg/L) at selected groundwater locations.

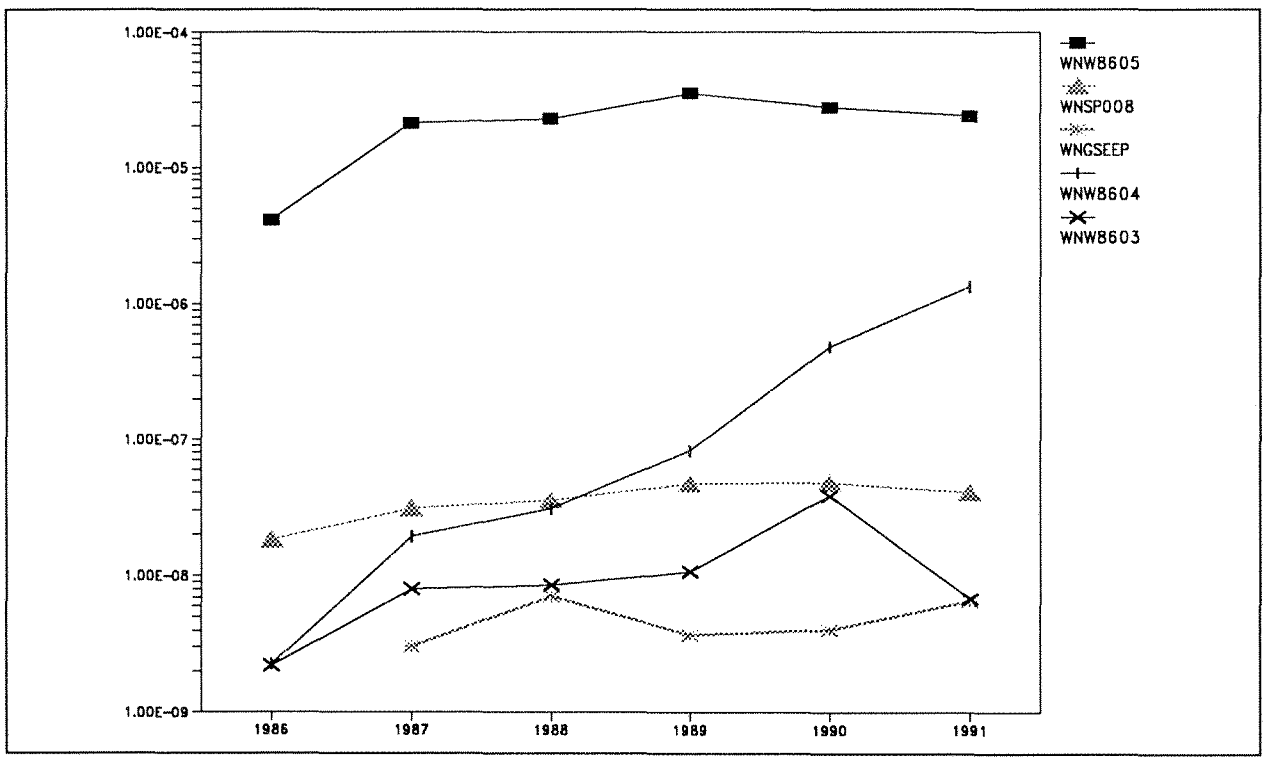


Figure 3-43. Six-year trends of averaged gross beta activity (μCi/mL) at selected locations in the sand and gravel unit.

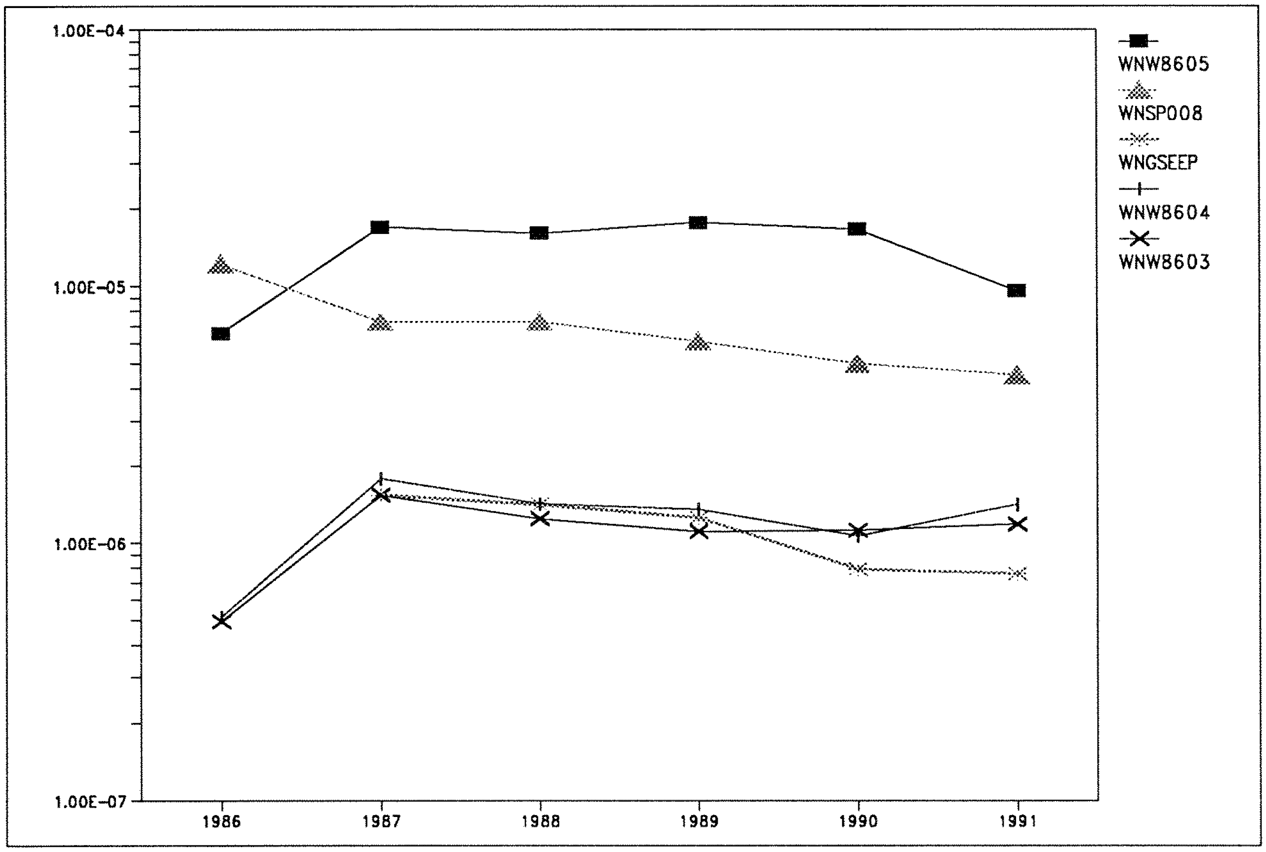
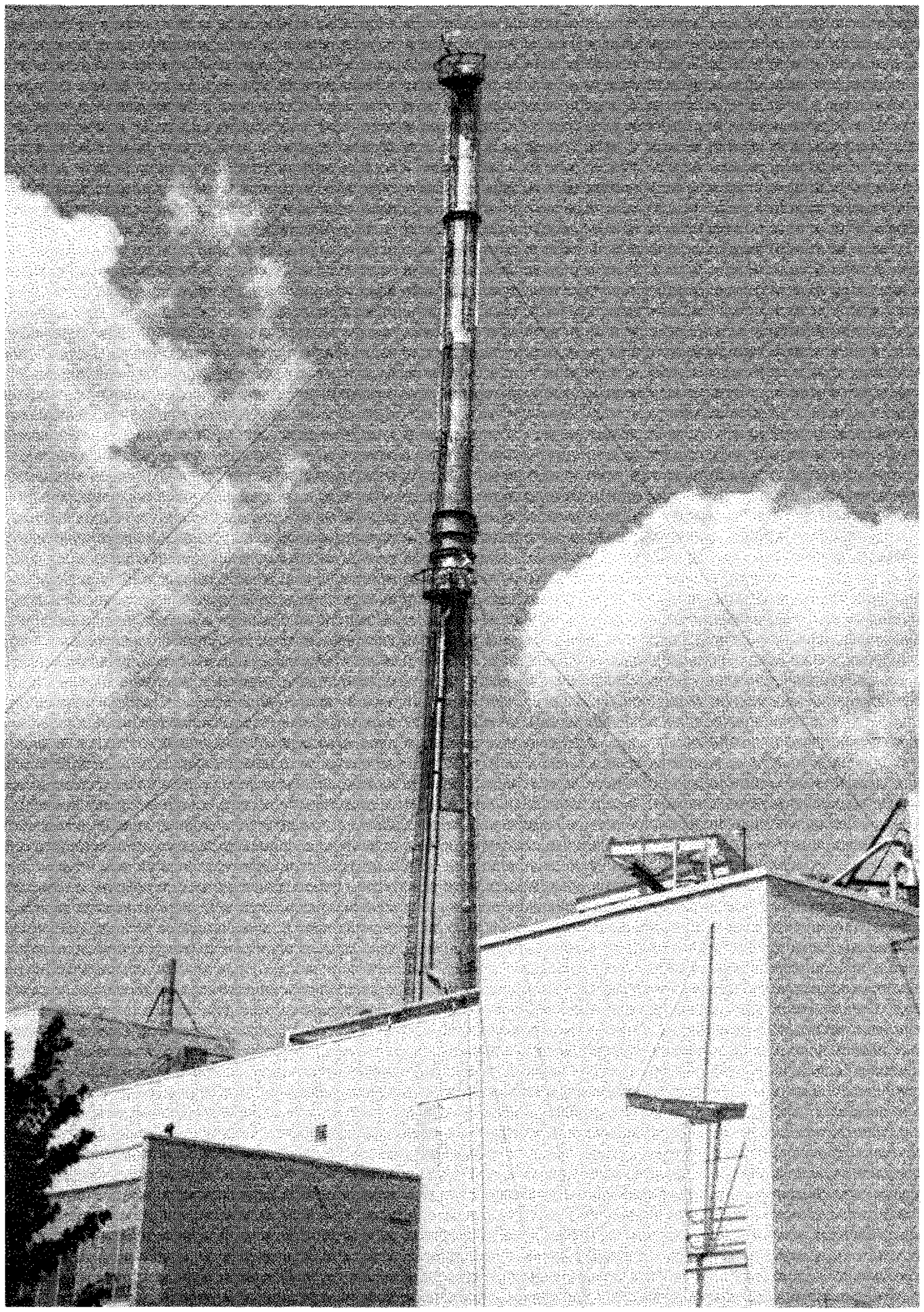


Figure 3-44. Six-year trends of averaged tritium activity (μCi/mL) at selected locations in the sand and gravel unit.



The West Valley Demonstration Project Main Plant Ventilation Stack

Radiological Dose Assessment

Each year the potential radiological dose to the public from the West Valley Demonstration Project is assessed in order to ensure that no individual could possibly have received an exposure exceeding the limits established by the regulatory agencies. The results of these conservative dose calculations demonstrate that the hypothetical maximum dose to an off-site resident is well below permissible standards and is consistent with the "as low as reasonably achievable" philosophy of radiation protection.

Dose Estimates

This chapter describes the methods used to estimate the dose to the public from radionuclides emitted from the Project through air and water discharges during 1991. The dose estimates, based on concentrations of radionuclides measured in air and water collected from monitored on-site effluent points throughout 1991 are compared to the radiation standards established by the Department of Energy (DOE) and the Environmental Protection Agency (EPA) for protection of the public. The radiation doses reported for 1991 are also compared to the doses reported in previous years.

Computer Modeling

Because of the difficulty of measuring the small amounts of radionuclides emitted from the site beyond those that occur naturally in the environment, computer codes were used to model the environmental dispersion of the radionuclides emitted from on-site monitored ventilation stacks and liquid discharge points and to calculate the effective dose equivalent (EDE) to the maximally exposed off-site individual and the collective effective dose equivalent (CEDE) to the population.These models have been approved by the Department of Energy and the Environmental Protection Agency to demonstrate compliance with radiation standards.

Radiological dose is evaluated for the three major exposure pathways: external irradiation, inhalation, and ingestion of local food products. The dose contributions from each radionuclide and pathway combination are then summed to obtain the reported dose estimates.

Sources of Radiation Energy and Radiation Exposure

Radionuclides

Atoms that emit radiation are called radionuclides. Radionuclides are unstable isotopes (variations of an element) that have the same number of protons and electrons 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 — the numbers of protons and neutrons — in the nucleus.

Once a radioactive atom decays by emitting radiation, the resulting daughter atom may itself be radioactive or stable. Each radioactive isotope has a unique half-life that represents the time it takes for 50% of the atoms to decay. Strontium-90 and cesium-137 have half-lives of about thirty years, while plutonium-239 has a half-life of 24,000 years.

Radiation Dose

The energy released from a radionuclide is eventually deposited in matter encountered along the path of radiation, resulting in a radiation dose to the absorbing material. The absorbing material can be either inanimate matter or living tissue.

While most of the radiation dose affecting the general public is background radiation, manmade sources of radiation may also contribute to the radiation dose to individual members of the public. Such sources can 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.

The West Valley Demonstration Project is part of the nuclear fuel cycle. The radionuclides present at the site are left over from the recycling of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site annually through ventilation systems and liquid discharges. An even smaller fraction actually contributes to the radiation dose to the surrounding population.

Health Effects of Low Levels of Radiation

The concept of dose equivalent (DE) was developed by the radiation protection community to allow a rough comparison of doses from different types of radiation.

The primary effect of low levels of radiation in an exposed individual appears to be an increased risk of cancer. Radionuclides entering the body through air, water, or food are usually distributed unevenly in different organs of the body. For example, isotopes of iodine concentrate in the thyroid gland. Strontium, plutonium, and americium isotopes concentrate in the skeleton. Uranium and plutonium isotopes, when inhaled, remain in the lungs for a long time. Some radionuclides such as tritium, carbon-14, or cesium-137 will be distributed uniformly throughout the body. 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).

Dose Estimation Methodology

The International Commission on Radiological Protection (ICRP) found a way to account for this difference in radionuclide distribution and organ sensitivity. In Publications 26 (1977) and 30 (1979), the Commission developed an organ-weighted (weighting factor) average dose methodology to limit permissible worker exposures following intakes of radionuclides. This weighting factor — a ratio of the risk from a dose to a specific organ or tissue to the total risk when the whole body is uniformly irradiated — represents the relative sensitivity of a particular organ to develop a fatal effect. For example, to determine the weighting factor following a uniform irradiation, the risk factor of death from cancer of a specific organ is divided by the total risk of dying from cancer. Organ-weighted dose equivalents are then summed to obtain an effective dose equivalent (EDE).

Units of Measurement

The U.S. unit of measurement for dose equivalent is the rem. The international unit of measurement of dose equivalent is the sievert (Sv), which is equal to 100 rem. The millirem (mrem) and millisievert (mSv) are used more frequently to report the low dose equivalents encountered in environmental exposures.

The National Council on Radiation Protection and Measurements (NCRP) Report 93 (1987) estimates that the average annual effective dose equivalent (EDE) received by an individual living in the U.S. is about 360 mrem (3.6 mSv) from both natural and manmade sources of radiation (Fig. 4-1). This number is based on the collective EDE, defined as the total EDE received by a population (expressed in units of person-Sv or person-rem). The average individual EDE is obtained by dividing the collective EDE by the population.

Risk Estimate

The Committee on Biological Effects of Ionizing Radiations (BEIR V) has estimated that the increased risk of dying from cancer from a single acute dose of 10 rem (0.1 Sv) is about 0.8% of the background risk of cancer. According to the BEIR Committee, chronic exposure,

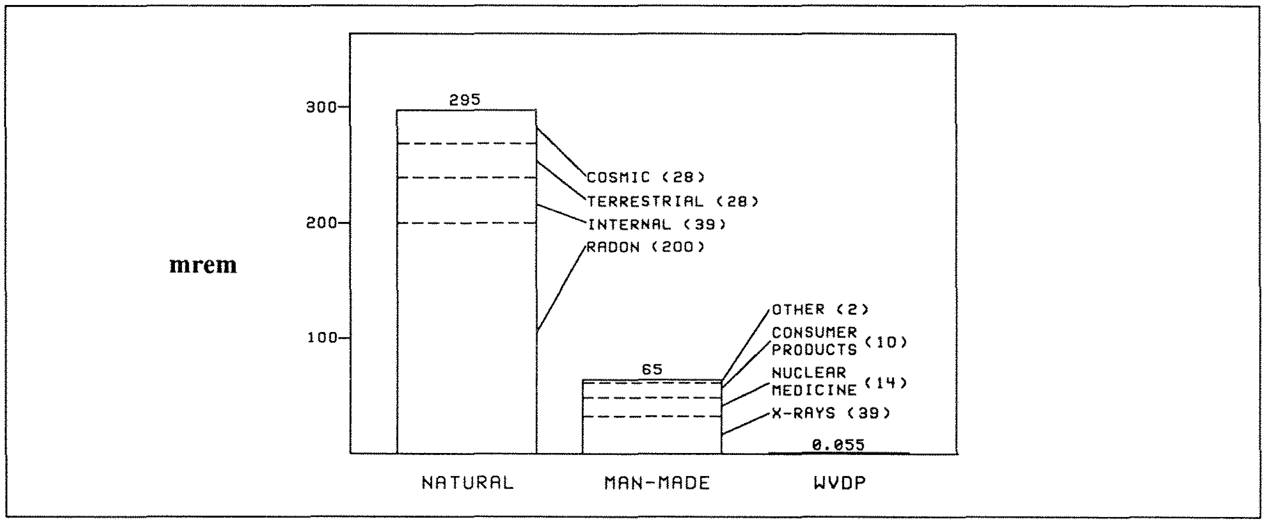


FIGURE 4-1. COMPARISON OF ANNUAL RADIATION DOSE (MREM) TO AN AVERAGE MEMBER OF THE UNITED STATES POPULATION (NCRP 1987) WITH THE MAXIMUM DOSE TO AN OFF-SITE RESIDENT FROM 1991 WVDP EFFLUENTS.

i.e., accumulation of the same dose over long periods of time, might, compared to acute exposure, reduce the risk by a factor of two or more.

The BEIR Committee has stressed that the health effects of very low levels of radiation are not clear, and any use of risk estimates at these levels is subject to great uncertainty (BEIR 1990). As will be shown in the following sections, the estimated maximum EDE received by a member of the public from Project activities during 1991 is many orders of magnitude lower than the exposures considered in the BEIR report.

Estimated Radiological Dose from Airborne Effluents

Sources of Radioactivity from the WVDP

As reported in Chapter 2, *Environmental Monitoring*, five stacks were monitored for radioactive air emissions during 1991. The activity that was released to the atmosphere from these stacks is listed in Tables C-2.1 through C-2.11 in *Appendix C-2*.

The main plant stack, which vents to the atmosphere at a height of 63 meters (208 ft), is considered an elevated release; all other releases are considered ground level (10 m) releases.

Meteorological Data

Wind data collected from the on-site meteorological tower during 1991 were used as input to the dose assessment codes. Data collected at the 60-meter and 10-meter heights were used in combination with elevated and ground level effluent release data, respectively.

Applicable Standards

Airborne emission of radionuclides are regulated by the EPA under the Clean Air Act. Department of Energy facilities are subject to 40 CFR 61, subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAPs) Radionuclides. The applicable standard for radionuclides released during 1991 is 10 mrem (0.10 mSv) EDE for any member of the public.

Maximum Dose to an Off-Site Resident

Based on the airborne radioactivity released from the site during 1991 and using CAP88-PC, a person living in the vicinity of the WVDP was estimated to receive an EDE of 4.9×10^{-4} mrem (4.9×10^{-6} mSv). This hypothetical maximally exposed individual was assumed to reside continuously about 1.9 kilometers north-northwest of the site and to eat only locally produced foods. Approximately 80% of the dose from airborne emissions in 1991 was contributed by iodine-129. Americium-241 and isotopes of plutonium made up much of the remainder.

The dose reported above is 0.005% of the 10 mrem (0.10 mSv) standard and can be compared to about one minute of the annual background radiation received by an average member of the U.S. population.

Collective Dose to the Population

The CAP88-PC version of AIRDOS-EPA was used to estimate the collective effective dose equivalent (CEDE) to the population. According to census projections for 1991, an estimated 1.7 million people reside within 80 kilometers (50 mi) of the WVDP. This population received an estimated $4.7x10^{-3}$person-rem ($4.7x10^{-5}$person-Sv) collective EDE from radioactive airborne effluents released from the WVDP during 1991. The resulting average EDE per individual is $2.8x10^{-6}$ mrem ($2.8x10^{-8}$mSv).

There are no standards limiting the collective EDE to the population. However, the calculated average individual EDE is 110 million times lower than the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation (equivalent to an exposure of less than one second of background radiation).

Estimated Radiological Dose from Liquid Effluents

Sources of Radioactivity from the WVDP

Six batch releases of liquid radioactive effluents were monitored during 1991. The radioactivity that was discharged in these effluents is listed in *Appendix C-1*, Table C-1.1.

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 (USEPA 1984b,c). The potable water wells sampled for radionuclides are upgradient of the West Valley Demonstration Project and are not considered a realistic pathway in the dose assessment. Since Cattaraugus Creek is not designated as a drinking water supply, the estimated radiation dose was compared with the limits stated in DOE Order 5400.5.

Dose Assessment Methodology

The computer code LADTAP II (Simpson and McGill 1980) was used to calculate the EDE to the maximally exposed off-site individual and the collective EDE to the population from routine releases

and dispersion of these effluents. Since the effluents eventually reach Cattaraugus Creek, which is not used as a source of drinking water, the local exposure pathway calculated by the code is from the consumption of 21 kilograms (46 lb) of fish caught in the creek. Population dose estimates assume that the radionuclides are further diluted in Lake Erie before reaching municipal drinking water supplies. A detailed description of LADTAP II is given in *Radiological Parameters for Assessment of WVDP Activities* (Faillace and Prowse 1990).

Maximum Dose to an Off-Site Individual

Based on the radioactivity in effluents released from the WVDP during 1991, an off-site individual was estimated to receive a maximum EDE of $5.5x10^{-2}$ mrem ($5.5x10^{-4}$mSv). Approximately 98% of this dose is from cesium-137. This dose is about 5,400 times lower than the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation (equivalent to an exposure of two hours of background radiation).

Collective Dose to the Population

As a result of radioactivity released in liquid effluents from the WVDP during 1991, the population living within 80 kilometers (50 mi) of the site received a collective EDE of $1.1x10^{-2}$ person-rem ($1.1x10^{-4}$ person-Sv). This estimate is based on a population of 1.7 million living within the 80-kilometer radius. The resulting average EDE per individual is $6.5x10^{-6}$ mrem ($6.5x10^{-8}$mSv), or approximately 46 million times lower than the 300 mrem (3 mSv) that an average person receives in one year from natural background radiation (equivalent to an exposure of less than one second of background radiation).

Estimated Radiological Dose from All Pathways

The potential dose to the public from both airborne and liquid effluents released from the Project during 1991 is the sum of the individual dose contributions. The maximum EDE from all pathways to a nearby resident was $5.5x10^{-2}$ mrem ($5.5x10^{-4}$ mSv).

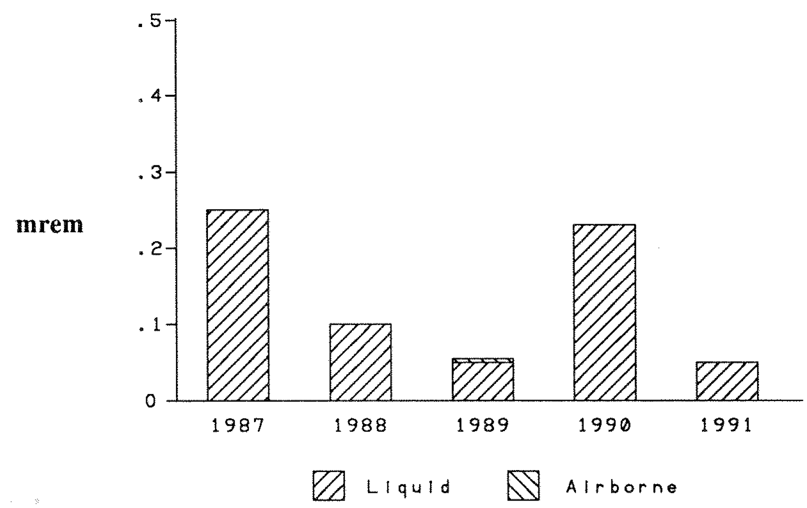


FIGURE 4-2.. MAXIMUM DOSE EQUIVALENT (MREM) FROM LIQUID AND AIRBORNE EFFLUENTS TO AN INDIVIDUAL RESIDING NEAR THE WVDP.

This dose is 0.05% 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 1.6×10^{-2} person-rem (1.6×10^{-4} person-Sv), with an average EDE of 9.4×10^{-6} mrem (9.4×10^{-8} mSv) per individual.

Table 4-1 summarizes the dose contributions from all pathways and compares the individual doses to the applicable standards.

Figure 4-2 shows the trend in dose to the maximally exposed individual over the last five years. The estimated dose for 1991 is lower than the dose reported in 1990.

Figure 4-3 shows the trend in collective dose to the population. The estimated collective dose for 1991 is lower than the dose reported in 1990.

Estimated Radiological Dose from Local Food Consumption

In addition to dose estimates based on dispersion modeling, the maximum CEDE to a nearby resident from consumption of locally produced food can also be estimated. Because the estimated doses using the computer models already incorporate the food pathway, the doses from food consumption should not be added to doses reported in previous sections but should serve as an additional means of measuring the effect of Project operations.

Near-site and control samples of fish, milk, beef, venison, fruit, and vegetables were collected and analyzed for various radionuclides, including tritium, potassium-40, 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 are the basis for these dose estimates.

When statistically significant differences were found between near-site and background sample concentrations, the excess near-site sample concentration was used as a basis for the dose estimate. Most of the measured radionuclides were found to be under the minimum detectable concentration. When this was the case for both near-site and control samples, the concentrations in both were assumed to be at background levels.

The EDE to nearby residents from the consumption of foods with radionuclide concentrations above background concentration was estimated. The potential dose was calculated by multiplying the excess concentration by the maximum adult annual consumption rate for each food and the ingestion unit dose factor for 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 (USNRC 1977). The internal dose conversion factors

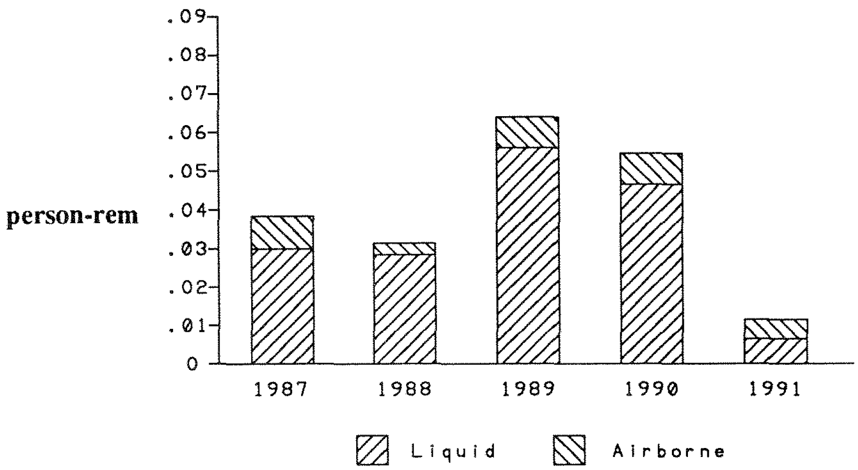


FIGURE 4-3. COLLECTIVE DOSE EQUIVALENT (PERSON-REM) FROM LIQUID AND AIRBORNE EFFLUENTS TO THE POPULATION RESIDING WITHIN 80 KM OF THE WEST VALLEY DEMONSTRATION PROJECT.

were obtained from *Internal Dose Conversion Factors for Calculation of Dose to the Public* (U.S. Department of Energy 1988).

The results of the dose estimates for each food type are reported in the following sections. The four-year trend in total EDE from consumption of all the sampled food products is plotted in Figure 4 - 4. All of the calculated doses are well below both the EPA and DOE limits discussed in the previous sections.

Milk

Milk samples were collected from various nearby dairy farms throughout 1991. 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, and cesium-137. Only cesium-137 was found above minimum detectable concentration levels in near-site samples. To obtain a conservative estimate, the average background concentration was subtracted from the near-site sample from one location with the highest reported concentrations. Based on an annual consumption rate of 310 liters (327 qts), the maximum collective EDE (CEDE) from drinking this milk was estimated to be $2.7x10^{-2}$ mrem ($2.7x10^{-4}$ mSv).

Beef

Near-site and control samples of locally raised beef were collected in mid- and late 1991. These samples were measured for strontium-90, cesium-134, cesium-137, and potassium-40 concentrations. (Potassium-40 provides a built-in calibration spike from a natural isotope of potassium not released in Project effluents.) Only cesium-134 was detected above the minimum detectable concentration level in the maximum near-site sample, with the highest excess concentration reported during late 1991. Based on an annual consumption rate of 110 kilograms (242 lbs), the maximum CEDE from eating this meat was estimated to be $1.8x10^{-1}$ mrem ($1.8x10^{-3}$ mSv).

Venison

Meat samples from three near-site and three control deer were collected in the last months of 1991. These samples were measured for strontium-90, cesium-134, cesium-137, and potassium-40 concentrations. Only cesium-134 was detected above minimum detectable concentration levels. Based on an annual consumption rate of 45 kilograms (99.1 lbs), the maximum CEDE from eating this meat was estimated to be $9.7x10^{-3}$ mrem ($9.7x10^{-5}$ mSv).

Produce (Beans, Apples, and Corn)

Near-site and control samples of beans, apples, and corn were collected in 1991. These samples were measured for tritium, strontium-90, potassium-40, cobalt-60, and cesium-137 concentrations. Only strontium-90 in beans was detected above the minimum detectable concentration level. Based on an annual consumption rate of 52 kilograms (115 lbs), which is one-tenth of the maximum

TABLE 4 - 1

SUMMARY OF DOSE ASSESSMENT FROM 1991 WEST VALLEY DEMONSTRATION PROJECT EFFLUENTS

	Maximum Dose to an Individual [1]	Maximum Dose to the Population [2]
Effective Dose Equivalent from Airborne Emissions [3]	4.9E-04 mrem (4.9E-06 mSv)	4.7E-03 person-rem (4.7E-05 person-Sv)
(percent of EPA standard)	(4.9E-03%)	NA
EPA Radiation Protection Standard [4]	10 mrem	NA
Effective Dose Equivalent from Liquid Effluents [5]	5.5E-02 mrem (5.5E-04 mSv)	1.1E-02 person-rem (1.1E-04 person-Sv)
Effective Dose Equivalent from all Releases	5.5E-02 mrem (5.5E-04 mSv)	1.6E-02 person-rem (1.6E-04 person-Sv)
(percent of DOE standard)	(0.06%)	NA
(percent of background)	(0.02%)	(3.1E-06%)
DOE Radiation Protection Standard [6]	100 mrem	NA
Background Effective Dose Equivalent [7]	300 mrem (3 mSv)	510,000 person-rem (5100 person-Sv)

[1] Maximally exposed individual at a residence 1.9 km NNW from the main plant.

[2] Population of 1.7 million within 80 km of the site.

[3] Calculated using AIRDOS-EPA (CAP88-PC for individual and population).

[4] Airborne emissions only.

[5] Calculated using methodology described in WVDP-065, Rev.2 (10/5/90).

[6] Applies to combined doses from both airborne and liquid effluents.

[7] U.S. average (NRCP 1987).

Note: In scientific notation 4.9E-04 = $4.9x10^{-4}$

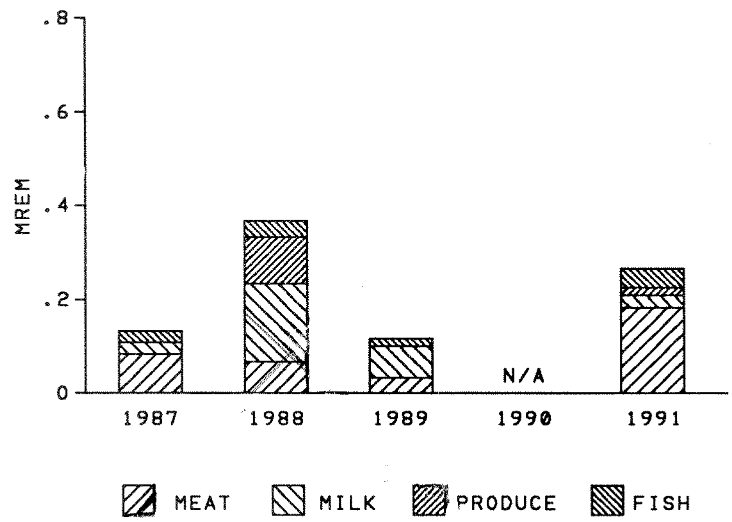


Figure 4-4. Maximum Committed Effective Dose Equivalent (mrem) to an Individual from Consumption of Foods Produced Near the West Valley Demonstration Project.

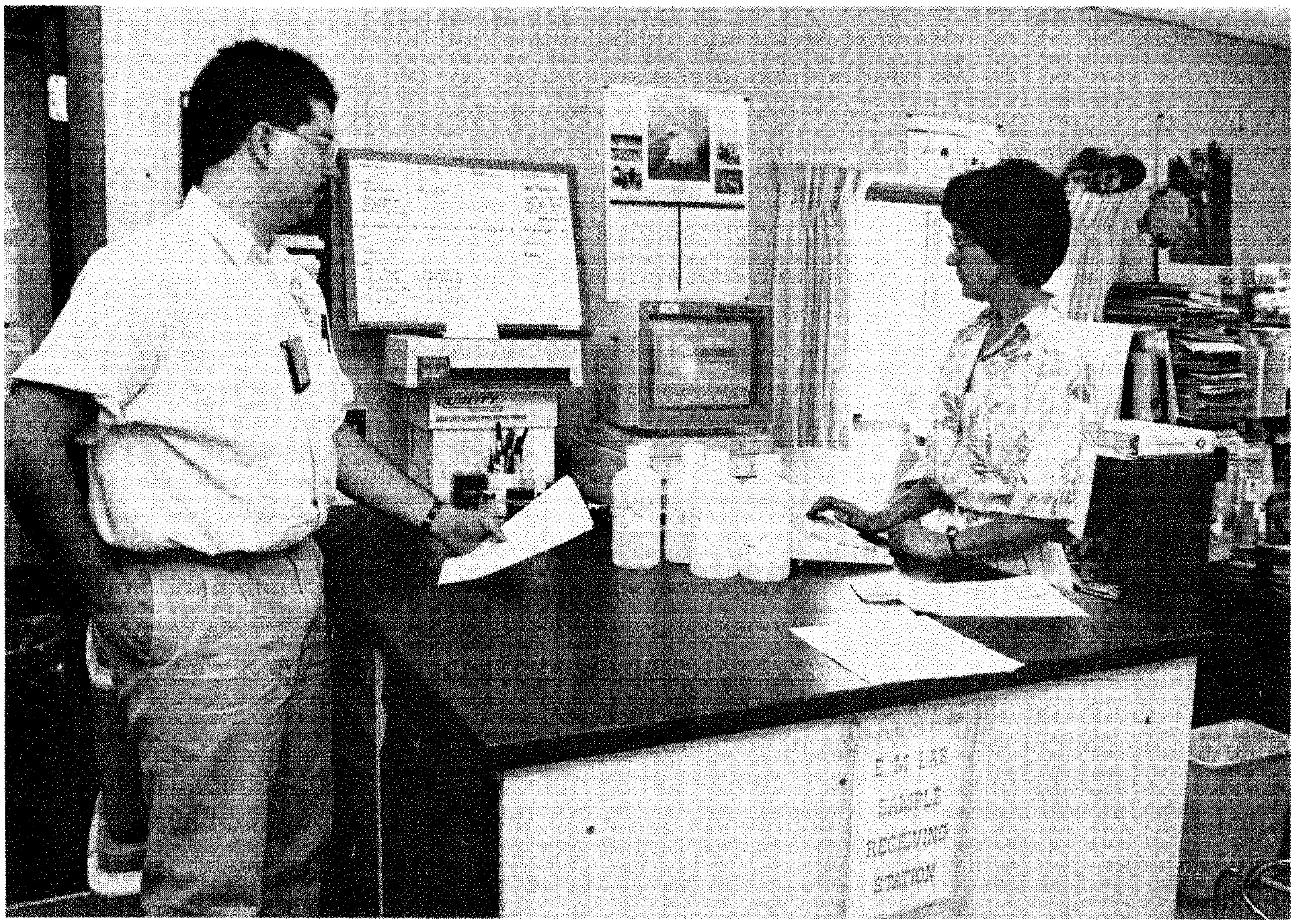
annual consumption rate of 520 kilograms (1150 lbs) for all produce, the maximum CEDE from eating these beans was estimated to be 1.3×10^{-2} mrem (1.3×10^{-4} mSv).

Fish

Fish were caught in the second and third quarters of 1991 in Cattaraugus Creek upstream (control samples) and downstream of the site (above and below the Springville dam). Samples of fish flesh were measured for strontium-90, cesium-134, and cesium-137 concentrations. Only strontium-90 was detected above minimum detectable concentration levels, with the highest excess concentration reported in fish caught upstream of the Springville dam. Based on an annual consumption rate of 21 kilograms (46 lbs), the maximum CEDE from eating this fish was estimated to be 3.5×10^{-2} mrem (3.5×10^{-4} mSv).

Conclusions

Based on dose assessment, the West Valley Demonstration Project during 1991 was in compliance with all applicable EPA standards and DOE Orders. The effective dose equivalent to members of the public estimated from effluent dispersion models and radionuclide concentrations in food samples was below the dose limits, indicating no measurable effects on the public's health.



Computerized Sample Receiving Station in the Environmental Laboratory

Quality Assurance

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

Organizational Responsibilities

The Safety and Environmental Assessment (S&EA) department is responsible for ensuring the quality of the environmental monitoring program. Environmental Laboratory management and staff are directly responsible for carrying out sampling and analytical activities in a manner consistent with good quality assurance practices.

Program Design

The quality assurance program for environmental monitoring at the WNYNSC is consistent with DOE Order 5700.6C, *Quality Assurance*, and the WVDP's *Environmental Quality Assurance Plan* (WVNS 1991), and is based directly upon the eighteen-element program outlined in *Quality Assurance Program Requirements for Nuclear Facilities* (American Society of Mechanical Engineers 1989), which describes the major aspects of a good quality assurance program. The program focuses upon assigning responsibilities and upon thorough planning, specification, control, and documentation of all aspects of an activity:

√ ***Responsibility.*** Responsibilities involved in overseeing and managing an activity are clearly defined. Personnel who check and verify the activity are independent of those who perform the activity.

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

√ ***Control of design, procedures, items, and documents.*** Any activity, equipment, or construction is clearly described or defined and tested, and changes in the design are tested and documented. Procedures clearly state what will be done and are followed. Any equipment or particular items are clearly identified, inspected, calibrated, and tested before use. Calibration status is clearly labeled. Items that do not conform are identified and separated from other items and the nonconformity is documented. Only approved procedures are used.

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

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

√ ***Audits.***

Scheduled audits and self-assessments verify compliance with all aspects of the quality assurance program and determine its effectiveness.

Any vendors providing analytical services for the environmental monitoring program are contractually required to maintain a quality assurance program consistent with these elements.

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 must be trained in that procedure and demonstrate proficiency.

New procedures are developed each time an activity is added to the monitoring program. Procedures are reviewed annually and are updated when necessary. All procedures are controlled so that only those that are current 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 is consistent and repeatable and is a means of tracking down possible sources of error. For example, 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.

Samples are collected into appropriate containers and labeled immediately with pertinent information. Date, time, person doing the collecting, and special field sampling conditions are recorded and become part of the record for that sample. If necessary, samples are preserved as soon as possible after collection.

In order to monitor 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 at the same location at the same time. From that point, they are treated as separate samples. Field duplicates provide a means of assessing the precision of collection methods and 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. No field contamination problems have been detected.

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 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 on the site have collecting equipment that remains at that location. This equipment is "dedicated" equipment, and special equipment blanks are not necessary at these locations because the equipment is used exclusively at that site.

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 and remain there throughout the sampling. Trip blanks are collected only when volatile organics are being monitored in order to detect any volatile organic contamination from the containers, coolers, or from handling during collection, storage, or shipping. No contamination from these sources has been found.

Environmental background samples:

The environmental monitoring program includes samples taken from locations remote from the site for each pathway being monitored for possible radiological contamination, such as air, water, vegetation, and meat. Analysis of these samples that are clearly outside of site influence show natural radiological concentrations and serve as backgrounds or "controls," another form of field quality control sample. These 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

In order to monitor the accuracy and precision of data produced by the Environmental Laboratory, laboratory quality control practices specific to each analytical method are clearly described in approved references or procedures. Laboratory quality control consists of proper training of analysts, maintenance and calibration of measuring equipment and instrumentation, and specific methods of processing samples 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. Results of Environmental Laboratory and vendor laboratory analyses also are compared to certified results from laboratories operated by the Department of Energy and the Environmental Protection Agency.

Standards:

Laboratory standards are materials containing a known concentration of the analyte of interest, such as a pH buffer or a Pu-239 counting standard, and are either NIST-traceable standards or standard reference materials from other sources. At a minimum, one reference standard is analyzed for every ten sample analyses, or one per day, to determine if the method is producing results within acceptable limits.

The results of analyses of standards are plotted on control charts, which specify acceptable limits. If the method of analysis produces results within acceptable limits, then analysis of actual environmental samples may proceed and the results deemed useable.

Laboratory spikes:

Another form of standard analysis is a laboratory spike, in which a known amount of analyte is added to a sample or blank before the sample is analyzed. The percent recovery of the analyte is an indication of 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. Acceptance limits are documented for spike recovery and spike results are recorded on control charts.

Control charts are routinely monitored. To supplement the routine analysis of standards, quality control samples of known concentrations are submitted to analysts in the laboratory by the S&EA quality assurance staff. The concentrations of the samples are unknown to the analyst and serve as an additional performance check on the accuracy of Environmental Laboratory analyses.

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, serves as a laboratory blank for both radiological and chemical water analyses. 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 "run" of samples for a given analyte.

S&EA quality assurance staff also provide blank samples to check possible cross-contamination in the Environmental Laboratory.

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 in calculations of radiological activity.

A background count is taken before each day's counting. Background counts with defined acceptance limits are recorded on control charts. An unacceptable count will require 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 criteria of acceptability. As with standards, duplicate samples are submitted for analysis by S&EA quality assurance personnel as an additional performance check on laboratory precision.

Crosschecks:

The Environmental Laboratory participates in formal radiological crosscheck programs conducted by the Department of Energy's Radiological and Environmental Science Laboratory (RESL), the Environmental Monitoring Systems Laboratory of the USEPA (EMSL) in Las Vegas, and the Environmental Measurements Laboratory (EML) in New York City. Crosscheck performance is summarized in Appendix D.

In conjunction with the on-site Analytical and Process Chemistry Laboratory, the Environmental Laboratory maintains certification with the New York State Department of Health (NYSDOH) to analyze samples for various nonradiological parameters.

More than 13,000 measurements were made by the Environmental Laboratory in 1991, including samples collected by laboratory staff and samples submitted to the laboratory by other departments or agencies. Roughly 60% of these samples were analyzed by the Environmental Laboratory staff, with the rest being sent to other laboratories.

Samples not analyzed by the Environmental Laboratory must maintain a similar level of quality control that is specified in contracts between the site and the vendor laboratories. Vendor laboratories are required to participate in all relevant crosschecks and to maintain all relevant certifications.

Personnel Training

Anyone performing environmental monitoring program activities must be trained in the appropriate procedures and qualified accordingly before carrying out the procedure 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 all maintained as documentation of the environmental monitoring program. All records pertaining to the program are reviewed routinely and securely stored.

The Laboratory Information Management System (LIMS), installed in the Environmental Laboratory in late 1990, is used to log samples, print labels, store and process data, monitor quality control samples, track samples, produce sampling and analytical worklists, and generate reports. In late 1991 a major vendor laboratory began providing data in electronic form for direct entry into the LIMS.

Chain-of-custody Procedures

Field data sheets, which are filled out when samples are collected, serve as chain-of-custody records for routine samples. Samples are brought in from the field and logged at the sample receiving station, after which they are stored in a sample lock-up before analysis or shipping.

Samples sent to other laboratories for analysis are accompanied by a chain-of-custody/analytical request form. Signature control must be maintained by the agent transporting the samples. By contract, vendor laboratories are required to maintain internal chain-of-custody records and to store the samples under secure conditions.

Audits

Routine internal appraisals of the Safety & Environmental Assessment Department and the Environmental Laboratory are conducted by site quality assurance personnel, who also audit the environmental monitoring programs. Off-site commercial laboratories under contract to perform environmental analyses for the WVDP are audited at least annually by teams of environmental and quality assurance professionals. In addition, external agencies audit the program as a whole. (See the *Environmental Compliance Summary: Calendar Year 1991.)*

Performance Reporting

The performance of the laboratory in crosscheck programs is published in the summary of results for each crosscheck. The Environmental Laboratory results are compared with the true value for the samples and with those of other laboratories participating in the crosscheck. Crosscheck summaries are issued when results are received and the causes of missed crosscheck analyses are investigated as part of the corrective action process.

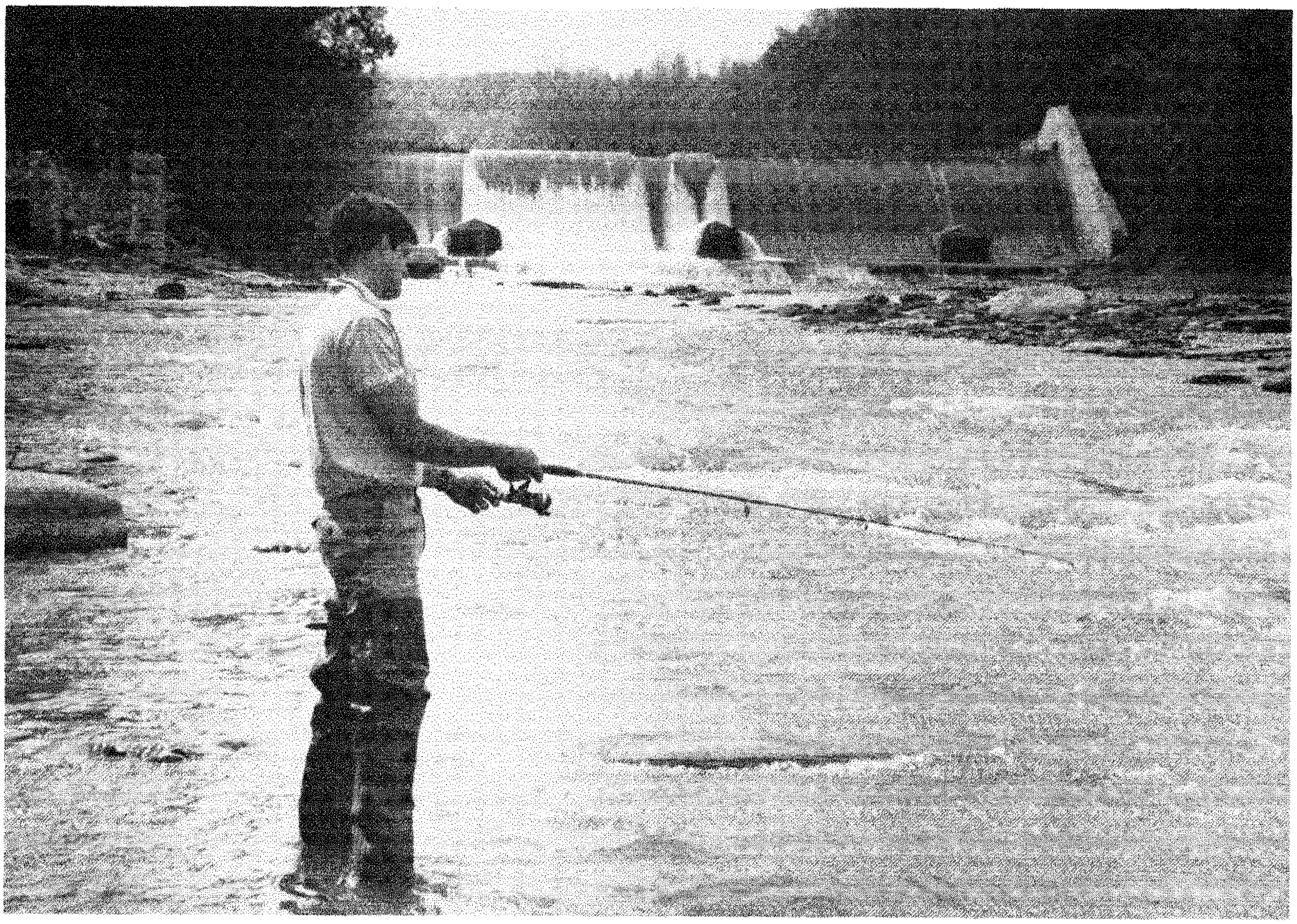
Monthly trend analysis reports document possible warning levels or trends picked up as part of the environmental monitoring program.

Monthly State Pollutant Discharge Elimination System (SPDES) discharge reports are generated and submitted to the New York State Department of Environmental Conservation (NYSDEC). These reports document analysis of permitted water discharges required by NYSDEC.

Independent Data Verification

All Environmental Laboratory analytical data is reviewed and approved by a qualified person other than the person conducting the analysis. As part of the verification procedure, quality control samples analyzed in conjunction with the samples are examined and calculations are checked before approval. S&EA quality assurance personnel also conduct checks of the data in addition to the initial routine reviews. All software used to generate data is subjected to a verification procedure before being used.

Data must be formally evaluated and approved before being reported or used in calculations. Reports generated from data are peer reviewed before being issued. In addition, the correct transcription of data from data packets to the LIMS must be verified before the sample data in the LIMS can be formally approved and used in reports.



Environmental Sampling —An Art As Well As A Science

Appendix A

1991 Environmental Monitoring Program

1991 Environmental Monitoring Program

The following schedule represents the West Valley Demonstration Project's routine environmental monitoring program for 1991. This schedule meets or exceeds the minimum program needed to satisfy the requirements of DOE ORDER 5400.1. It also meets requirements of DOE ORDER 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 are the bases for selecting most of the schedule specifics. Additional monitoring is mandated by operational safety requirements (OSRs) and air and water discharge permits (40 CFR 61 and SPDES), which also require a formal report. These specific cases are identified in the schedule under "Monitoring/Reporting Requirements."

Schedule Of Environmental Sampling

The following table is a schedule of environmental sampling at the West Valley Demonstration Project. Locations of the sampling points are shown in Figures A-1 through A-9. The index below is a list of the codes for various sample locations. Table headings in the schedule are as follows:

Sample Location Code. The physical location where the sample is collected is described. The code consists of seven characters: The first character identifies the sample medium as Air, Water, Soil/Sediment, Biological, or Direct Measurement. The second character specifies oN-site or oFf-site. The remaining characters describe the specific location (e.g., AFGRVAL is Air oFf-site at GReat VALley).

Monitoring/Reporting Requirements. The basis for monitoring that location, any additional references to permits or OSRs, and the reports generated from the sample data are noted here.

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. Describes the number of discrete physical samples collected annually for each analyte.

Analyses Performed/Composite Frequency. Describes the kind of analyses, the frequency of sample compositing, and the analytes measured in the composited samples.

Summary Of Monitoring Program Changes In 1991

Location Code	Description of Changes
WNSP006 WNSWAMP WNSW74A WFBCBKG	Added semiannual grab samples for analysis of TOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3, F, HCO_3, and CO_3.
WNSP007	Added Sr-90 and gamma scan to analyses of 24-hour composites collected three times a month.
*WNDCELD	Reduced grab-sample frequency from weekly to monthly.
*WNSTAW Series	Deleted WNSTAW1, WNSTAW2, WNSTAW3, WNSTAW7, and WNSTAW8 from sampling program.
WNW Series	Added ninety-six groundwater monitoring wells to routine program.
WFBCBKG	Analyses added to quarterly composites: C-14, I-129, Pu/U isotopic, Am-241.
WFBIGBR	Added monthly liquid grab-sampling site. Analyzed for gross alpha, gross beta, H-3, Sr-90, and gamma isotopic at background site on Cattaraugus Creek.
AFRSPRD AFGRVAL	Added analysis of U isotopic, Pu isotopic, and Am-241 to air filter samples from closest and farthest site.
On-site Soils	On-site samples at locations SNSW74A, SNSWAMP, and SNSP006 were collected near locations WNSW74A, WNSWAMP, and WNSP006.
*SF Soil Series	Deleted Little Valley background site.

* Require DOE approval before implementation

Index of Environmental Monitoring Program Sampling Points

ON-SITE AIR EFFLUENT SAMPLING POINTS (FIG. A-1)

LIQUID EFFLUENT AND ON-SITE WATER SAMPLING POINTS (FIG. A-2)

ON-SITE GROUNDWATER SAMPLING POINTS AND SEEPS (FIG. A-3)

*Not detailed on map

Index of Environmental Monitoring Program Sampling Points

*Not detailed on map

OFF-SITE BIOLOGICAL SAMPLING POINTS (FIGS. A-5 AND A-9)

DIRECT MEASUREMENT DOSIMETRY (FIGS. A-7, A-8, AND A-9)

1991 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
	Airborne radioactive effluent points including LWTS and Vitrification Off-Gas	Continuous off-line air particulate monitors	→ Continuous measurement of fixed filter, replaced weekly	→ N/A	→ Real time alpha and beta monitoring
ANSTACK Main Plant Ventilation Exhaust Stack **ANSTSTK** Supernatant Treatment System (STS) Ventilation Exhaust	<u>Required by</u>: • OSR-GP-1 • 40 CFR 61 <u>Reported in</u>: • Monthly Environmental Monitoring Trend Analysis • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report • Air Emissions Annual Report (NESHAP)	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, Am-241, gamma isotopic
		Continuous off-line desiccant columns for water vapor collection	→ Weekly	→ 52 each location	→ H-3
		Continuous off-line charcoal cartridges	→ Weekly	→ Weekly cartridges composited to 4 each location	→ Quarterly composite for I-129

*Weekly gamma isotopic only if gross activity rises significantly.

Sampling Rationale	
ANSTACK	DOE/EH-0173T, 3.0; OSR-GP-1, 1.A, 2.B; and DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from most process areas, including cell ventilation, vessel off gas, FRS and head end ventilation, analytical area.
ANSTSTK	DOE/EH-1073T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from building areas involved in treatment of high-level waste supernatant.

1991 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
ANCSSTK Cement Solidification System (CSS) Ventilation Exhaust ANCSRFK Contact Size Reduction Facility Exhaust	Airborne radioactive effluent points Required by: • OSR-GP-1 • 40 CFR 61 Reported in: • Monthly Environmental Monitoring Trend Analysis • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report • 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, Am-241, gamma isotopic
		Continuous off-line charcoal cartridges	→ Weekly	→ Weekly cartridges composited to 4 each location	→ Quarterly composite for I-129

*Weekly gamma isotopic only if gross activity rises significantly.

Sampling Rationale	
ANCSSTK	DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from process areas and cell used for decontaminated high-level radioactive supernatant solidification with cement.
ANCSRFK	DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and 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.

1991 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: • OSR-GP-1 • 40 CFR 61 Reported by: • Monthly Environmental Monitoring Trend Analysis • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report • 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 (maximum of 26 operating weeks expected)	→ Collected and replaced every seven operating days, or at least monthly when unit is operated	→ 26	→ Filters for gross alpha/beta, gamma isotopic* upon collection
				Collected filters composited to 4	→ Quarterly composites for Sr-90, Pu/U isotopic, Am-241, gamma isotopic

*Weekly gamma isotopic only if gross activity rises significantly.

Sampling Rationale	
ANSUPCV	DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from area where low-level radioactive waste volume is reduced by compaction.

1991 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: • OSR-GP-2 • SPDES Permit Reported in: • Monthly SPDES DMR • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report	Grab liquid	→ Daily, during Lagoon 3 discharge[a]	→ 40-80	→ Daily for gross beta, conductivity, pH, flow
				7-12	→ Every 6 days a sample is analyzed for gross alpha/beta, H-3, Sr-90, gamma isotopic
				Daily samples composited to 4-6	→ Weighted monthly composite for gross alpha/beta, H-3, C-14, Sr-90, I-129, gamma isotopic, Pu/U isotopic, Am-241
		Composite liquid	→ Twice during discharge, near start and near end	→ 8-16	→ Two 24-hour composites for Al, NH_3, As, BOD-5, Fe, Zn, pH, suspended solids, SO_4, NO_3, NO_2, Cr^{+6}, Cd, Cu, Pb, Ni
		Grab liquid	→ Twice during discharge, near start and near end	→ 8-16	→ Settleable solids, pH, cyanide amenable to chlorination, oil and grease, Dichlorodifluoromethane, Trichlorofluoromethane, 3,3-Dichlorobenzidine, Tributylphosphate, Vanadium
		Composite liquid	→ Annually	→ 1	→ Annually, a 24-hour composite for: Cr, Se, Ba, Sb
		Grab liquid	→ Annually	→ 1	→ Chloroform
		Grab liquid	→ Semiannually	→ 2	→ Bis(2-Ethylhexyl) Phthalate, 4-Dodecene

[a]Lagoon 3 is discharged between 4 and 8 times per year, as necessary, averaging 10 days per discharge.

Sampling Rationale

WNSP001 DOE 5400.5 and 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 regulations are met for radiological parameters by daily grab sampling during periods of Lagoon 3 discharge. Sampling for chemical constituents is performed near the beginning and end of discharge periods to meet the site SPDES permit. Both grab samples and 24-hour composite samples are collected.

1991 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: • OSR-GP-2 Reported in: • Monthly Environmental Monitoring Trend Analysis • Annual Environmental Monitoring Report	Timed continuous composite liquid	→ Weekly (samples collected simultaneously for NYSDOH)	→ 52	→ Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic and Sr-90
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, Am-241
		Grab liquid	→ Semiannually	→ 2	→ TOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3, F, HCO_3, CO_3
WNSP007 Sanitary Waste Discharge	Liquid effluent point for sanitary and utility plant combined discharge Required by: • SPDES Permit Reported by: • Monthly SPDES DMR • Monthly Environmental Monitoring Trend Analysis • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report	24-hour composite liquid	→ 3 each month	→ 36	→ Gross alpha/beta, H-3, suspended solids, NH_3, BOD-5, Fe, Sr-90, gamma scan
		Grab liquid	→ Weekly	→ 52	→ pH, settleable solids
		Grab liquid	→ Annually	→ 1	→ Chloroform
WNSTPBS Sanitary Waste Sludge	Operational STP Monitoring	Grab sludge	→ On demand (at least monthly)	→ 12	→ Gross alpha/beta, H-3

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.
WNSP007	DOE 5400.5 and 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.
WNSTPBS	DOE 5400.5. Composite of STP surge tank, sludge holding tank, and clarifier sludge analyzed for operational screening.

1991 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 N.E. Swamp Drainage	Site surface drainage Reported in: • Annual Effluent and On-Site Discharge Report	Grab liquid	→ Monthly (samples collected simultaneously for NYSDOH)	→ 12	→ Gross alpha/beta, H-3, pH
		Grab liquid	→ Semiannually	→ 2	→ TOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3, F, HCO_3, CO_3
WNSW74A North Swamp Drainage	Site surface drainage Reported in: • Annual Effluent and On-Site Discharge Report	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, Am-241
		Grab liquid	→ Seimiannually	→ 2	→ TOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3, F, HCO_3, CO_3
WN8D1DR High-Level Waste Farm Underdrain	Drains subsurface water from HLW storage tank area Reported in: • Monthly Environmental Monitoring Trend Analysis	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
				Weekly samples composited to 12 each location	→ Monthly composite for gamma isotopic, Sr-90
WNSP008 French drain	Drains subsurface water from LLWT Lagoon area Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • Annual Effluent and On-Site Discharge Report • Annual Environmental Monitoring Report	Grab liquid	→ 3 each month	→ 36	→ pH, conductivity, BOD-5, Fe
		Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3
		Grab liquid	→ Annually	→ 1	→ Ag, Zn

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 collected 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 collected 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. This site is also monitored as part of the groundwater program (see SSWMU #1).
WNSP008	DOE/EH-0173T, 5.10.1.3. French drain of subsurface water from lagoon (LLWTF) area. NYSDEC SPDES permit also provides for the sampling of this discrete drainage path for uncontrolled subsurface waters before they flow into Erdman Brook. Waters collected 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.

1991 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
WNSP005 Facility Yard Drainage	Combined drainage from facility yard area. Reported in: • Internal Review	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNCOOLW Cooling Tower Basin	Cools plant utility steam system water Reported in: • Internal Review	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNSP003 SDA Holding Lagoon	State Disposal Area Holding Lagoon Reported in: • Annual Environmental Monitoring Report • NYSERDA	Grab liquid	→ Annually (as required)	→ 2	→ Gross alpha/beta, H-3, pH, gamma isotopic, Sr-90,

Sampling Rationale	
WNSP005	Facility yard surface water drainage; generally in accordance with DOE/EH-0173T, 5.10.1.1. Formerly, 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 collected represent surface and subsurface drainages primarily from the main plant yard area. Historically this point was used to monitor sludge pond(s) 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 for radiological parameters primarily.
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. Process knowledge indicates that radiological monitoring is of primary significance.
WNSP003	SDA effluent and area surface water holding lagoon; generally in accordance with DOE/EH-0173T, 5.10.1.1. Formerly, in accordance with NYSDEC SPDES permit no. NY0000973. Operational sampling carried out to characterize waters contained within SDA holding lagoon. Characterization for radiological constituents only as per agreement with NYSERDA.

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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 <u>Reported in:</u> • Internal Review • NYSERDA	Grab liquid	→ Monthly (samples collected simultaneously by NYSDOH)	→ 12	→ Gross alpha/beta, H-3, pH
WNERB53 Erdman Brook N of Disposal Areas	Drains NYS and WVDP disposal areas <u>Reported in:</u> • Internal Review • NYSERDA	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
			→ Monthly sample collected by NYSDOH	→ 12	
WNNDADR Ditch N of WVDP NDA and SDA	Drains WVDP disposal and storage area <u>Reported in:</u> • Internal Review • Monthly Environmental Monitoring Trend Analysis	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
WNDCELD Drainage S of Drum Cell	Drains WVDP storage area <u>Reported in:</u> • Internal Review	Grab liquid	→ Monthly*	→ 12	→ pH, gross alpha/beta, gamma isotopic, H-3
				Monthly samples composited to 4	→ Quarterly composite for Sr-90, I-129

* Reduction of frequency of drum cell monitoring from weekly to monthly is pending DOE approval.

** Treatment system upgraded in 1991.

Sampling Rationale	
WNFRC67	DOE/EH-0173T, 5.10.1.1. Monitoring the potential influence of both the New York State low-level waste disposal area (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.

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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	Sources of potable water within site perimeter Reported in: • Internal Review	Grab liquid	→ Monthly	→ 12 each per location	→ Gross alpha/beta, H-3, pH
WNDNKEL Environmental Lab Drinking Water		Grab liquid	→ Annually*	→ 1 each location	→ Toxic metals, pesticides, chemical pollutants
WNDNKUR Potable Water Storage Tank (UR)		Grab liquid	→ Quarterly**	→ 8	→ Volatile organic compounds

*WNDNKEL and WNDKUR only.

Sampling Rationale	
WNDNK Series	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.3. 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, 5.10.1.3. 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, 5.10.1.3. Same rationale as WNDNKMS but sampled at the main plant water fountain.
WNDNKEL	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.3. Potable water sampled at the Environmental Laboratory in order to monitor the point farthest away from the point of potable water generation.
WNDNKUR	Site drinking water; generally according to DOE/EH-0173T, 5.10.1.3. Sampled at the Utility Room so as to monitor the point closest to the point of potable water generation.

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ENVIRONMENTAL SURVEILLANCE:

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 includes: **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 groundwater effluent Reported in: • Internal Review	Grab liquid →	Annually →	1* each location →	Gross alpha/beta, H-3, pH, conductivity, chloride, Fe, Mn, Na, phenols, 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. This reduction of sites is pending DOE approval.
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 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 km north of the WVDP.

1991 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
Low-Level Waste Treatment Facilities (SSWMU #1) WNW 0103 U 0104 U 0105 0106 0107 0108 0109 0110 0111 0114 0115 0116 8603 8604 8605 Surface: WNSP008 Miscellaneous Small Units (SSWMU #2) WNW 0201 U 0202 U 0203 U 0204 U 0205 0206 0207 0208 8606	Groundwater monitoring wells around site super solid waste management units (SSWMUs) Reported in: • Annual Environmental Monitoring Report • RCRA RFI Reports	Grab liquid	→ 4 times semiannually	→ 8 each well	→ Gross alpha/beta, H-3, gamma isotopic, TOC, TOX, VOA
		Direct measurement of sample discharge water	→ Before and after grab sample collection	→ 16 each well	→ Temperature, pH, conductivity
		Grab liquid	→ Semiannually	→ 2 each well	→ Cl, Mn, Na, K, Ca, Mg, Fe, Phenols, SO_4, NH_3, NO_3+NO_2-N, HCO_3, CO_3
		Grab liquid	→ 4 times annually - first year of monitoring only	→ 4 each well	→ As, Ba, Cd, Cr, F, Pb, Hg, Se, Ag, Endrin, Lindane, Methoxychlor, 2,4,5-TP (Silvex), 2,4-D, Toxaphene, Radium, NO_3+NO_2-N, Turbidity

NOTE: "U" designates upgradient well; "B" designates background well; the remainder are downgradient. Sampling and analysis conducted as outlined in the RCRA Groundwater Technical Enforcement Guidance Document (EPA OSWER 9950.1) and the Statistical Analysis of Monitoring Data at RCRA Facilities (EPA/530-SW-89-026). Well WNW8604 is being re-evalutated for possible SSWMU reassignment.

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. The groundwater monitoring program covered in the "Sampling and Analysis Plan (SAP) Groundwater Monitoring Network," Draft W, October 1990, in the Annual Site Groundwater Protection Management Program Plan, WVDP-091, and in the 1991 RCRA RFI Workplan.
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, and the kerosene tank.

1991 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
Liquid Waste Treatment System (SSWMU #3) WNW 0301 U 0302 U 0305 xx0306 0307 NB1S B HLW Storage and Processing Tank (SSWMU #4) WNW 0401 U 0402 U 0403 U 0404 U 0405 0406 0407 0408 0409 xx0410 U xx0411 U 8607 8608 8609	Groundwater monitoring wells around site super solid waste management units (SSWMUs) Reported in: • Annual Environmental Monitoring Report • RCRA RFI Reports	Grab liquid	→ 4 times semiannually	→ 8 each well	→ Gross alpha/beta, H-3, gamma isotopic, TOC, TOX, VOA
		Direct measurement of sample discharge water	→ Before and after grab sample collection	→ 16 each well	→ Temperature, pH, conductivity
		Grab liquid	→ Semiannually	→ 2 each well	→ Cl, Mn, Na, K, Ca, Mg, Fe, Phenols, SO_4, NH_3, NO_3+NO_2-N, HCO_3, CO_3
		Grab liquid	→ 4 times annually - first year of monitoring only	→ 4 each well	→ As, Ba, Cd, Cr, F, Pb, Hg, Se, Ag, Endrin, Lindane, Methoxychlor, 2,4,5-TP (Silvex), 2,4-D, Toxaphene, Radium, NO_3+NO_2-N, Turbidity

NOTE: "U" designates upgradient well; "B" designates background well; the remainder are downgradient.

xx- Installed wells which are dry and not used for groundwater monitoring. They are not included in the total of 106 wells of the monitoring 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. The groundwater monitoring program covered in the "Sampling and Analysis Plan (SAP) Groundwater Monitoring Network" Draft W, October 1990, in the Annual Site Groundwater Protection Management Program Plan, WVDP-091, and in the 1991 RCRA RFI Workplan.
SSWMU #3	Liquid waste treatment system containing liquid effluent from the supernatant treatment system.
SSWMU #4	High level waste storage and processing area, including the high-level radioactive waste tanks, the supernatant treatment sytem, and the vitrification facility.

1991 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
Maintenance Shop Leach Fields (SSWMU #5) **WNW** **0501 U** **0502** Low-Level Waste Storage Area (SSWMU #6) **WNW** **0601** **0602** **0603 U** **0604** **0605** **8607 U** **8608 U** CPC Waste Storage Area (SSWMU #7) **WNW** **0701 U** **0702** **0703** **0704** **0705** **0706 U** **0707**	Groundwater monitoring wells around site super solid waste management units (SSWMUs) Reported in: • Annual Environmental Monitoring Report • RCRA RFI Reports	Grab liquid	→ 4 times semiannually	→ 8 each well	→ Gross alpha/beta, H-3, gamma isotopic, TOC, TOX, VOA
		Direct measurement of sample discharge water	→ Before and after grab sample collection	→ 16 each well	→ Temperature, pH conductivity
		Grab liquid	→ Semiannually	→ 2 each well	→ Cl, Mn, Na, K, Mg, Ca, Fe, Phenols, SO_4, NH_3, NO_3+NO_2-N, HCO_3, CO_3
		Grab liquid	→ 4 times annually - first year of monitoring only	→ 4 each well	→ As, Ba, Cd, Cr, F, Pb, Hg, Se, Ag, Endrin, Lindane, Methoxychlor, 2,4,5-TP (Silvex,) 2,4-D, Toxaphene, Radium, NO_3+NO_2-N, Turbidity

NOTE: "U" designates upgradient well; "B" designates background well; the remainder are downgradient.

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 determinaton 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. The groundwater monitoring program is covered in the "Sampling and Analysis Plan (SAP) Groundwater Monitoring Network" Draft W, October 1990, in the Annual Site Groundwater Protection Management Program Plan, WVDP-091, and in the 1991 RCRA RFI Workplan.
SSWMU #5	Maintenance shop sanitary leach field, formally 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.

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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 (SSWMU #8) WNW **0801** U **0802** **0803** **0804** U **WNGSEEP** **WNDMPNE** **8612**	Groundwater monitoring wells around site super solid waste management units (SSWMUs) Reported in: • Annual Environmental Monitoring Report • RCRA RFI Reports	Grab liquid	→ 4 times semiannually	→ 8 each well	→ Gross alpha/beta, H-3, gamma isotopic, TOC, TOX, VOA
		Direct measurement of sample discharge water	→ Before and after grab sample collection	→ 16 each well	→ Temperature, pH, conductivity
		Grab liquid	→ Semiannually	→ 2 each well	→ Cl, Mn, Na, K, Mg, Fe, Ca, Phenols, SO_4, NH_3, NO_3+NO_2-N, HCO_3, CO_3
NRC-licensed disposal area (SSWMU #9) WNW **0901** U **0902** U **0903** **0904** **0905** **0906** **0907** **0908** U **8610** **8611**			→ 4 times annually - first year of monitoring only	→ 4 each well	→ As, Ba, Cd, Cr, F, Pb, Hg, Se, Ag, Endrin, Lindane, Methoxychlor, 2,4,5-TP (Silvex), 2,4-D, Toxaphene, Radium, NO_3+NO_2-N,Turbidity
RTS Drum Cell (SSWMU #10) WNW **1001** U **1002** **1003** **1004** **1005** U **1006** **1007** **1008b** B **1008c** B					

NOTE: "U" designates upgradient well; "B" designates background well; the remainder are downgradient.

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. The groundwater monitoring program is covered in the "Sampling and Analysis Plan (SAP) Groundwater Monitoring Network," Draft W, October 1990, and in the Annual Site Groundwater Protection Management Program Plan, WVDP-091, and in the 1991 RCRA RFI Workplan.
SSWMU #8	Construction and demolition debris landfill, used by NFS and the WVDP to dispose of nonhazardous and nonradioactive materials.
SSWMU #9	NRC-licensed disposal area (NDA) contains radioactive wastes generated by NFS and the WVDP.
SSWMU #10	Radioactive waste treatment drum cell contains stored cement stabilized low-level radioactive waste.

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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) **WNW** **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** Fuel Storage Area **WNW** **8613A** **8613B** **8613C**	Groundwater monitoring wells around site super solid waste management units (SSWMUs) Reported in: • Annual Environmental Monitoring Report • RCRA RFI Reports	Grab liquid	→ 4 times semiannually	→ 8 each well	→ Gross alpha/beta, H-3, gamma isotopic, TOC, TOX, VOA
		Direct measurement of sample discharge	→ Before and after grab sample collection	→ 16 each well	→ Temperature, pH, conductivity
		Grab liquid	→ Semiannually	→ 2 each well	→ Cl, Mn, Na, K, Mg, Pb, Ca, Fe, Phenols, SO_4, NH_3, NO_3+NO_2-N, HCO_3, CO_3
		Grab liquid	→ 4 times annually - first year of monitoring only	→ 4 each well	→ As, Ba, Cd, Cr, F, Pb, Hg, Se, Ag, Endrin, Lindane, Methoxychlor, 2,4,5-TP (Silvex), 2,4-D, Toxaphene, Radium, NO_3+NO_2-N, Turbidity

NOTE: "U" designates upgradient well; "B" designates background well; the remainder are downgradient.

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. The groundwater monitoring program is covered in the "Sampling and Analysis Plan (SAP) Groundwater Monitoring Network," Draft W, October 1990, in the Annual Site Groundwater Protection Management Program Plan, WVDP-091, and in the 1991 RCRA RFI Workplan.
SSWMU #11	State-licensed disposal area (SDA) was operated by NFS as a commercial low level disposal facility and also received wastes from NFS reprocessing operations.
Fuel Storage Area	Monitors groundwater in the vicinity of underground fuel storage tanks; this is not included in any of the SSWMUs.

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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: • Annual Environmental Monitoring Report	Timed continuous composite liquid	→ Biweekly	→ 26	→ pH
				Biweekly samples composited to 12	→ Monthly composite for gross alpha/beta, H-3*
				Biweekly 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: • Monthly Environmental Monitoring Trend Analysis • Annual Environmental Monitoring Report	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
WFBCBKG Buttermilk Creek near Fox Valley	Unrestricted surface water background Reported in: • Monthly Environmental Monitoring Trend Analysis • Annual Environmental Monitoring Report	Timed continuous composite liquid	→ Biweekly	→ 26	→ pH
				Biweekly samples composited to 12	→ Monthly composite for gross alpha/beta, H-3*
				Biweekly samples composited to 4	→ Quarterly composite for gamma isotopic, Sr-90, C-14, I-129, Pu/U isotopic, Am-241
		Grab liquid	→ Semiannually	→ 2	→ TOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3, F, HCO_3, CO_3
WFBIGBR Cattaraugus Creek at Bigelow Bridge	Unrestricted surface water background	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, Sr-90, and gamma isotopic

*Monthly composite is composited quarterly for 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.

Since Buttermilk Creek is the surface water that receives all WVDP effluents and empties into Cattaraugus Creek, then **WFFELBR** monitors the potential influence of WVDP drainage into Cattaraugus Creek directly downstream of 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.

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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** 4.0 km NW **WFWEL04** 3.0 km NW **WFWEL05** 2.5 km SW **WFWEL06** (background) 29 km S **WFWEL07** 4.0 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: • Annual Environmental Monitoring Report	→ Grab liquid	→ Annual	→ 1 each location	→ Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

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 km south of the Project and is considered a background drinking water source.

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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 **AFSPRVL** 7 km N at Springville **AFWEVAL** 6 km SSE at West Valley **AFDNKRK** 50 km W at Dunkirk (background) **AFBOEHN** 2.3 km SW on Dutch Hill Road **AFRT240** 2.0 km NE on Route 240 **AFRSPRD** 1.5 km NW on Rock Springs Road **AFGRVAL** 29 km S at Great Valley	Particulate air samples around WNYNSC perimeter <u>Reported in</u>: • Annual Environmental Monitoring Report • Monthly Environmental Monitoring Trend Analysis (**AFBOEHN**, **AFRT240**, **AFRSPRD**, and **AFGRVAL** only)	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, U-isotopic**, Pu-isotopic**, Am-241**
		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

U-isotopic, Pu-isotopic and Am-241 analyses conducted at **AFRSPRD and **AFGRVAL** only.

AFFXVRD **AFTCORD** **AFRT240**	DOE/EH-0173T, 5.7.4. Air samplers put into service by NFS as part of the site's original monitoring program. Perimeter locations chosen to obtain data from places most likely to provide highest concentrations, based on meteorological data. Sample heads are placed 4 meters above the ground. Note: The remaining air sampling heads are positioned within the human breathing zone above ground.
AFRSPRD	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.
AFBOEHN	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 privately owned property at the perimeter.
AFGRVAL	DOE/EP-0023, 4.2.3 Off-site (remote) sampler considered to be representative of natural background radiation. Located on privately owned property 29 km south of the site (typically upwind). I-129 and H-3 sampled here also.
AFDNKRK	DOE/EP-0023, 4.2.3 Off-site (remote) sampler considered to be representative of natural background radiation. Located 50 km west of the site (upwind) on privately owned property.
AFWEVAL	DOE/EP-0023, 4.2.3 Off-site (remote) sampler located on private property in nearby community within 15 km of the site (southeast).
AFSPRVL	DOE/EP-0023, 4.2.3. Off-site (remote) sampler located on private property in nearby community within 15 km of the site (north).

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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 2.5 km SW **AFFXFOP** 3.0 km SSE **AFTCFOP** 3.7 km NNW **AF24FOP** 2.0 km NE **ANRGFOP** Met tower on-site	Collection of fallout particulate and precipitation around WNYNSC perimeter Reported in: • Annual Environmental Report	Integrating liquid	→ Monthly	→ 12 each location	→ Gross alpha/beta, H-3, pH
SF Soil Series Surface Soil (at each of nine air samplers)	Long-term fallout accumulation Reported in: • Annual Environmental Monitoring Report	Surface plug composite soil	→ Annually	→ 1 each location	→ Gamma isotopic, Sr-90, Pu-239, Am-241, plus U-isotopic 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: • Annual Environmental Monitoring Report	Grab stream sediment	→ Semiannually, (1st sample of SFBCSED and SFSDSED each spring split with NYSDOH) → Annually	→ 2 each location → 1 each location (SFTCSED and SFBCSED only)	→ Gross alpha/beta, gamma isotopic and Sr-90 → U/Pu isotopic, Am-241
SN On-site Soil Series: **SNSW74A** (Near WNSW74A) **SNSWAMP** (Near WNSWAMP) **SNSP006** (Near WNSP006)	Reported in: • Special Report	Surface plug or grab	→ Annual	→ 1 each location	→ Gamma isotopic, Sr-90, Pu-239, Am-241, U-isotopic, also metals and organic analytes to be determined

Sampling Rationale

AFDHFOP **AFFXFOP** **AFTCFOP**	DOE/EP-0023, 4.7.
AF24FOP	Collection of fallout particles and precipitation around the site perimeter established air sampling locations. Indicates short-term effects.
ANRGFOP	Collection of fallout particles and precipitation on-site at the meteorological tower. Indicates short-term effects.
SF Soil Series	DOE/EH-0173T, 5.9.1. **SFWEVAL** (West Valley), **SFFXVRD** (Fox Valley Road), **SFSPRVL** (Springville), **SFTCORD** (Thomas Corners), **SFRT240** (Route 240), SFDNKRK (Dunkirk), **SFBOEHN** (Boehn Road-Dutch Hill), **SFGRVAL** (Great Valley), **SFRSPRD** (Rock Springs Road): Collection of long-term fallout data at established air sampler locations via soil sampling.
SFTCSED	Sediment deposition in Buttermilk Creek immediately downstream of all facility liquid effluents.
SFBCSED	Sediment deposition in Buttermilk Creek upstream of facility effluents (background).
SFCCSED	Sediment deposition in Cattaraugus Creek at Felton Bridge. Location is first access point of Cattaraugus Creek downstream of the confluence with Buttermilk Creek.
SFSDSED	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	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.
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).
SNWSWAMP	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).

1991 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 Cattaraugus Creek downstream of the Buttermilk Creek Confluence **BFFCTRL** Control Sample from nearby stream not affected by WVDP (7 km or more upstream of site effluent point) **BFFCATD** Cattaraugus Creek downstream of Springville Dam	Fish in waters up and downstream of facility effluents Reported in: • Annual Environmental Monitoring Report	Individual collection, biological	Semiannually, (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, 9 km WNW **BFMCTLS** Control location 25 km S **BFMCTLN** Control location 30 km N **BFMWIDR** Dairy farm, 3.5 km SE of site **BFMHAUR** Dairy farm 2.5 km SSW	Milk from animals foraging around facility perimeter Reported in: • Annual Environmental Monitoring Report	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, BFMHAUR**) →	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	Background control fish sample.
BFMREED **BFMCOBO** **BFMWIDR** **BFMHAUR**	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**	Background control milk samples collected far from site.

1991 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) **BFHNEAR** Beef cattle/milk cow forage from near-site location	Fruit and vegetables grown near facility perimeter downwind if possible Reported in: • Annual Environmental Monitoring Report	Grab biological (fruits and vegetables)	→ Annually, 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		Grab biological	→ Annually **(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	Meat (beef foraging near facility perimeter, downwind if possible) Reported in: • Annual Environmental Monitoring Report	Grab biological	→ Semiannually	→ 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	Meat (deer foraging near facility perimeter) Reported in: • Annual Environmental Monitoring Report	Individual collection biological	→ Annually, 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

BFVNEAR DOE/EH-0173T, 5.8.2.2.

Fruits and vegetables collected from areas near the site. 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 with either beef or milk sample location.

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. 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. For animals foraging downwind in areas of maximum probable site impact.

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.

1991 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 Dosimetery (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** 1500 m NW (downwind receptor) **#21** Springville 7 km N **#22** West Valley 5 km SSE **#23** Great Valley 9 km S (background) **#37** Dunkirk 50 km NW (background) **#41** Sardinia-Savage Road 24 km NE (background)	Direct radiation around facility Reported in: • Monthly Environmental Monitoring Trend Analysis • Annual Environmental Monitoring Report	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 and 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, a biennial HPIC gamma radiation measurement is completed at all TLD locations.

1991 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) Onsite: **#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	Direct radiation on facility grounds Reported in: • Monthly Environmental Monitoring Trend Analysis • Annual Environmental Monitoring Report	Integrating LiF TLD	→ Quarterly	→ 5 TLDs at each of 18 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., Rock Springs Road), is below 100 mr/annum from site activities. Potential TLD sampling locations are continually evaluated with respect to site activities.

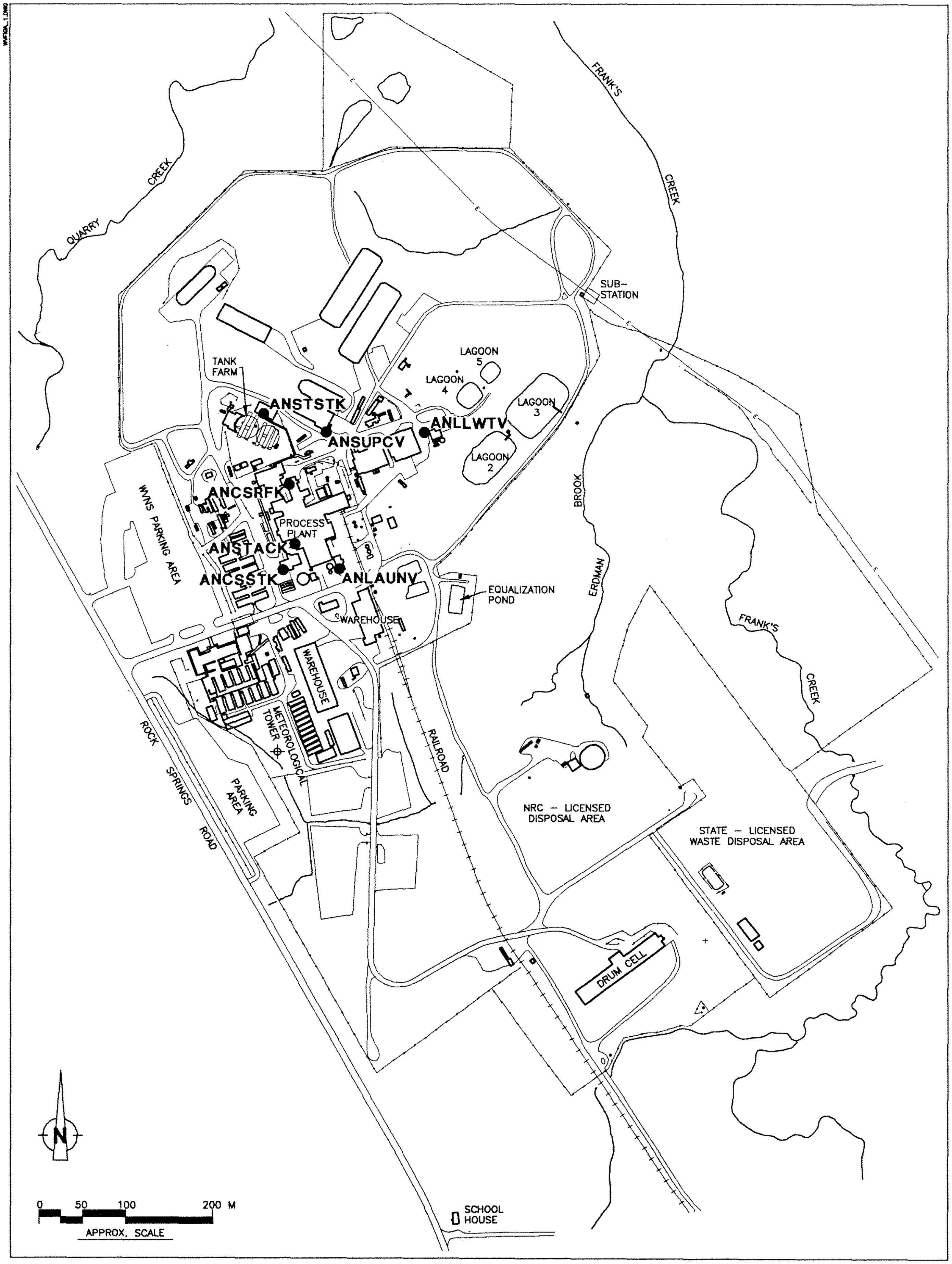


Figure A-1. Location of On-Site Air Effluent Points.

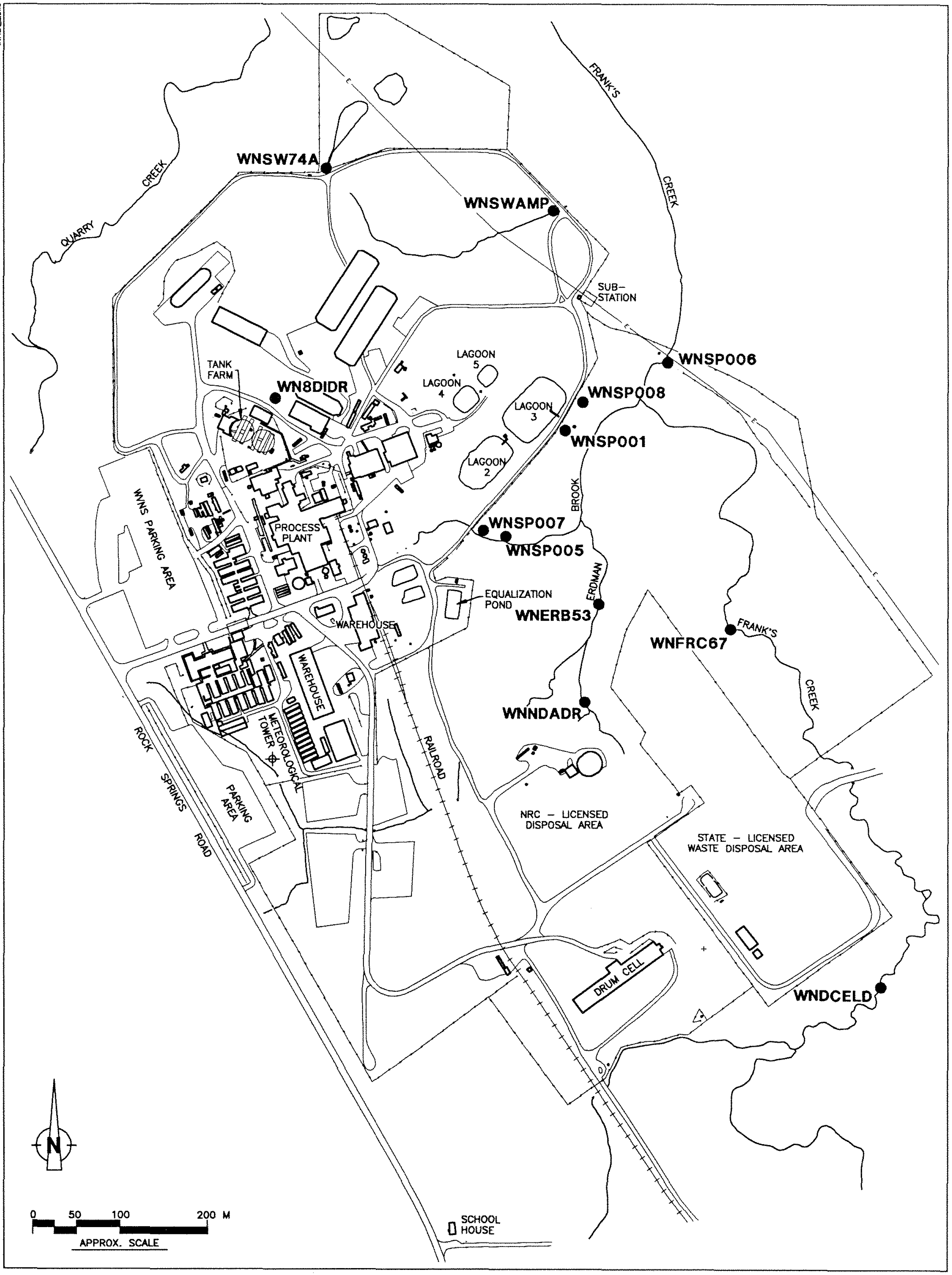


Figure A-2. Sampling Locations for On-Site Surface Water.

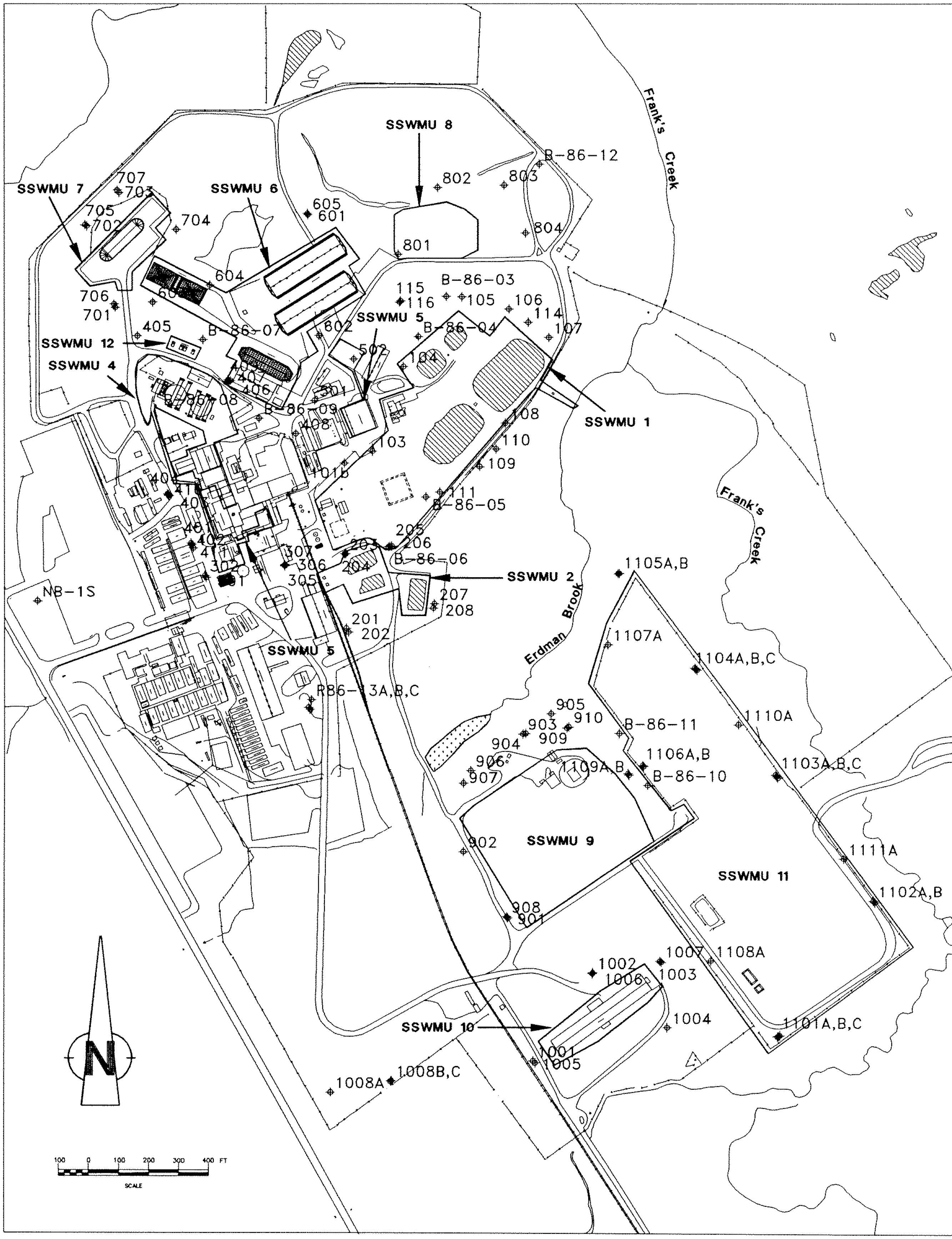


Figure A-3. Location of On-site Groundwater Monitoring Network Wells

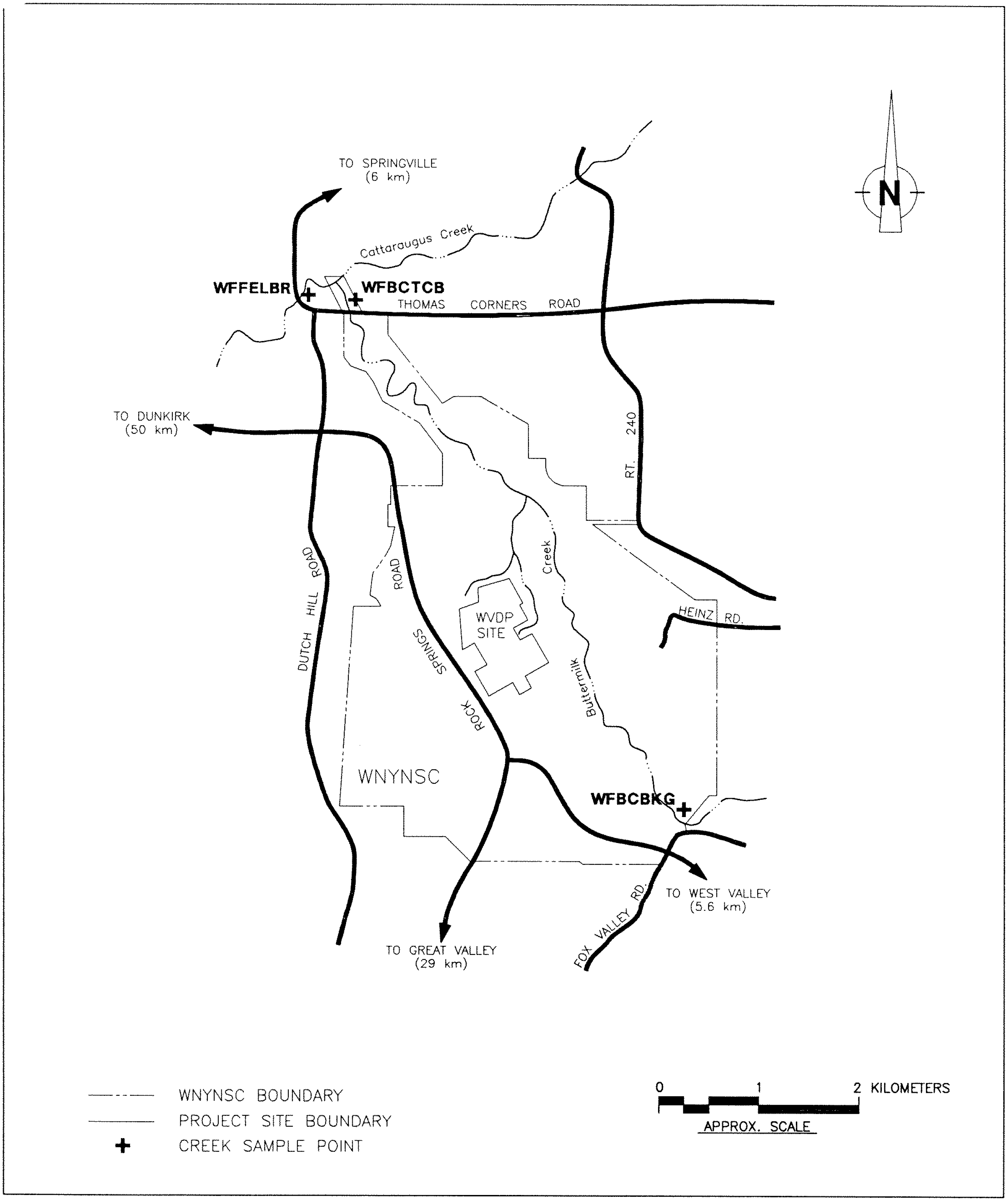


Figure A-4. Location of Off–Site Surface Water Samplers.

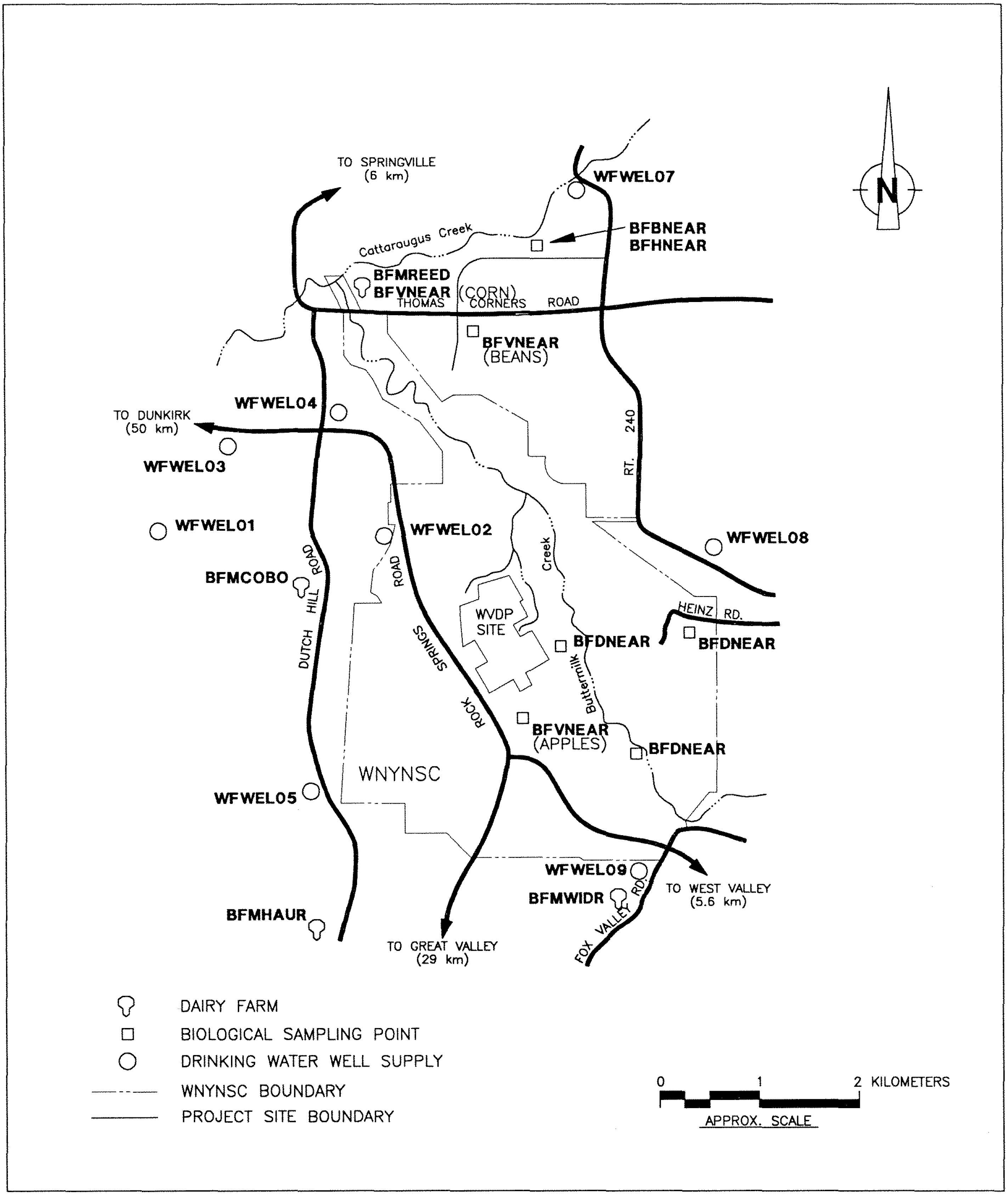


Figure A-5. Near–Site Drinking Water and Biological Sampling Points – 1991.

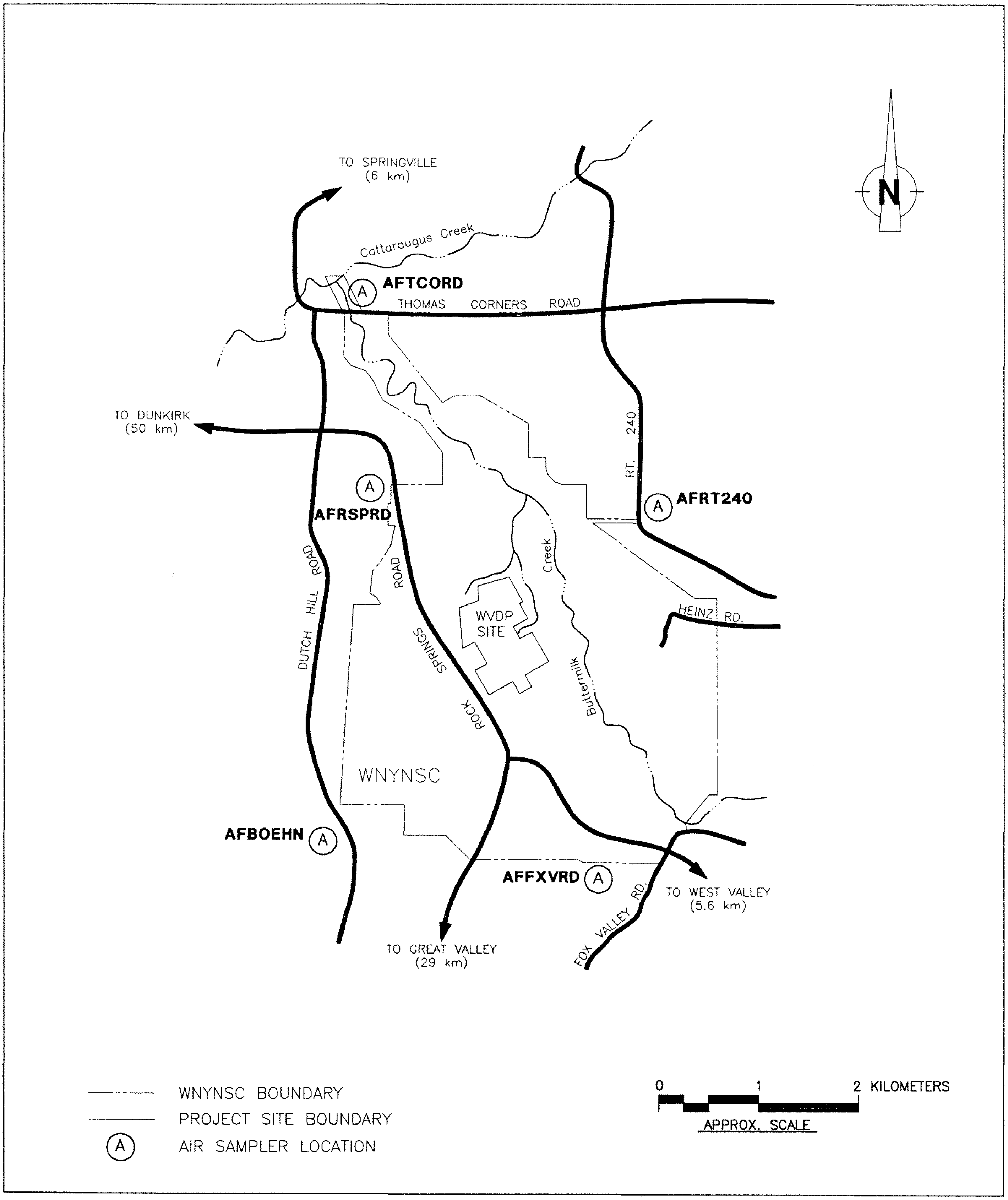


Figure A-6. Location of Perimeter Air Samplers.

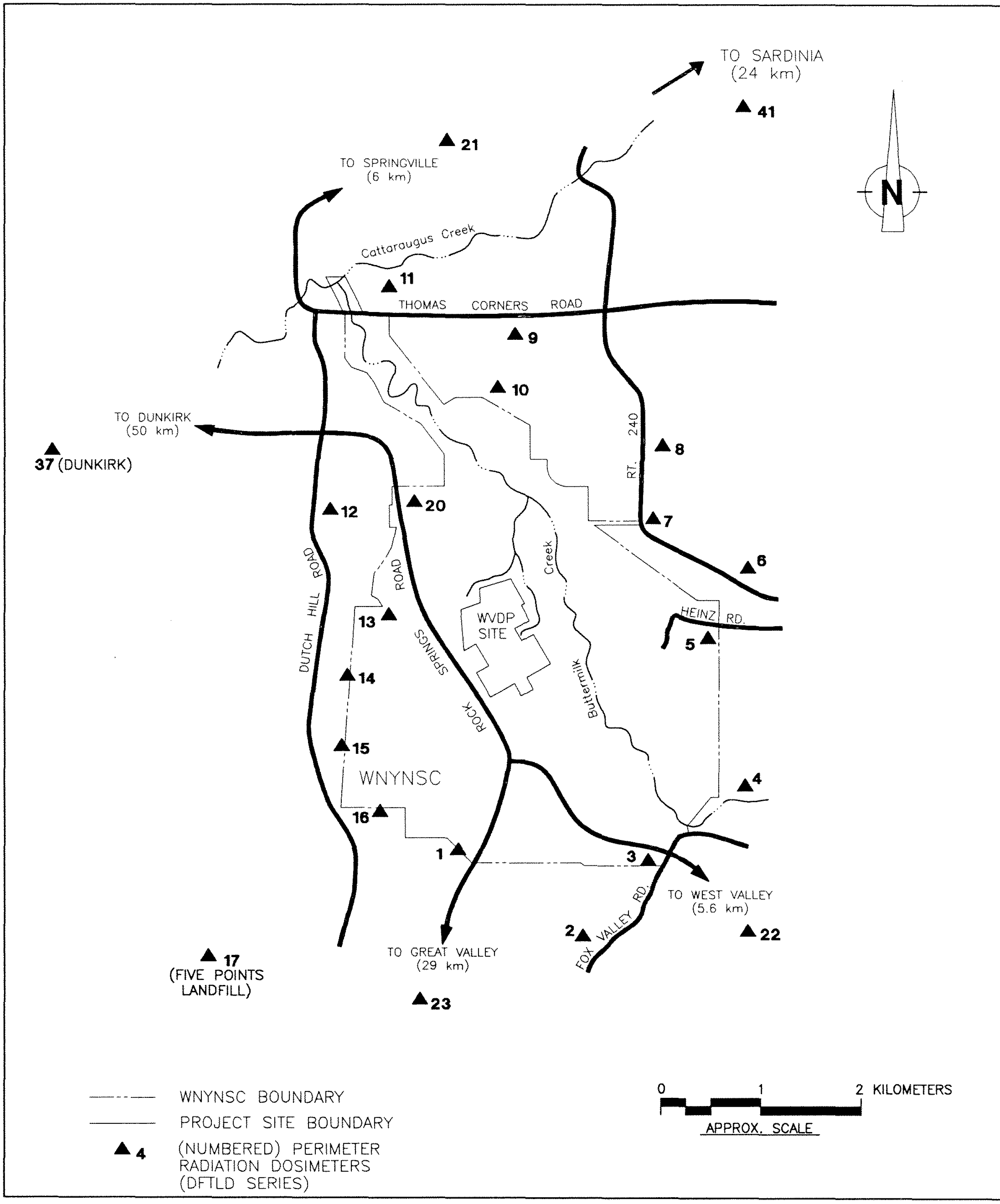


Figure A-7. Location of Off-Site Thermoluminescent Dosimetry (TLD).

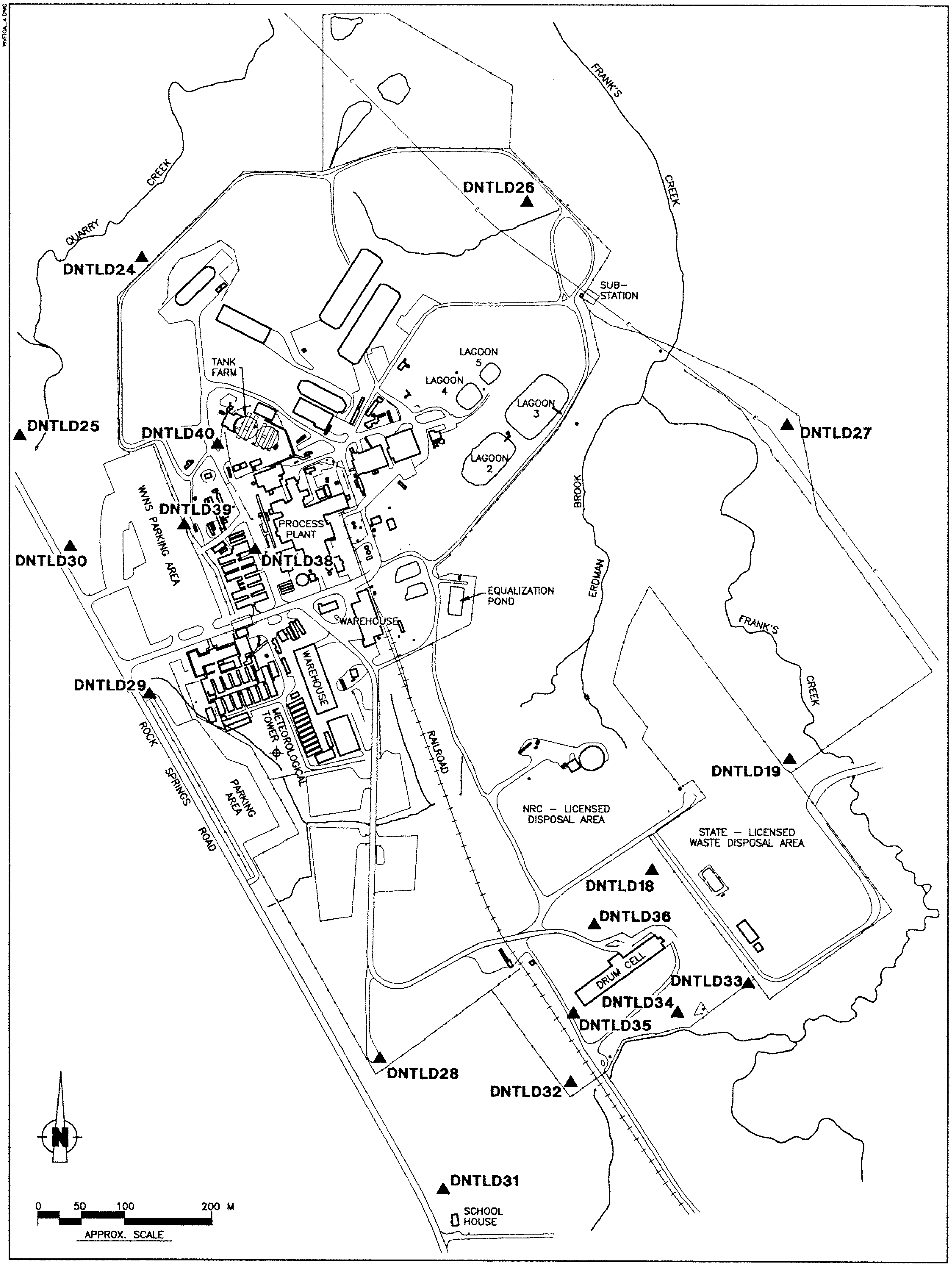
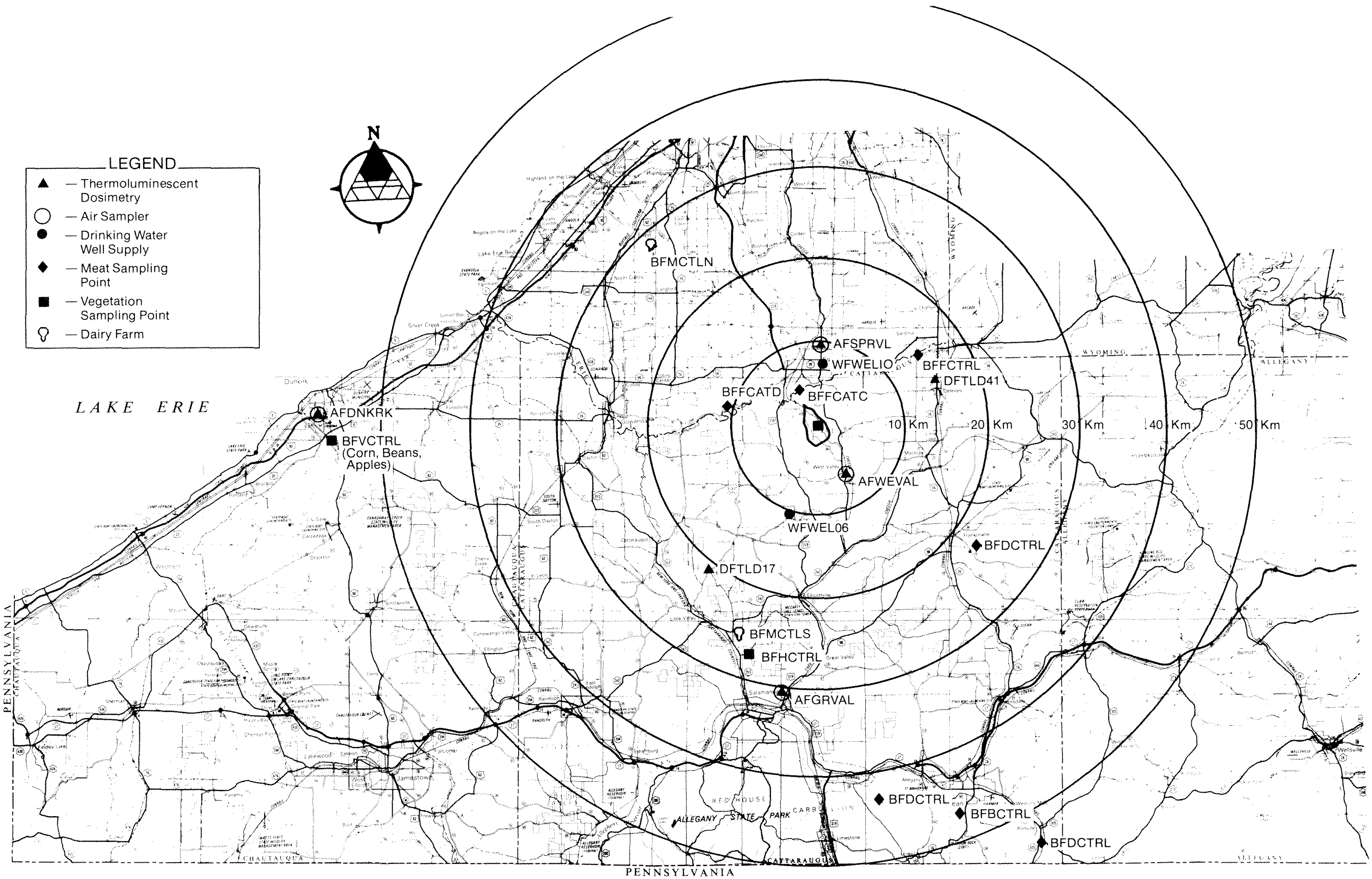


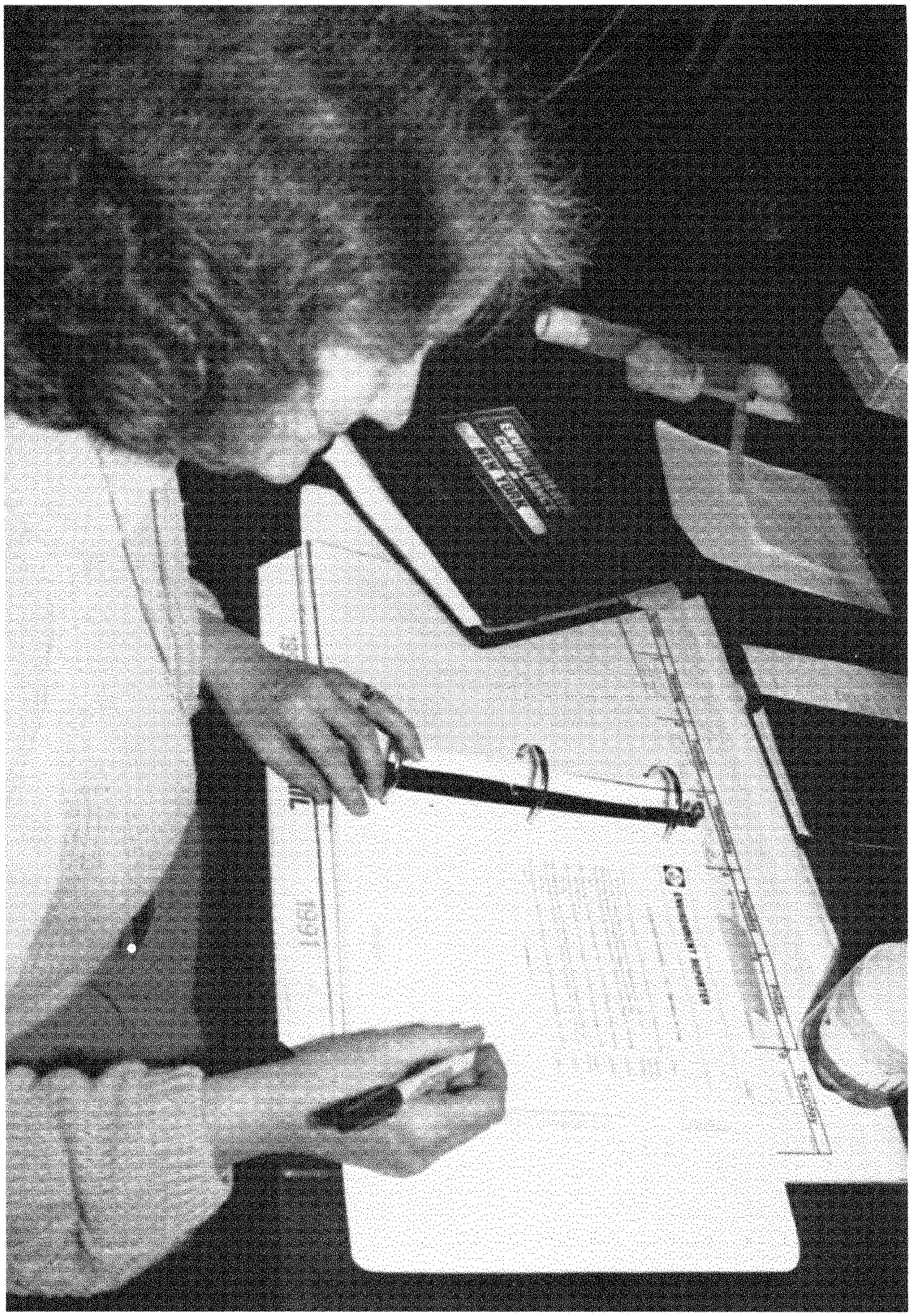
Figure A-8. Location of On-Site Thermoluminescent Dosimetry (TLD).



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

0 5 10 15 20 25K

Figure A-9. Environmental Sample Points more than 5 km from the WVDP Site



Keeping Up with Regulatory Changes

Appendix B

Regulations and Standards

Table B-1
*Department of Energy Radiation Protection Standards and Concentration Guides **

Effective Dose Equivalent Radiation Standard for Protection of the Public

Continuous exposure of any member of the public from routine activities: 100 mrem/year (1 mSv/year) from all exposure pathways

Department of Energy Derived Concentration Guides (DCGs) for Ingestion of Drinking Water and Inhaled Air (μCi/mL)

Radionuclide:	*In Air*	*In Water*	*Radionuclide:*	*In Air*	*In Water*
H-3	1E-07	2E-03	Th-232	7E-15	5E-08
C-14	6E-09	7E-05	U-232	2E-14	1E-07
Fe-55	5E-09	2E-04	U-233	9E-14	5E-07
Co-60	8E-11	5E-06	U-234	9E-14	5E-07
Ni-63	2E-09	3E-04	U-235	1E-13	6E-07
Sr-90	9E-12	1E-06	U-236	1E-13	5E-07
Zr-93	4E-11	9E-05	U-238	1E-13	6E-07
Nb-93m	4E-10	3E-04	Np-239	5E-09	5E-05
Tc-99	2E-09	1E-04	Pu-238	3E-14	4E-08
Ru-106	3E-11	6E-06	Pu-239	2E-14	3E-08
Rh-106m	6E-08	2E-04	Pu-240	2E-14	3E-08
Sb-125	1E-09	5E-05	Pu-241	1E-12	2E-06
Te-125m	2E-09	4E-05	Am-241	2E-14	3E-08
I-129	7E-11	5E-07	Am-243	2E-14	3E-08
Cs-134	2E-10	2E-06	Cm-243	3E-14	5E-08
Cs-135	3E-09	2E-05	Cm-244	4E-14	6E-08
Cs-137	4E-10	3E-06	Gross Alpha		
Pm-147	3E-10	1E-04	(as Am-241)	2E-14	3E-08
Sm-151	4E-10	4E-04	Gross Beta		
Eu-152	5E-11	2E-05	(as Sr-90)	9E-12	1E-06
Eu-154	5E-11	2E-05			
Eu-155	3E-10	1E-04			

***** Ref: DOE Order 5400.5 (February 8, 1990). Effective May 8, 1990.***

Table B-2
Environmental Standards and Regulations

The following environmental standards and laws are applicable, in whole or in part, to the West Valley Demonstration Project:

DOE Order 5400.1. November 1988. *General Environmental Protection Program.*

DOE Order 5480.1B. September 1986. *Environment, Safety, and Health Program for DOE Operations.*

DOE Order 5484.1. February 1981. *Environmental Protection, Safety, and Health Protection Information Reporting Requirements.*

Clean Air Act. 42 USC 1857 et seq., as amended, and implementing regulations.

Federal Water Pollution Control Act (Clean Water Act) 33 USC 1251, as amended, and implementing regulations.

Resource Conservation and Recovery Act. 42 USC 6905, as amended, and implementing regulations.

National Environmental Policy Act. PL 911-190. 42 USC 4321-4347, January 1, 1970, as amended, and implementing regulations.

Comprehensive Environmental Response, Compensation, and Liability Act. 42 USC 960 (including Superfund Amendments and Reauthorization Act of 1986), and implementing regulations.

Toxic Substances Control Act. 15 USC 2610, as amended, and implementing regulations.

Environmental Conservation Law of New York State.

The standards and guidelines applicable to releases of radionuclides from the West Valley Demonstration Project are found in DOE Order 5400.5.

Ambient water quality standards contained in the State Pollutant Discharge Elimination System (SPDES) permit issued for the facility are listed in Table C - 5.1 in Appendix C - 5. Airborne discharges are also regulated by the Environmental Protection Agency under the National Emission Standards for Hazardous Air Pollutants, 40 CFR 61. 1984.

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
Calendar Year 1991

Type of Permit	*Issued by*	*Expiration*	*Permit Number*
Certificates to Operate Air Contamination Source			
Boiler	NYSDEC	6/94	042200-0114-00002
Boiler	NYSDEC	6/94	042200-0114-00003
Incinerator [1]	NYSDEC	6/94	042200-0114-00004
Low-level Waste Treatment Facility Nitric Acid Storage Tank	NYSDEC	6/94	042200-0114-0010
Cement Storage Silo Ventilation System	NYSDEC	6/94	042200-0114-CSS01
Analytical & Process Chemistry Laboratory Equipment	NYSDEC	6/94	042200-0114-15F-1
Tank #35157 Vent	NYSDEC	6/94	042200-0114-35157
Tank #33154 Vent	NYSDEC	6/94	042200-0114-33154
Tank #14D-2 Vent	NYSDEC	6/94	042200-0114-14D-2
Tank #14D-2A Vent	NYSDEC	6/94	042200-0114-14D2-A
Source-Capture Welding System	NYSDEC	6/94	042200-0114-MS001
Paint Booth [2]	NYSDEC	6/94	042200-0114-MS002
Nitric Acid Tank (250-gal.) Vent	NYSDEC	6/94	042200-0114-MDB07
State Pollutant Discharge Elimination System Permit [3]	NYSDEC		NY0000973
Certificates to Operate Radioactive Air Source [4]			
Building 01-14 Ventilation System	EPA		WVDP-187-01
Contact Size-reduction & Decontamination Facility	EPA		WVDP-287-01

Table B - 3
West Valley Demonstration Project Environmental Permits
Calendar Year 1991

Type of Permit	*Issued by*	*Expiration*	*Permit Number*
Certificate to Operate Radioactive Air Source [4]			
Low-level Waste Supercompactor Ventilation System	EPA		WVDP-487-01
Outdoor Ventilation System	EPA		WVDP-587-01
Process Building Ventilation System	EPA		WVDP-687-01
Depredation Permit [5]	US Dept.of the Interior, Fish & Wildlife Service and NYSDEC		PRT-747595
Restricted Burning Permit	NYSDEC	1991	#1027
Hazardous Waste Treatment and Storage Interim Status Application (RCRA Part A) [6]	NYSDEC		NA

[1] *Nonradioactive waste is removed to a commercial landfill and is not incinerated. The permit became inactive in February 1990. The incinerator has been sealed.*

[2] *Permit was terminated during 1991.*

[3] *Renewal application was submitted to the New York State Department of Environmental Conservation in May 1990.*

[4] *National Emission Standards for Hazardous Air Pollutants (NESHAP) temporary permits are valid until the final permits are issued.*

[5] *Permit renewal request submitted to the Fish and Wildlife Service in January 1991.*

[6] *Will operate under RCRA interim status until NYSDEC requests Part B of the RCRA application.*

Collecting a Sample at a Continuous-Stream Sample Station

Appendix C - 1

Summary of Water and Sediment Monitoring Data

Table C - 1.1
Total Radioactivity of Liquid Effluents Released from Lagoon 3 in 1991 (curies)

QTR	ALPHA	BETA	H-3	C-14	SR-90	I-129	CS-137
1st Qtr	1.66±1.02E-04	1.93±0.06E-02	7.91±0.20E-01	2.12±0.50E-03	1.15±0.07E-03	<1.38E-05	3.00±0.37E-03
2nd Qtr	7.76±5.73E-05	9.19±0.35E-03	1.59±0.10E-01	<8.53E-05	1.09±0.06E-03	4.61±0.93E-04	3.04±0.32E-03
3rd Qtr	5.16±4.55E-05	5.89±0.23E-03	7.52±0.26E-02	1.50±0.39E-04	8.38±0.43E-04	4.21±0.60E-05	7.30±1.20E-04
4th Qtr	3.26±2.42E-05	4.01±0.16E-03	6.38±0.21E-02	<3.11E-05	3.90±0.27E-04	2.68±0.01E-05	1.64±0.21E-03
TOTAL	3.27±1.28E-04	3.83±0.07E-02	1.09±0.02E-00	2.29±0.51E-03	3.47±0.10E-03	5.22±0.94E-04	8.42±0.55E-03
AVG *(μCi/mL)*	9.78E-09	1.14E-06	3.25E-05	6.85E-08	1.03E-07	1.56E-08	2.51E-07

QTR	U-232	U-234	U-235	U-238	PU-238	PU-239/240	AM-241
1st Qtr	*6.79±0.77E-05	4.87±0.66E-05	1.53±1.28E-06	1.71±0.34E-05	<2.18E-06	<8.58E-07	2.55±1.25E-06
2nd Qtr	*3.9E±0.40E-05	5.84±3.32E-06	<3.21E-06	7.13±6.05E-06	<2.33E-06	<7.86E-07	3.99±1.47E-06
3rd Qtr	*3.31±0.56E-05	1.89±0.26E-05	<2.36E-07	6.87±1.29E-06	<9.71E-07	<3.29E-07	1.63±0.73E-06
4th Qtr	*3.21±2.29E-05	3.52±1.64E-06	<2.94E-07	1.38±1.22E-06	2.64±1.95E-07	<1.41E-07	3.59±2.68E-07
TOTAL	1.72±0.30E-04	7.70±0.80E-05	<3.47E-06	3.24±0.72E-05	<3.34E-06	<1.22E-06	8.53±2.08E-06
AVG *(μCi/mL)*	5.13E-09	2.30E-09	< 5.40E-11	9.69E-10	<9.97E-11	<3.64E-11	2.55E-10

* *Calculated values for U-232 are provisional, pending resolution of analytical uncertainties. First quarter U-232 results are estimated.*

Table C - 1.2
Comparison of 1991 Lagoon 3 Liquid Effluent Radioactivity Concentrations with Department of Energy Guidelines

ISOTOPE	TOTAL	AVG CONC.(µCi/mL)	DCG (µCi/mL)	% OF DCG
Alpha	3.27E+02	9.78E-09	N/A [b]	————
Beta	3.83E+04	1.14E-06	N/A [b]	————
H-3	1.09E+06	3.25E-05	2E-03	1.6
C-14	2.29E+03	6.85E-08	7E-05	.1
Sr-90	3.47E+03	1.03E-07	1E-06	10.3
I-129	5.22E+02	1.56E-08	5E-07	3.1
Cs-137	8.42E+03	2.51E-07	3E-06	8.4
U-234 [c]	7.70E+01	2.30E-09	5E-07	.5
U-235 [c]	3.47E+00	< 5.40E-11	6E-07	.0
U-238 [c]	3.24E+01	9.69E-10	6E-07	.2
Pu-238	3.34E+00	< 9.97E-11	4E-08	<..2
Pu-239/240	1.22E+00	< 3.64E-11	3E-08	<.1
Am-241	8.53E+00	2.55E-10	3E-08	.9
TOTAL % OF DCG				25.4 (d)

Notes:

[a] *Total volume released: 3.35E+10 mL*

[b] *Derived concentration guides (DCGs) are not applicable to gross alpha or beta activity.*

[c] *Total U (µg) = 1.43E+08; Average U (mg/L) = 4.27E-03.*

[d] *Total percent of DCGs for specific measured radinuclides does not include percent of DCG for U-232 because of analytical uncertainties. Total percent DCG including provisional reporting of U-232 would be 30.5 for 1991.*

Table C - 1.3
1991 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP at Fox Valley (WFBCBKG)

MONTH	ALPHA	BETA	H-3	SR-90	CS-137
January	<1.06E-09	3.36±1.91E-09	<1.00E-07		
February	<1.22E-09	2.74±1.79E-09	<1.00E-07		
March	<1.81E-09	7.47±2.63E-09	<1.00E-07		
1ST QTR				<1.95E-09	<1.06E-08
April	<9.31E-10	5.25±2.12E-09	1.55±1.30E-07		
May	<1.32E-09	2.21±1.73E-09	<1.00E-07		
June	3.02±2.67E-09	3.30±1.94E-09	<1.00E-07		
2ND QTR				2.23±1.60E-09	<1.18E-08
July	6.12±1.80E-10	5.30±2.14E-09	<1.00E-07		
August	<2.52E-09	3.38±2.12E-09	<1.00E-07		
September	<1.38E-09	4.29±2.07E-09	<1.00E-07		
3RD QTR				1.85±1.70E-09	<3.40E-08
October	<1.43E-09	2.65±1.63E-09	<1.00E-07		
November	<1.80E-09	3.57±1.88E-09	<1.00E-07		
December	<1.30E-09	2.83±1.62E-09	<1.20E-07		
4TH QTR				2.43±1.73E-09	<3.40E-08

Table C - 1.4
1991 Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP at Thomas Corners (WFBCTCB)

MONTH	ALPHA	BETA	H-3	SR-90	CS-137
January	<2.05E-09	4.42±2.04E-09	<1.00E-07		
February	<1.85E-09	5.07±2.05E-09	<1.00E-07		
March	4.57±3.69E-09	6.64±2.60E-09	<1.00E-07		
1ST QTR				1.32±1.30E-09	<1.06E-08
April	<1.57E-09	7.15±2.36E-09	<1.00E-07		
May	<1.26E-09	4.20±2.03E-09	<1.00E-07		
June	<1.84E-09	3.55±0.42E-08	<1.00E-07		
2ND QTR				2.77±1.60E-09	<1.18E-08
July	<2.64E-09	1.15±0.28E-08	<1.00E-07		
August	<5.14E-09	1.16±0.28E-08	<1.23E-07		
September	<2.32E-09	1.13±0.27E-08	<1.00E-07		
3RD QTR				6.20±1.80E-09	<3.40E-08
October	<2.42E-09	1.22±0.25E-08	<1.00E-07		
November	<1.60E-09	7.00±2.11E-09	<1.00E-07		
December	<1.73E-09	6.49±1.98E-09	<1.00E-07		
4TH QTR				3.83±0.60E-08	<1.10E-08

Table C - 1.5
1991 Radioactivity Concentrations (μCi/mL) in Surface Water Downstream of the WVDP at Frank's Creek (WNSP006)

MONTH	ALPHA	BETA	H-3
January	<2.49E-09	1.71±0.09E-07	8.34±0.44E-06
February	<1.95E-09	1.92±0.32E-08	1.59±1.04E-07
March	<2.26E-09	6.06±0.52E-08	1.78±0.16E-06
April	<1.70E-09	3.11±0.40E-08	3.26±1.26E-07
May	<2.83E-09	9.23±0.66E-08	1.20±0.15E-06
June	<4.52E-09	1.23±0.08E-07	1.55±0.16E-06
July	<3.41E-09	5.45±0.54E-08	2.06±1.25E-07
August	<5.43E-09	3.78±0.14E-07	4.56±0.26E-06
September	<3.47E-09	5.06±0.51E-08	1.37±1.13E-07
October	<3.96E-09	4.32±0.46E-08	<1.13E-07
November	<2.68E-09	3.24±0.38E-08	<1.08E-07
December	<1.74E-09	5.43±0.46E-08	5.38±1.33E-07

Table C - 1.6
1991 Radioactivity Concentrations (μCi/mL) in Surface Water Downstream of the WVDP at Frank's Creek (WNSP006)

	C-14	SR-90	I-129	CS-137	U-234
1st Qtr	<8.38E-09	1.36±0.27E-08	1.30±1.19E-09	<2.38E-08	4.10±1.50E-10
2nd Qtr	<6.60E-09	1.90±0.31E-08	<1.18E-09	<3.59E-08	4.30±2.70E-10
3rd Qtr	<8.00E-09	3.87±0.45E-08	4.00±2.10E-09	<3.47E-08	2.70±1.40E-10
4th Qtr	7.20±6.70E-09	2.17±0.37E-08	4.40±1.30E-09	<2.35E-08	3.30±1.20E-10

	U-235	U-238	PU-238	PU-239/240	AM-241
1st Qtr	<2.66E-11	1.80±1.10E-10	1.40±1.20E-10	<6.70E-11	3.50±3.10E-10
2nd Qtr	<8.60E-11	2.70±2.20E-10	<4.70E-10	<2.20E-10	<1.38E-10
3rd Qtr	<3.90E-11	<1.40E-10	<9.40E-11	<4.70E-11	<2.66E-10
4th Qtr	<2.44E-11	1.30±0.80E-10	<1.82E-11	<3.20E-11	2.80±0.70E-10

Table C - 1.7
1991 Radioactivity Concentrations (μCi/mL) in Surface Water Downstream of Buttermilk Creek at Felton Bridge (WFFELBR)

MONTH	ALPHA	BETA	H-3	SR-90	CS-137
January	<1.94E-09	4.56±2.11E-09	<1.00E-07	5.31±2.60E-09	<3.19E-09
February	4.93±2.90E-09	5.77±2.20E-09	<1.00E-07	2.11±1.60E-09	<1.06E-08
March	<1.78E-09	1.94±1.77E-09	<1.00E-07	2.00±1.70E-09	<1.06E-08
April	<1.77E-09	4.85±2.09E-09	<1.00E-07	6.64±2.10E-09	<3.59E-09
May	<1.90E-09	7.21±2.31E-09	<1.00E-07	1.71±1.30E-09	<1.08E-08
June	<3.00E-09	2.42±2.03E-09	<1.00E-07	2.77±1.60E-09	<1.08E-08
July	<4.89E-09	4.53±2.25E-09	<1.00E-07	6.87±2.30E-09	<1.18E-08
August	<3.27E-09	3.12±2.04E-09	<1.00E-07	2.24±1.60E-09	<1.18E-08
September	<1.40E-09	3.31±1.95E-09	<1.00E-07	<1.40E-09	<4.22E-09
October	<1.73E-09	3.97±1.85E-09	<1.00E-07	5.13±2.73E-09	5.44±5.34E-09
November	<2.32E-09	3.89±1.87E-09	<1.00E-07	3.49±2.08E-09	<6.88E-09
December	<1.76E-09	4.10±1.78E-09	<1.00E-07	2.23±1.48E-09	<7.60E-09

Table C - 1.8
1991 Results of Sampling of Potable Well Water around the WVDP Site

WELL	pH	CONDUCTIVITY (μmhos/cm@25°C)	ALPHA (μCi/mL)	BETA (μCi/mL)	H-3 (μCi/mL)	CS-137 (μCi/mL)
WFWEL01	7.46	386	<1.38E-09	4.16±2.50E-09	<1.00E-07	<3.40E-08
WFWEL02	6.72	360	<1.29E-09	3.41±2.40E-09	<1.00E-07	<3.40E-08
WFWEL03	6.74	846	<2.40E-09	5.11±2.80E-09	<7.37E-08	<3.40E-08
WFWEL04	8.00	1660	<8.00E-09	3.33±2.80E-09	<1.00E-07	<3.40E-08
WFWEL05	7.04	394	<1.20E-09	4.50±2.50E-09	<1.00E-07	<3.40E-08
WFWEL06	6.95	610	<1.59E-09	2.92±2.40E-09	<6.08E-08	<2.31E-08
WFWEL07	6.97	455	<1.11E-09	<2.17E-09	<1.00E-07	<2.31E-08
WFWEL08	7.06	458	<1.71E-09	5.32±2.70E-09	<1.00E-07	<2.31E-08
WFWEL09	10.35*	616	<2.60E-09	2.76±2.40E-09	<1.00E-07	<2.31E-08
WFWEL10	7.56	264	<1.29E-09	2.37±2.20E-09	<7.72E-08	<2.31E-08

** High pH value attained confirmed for 1991 sample collected. However, a follow-up sample collected April 7, 1992 returned to a more normal value of 7.92.*

Table C - 1.9

1991 Radioactivity Concentrations in Stream Sediments around the WVDP

(μCi/g dry weight from upper 15 cm)

LOCATION	DATE	ALPHA	BETA	K-40	CS-137	SR-90	CO-60
SFBCSED	6/91	1.4±0.60E-05	3.1±0.30E-05	1.26±0.13E-05	4.44±2.31E-08	< 5.52E-08	< 1.9E-08
SFSDSED	6/91	5.7±4.80E-06	2.9±0.30E-05	1.01±0.01E-05	1.98±0.32E-07	< 5.2E-08	< 1.8E-08
SFTCSED	6/91	1.15±0.60E-05	3.2±0.30E-05	1.24±0.12E-05	2.08±0.21E-06	< 1.35E-07	<1.85E-08
SFCCSED	6/91	6.1±4.90E-06	2.9±0.30E-05	1.06±0.11E-05	2.5±0.34E-07	< 4.2E-08	<2.02E-08
SFBISED	6/91	1.3±0.60E-05	3.2±0.30E-05	1.19±0.12E-05	6.89±2.94E-08	8.8±5.70E-08	<1.82E-08
SFBCSED	11/91	1.2±0.50E-05	3.2±0.30E-05	1.44±0.14E-05	8.37±2.96E-08	2±0.80E-07	<1.69E-08
SFSDSED	11/91	1.5±0.81E-05	3.2±2.20E-05	1.27±0.13E-05	1.99±1.66E-07	< 4.29E-08	<1.72E-08
SFTCSED	11/91	1.2±0.50E-05	3.6±0.30E-05	1.59±0.16E-05	1.71±0.17E-06	1.3±0.50E-07	<2.04E-08
SFCCSED	11/91	1.0±0.50E-05	3.8±0.30E-05	1.52±0.15E-05	3.87±0.39E-07	3.6±0.90E-07	<1.56E-08
SFBISED	11/91	1.4±0.60E-05	3.3±0.30E-05	1.36±0.14E-05	5.0±2.50E-08	9.2±4.00E-08	<2.12E-08
		U-234	**U-235**	**U-238**	**PU-238**	**PU-239/240**	**AM-241**
SFBCSED	6/91	4.8±0.90E-08	< 2.1E-09	3.6±0.80E-08	< 4.1E-09	< 6.9E-09	< 1.7E-08
SFTCSED	6/91	6.65±1.46E-08	< 2.4E-09	5.45±1.37E-08	<2.26E-08	< 1.4E-08	<2.07E-08

Table C - 1.10

1991 Contributions by the New York State Low-level Waste Disposal Area to Radioactivity in WVDP Liquid Effluents (curies)

TOTALS

Gross Alpha	**<8.5E-07**
Gross Beta	**1.21±0.2E-03**
H-3	**4.02±0.1E-02**
Sr-90	**6.01±0.1E-04**
Cs-137	**<1.6E-05**

Table C - 1.11

1991 Radioactivity Concentrations in Surface Soil Sediments Collected at Air Sampling Stations around the WVDP *(μCi/g dry weight from upper 15 cm)*

LOCATION	K-40	CS-137	SR-90	AM-241	PU-239/240
SFFXVRD	1.14±0.11E-05	9.31±0.93E-07	3.20±0.60E-07	< 9.80E-09	<1.90E-08
SFRSPRD	1.42±0.14E-05	2.08±0.21E-06	5.80±0.80E-07	< 2.47E-08	<1.10E-07
SFRT240	1.21±0.12E-05	1.03±0.13E-06	2.90±0.60E-07	< 1.60E-08	<1.60E-08
SFSPRVL	1.71±0.17E-05	1.03±0.10E-06	2.40±0.50E-07	< 1.14E-08	<2.26E-08
SFTCORD	2.13±0.21E-05	4.89±0.55E-07	1.85±0.50E-07	< 8.20E-09	<1.22E-08
SFWEVAL	1.14±0.11E-05	4.91±0.49E-07	2.20±0.60E-07	< 7.00E-09	<3.06E-08
SFGRVAL	9.98±1.00E-06	4.38±0.44E-06	4.70±0.70E-07	2.10±1.50E-08	<3.20E-08
SFBOEHN	1.25±0.13E-05	1.69±0.17E-06	2.00±0.60E-07	<1.07E-08	<3.50E-08
SFDNKRK	1.66±0.17E-05	3.78±0.43E-07	1.20±0.50E-07	<1.84E-08	<9.40E-08
SFLTVAL	1.55±0.16E-05	3.09±0.59E-07	8.90±4.20E-08	<1.50E-08	<2.10E-08

LOCATION	U -234	U-235	U-238
SFRSPRD	5.70±1.50E-08	<3.30E-09	5.50±1.40E-08
SFGRVAL	1.50±0.50E-07	<9.30E-09	1.10±0.40E-07
SFBOEHN	1.20±0.50E-07	<1.11E-08	8.00±4.10E-08

Table C - 1.12

1991 Water Quality Concentrations *(mg/L)* *in Surface Water at Locations WFBCBKG and WNSP006*

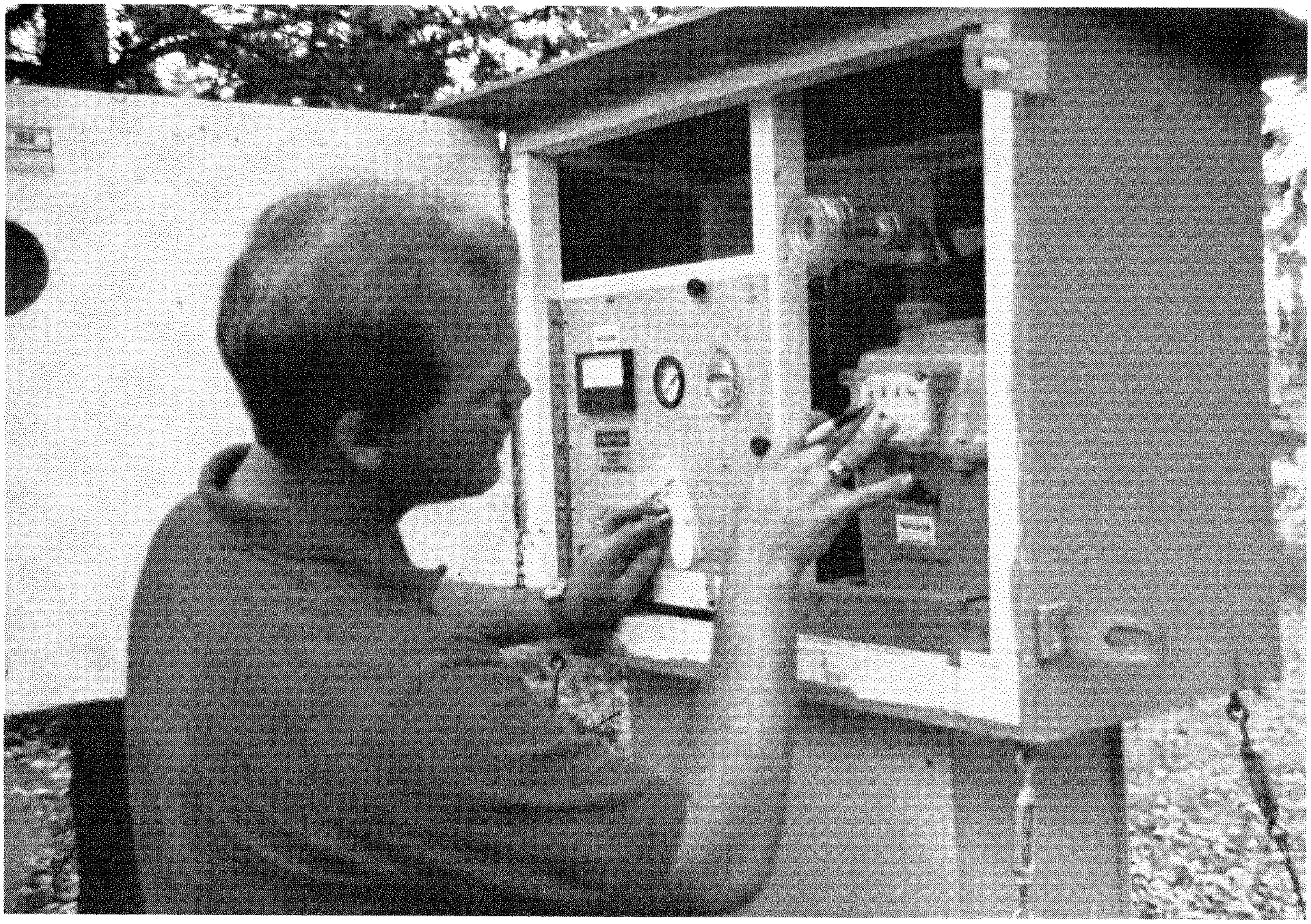
LOCATION	DATE	pH	*Conductivity	TOC	TOX	Chloride	Sulfate	Niitrate-N	Fluoride	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)
WFBCBKG	6/25	**7.66	N/A	3.1	0.650	9	22	0.38	<0.1	100	30
WFBCBKG	11/20	7.87	N/A	3.1	<0.005	12	52	0.10	N/A	110	<1.0
WNSP006	6/25	***7.60	***462	3.9	0.120	60	19	9.7	<0.1	230	<1.0
WNSP006	11/20	7.83	650	7.2	0.047	62	62	3.1	N/A	130	<1.0

LOCATION	DATE	CA	MG	NA	K	BA	MN		FE	
		Total	Total	Total	Total	Total	Total	Soluble	Total	Soluble
WFBCBKG	6/25	44	7.7	6.7	2.2	0.110	0.250	<0.005	5.600	0.056
WFBCBKG	11/20	51	7.2	10	1.8	0.120	0.024	0.005	0.180	<0.030
WNSP006	6/25	36	5.9	34	4.6	<0.050	0.350	0.320	2.400	0.260
WNSP006	11/20	60	8.8	35	2.7	0.059	0.040	0.029	0.290	0.110

** Measured in μmhos / cm at $25^{o}C$*

*** Average of biweekly measurements during semiannual period*

**** Average of weekly measurements during semiannual period*



Recording Air Flow at an Environmental Air Sampler

Appendix C - 2

Summary of Air Monitoring Data

Table C - 2.1
1991 Airborne Radioactive Effluent Monthly Totals (curies) from the Main Ventilation Stack (ANSTACK)

MONTH	ALPHA	BETA	H-3
January	1.80±0.6E-07	4.53±0.3E-06	7.85±1.7E-03
February	4.35±3.3E-08	1.78±0.2E-06	1.03±0.2E-02
March	6.82±4.8E-08	6.47±0.3E-06	1.12±0.2E-02
April	4.85±3.4E-08	2.61±0.2E-05	9.16±1.7E-03
May	1.15±0.6E-07	3.53±0.3E-06	7.91±1.7E-03
June	1.15±0.7E-07	3.53±0.4E-06	1.09±0.1E-02
July	5.05±3.4E-08	2.32±0.2E-06	1.01±0.1E-02
August	8.01±4.8E-08	1.71±0.2E-06	9.97±0.7E-03
September	6.30±4.0E-08	2.02±0.2E-06	1.00±0.1E-02
October	4.08±3.0E-08	7.26±1.0E-07	8.59±0.6E-03
November	8.43±4.9E-08	1.31±0.1E-05	1.10±0.1E-02
December	5.49±3.1E-08	2.83±0.2E-06	6.88±0.6E-03
TOTALS	9.44±1.6E-07	6.86±0.1E-05	1.14±0.01E-01

Table C - 2.2
1991 Airborne Radioactive Effluent Quarterly Totals (curies) from the Main Ventilation Stack (ANSTACK)

QTR	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1st Qtr	<3.18E-08	4.20±0.1E-06	9.84±0.2E-06	<3.57E-08	7.87±0.8E-06	<1.08E-07
2nd Qtr	<4.25E-08	1.71±0.1E-06	1.28±0.03E-05	<4.46E-08	8.29±0.8E-06	<1.31E-07
3rd Qtr	<2.83E-08	1.13±0.1E-06	1.99±0.05E-05	<3.15E-08	5.46±0.5E-06	<9.45E-08
4th Qtr	<2.81E-08	5.51±0.3E-06	8.37±0.2E-06	<3.15E-08	1.00±0.8E-06	<8.66E-08
TOTALS	<6.64E-08	1.26±0.04E-05	5.09±0.1E-05	<7.24E-08	2.26±0.1E-05	<2.13E-07

QTR	U-232	U-234	U-235	U-238	PU-238	PU-239/240	AM-241
1st Qtr	6.80±3.4E-08	<1.20E-08	<7.27E-09	<1.15E-08	<1.39E-08	3.41±3.1E-08	1.15±0.5E-07
2nd Qtr	<2.1E-08	<1.92E-08	<1.50E-08	<1.55E-08	4.72±2.9E-08	5.77±2.1E-08	1.39±0.4E-07
3rd Qtr	<4.8E-08	<8.14E-09	<3.60E-09	<1.65E-08	1.65±1.6E-08	1.63±1.1E-08	<8.66E-08
4th Qtr	<3.3E-09	<5.51E-09	<3.96E-09	<5.51E-09	4.20±1.8E-08	7.35±2.6E-08	1.99±0.4E-07
TOTALS	9.19±6.3E-08	<2.47E-08	<1.75E-08	<2.60E-08	1.20±0.4E-07	1.82±0.5E-07	5.40±1.2E-07

Table C - 2.3

Comparison of 1991 Main Stack Exhaust Radioactivity Concentrations with Department of Energy Guidelines

ISOTOPE	HALF-LIFE	TOTAL µCI RELEASED [(a)]	AVG CONC (µCi/mL)	DCG(µCI/ML)	% OF DCG [(c)]
Alpha	N/A	9.44 E-01 (2.50 E+04 Bq)	1.3E-15	N/A [(b)]	—
Beta	N/A	6.86 E+01 (1.67 E+06 Bq)	6.1 E-14	N/A [(b)]	—
H-3	12.35 yrs	1.14 E+05 (3.92 E+09 Bq)	1.5 E-10 [(d)]	1 E-07	0.2
Co-60	5.27 yrs	<6.6E-02 (<2.5 E+03 Bq)	< 8.9E-17	8 E-11	0.0
Sr-90	29.124 yrs	1.26 E+01 (4.67 E+05 Bq)	1.7E-14	9 E-12	0.2
I-129	1.57 E+07 yrs	5.09 E+01 (1.89 E+06 Bq)	6.8E-14	7 E-11	0.1
Cs-134	2.06 yrs	<7.2E-02 (<9.7E+03 Bq)	< 9.7E-17	2 E-10	0.0
Cs-137	30 yrs	2.26 E+01 (8.37 E+05 Bq)	3.0 E-14	4 E-10	0.0
Eu-154	8.8 yrs	<2.1E-01 (<7.9 E+03 Bq)	< 2.9E-16	5 E-11	0.0
U-234 [(e)]	2.45 E+05 yrs	<2.5E-02 (<9.2E+02 Bq)	< 3.3E-17	9 E-14	0.0
U-235 [(e)]	7.1 E+08 yrs	<1.8E-02 (<6.5 E+02 Bq)	< 2.4E-17	1 E-13	0.0
U-238 [(e)]	4.47 E+09 yrs	<2.6E-02 (<9.6E+02 Bq)	3.5E-17	1 E-13	0.0
Pu-238	87.07 yrs	1.20 E-01 (4.44 E+03 Bq)	1.6E-16	3 E-14	0.5
Pu-239/240	2.4 E+04 yrs	1.82 E-01 (6.73 E+03 Bq)	2.4E-16	2 E-14	1.2
Am-241	432 yrs	5.40 E-01 (2.00 E+04 Bq)	7.3E-16	2 E-14	3.7
					5.9 [(f)]

Notes:

a) *Total volume released at 50,000 cfm = 7.44E+14 mL/year. µCi values are expressed also in Bq.*

b) *Derived concentration guides (DCGs) are not specified for gross alpha or gross beta activity.*

c) *Total percent DCGs for applicable measured radionuclides.*

d) *Tritium reported in pCi/mL = 1.4E-04*

e) *Total U (µg) = 1.42E+05; average U (pg/mL) = 1.91E-04*

f) *Total percent DCGs for specific measured radionuclides does not include % of DCG for U-232 because of analytical uncertainties. Total % of DCGs including provisional reporting of U-232 would be 6.5% for 1991.*

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.

Table C - 2.4
1991 Airborne Radioactive Effluent Monthly Totals (curies) from the Cement Solidification SystemVentilation Stack (ANCSSTK)

MONTH	ALPHA	BETA
January	<6.4E-09	<1.6E-08
February	<3.7E-09	2.00±1.6E-08
March	<5.4E-09	2.67±2.1E-08
April	<3.9E-09	<1.8E-08
May	<5.7E-09	2.60±1.9E-08
June	<5.2E-09	<2.2E-08
July	<6.0E-09	1.87±1.7E-08
August	<5.6E-09	2.38±2.3E-08
September	<4.7E-09	1.92±1.8E-08
October	<3.4E-09	<1.3E-08
November	<4.3E-09	<1.2E-08
December	<4.9E-09	1.72±1.6E-08
TOTALS	<1.7E-08	2.34±0.6E-07

Table C - 2.5
1991 Airborne Radioactive Effluent Quarterly Totals (curies) from the Cement Solidification SystemVentilation Stack (ANCSSTK)

QTR	CO-60	SR-90	I-129	CS-134	CS-137	EU-154	
1st Qtr	<5.6E-09	<2.2E-09	<4.6E-09	<5.6E-09	<5.5E-09	<1.6E-09	
2nd Qtr	<7.6E-09	<4.7E-09	3.96±1.1E-08	<7.5E-09	<6.9E-09	<2.4E-08	
3rd Qtr	<5.6E-09	5.59±4.6E-09	2.17±1.1E-08	<5.8E-09	<5.7E-09	<1.5E-08	
4th Qtr	<6.3E-09	<3.8E-09	4.72±1.2E-08	<5.8E-09	<5.2E-09	<2.0E-08	
TOTALS	<1.3E-08	1.63±0.8E-08	1.13±0.2E-07	<1.2E-08	<1.2E-08	<3.5E-08	
QTR	**U-232**	**U-234**	**U-235**	**U-238**	**PU-238**	**PU-239/240**	**AM-241**
1st Qtr	<4.9E-09	6.09±4.1E-09	<1.9E-09	3.76±2.6E-09	<4.3E-09	1.98±1.9E-08	2.49±1.0E-08
2nd Qtr	<3.0E-09	< 4.7E-10	< 3.8E-10	1.17±0.8E-09	7.11±6.1E-09	<1.4E-09	9.65±4.1E-09
3rd Qtr	<1.8E-09	<4.2E-10	<4.2E-10	<5.6E-10	<2.9E-09	<5.8E-10	9.14±7.6E-09
4th Qtr	<6.2E-10	<6.4E-10	<6.6E-10	<6.8E-10	<8.2E-10	<8.7E-10	<4.1E-09
TOTALS	<6.1E-09	7.62±4.2E-09	3.36±2.1E-09	6.17±2.9E-09	1.51±0.8 E-08	2.26±1.0E-08	4.78±1.4 E-08

Table C - 2.6
1991 Airborne Radioactive Effluent Monthly Totals (curies) from the Contact Size-Reduction Facility Ventilation Stack (ANCSRFK)

MONTH	ALPHA	BETA
January	<2.9E-09	1.29±1.0E-08
February	<3.0E-09	1.50±1.1E-08
March	<4.7E-09	3.05±1.3E-08
April	<2.5E-09	1.70±1.0E-08
May	<3.4E-09	1.67±1.0E-08
June	<3.4E-09	2.05±1.1E-08
July	<2.6E-09	2.50±1.0E-08
August	<3.5E-09	2.07±1.2E-08
September	<2.4E-09	1.25±0.9E-08
October	<2.0E-09	1.47±0.8E-08
November	<2.2E-09	1.56±0.8E-08
December	<2.4E-09	1.29±0.8E-08
TOTALS	<1.05E-08	2.14±0.4E-07

Table C - 2.7
1991 Airborne Radioactive Effluent Quarterly Totals (curies) from the Contact Size-Reduction Facility Ventilation Stack (ANCSRFK)

QTR	CO-60	SR-90	I-129	CS-134	CS-137	EU-154	
1st Qtr	<4.0E-09	<1.3E-09	<3.5E-09	<4.0E-09	<4.0E-09	<1.0E-08	
2nd Qtr	<2.8E-09	<2.0E-09	3.25±1.2E-08	<2.9E-09	<2.8E-09	<9.9E-09	
3rd Qtr	4.25±3.7E-09	<2.3E-09	1.09±0.7E-08	<4.1E-09	6.24±3.7E-09	<1.2E-08	
4th Qtr	<3.8E-09	<1.9E-09	3.84±0.9E-08	<3.7E-09	<3.7E-09	<1.2E-08	
TOTALS	1.48±0.7E-08	<3.8E-09	8.53±1.7E-08	<7.4E-09	1.67±0.7E-08	<2.2E-08	
QTR	**U-232**	**U-234**	**U-235**	**U-238**	**PU-238**	**PU-239/240**	**AM-241**
1st Qtr	<1.1E-09	<1.1E-09	<6.0E-10	9.07±7.9E-10	<1.6E-09	2.04±0.8E-08	2.83 ±2.6E-09
2nd Qtr	<5.4E-09	<8.2E-10	<3.4E-10	<6.8E-10	<2.7E-09	<8.8E-10	3.97 ±2.0E-09
3rd Qtr	<2.2E-09	<2.8E-10	<2.7E-10	<2.8E-10	<1.8E-09	<4.8E-10	5.10 ±3.4E-09
4th Qtr	<4.5E-10	<3.7E-10	<3.7E-10	<3.8E-10	2.30±1.5E-09	5.39±2.3E-09	7.09 ±2.3E-09
TOTALS	<6.0E-09	<1.4E-09	<8.3E-10	2.25±1.1E-09	8.40±3.9E-09	2.72±0.8E-08	1.90 ±0.5E-08

Table C - 2.8
1991 Airborne Radioactive Effluent Monthly Totals (curies)
from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

MONTH	ALPHA	BETA
January	<2.0E-09	<6.5E-09
February	<2.0E-09	<6.5E-09
March	<3.0E-09	1.32±0.8E-08
April	<1.8E-09	9.70±7.6E-09
May	<2.5E-09	7.38±7.2E-09
June	<1.9E-09	1.23±0.8E-08
July	<2.1E-09	8.74±7.0E-09
August	<2.3E-09	8.42±8.1E-09
September	<2.2E-09	<6.9E-09
October	<1.7E-09	<6.0E-09
November	<2.2E-09	1.10±0.6E-08
December	<2.1E-09	<6.2E-09
TOTALS	<7.5E-09	1.02±0.2E-07

Table C - 2.9
1991 Airborne Radioactive Effluent Quarterly Totals (curies)
from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

QTR	CO-60	SR-90	I-129	CS-134	CS-137	EU-154	
1st Qtr	<2.4E-09	<9.8E-10	1.14±0.02E-06	<2.2E-10	<2.4E-10	<7.2E-09	
2nd Qtr	<3.1E-09	<1.3E-09	4.72±0.2E-07	<2.5E-09	< 1.8E-09	<7.8E-09	
3rd Qtr	<2.2E-09	<2.2E-09	4.52±0.4E-07	2.67±2.0E-09	<1.6E-09	<5.8E-09	
4th Qtr	<2.5E-09	<2.0E-09	2.56±0.2E-07	<2.3E-09	6.44±2.8E-09	<7.1E-09	
TOTALS	<5.1E-09	<3.4E-09	2.32±0.05E-06	7.67±3.9E-09	1.00±0.3E-08	<1.4E-08	
QTR	**U-232**	**U-234**	**U-235**	**U-238**	**PU-238**	**PU-239/240**	**AM-241**
1st Qtr	<3.6E-09	<1.2E-10	<1.2E-09	<2.5E-09	<2.3E-09	3.78±3.1E-09	1.47±0.5E-08
2nd Qtr	<7.8E-10	<2.1E-10	<1.6E-10	5.11±3.3E-10	<1.5E-09	<5.1E-10	4.44±1.6E-09
3rd Qtr	<6.5E-10	<4.5E-10	<2.6E-10	<6.4E-10	<1.4E-09	<2.8E-10	<1.5E-09
4th Qtr	<2.7E-10	<3.6E-10	<2.7E-09	<5.0E-10	<4.1E-10	<4.3E-10	1.11±1.0E-09
TOTALS	<3.8E-09	<6.2E-10	<3.0E-09	<2.6E-09	<3.1E-09	4.99±3.2E-09	2.13±0.6E-08

Table C - 2.10
1991 Airborne Radioactive Effluent Monthly Totals (curies) from the Supercompactor Ventilation Stack (ANSUPCV)

MONTH	ALPHA	BETA
January	<1.3E-10	1.08±0.5E-09
February	<1.0E-10	1.53±0.4E-09
March	<1.9E-10	1.20±0.5E-09
April	1.2±1.1E-10	1.44±0.6E-09
May	<2.2E-10	1.76±0.6E-09
June	<8.6E-11	2.65±0.6E-09
July	1.24±1.2E-10	1.65±0.5E-09
August	<1.5E-10	1.44±0.5E-09
September	3.06±2.1E-10	2.16±0.6E-09
October	2.14±1.7E-10	5.49±3.3E-10
November	<8.8E-11	9.79±3.0E-10
December	<1.2E-10	6.00±3.5E-10
TOTALS	1.73±0.5E-09	1.70±0.2E-08

Table C - 2.11
1991 Airborne Radioactive Effluent Quarterly Totals (curies) from the Supercompactor Ventilation Stack (ANSUPCV)

QTR	CO-60	SR-90	CS-134	CS-137	EU-154	AM-241
1st Qtr	<4.4E-10	<2.3E-10	<3.6E-10	1.86±0.6E-09	<1.3E-09	2.84±1.2E-09
2nd Qtr	<5.3E-10	<3.9E-10	<5.5E-10	1.49±0.8E-09	<1.6E-09	2.00±1.8E-10
3rd Qtr	<5.5E-10	<4.2E-10	<6.2E-10	<6.2E-10	<1.8E-09	<1.4E-09
4th Qtr	<5.5E-10	<3.3E-10	<5.8E-10	<5.4E-10	<1.8E-09	8.00±4.0E-10
TOTALS	<1.0E-09	<7.0E-10	<1.1E-09	4.51±1.3E-09	<3.3E-09	5.22±1.9E-09

QTR	U-232	U-234	U-235	U-238	PU-238	PU-239/240
1st Qtr	5.33±4.0E-10	<4.8E-10	<2.9E-10	<2.9E-10	<5.2E-10	8.00±7.6E-10
2nd Qtr	<4.9E-10	2.84±2.7E-10	<1.2E-10	<1.2E-10	<3.2E-10	<1.5E-10
3rd Qtr	<8.7E-10	<4.8E-11	<4.8E-11	<4.8E-11	<2.4E-10	<7.1E-11
4th Qtr	<8.7E-11	<4.6E-11	<4.6E-11	<4.6E-11	5.78±2.2E-10	<1.2E-10
TOTALS	<1.1E-09	8.53±5.5E-10	<3.2E-10	<3.2E-10	1.65±0.7E-09	1.14±0.8E-09

Table C - 2.12

1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) *at the Fox Valley Air Sampler* (AFFXVRD)

	ALPHA	BETA	SR-90	CS-137
January	1.12±1.56E-15	1.84±0.33E-14		
February	7.87±7.26E-16	1.70±0.33E-14		
March	9.12±8.31E-16	1.59±0.32E-14		
1ST QTR			<8.19E-17	<1.97E-16
April	7.19±6.96E-16	1.42±0.30E-14		
July	9.26±8.23E-16	1.54±0.31E-14		
June	1.16±0.85E-15	1.52±0.30E-14		
2ND QTR			<6.9E-17	<2.58E-16
July	8.76±6.88E-16	1.77±0.32E-14		
August	< 8.43E-16	1.96±0.39E-14		
September	1.03±0.96E-15	1.94±0.39E-14		
3RD QTR			<7.67E-17	<3.21E-16
October	1.43±1.07E-15	2.52±0.39E-14		
November	< 4.30E-16	5.14±1.52E-15		
*December**	< 1.73E-14	<1.14E-13		
4TH QTR			<5.54E-17	<2.27E-16

** December detection limits are elevated because of a sample failure.*

Table C - 2.13

1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) *at the Rock Springs Road Air Sampler* (AFRSPRD)

	ALPHA	BETA	SR-90	CS-137	I-129
January	9.56±9.27E-16	2.06±0.41E-14			
February	<7.34E-16	1.77±0.34E-14			
March	<8.65E-16	1.60±0.36E-14			
1ST QTR			<8.40E-17	<2.29E-16	<2.84E-16
April	1.13±0.85E-15	1.61±0.33E-14			
May	8.27±7.53E-16	1.70±0.31E-14			
June	8.69±7.78E-16	1.42±0.30E-14			
2ND QTR			<1.03E-16	<2.53E-16	<1.98E-16
July	9.30±6.89E-16	2.15±0.33E-14			
August	8.02±6.78E-16	1.81±0.32E-14			
September	7.89±7.33E-16	1.83±0.33E-14			
3RD QTR			<6.92E-17	<1.65E-16	<1.04E-16
October	1.35±0.88E-15	2.16±0.30E-14			
November	<9.37E-16	2.02±0.33E-14			
December	9.73±8.56E-16	1.90±0.31E-14			
4TH QTR			2.75± 1.1E-16	<2.68E-16	3.12±2.20E-16

Table C - 2.14

1991 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Route 240 Air Sampler (AFRT240)

	ALPHA	BETA	SR-90	CS-137
January	9.38±8.10E-16	1.90±0.34E-14		
February	8.76±7.54E-16	1.74±0.33E-14		
March	<1.38E-15	2.02±0.61E-14		
1ST QTR			<6.24E-17	<2.27E-16
April	9.41±7.81E-16	1.54±0.31E-14		
May	< 7.40E-16	1.74±0.34E-14		
June	8.99±7.98E-16	1.62±0.32E-14		
2ND QTR			<9.79E-17	<3.05E-16
July	1.15±0.79E-15	1.94±0.34E-14		
August	8.00±7.39E-16	1.98±0.34E-14		
September	<6.53E-16	1.79±0.33E-14		
3RD QTR			<7.39E-17	3.14±2.77E-16
October	1.60±0.98E-15	2.06±0.31E-14		
November	1.07±0.94E-15	2.15±0.33E-14		
December	<2.45E-15	2.78±1.01E-14		
4TH QTR			<9.00E-17	<1.74E-16

Table C - 2.15

1991 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Springville Air Sampler (AFSPRVL)

	ALPHA	BETA	SR-90	CS-137
January	1.34±0.94E-15	1.87±0.34E-14		
February	1.32±0.87E-15	1.72±0.32E-14		
March	8.96±7.87E-16	1.4±0.29E-14		
1ST QTR			<6.11E-17	2.65±2.30E-16
April	9.51±7.47E-16	1.42±0.29E-14		
May	<7.03E-16	1.51±0.30E-14		
June	1.13±0.83E-15	1.49±0.29E-14		
2ND QTR			<5.66E-17	<2.63E-16
July	9.98±7.13E-16	1.76±0.31E-14		
August	1.04±0.77E-15	1.87±0.32E-14		
September	<6.36E-16	1.72±0.31E-14		
3RD QTR			<5.63E-17	<2.05E-16
October	1.95±1.04E-15	2.26±0.31E-14		
November	8.96±7.51E-16	1.86±0.26E-14		
December	1.10±0.78E-15	1.65±0.26E-14		
4TH QTR			<5.25E-17	<1.78E-16

Table C - 2.16

1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) *at the Thomas Corners Road Air Sampler* (AFTCORD)

	ALPHA	BETA	SR-90	CS-137
January	1.12±0.87E-15	2.06±0.36E-14		
February	1.01±0.72E-15	1.64±0.33E-14		
March	1.04±0.92E-15	1.57±0.33E-14		
1ST QTR			<6.90E-17	3.61±2.47E-16
April	8.64±6.99E-16	1.29±0.29E-14		
May	7.26±6.81E-16	1.17±0.28E-14		
June	9.08±7.90E-16	1.44±0.29E-14		
2ND QTR			<6.73E-17	<1.90E-16
July	6.77±5.00E-16	1.56±0.33E-14		
August	1.19±0.91E-15	2.22±0.42E-14		
September	1.12±1.02E-15	2.09±0.44E-14		
3RD QTR			<9.40E-17	4.31±3.35E-16
October	1.02±0.87E-15	2.05±0.35E-14		
November	1.31±0.93E-15	1.93±0.31E-14		
December	1.25±0.91E-15	1.79±0.29E-14		
4TH QTR			<3.93E-17	<2.37E-16

Table C - 2.17

1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) *at the West Valley Air Sampler* (AFWEVAL)

	ALPHA	BETA	SR-90	CS-137
January	1.54±1.06E-15	2.27±0.40E-14		
February	1.21±0.91E-15	2.14±0.37E-14		
March	9.09±8.64E-16	1.76±0.34E-14		
1ST QTR			<6.83E-17	<1.96E-16
April	1.15±0.84E-15	1.59±0.32E-14		
May	8.62±7.47E-16	1.59±0.30E-14		
June	8.53±7.32E-16	1.53±0.29E-14		
2ND QTR			<5.71E-17	<2.77E-16
July	1.03±0.71E-15	1.84±0.31E-14		
August	7.23±6.68E-16	1.68±0.30E-14		
September	<6.62E-16	1.51±0.30E-14		
3RD QTR			<1.08E-16	<1.85E-16
October	1.78±0.98E-15	2.04±0.29E-14		
November	8.70±7.11E-16	1.75±0.25E-14		
December	8.76±6.80E-16	1.62±0.24E-14		
4TH QTR			<4.18E-17	<1.96E-16

Table C - 2.18
1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) at the Great Valley Air Sampler (AFGRVAL)

	ALPHA	BETA	SR-90	CS-137	I-129
January	1.38±1.07E-15	1.95±0.39E-14			
February	8.70±8.25E-16	1.85±0.37E-14			
March	< 8.63E-16	1.57±0.34E-14			
1ST QTR			< 8.98E-17	< 2.41E-16	4.05±2.73E-16
April	1.07±0.86E-15	1.40±0.32E-14			
May	9.28±7.58E-16	1.50±0.29E-14			
June	8.27±7.09E-16	1.35±0.27E-14			
2ND QTR			< 6.87E-17	< 2.90E-16	< 2.08E-16
July	1.11±0.73E-15	1.69±0.29E-14			
August	8.22±6.91E-16	1.54±0.29E-14			
September	7.97±7.05E-16	1.52±0.29E-14			
3RD QTR			< 1.64E-17	< 2.07E-16	< 2.13E-16
October	1.45±0.93E-15	2.04±0.31E-14			
November	9.15±7.61E-16	1.62±0.25E-14			
December	< 6.13E-16	1.50±0.25E-14			
4TH QTR			< 4.65E-17	< 2.00E-16	2.24±2.08E-16

Table C - 2.19
1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) at the Dunkirk Air Sampler (AFDNKRK)

	ALPHA	BETA	SR-90	CS-137
January	1.14±1.03E-15	2.32±0.43E-14		
February	9.31±8.84E-16	2.26±0.41E-14		
March	1.23±1.04E-15	1.91±0.38E-14		
1ST QTR			<7.90E-17	1.92± 0.2E-17
April	9.90±8.39E-16	1.63±0.35E-14		
May	1.37±0.92E-15	1.52±0.30E-14		
June	9.11±7.69E-16	1.38±0.28E-14		
2ND QTR			<6.99E-17	<2.67E-16
July	7.55±6.29E-16	1.75±0.31E-14		
August	8.79±7.40E-16	1.63±0.31E-14		
September	8.28±7.50E-16	1.61±0.31E-14		
3RD QTR			<5.33E-17	<1.39E-16
October	1.50±0.94E-15	2.01±0.30E-14		
November	1.84±1.15E-15	2.39±0.34E-14		
December	1.34±0.97E-15	2.30±0.34E-14		
4TH QTR			<4.91E-17	<2.00E-16

Table C - 2.20
1991 Radioactivity Concentrations in Airborne Particulates (μCi/mL) at the Dutch Hill Air Sampler (AFBOEHN)

	ALPHA	BETA	SR-90	CS-137
January	1.65± 1.25E-15	2.34± 0.46E-14		
February	< 9.04E-16	2.07± 0.42E-14		
March	< 1.11E-15	1.99± 0.44E-14		
1ST QTR			< 7.37E-17	4.05± 3.54E-16
April	<8.2E-16	1.86± 0.39E-14		
May	1.09± 0.97E-15	2.00± 0.38E-14		
June	1.25± 1.00E-15	1.61± 0.35E-14		
2ND QTR			< 7.61E-17	< 2.77E-16
July	< 7.04E-16	1.75± 0.37E-14		
August	9.77± 8.99E-16	1.88± 0.38E-14		
September	< 7.76E-16	1.68± 0.37E-14		
3RD QTR			< 9.73E-17	<2.40E-16
October	1.74± 1.14E-15	2.06± 0.36E-14		
November	< 8.08E-16	1.94± 0.32E-14		
December	1.12± 0.92E-15	1.63± 0.30E-14		
4TH QTR			< 6.27E-17	< 2.51E-16

Table C - 2.21
Radioactivity in Fallout in 1991 (nCi/m2/month)

DUTCH HILL (AFDHFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (µCi/mL)
January	<4.9E-03	1.1E-01	<1.0E-07
February	4.8E-02	1.8E-01	<1.0E-07
March	<3.7E-02	4.3E-01	2.73±1.3E-07
April	<2.0E-02	3.1E-01	1.42±1.3E-07
May	4.4E-02	2.8E-01	<1.0E-07
June	4.2E-02	1.3E-01	SAMPLE DRY
July	4.1E-02	3.7E-01	<1.0E-07
August	<1.7E-02	2.9E-01	<1.0E-07
September	3.8E-02	3.2E-01	<1.0E-07
October	6.2E-02	5.1E-01	<1.0E-07
November	<1.3E-02	1.9E-01	4.28±1.5E-07
December	<1.6E-02	2.1E-01	<1.0E-07

FOX VALLEY ROAD (AFFXFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (µCi/mL)
January	<8.4E-03	1.4E-01	<1.0E-07
February	8.5E-02	3.6E-01	<1.0E-07
March	<3.9E-02	5.6E-01	1.67±1.2E-07
April	4.1E-02	3.7E-01	1.83±1.3E-07
May	7.4E-02	3.3E-01	<1.0E-07
June	1.8E-02	1.6E-01	SAMPLE DRY
July	4.3E-02	3.5E-01	<1.0E-07
August	<2.4E-02	1.4E-01	<1.0E-07
September	2.5E-02	3.0 E-01	<1.0E-07
October	6.79E-02	5.5 E-01	<1.0E-07
November	<2.1E-02	1.9E-01	<1.0E-07
December	2.5E-02	1.6E-01	<1.0E-07

ROUTE 240 (AF24FOP)

MONTH	Gross Alpha	Gross Beta	H-3 (µCi/mL)
January	2.9E-02	3.4E-01	<1.0E-07
February	5.5E-02	2.7E-01	<1.0E-07
March	5.8E-02	6.6E-01	<1.0E-07
April	5.6E-02	4.0E-01	<1.0E-07
May	3.6E-02	2.0E-01	<1.0E-07
June	2.1E-02	1.7E-01	SAMPLE DRY
July	2.8E-02	3.7E-01	<1.0E-07
August	<1.4E-02	2.2E-01	SAMPLE DRY
September	3.0E-02	4.0E-01	<1.0E-07
October	7.9E-02	5.5E-01	<1.0E-07
November	2.0E-02	2.9E-01	<1.0E-07
December	<1.6E-02	2.4E-01	<1.4E-07

THOMAS CORNERS ROAD (AFTCFOP)

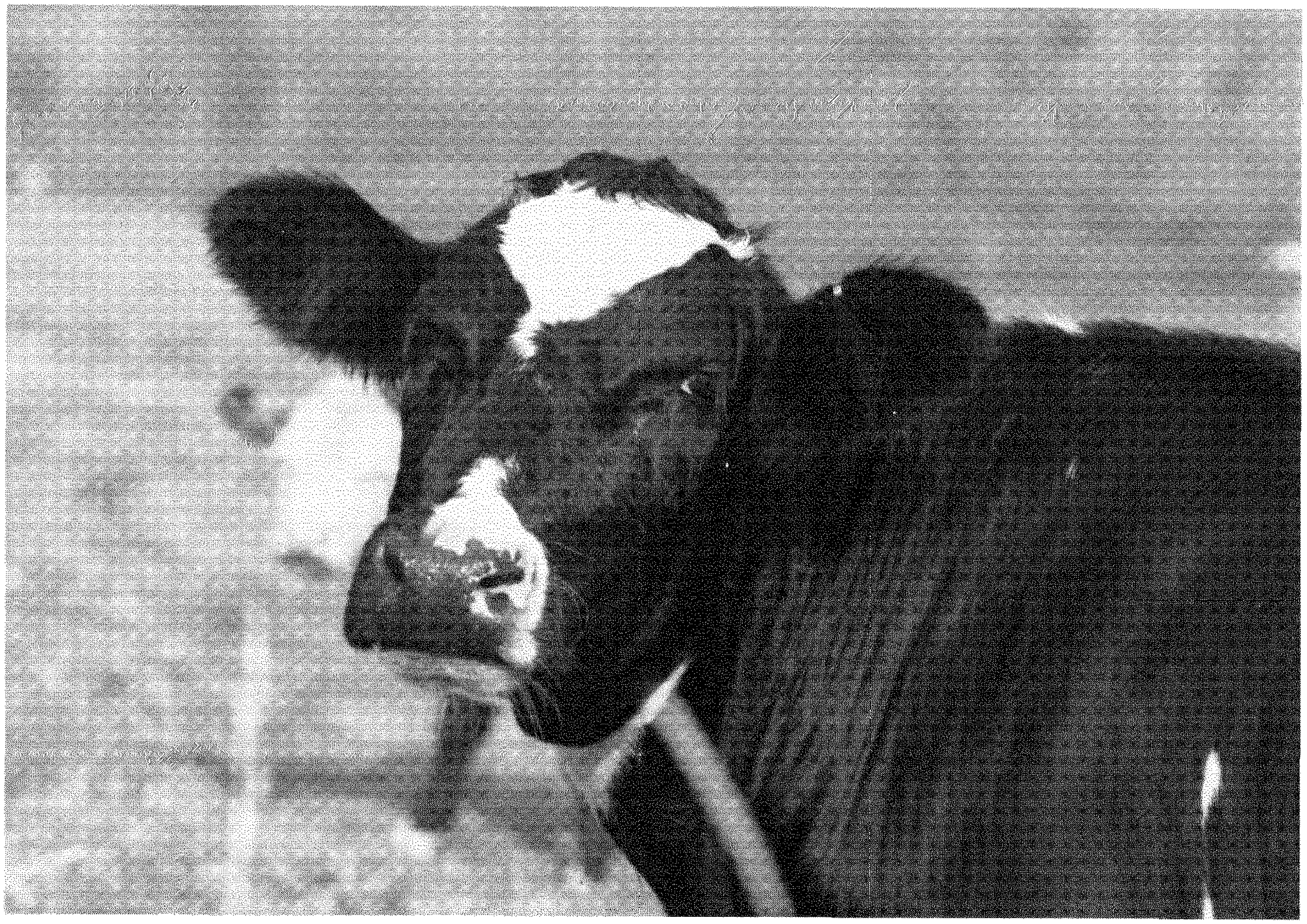
MONTH	Gross Alpha	Gross Beta	H-3 (µCi/mL)
January	4.1E-02	3.2E-01	<1.0E-07
February	9.6E-02	3.3E-01	<1.0E-07
March	<5.0E-02	8.2E-01	2.28±1.2E-07
April	6.4E-02	4.1E-01	<1.2E-07
May	4.7E-02	8.0E-01	<1.0E-07
June	2.0E-02	1.4E-01	SAMPLE DRY
July	4.8E-02	3.9E-01	<1.0E-07
August	<7.5E-03	7.4E-02	<1.0E-07
September	<3.3E-02	3.6E-01	<1.0E-07
October	5.7E-02	5.9E-01	<1.0E-07
November	<2.0E-02	2.6E-01	2.58±1.4E-07
December	<1.0E-02	3.0E-01	<1.0E-07

RAIN GAGE (ANRGFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (µCi/mL)
January	1.8E-02	5.0E-01	<1.0E-07
February	3.0E-02	2.5E-01	<1.0E-07
March	6.0E-02	8.8E-01	3.31±1.3E-07
April	<2.9E-02	3.5E-01	2.59±1.3E-07
May	1.2 E-01	5.2E-01	<1.0E-07
June	7.2E-02	2.0E-01	SAMPLE DRY
July	6.7E-02	3.9E-01	<1.0E-07
August	<1.4E-02	1.8E-01	<1.0E-07
September	<2.2E-02	2.7E-01	<1.0E-07
October	7.9E-02	6.7E-01	<1.0E-07
November	<1.6E-02	3.2E-01	2.88±1.5E-07
December	2.6E-02	2.7E-01	<1.4E-07

Table C - 2.22
pH of Precipitation Collected in Fallout Pots in 1991

MONTH	DUTCH HILL (AFDHFOP)	FOX VALLEY ROAD (AFFXFOP)	ROUTE 240 (AF24FOP)	THOMAS CORNERS ROAD (AFTCFOP)	RAIN GAGE (ANRGFOP)
January	3.74	4.14	3.91	3.93	3.86
February	3.93	4.17	3.83	3.98	3.96
March	3.93	4.27	4.09	3.99	3.96
April	3.96	4.13	6.63	4.15	4.09
May	5.18	5.83	8.07	4.84	7.54
June	DRY	DRY	DRY	DRY	DRY
July	3.54	3.44	3.49	3.84	3.90
August	3.67	3.78	DRY	3.14	3.54
September	3.61	3.80	4.16	4.16	3.80
October	3.62	3.82	4.05	3.93	4.09
November	3.72	4.17	3.71	3.97	4.17
December	3.51	4.37	3.58	3.58	3.45



Milk and meat samples are collected from local bovine herds.

Appendix C - 3

Summary of Biological Data

Table C - 3.1
1991 Radioactivity Concentrations in Milk (μCi/mL)

LOCATION	DATE	H-3	Sr-90	I-129	Cs-134	Cs-137	K-40
BFMCOBO (WNW FARM)	*1st Qtr*	<1.14E-07	<7.8E-10	<3.60E-10	<2.60E-09	3.90±2.6E-09	1.30±0.1E-06
BFMCOBO (WNW FARM)	*2nd Qtr*	<1.02E-07	2.10±0.8E-10	<3.79E-10	<2.53E-09	<2.30E-09	1.37±0.1E-06
BFMCOBO (WNW FARM)	*3rd Qtr*	<9.00E-08	2.20±0.3E-09	<3.50E-10	<2.31E-09	3.20±2.4E-09	1.18±0.1E-06
BFMCOBO (WNW FARM)	*4th Qtr*	<9.10E-08	7.90±0.4E-09	<4.50E-10	<2.60E-09	<2.50E-09	1.20±0.1E-06
BFMCTLN (CONTROL)	*1st Qtr*	3.30±1.3E-07	2.10±0.3E-09	<4.80E-10	<2.32E-09	<2.35E-09	1.31±0.1E-06
BFMCTLN (CONTROL)	*2nd Qtr*	<9.51E-08	1.70±0.3E-09	<3.30E-10	<2.50E-09	<2.60E-09	1.24±0.1E-06
BFMCTLN (CONTROL)	*3rd Qtr*	1.20±0.9E-07	1.10±0.2E-09	<4.30E-10	<2.20E-09	<2.28E-09	1.23±0.1E-06
BFMCTLN (CONTROL)	*4th Qtr*	<9.21E-08	9.50±0.4E-09	<3.91E-10	<2.20E-09	<2.20E-09	9.18±0.9E-07
BFMCTLS (CONTROL)	*1st Qtr*	<1.09E-07	9.50±2.8E-10	<3.90E-10	<2.41E-09	<2.30E-09	1.35±0.1E-06
BFMCTLS (CONTROL)	*2nd Qtr*	<9.70E-08	9.20±2.5E-10	<2.86E-10	<2.40E-09	<2.20E-09	1.29±0.1E-06
BFMCTLS (CONTROL)	*3rd Qtr*	1.30±0.90E-07	1.60±0.2E-09	<3.31E-10	<2.20E-09	<2.50E-09	1.43±0.1E-06
BFMCTLS (CONTROL)	*4th Qtr*	<9.20E-08	2.30±0.2E-09	<3.80E-10	<2.30E-09	<2.20E-09	1.20±0.1E-06
BFMREED (NNW FARM)	*1st Qtr*	<1.06E-07	<1.37E-10	<3.00E-10	<2.46E-09	<2.40E-09	1.32±0.1E-06
BFMREED (NNW FARM)	*2nd Qtr*	<8.10E-08	1.10±0.1E-09	<2.42E-10	<2.18E-09	<2.14E-09	1.05±0.1E-06
BFMREED (NNW FARM)	*3rd Qtr*	1.30±0.9E-07	1.40±0.2E-09	4.80±3.9E-10	<2.70E-09	<3.00E-09	1.46±0.2E-06
BFMREED (NNW FARM)	*4th Qtr*	<9.50E-08	5.30±0.3E-09	<4.73E-10	<2.14E-09	<2.40E-09	9.98±1.0E-07
BFMWIDR (SE FARM)	*Annual*	<8.90E-08	2.70±0.3E-09	<3.61E-10	<1.90E-09	<2.10E-09	1.23±0.1E-06
BFMHAUR (SSW FARM)	*Annual*	<9.40E-08	1.50±0.6E-09	<3.40E-10	<2.40E-09	3.30±2.4E-09	7.78±0.8E-07

Table C - 3.2
1991 Radioactivity Concentrations in Meat (μCi/g Dry)

LOCATION	%Moisture	H-3 (μCi/mL)	Sr-90 (μCi/g)	Cs-134 (μCi/g)	Cs-137 (μCi/g)	K-40 (μCi/g)
DEER FLESH BACKGROUND (BFDCTRL#1)	72%	5.50±3.10E-07	1.00±0.60E-08	<1.05E-08	1.29±0.17E-07	9.98±1.00E-06
DEER FLESH BACKGROUND (BFDCTRL#2)	75%	<3.60E-07	9.70±6.30E-09	1.50±1.20E-08	8.30±2.04E-08	9.69±0.97E-06
DEER FLESH BACKGROUND (BFDCTRL#3)	76%	<1.40E-07	<8.40E-09	<1.20E-08	1.11±0.19E-07	1.23±0.12E-05
DEER FLESH NEAR-SITE (BFDNEAR#1)	70%	<3.00E-07	<5.80E-09	<1.01E-08	<1.18E-08	1.05±0.11E-05
DEER FLESH NEAR-SITE (BFDNEAR#2)	72%	2.80±1.60E-07	<6.20E-09	1.10±1.00E-08	6.45±1.65E-08	1.19±0.12E-05
DEER FLESH NEAR-SITE (BFDNEAR#3)	71%	<2.60E-07	<1.90E-09	<1.14E-08	5.99±1.65E-08	9.05±0.91E-06
BEEF FLESH BACKGROUND (BFBCTRL)6/91	N/A	N/A	<2.09E-09	<3.01E-09 (μCi/gm wet)	3.90±2.90E-09 (μCi/gm wet)	7.25±0.23E-06 (μCi/gm wet)
BEEF FLESH BACKGROUND (BFBCTRL)6/91	N/A	N/A	<1.00E-10	<3.90E-09 (μCi/gm wet)	5.00±3.60E-09 (μCi/gm wet)	2.30±0.23E-06 (μCi/gm wet)
BEEF FLESH BACKGROUND (BFBCTRL)11/91	74%	N/A	<7.90E-09	<7.50E-08	<7.20E-08	1.22±0.22E-05
BEEF FLESH NEAR-SITE (BFBNEAR)6/91	N/A	N/A	<2.38E-09	<2.82E-09 (μCi/gm wet)	<2.60E-09 (μCi/gm wet)	2.65±0.27E-07 (μCi/gm wet)
BEEF FLESH NEAR-SITE (BFBNEAR)6/91	N/A	N/A	<2.90E-09	<3.40E-09 (μCi/gm wet)	4.00±3.20E-09 (μCi/gm wet)	2.59±0.26E-06 (μCi/gm wet)
BEEF FLESH NEAR-SITE (BFBNEAR)11/91	61%	N/A	<5.40E-09	7.00±6.10E-08	<6.20E-08	5.97±0.14E-06

Table C - 3.3
1991 Radioactivity Concentrations in Food Crops (μCi/g Dry)

LOCATION	% MOISTURE	H-3 (μCi/mL)	Sr-90	K-40	Co-60	Cs-137
BEANS-BACKGROUND (BFVCTRL)	92%	N/A	7.70±1.30E-09	2.46±0.25E-05	<3.74E-08	<3.07E-08
BEANS NEAR-SITE (BFVNEAR)	83%	1.40±1.0E-07	1.50±0.30E-08	2.09±0.21E-05	<2.13E-08	<2.20E-08
APPLES-BACKGROUND (BFVCTRL)	88%	6.50±1.1E-07	7.80±1.70E-09	7.85±0.79E-06	<3.78E-08	<3.80E-08
APPLES NEAR-SITE (BFVNEAR)	83%	5.90±1.0E-07	6.60±2.0E-09	6.20±0.63E-06	<2.80E-08	<2.69E-08
CORN-BACKGROUND (BFVCTRL)	80%	6.80±0.7E-08	3.30±1.80E-09	1.08±0.11E-05	2.30±2.0E-08	<1.90E-08
CORN NEAR-SITE (BFVNEAR)	54%	N/A	3.60±2.20E-09	4.58±0.46E-06	<6.90E-09	<7.30E-09
HAY-BACKGROUND (BFHCTLS)	N/A	N/A	1.10±0.10E-07	2.58±0.26E-05	<3.02E-08	5.00±3.0E-08
HAY NEAR-SITE (BFHNEAR)	N/A	N/A	1.70E±0.20E-07	<2.10E-06	<3.10E-08	<3.30E-08

Table C - 3.4
1991 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek (BFFCATC) above Springville Dam

	1st Half (μCi/g wet)			2nd Half (μCi/g dry)		
	Sr-90	*Cs-134*	*Cs-137*	*Sr-90*	*Cs-134*	*Cs-137*
Median	1.85E-08	<4.9E-08	<5.2E-08	4.8E-08	<2.9E-07	<2.36E-07
Geometric Deviation (Avg)	2.60	1.72	1.58	1.58	1.74	2.01
Maximum	6.20E-08	<7.3E-08	<9.2E-08	1.1E-07	<4.2E-07	<4.5E-07
Minimum	<3.5E-09	<1.9E-08	<2.9E-08	<3.0E-08	<1.4E-08	<1.4E-08
Moisture (Average %)	N/A			77.9		

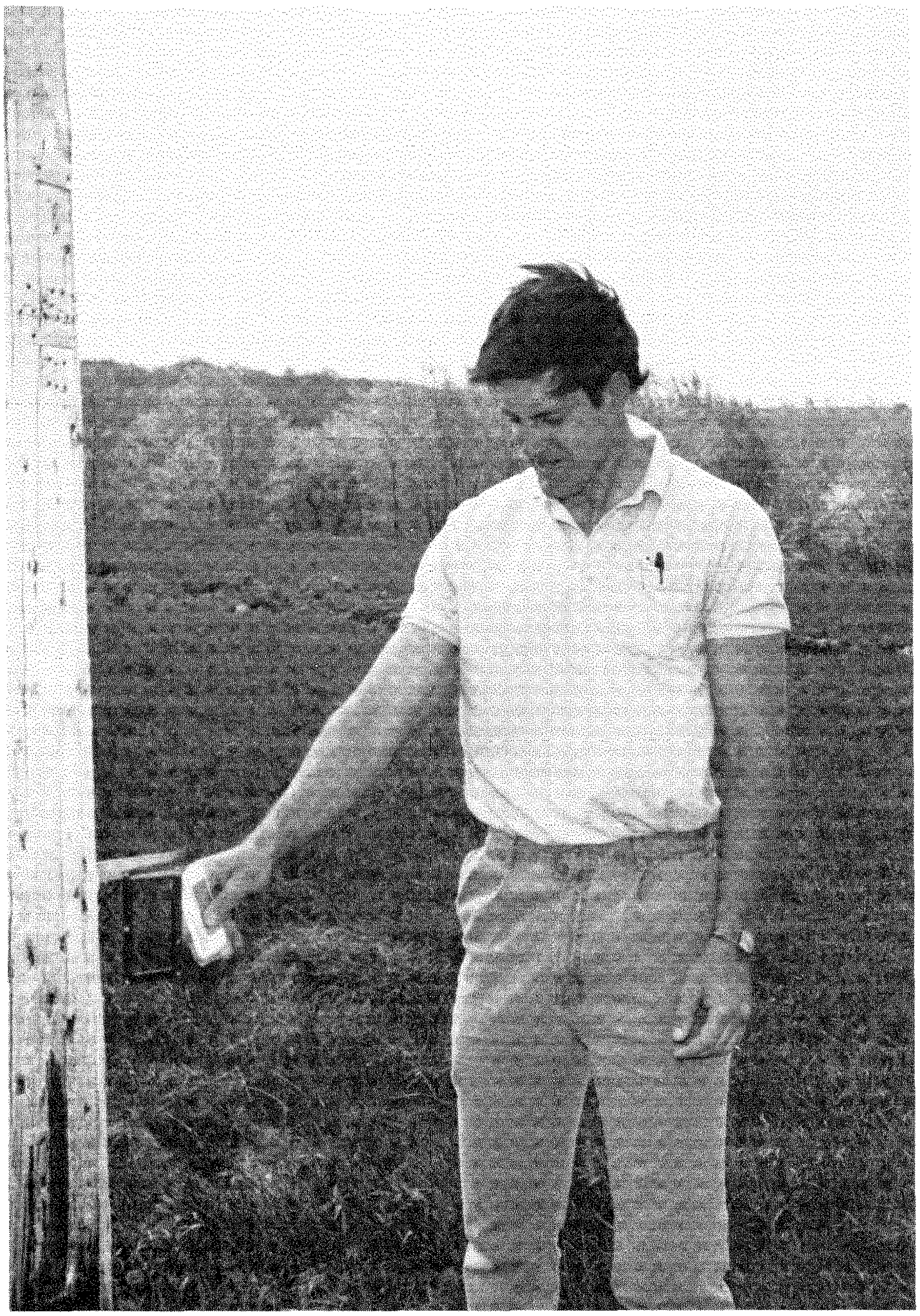
Cattaraugus Creek (BFFCTRL) Background

	1st Half (μCi/g wet)			2nd Half (μCi/g dry)		
	Sr-90	*Cs-134*	*Cs-137*	*Sr-90*	*Cs-134*	*Cs-137*
Median	8.0E-09	<4.4E-08	<4.0E-08	4.0E-08	<2.3E-07	<2.8E-07
Geometric Deviation (Avg)	6.34	1.73	1.88	1.70	1.65	1.63
Maximum	1.7E-08	<9.2E-08	<8.1E-08	6.6E-08	<4.0E-07	<4.4E-07
Minimum	<3.1E-10	<2.2E-08	<2.0E-08	1.5E-08	<9.4E-08	<9.8E-08
Moisture (Average %)	N/A			78.1		

Cattaraugus Creek (BFFCATD) below the Springville Dam (Annual) *
(μCi/g dry)

	Sr-90	*Cs-134*	*Cs-137*
Median	1.6E-08	<1.3E-07	<1.4E-07
Geometric Deviation (Avg)	7.03	3.50	9.44
Maximum	9.5E-08	<6.3E-07	<5.9E-07
Minimum	<4.8E-09	<6.5E-08	5.9E-08
Moisture (Average %)	76.8		

* *Sample not collected for the first half of 1991.*
N/A - Not available



Exchanging an Environmental TLD Package

Appendix C - 4

Summary of Direct Radiation Monitoring Data

Table C - 4.1

Summary of 1991 Quarterly Averages of TLD Measurements

(Roentgen ± 3 SD/Quarter)

Location Number	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
1	.027 ± .002	.019 ± .002	.019 ± .005	.023 ± .002	.022 ± .003
2	.022 ± .002	.019 ± .004	.019 ± .005	.023 ± .004	.021 ± .004
3	.020 ± .001	.017 ± .003	.017 ± .003	.023 ± .003	.019 ± .002
4	.020 ± .001	.018 ± .006	.020 ± .004	.023 ± .005	.020 ± .004
5	.021 ± .004	.019 ± .004	.021 ± .008	.024 ± .003	.021 ± .005
6	.020 ± .004	.017 ± .004	.017 ± .004	.023 ± .002	.019 ± .003
7	.019 ± .003	.017 ± .003	.018 ± .003	.021 ± .004	.019 ± .003
8	.019 ± .004	.017 ± .003	.018 ± .001	.024 ± .004	.019 ± .003
9	.019 ± .002	.017 ± .002	.017 ± .003	.021 ± .002	.019 ± .002
10	.020 ± .003	.017 ± .003	.018 ± .003	.023 ± .002	.019 ± .003
11	.022 ± .004	.019 ± .000	.019 ± .004	.025 ± .004	.021 ± .003
12	.020 ± .003	.020 ± .005	.019 ± .003	.023 ± .003	.020 ± .004
13	.021 ± .002	.020 ± .004	.021 ± .004	.025 ± .003	.022 ± .003
14	.021 ± .004	.019 ± .003	.019 ± .003	.024 ± .003	.021 ± .003
15	.020 ± .003	.017 ± .003	.018 ± .003	.022 ± .003	.019 ± .003
16	.020 ± .002	.018 ± .002	.019 ± .003	.024 ± .001	.020 ± .002
17	.022 ± .003	.018 ± .002	.018 ± .003	.022 ± .005	.020 ± .003
18**	.043 ± .005	.041 ± .007	.037 ± .008	.045 ± .004	.042 ± .006
19**	.023 ± .004	.023 ± .003	.024 ± .006	.028 ± .002	.024 ± .004
20	.020 ± .004	.018 ± .003	.018 ± .003	.023 ± .002	.020 ± .003
21	.020 ± .003	.018 ± .003	.018 ± .003	.022 ± .002	.019 ± .003
22	.020 ± .002	.017 ± .005	.019 ± .004	.021 ± .002	.019 ± .003
23	.018 ± .001	.017 ± .003	.016 ± .002	.021 ± .002	.018 ± .002
24**	1.345 ± .037	1.259 ± .132	1.135 ± .085	1.293 ± .202	1.258 ± .129
25	.034 ± .003	.032 ± .004	.033 ± .007	.036 ± .006	.034 ± .005
26	.030 ± .002	.029 ± .005	.028 ± .004	.032 ± .005	.030 ± .004
27	.023 ± .005	.020 ± .003	.021 ± .005	.026 ± .005	.022 ± .004
28	.022 ± .003	.022 ± .005	.022 ± .001	.026 ± .003	.023 ± .003
29	.027 ± .009	.023 ± .002	.023 ± .004	.027 ± .002	.025 ± .004
30	.033 ± .005	.031 ± .003	.030 ± .005	.033 ± .006	.032 ± .005
31	.022 ± .003	.019 ± .004	.019 ± .002	.024 ± .004	.021 ± .003
32	.032 ± .004	.031 ± .005	.030 ± .003	.035 ± .005	.032 ± .004
33	.039 ± .004	.036 ± .004	.037 ± .008	.042 ± .008	.039 ± .006
34	.057 ± .006	.055 ± .005	.054 ± .005	.062 ± .003	.057 ± .005
35	.077 ± .006	.075 ± .009	.069 ± .007	.080 ± .008	.075 ± .007
36	.068 ± .007	.067 ± .009	.063 ± .008	.073 ± .006	.067 ± .007
37	.019 ± .001	.016 ± .004	.017 ± .003	.021 ± .003	.018 ± .003
38**	.044 ± .007	.045 ± .004	.045 ± .003	.049 ± .009	.046 ± .006
39**	.079 ± .006	.085 ± .008	.083 ± .019	.091 ± .015	.085 ± .013
40**	.208 ± .009	.203 ± .023	.198 ± .033	.249 ± .028	.215 ± .025
41	.018 ± .002	.017 ± .004	.016 ± .004	.020 ± .004	.018 ± .003
Quarterly Average **	.026 ± .004	.024 ± .004	.024 ± .004	.029 ± .004	.026 ± .004

***** Locations shown on Figures A-3 and A-6.***

***** TLDs 18, 19, 24, 38, 39, and 40 are not included in the quarterly averages.***

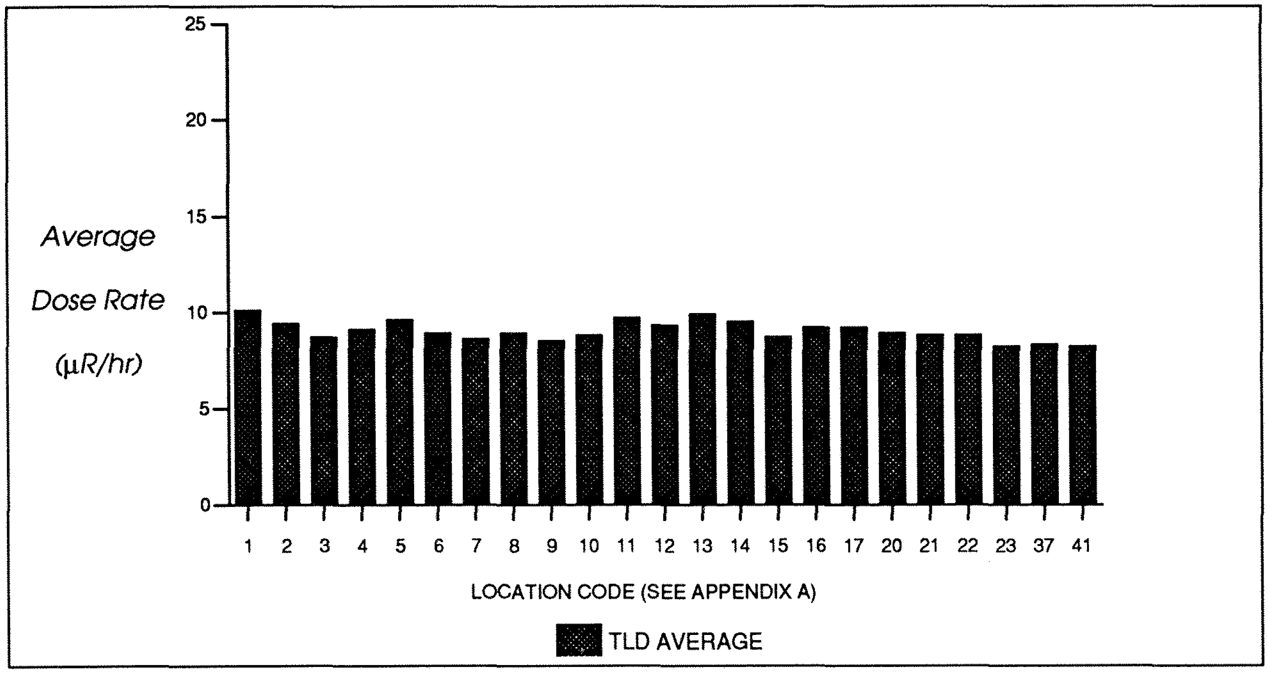


Figure C - 4.1

1991 Average Quarterly Gamma Exposure Rates around the West Valley Demonstration Project

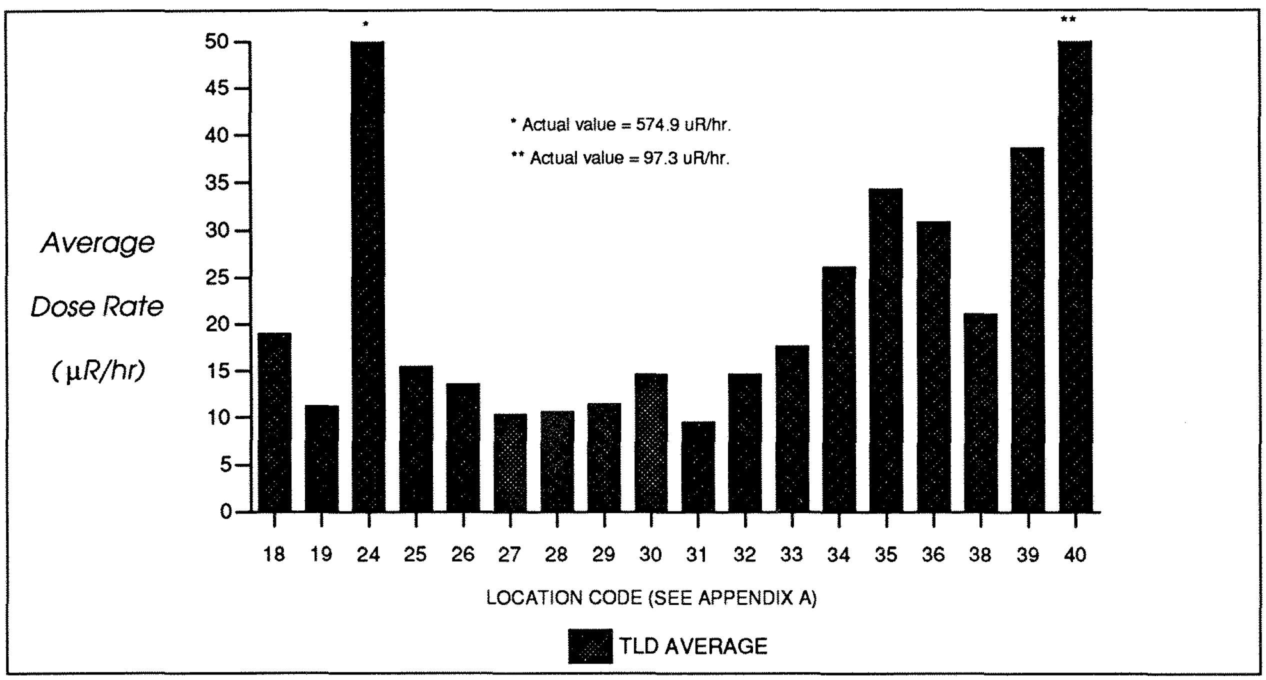


Figure C - 4.2

1991 Average Quarterly Gamma Exposure Rates on the West Valley Demonstration Project Site

Grab-Sampling Surface Water

Appendix C - 5

Summary of Nonradiological Monitoring Data

Table C - 5.1
West Valley Demonstration Project
State Pollutant Discharge Elimination System (SPDES) Sampling Program
Effective September 1990

Outfall	Parameter	Limit	Sample Frequency
001 (PROCESS AND STORM WASTEWATER)	Flow	Monitor	2 per discharge
	Aluminum, total	14.0 mg/L	2 per discharge
	Ammonia (NH3)	*	2 per discharge
	Arsenic, dissolved	0.15 mg/L	2 per discharge
	BOD-5	**	2 per discharge
	Iron, total	**	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	0.3 mL/L	2 per discharge
	pH (range)	6.0-9.0	2 per discharge
	Oil and grease	15.0 mg/L	2 per discharge
	Sulfate	Monitor	2 per discharge
	Nitrate	Monitor	2 per discharge
	Nitrite	Monitor	2 per discharge
	Chromium (hexavalent), total rec.	Monitor	2 per discharge
	Cadmium, total recoverable	0.007mg/L	2 per discharge
	Copper, total recoverable	0.03 mg/L	2 per discharge
	Lead, total recoverable	0.15 mg/L	2 per discharge
	Nickel, total	2.7 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	0.19 mg/L	2 per discharge
	Chromium, total	0.050 mg/L	annual
	Selenium, total	0.040 mg/L	annual
	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	semi-annual
	4-dodecene	0.6 mg/L	semi-annual
007 (SANITARY AND UTILITY WASTEWATER	Flow	Monitor	3 per month
	Ammonia	*	3 per month
	BOD-5	**	3 per month
	Iron, total	**	3 per month
	Suspended solids	45.0 mg/L	2 per month
	Settleable solids	0.3 mL/L	weekly
	pH (range)	6.0-9.0	weekly
	Chloroform	0.020 mg/L	annual
008 (FRENCH DRAIN WASTEWATER)	Flow	Monitor	3 per month
	BOD-5	**	3 per month
	Iron, total	**	3 per month
	pH (range)	6.0-9.0.	weekly
	Silver, total	0.008 mg/L	annual
	Zinc, total	0.100 mg/L	annual

* *Reported as flow-weighted average of outfalls 001 and 007. Limit is 2.1 mg/L.*

***Reported as flow-weighted average of outfalls 001, 007, and 008. Limits are 5.0 mg/L for BOD-5 and 0.31mg/L for FE. Iron data are net limits reported after background concentrations are subtracted.*

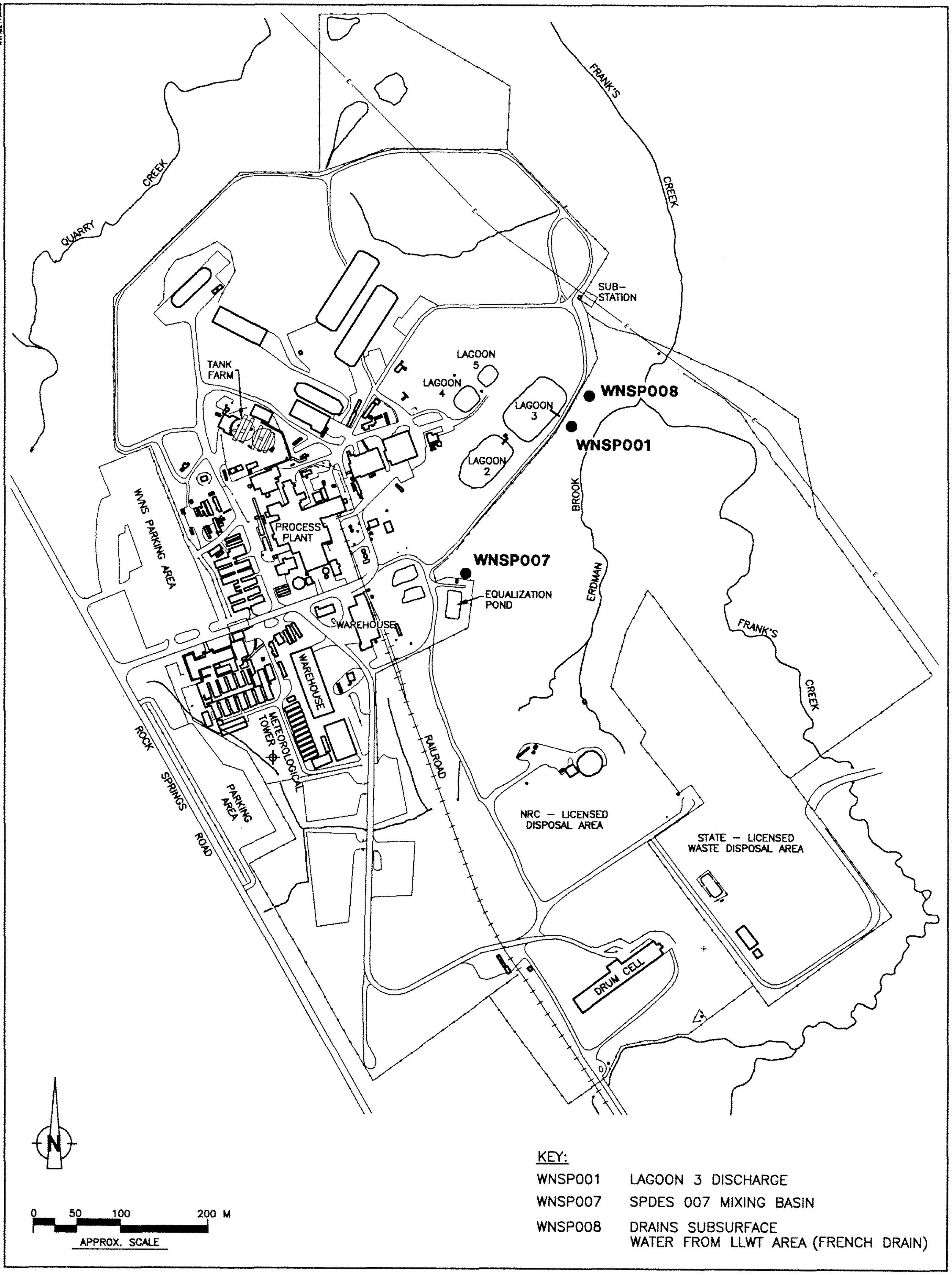


Figure C-5.1. SPDES Monitoring Points.

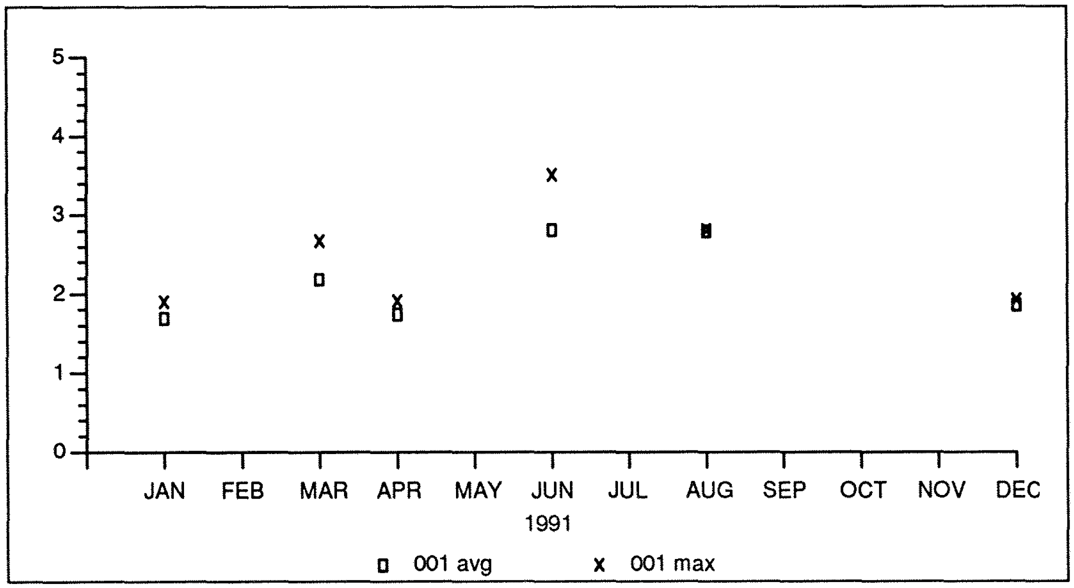


Figure C - 5.2

BIOCHEMICAL OXYGEN DEMAND-5

(mg/L)

Outfall 001

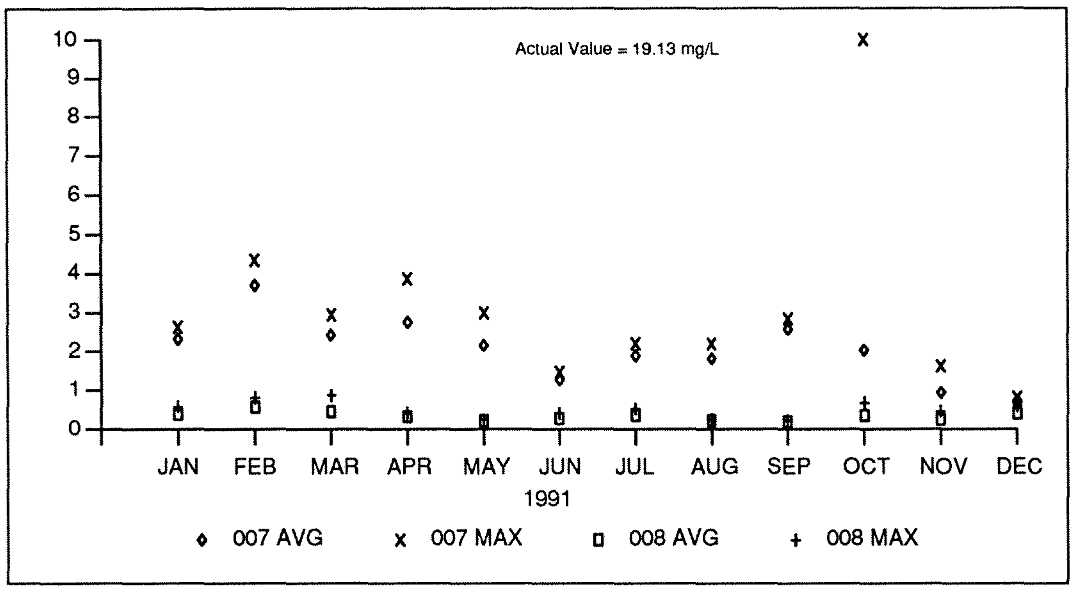


Figure C - 5.3

BIOCHEMICAL OXYGEN DEMAND-5

(mg/L)

Outfalls 007 and 008

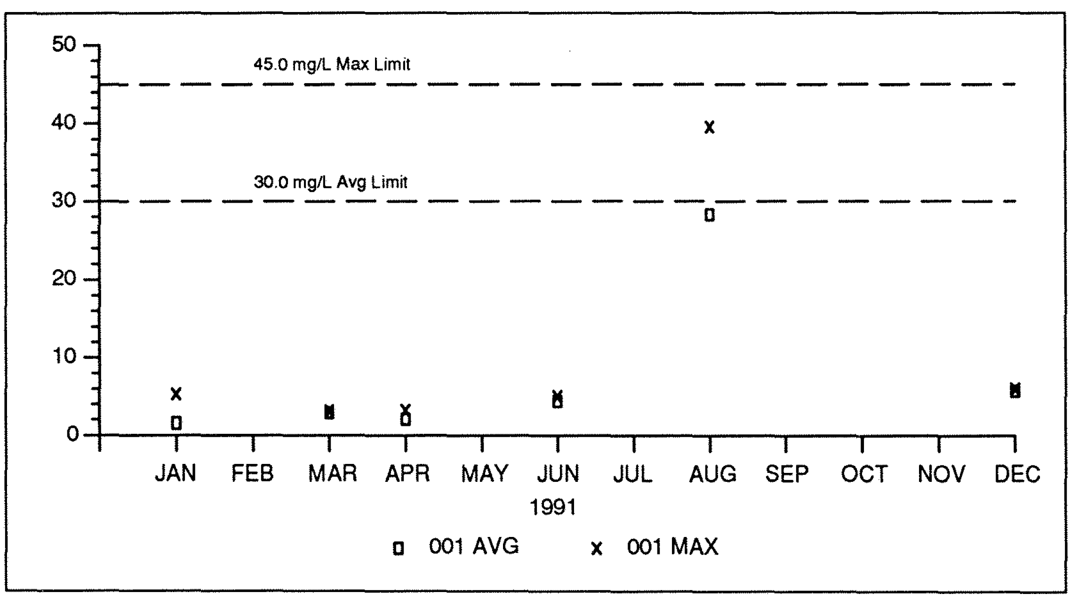


Figure C - 5.4

SUSPENDED SOLIDS

(mg/L)

Outfall 001

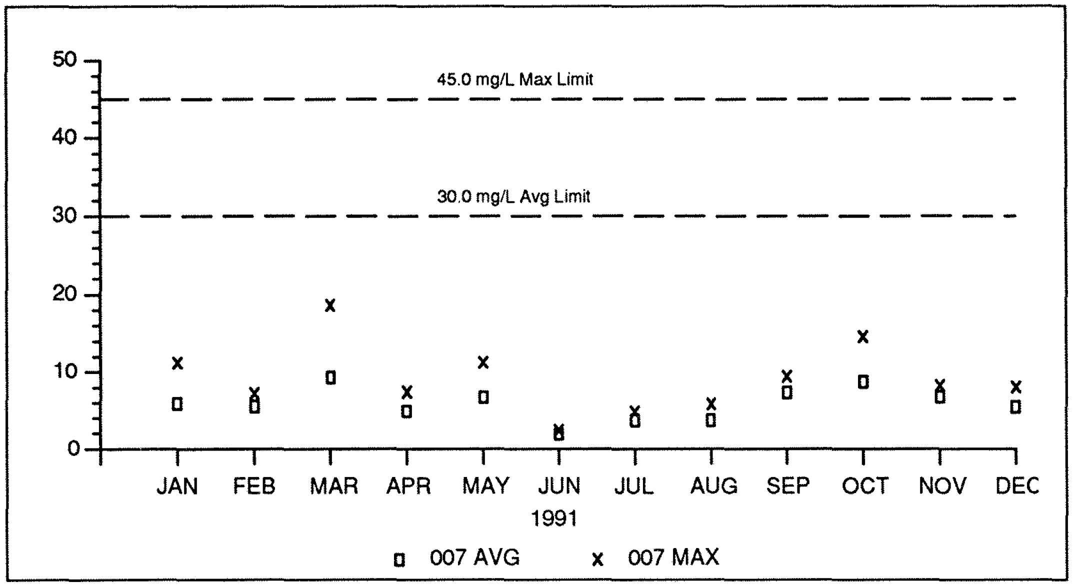


Figure C - 5.5

SUSPENDED SOLIDS

(mg/L)

Outfall 007

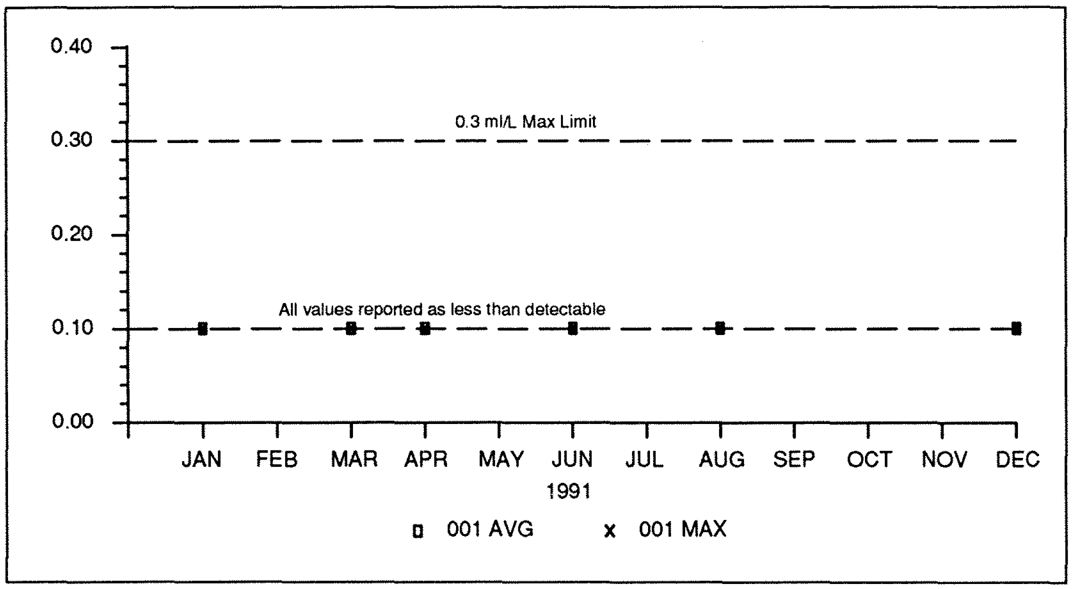


Figure C - 5.6

SETTLEABLE SOLIDS

(ml/L)

Outfall 001

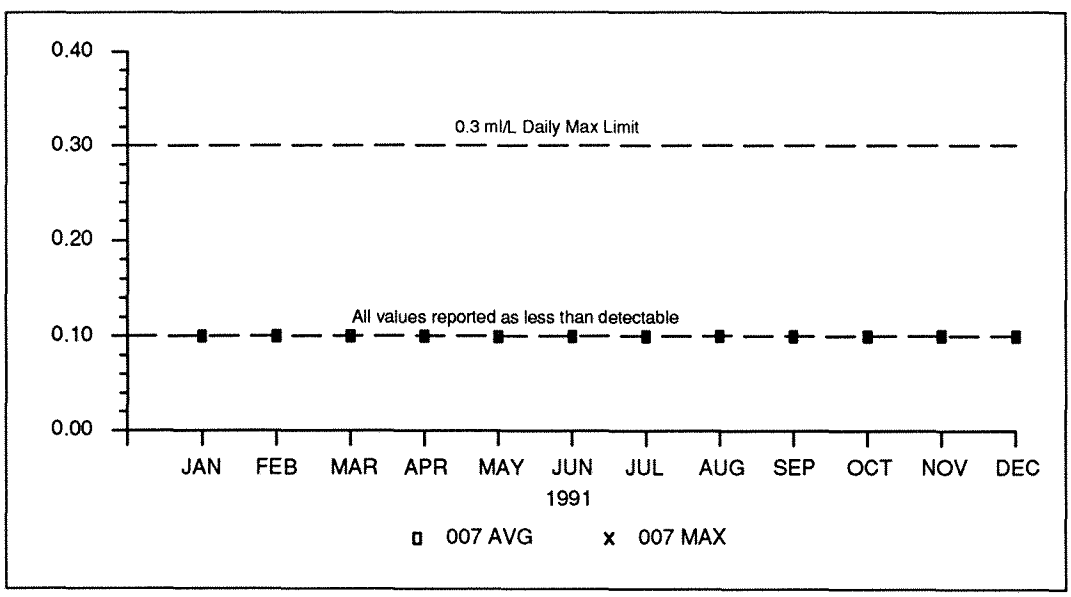


Figure C - 5.7

SETTLEABLE SOLIDS

(ml/L)

Outfall 007

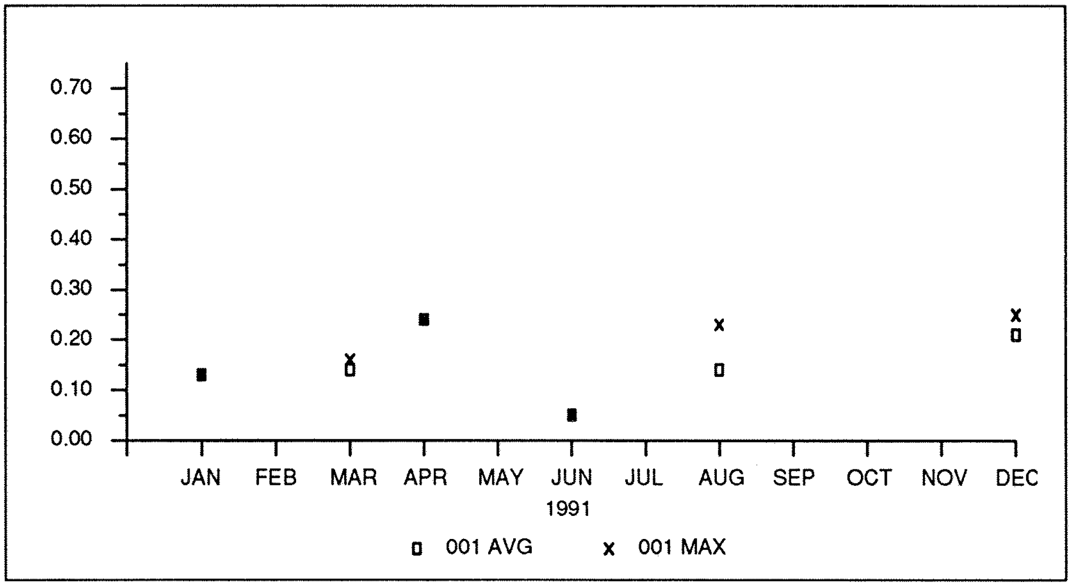


Figure C - 5.8

AMMONIA

(mg/L)

Outfall 001

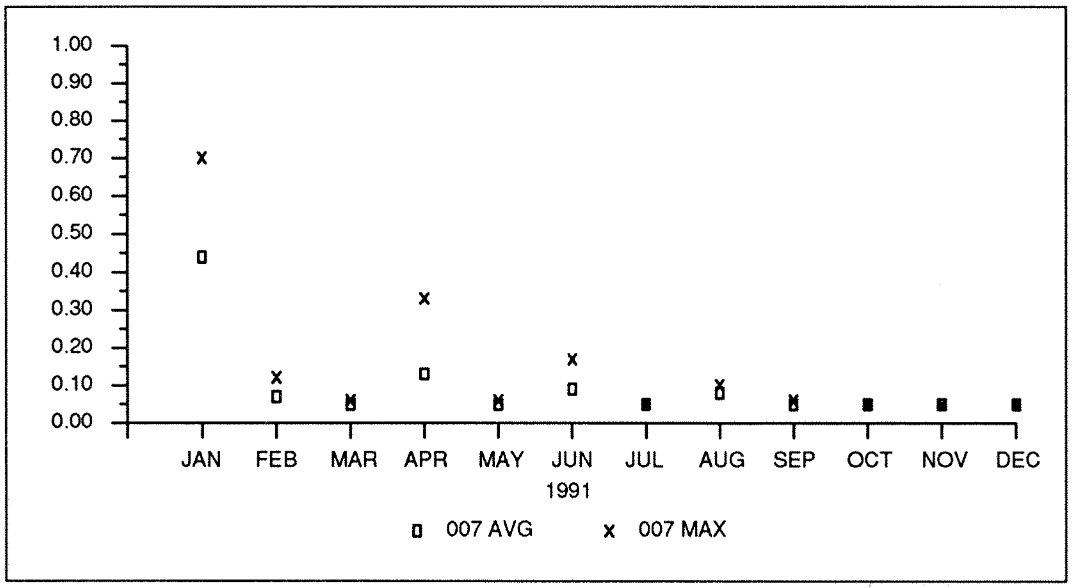


Figure C - 5.9

AMMONIA

(mg/L)

Outfall 007

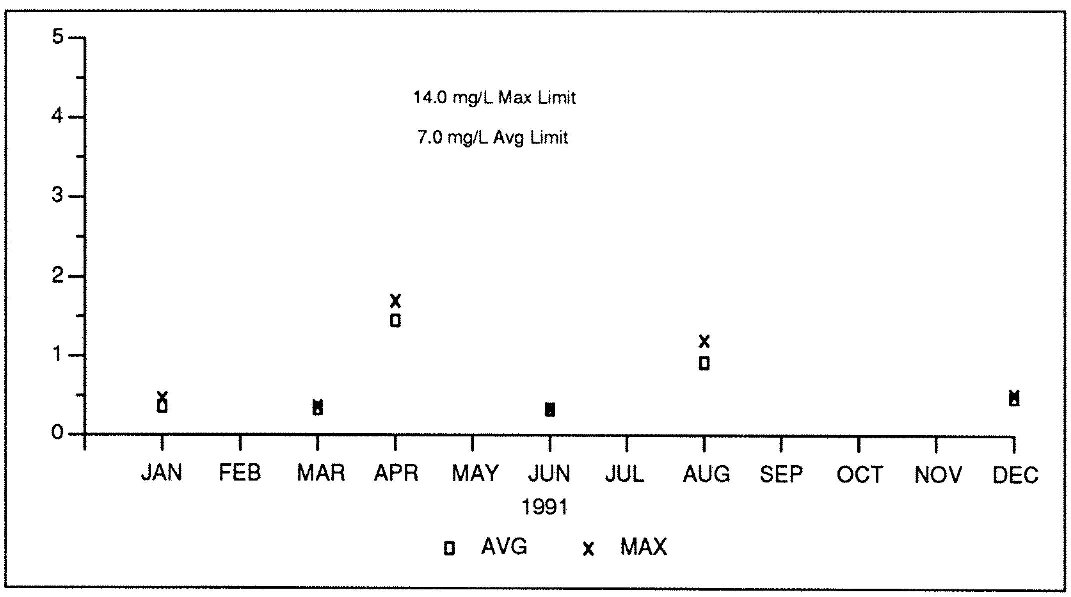


Figure C - 5.10

METALS
(ALUMINUM)

(mg/L)

Outfall 001

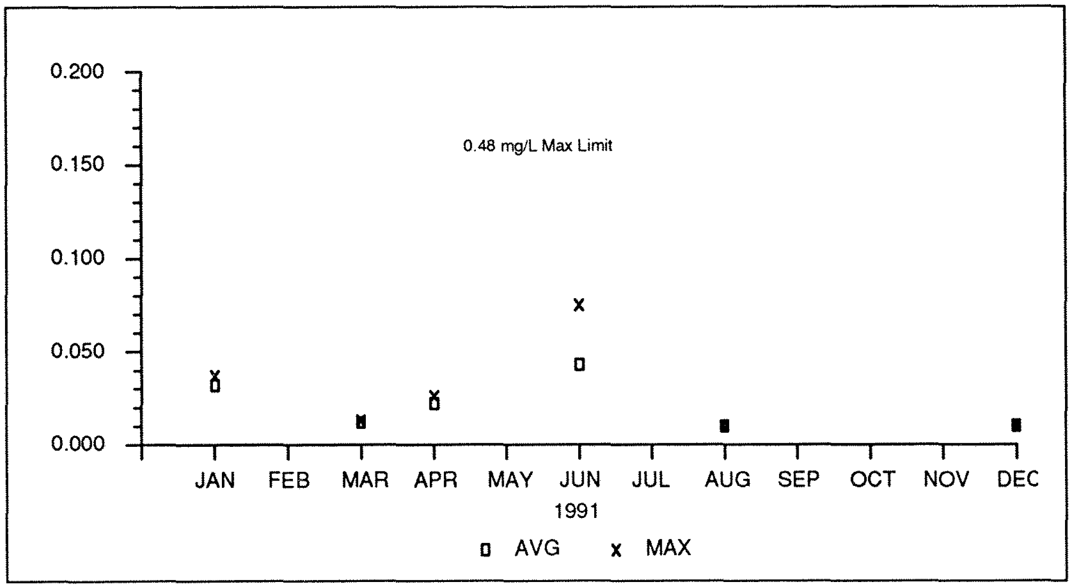


Figure C - 5.11

METALS (ZINC)
(mg/L)

Outfall 001

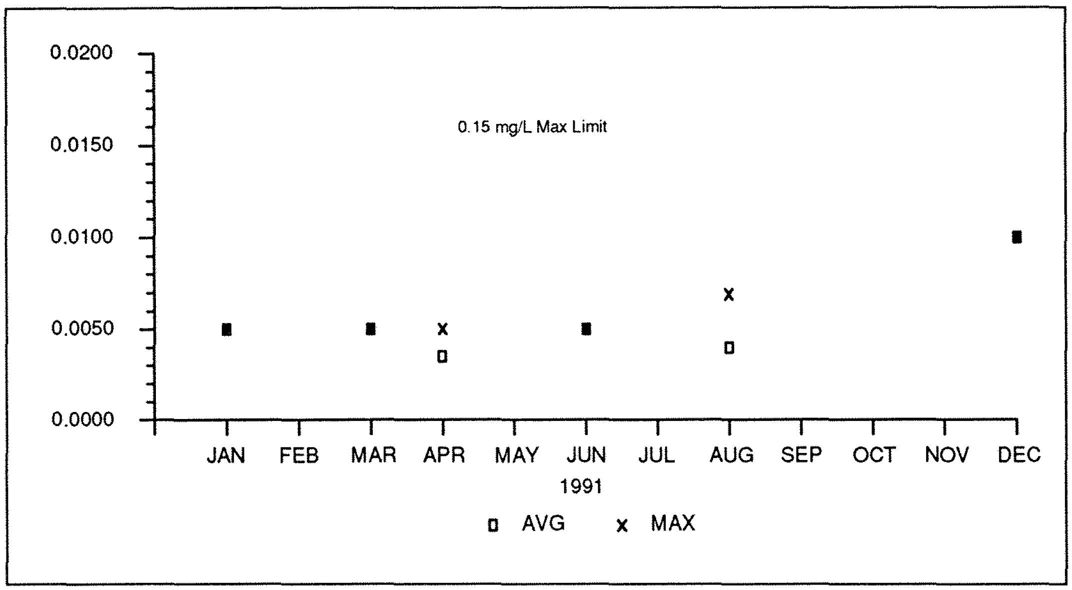


Figure C - 5.12

METALS (ARSENIC)
(mg/L)

Outfall 001

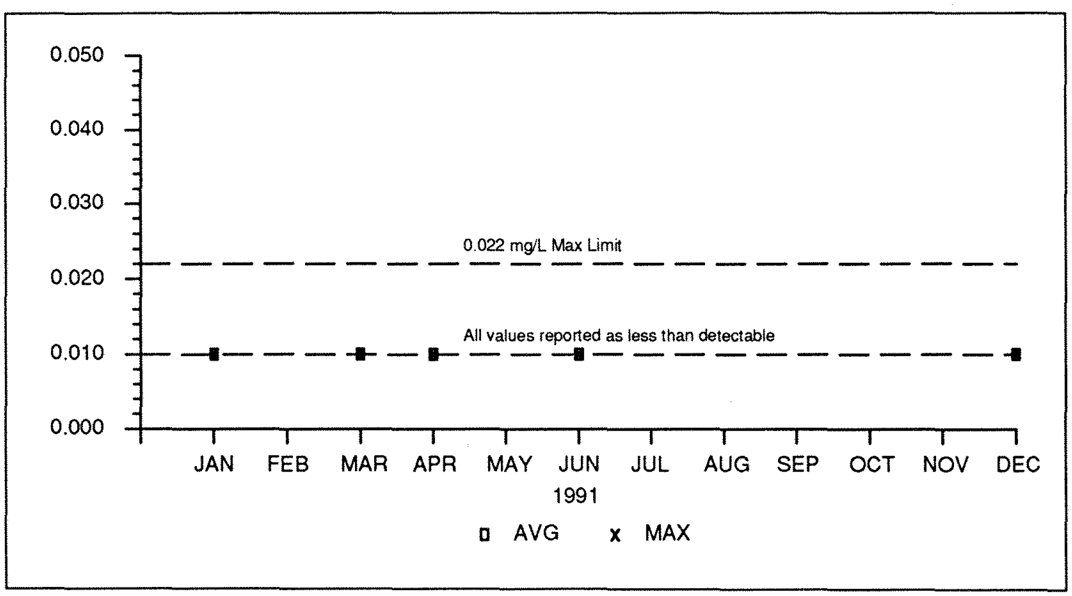


Figure C - 5.13

CYANIDE
(mg/L)

Outfall 001

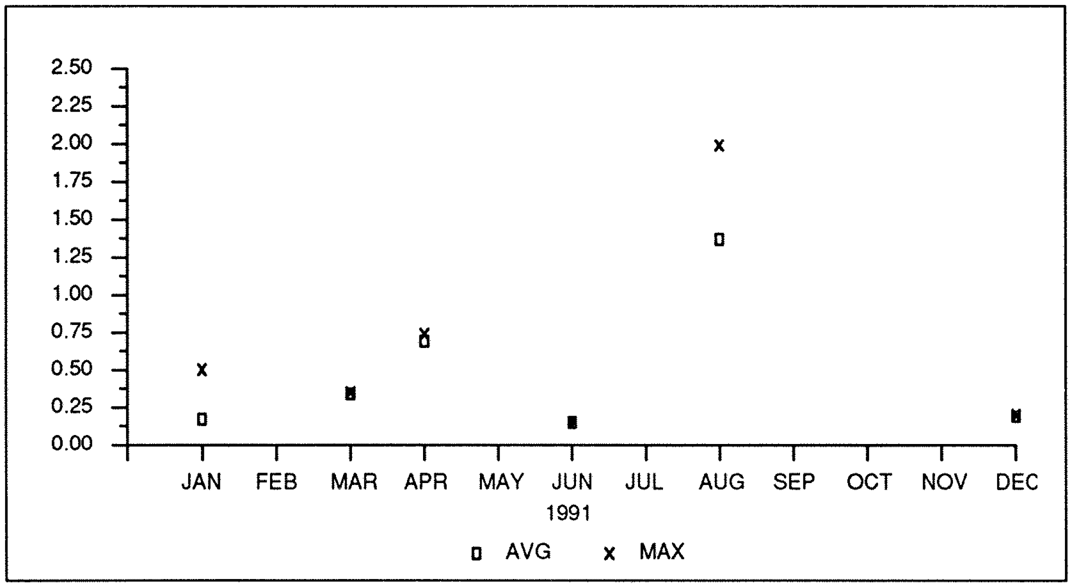


Figure C - 5.14

METALS (IRON)
(mg/L)

Outfall 001

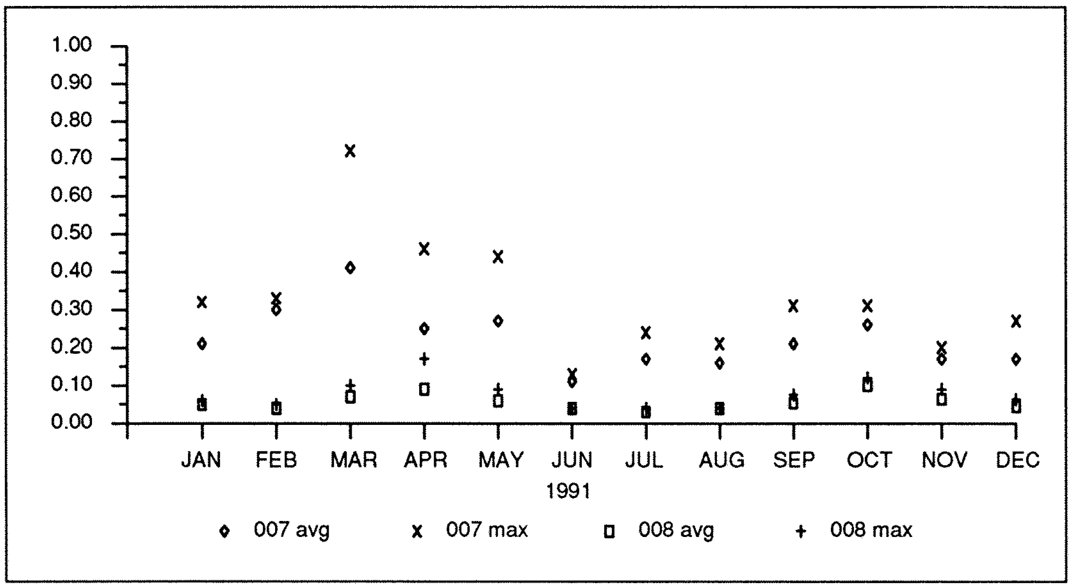


Figure C - 5.15

METALS (IRON)
(mg/L)

Outfalls 007 and 008

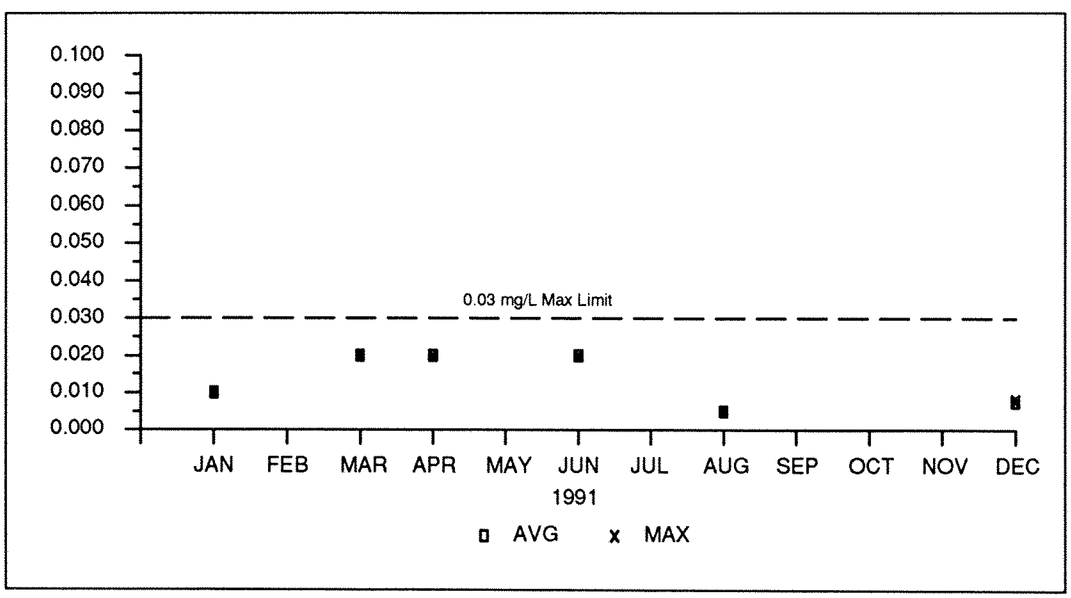


Figure C - 5.16

METALS (COPPER)
(mg/L)

Outfall 001

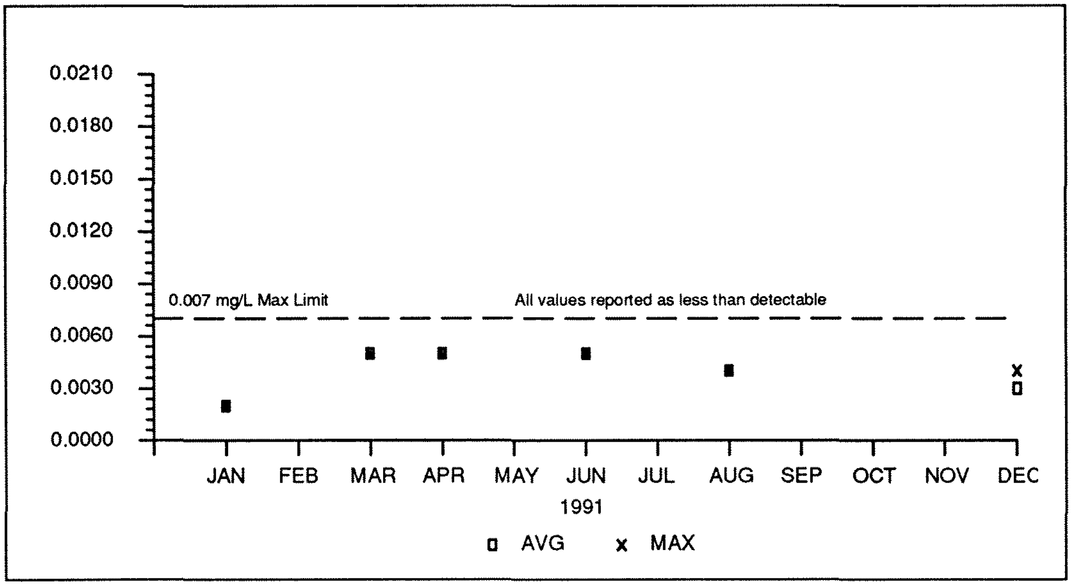


Figure C - 5.17

METALS (CADMIUM)
(mg/L)

Outfall 001

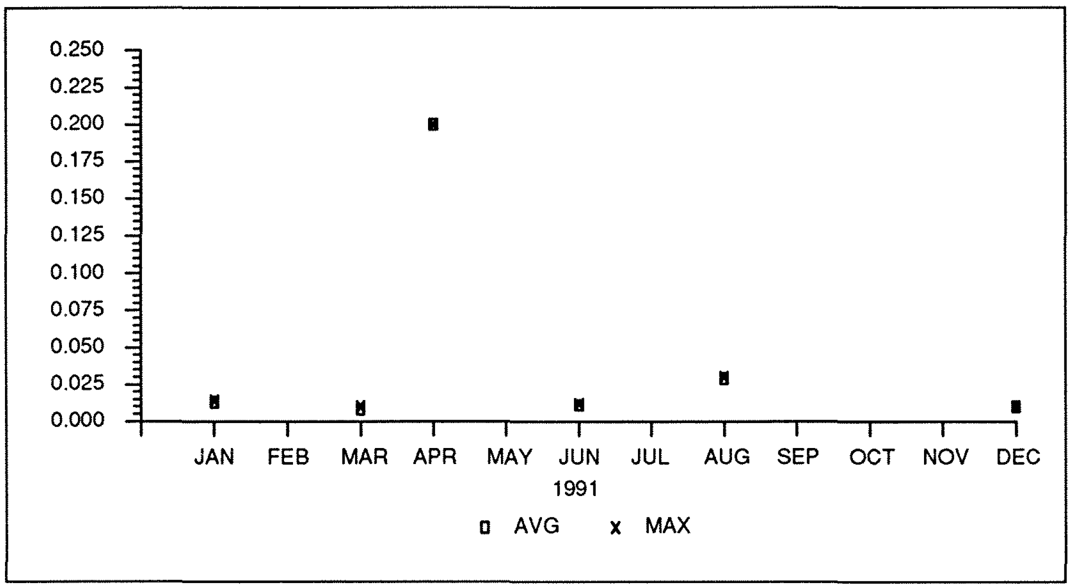


Figure C - 5.18

METALS (CHROMIUM,VI)
(mg/L)

Outfall 001

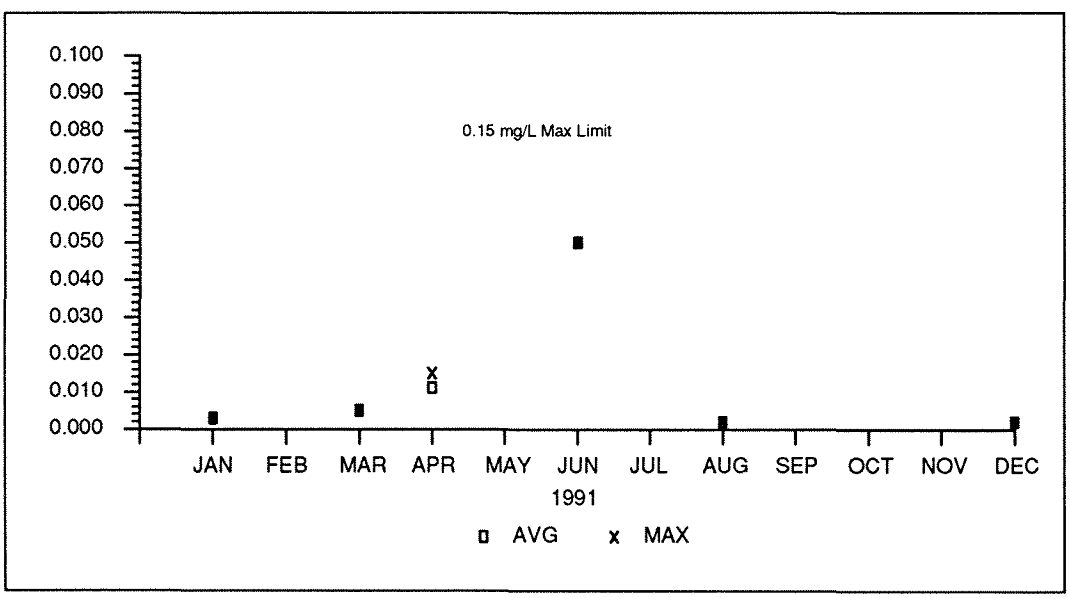


Figure C - 5.19.

METALS (LEAD)
(mg/L)

Outfall 001

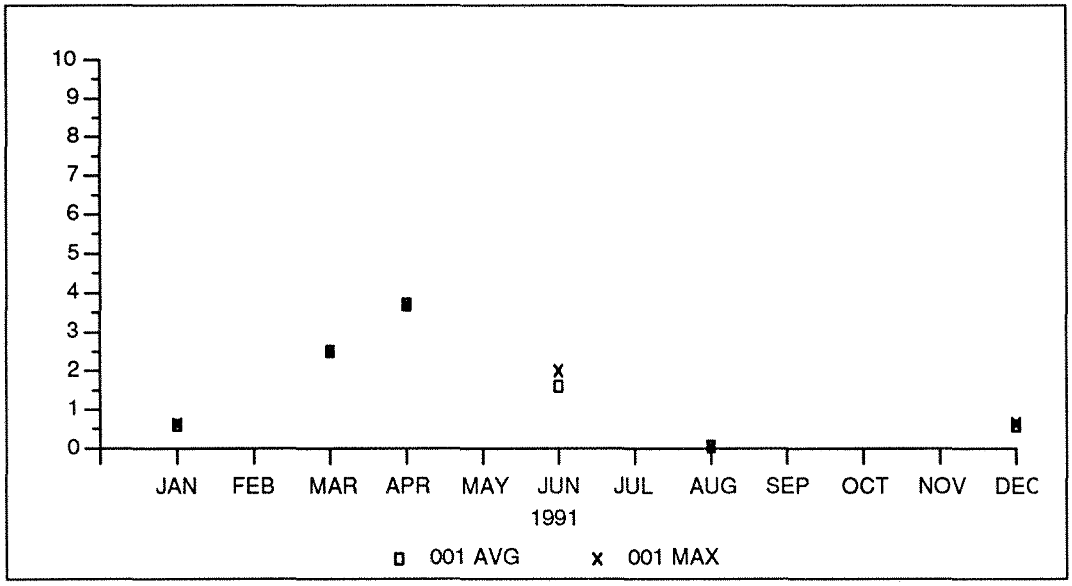


Figure C - 5.20

NITRATE (NO3-N)
(mg/L)

Outfall 001

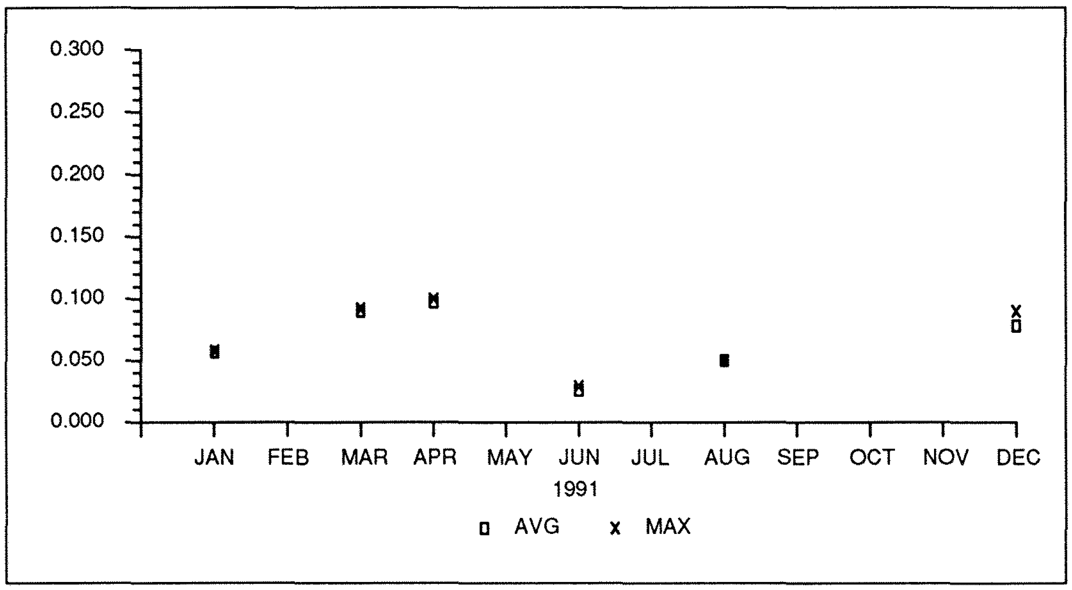


Figure C - 5.21

NITRITE (NO2 -N))
(mg/L)

Outfall 001

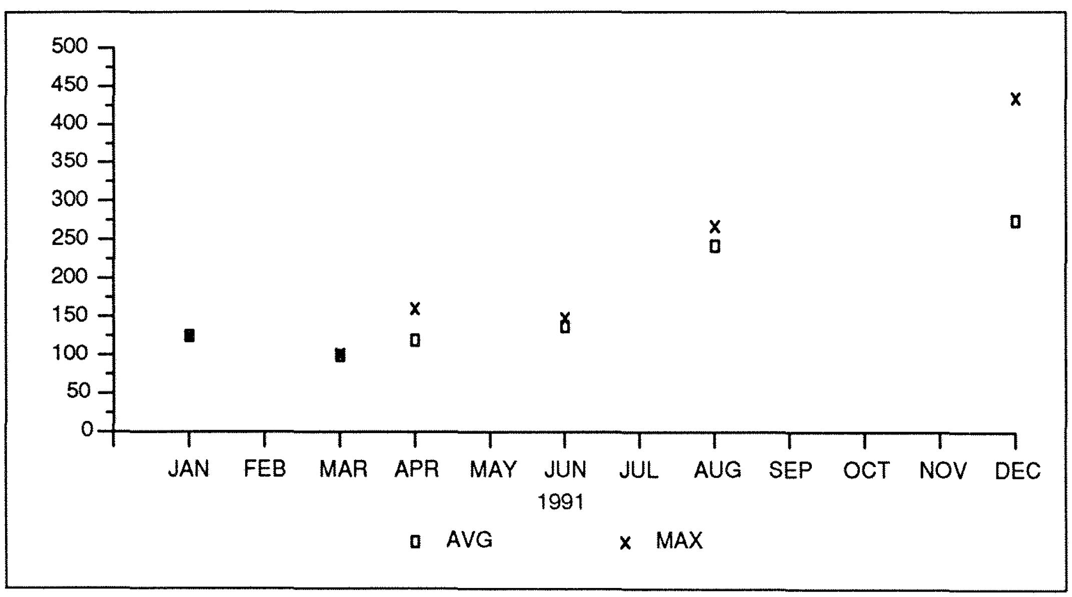


Figure C - 5.22

SULFATE -5
(mg/L)

Outfall 001

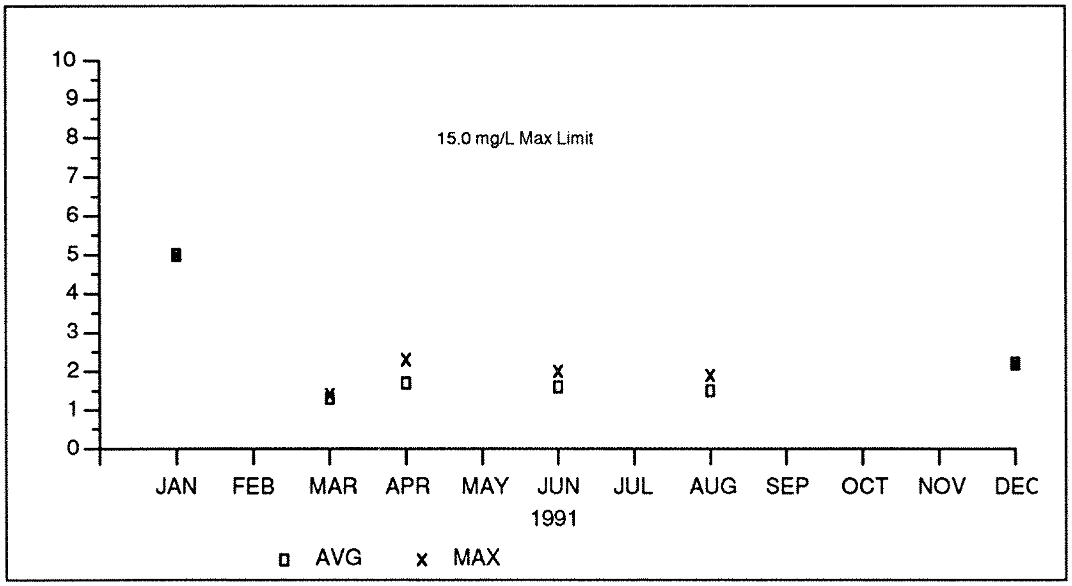


Figure C - 5.23

OIL AND GREASE
(mg/L)

Outfall 001

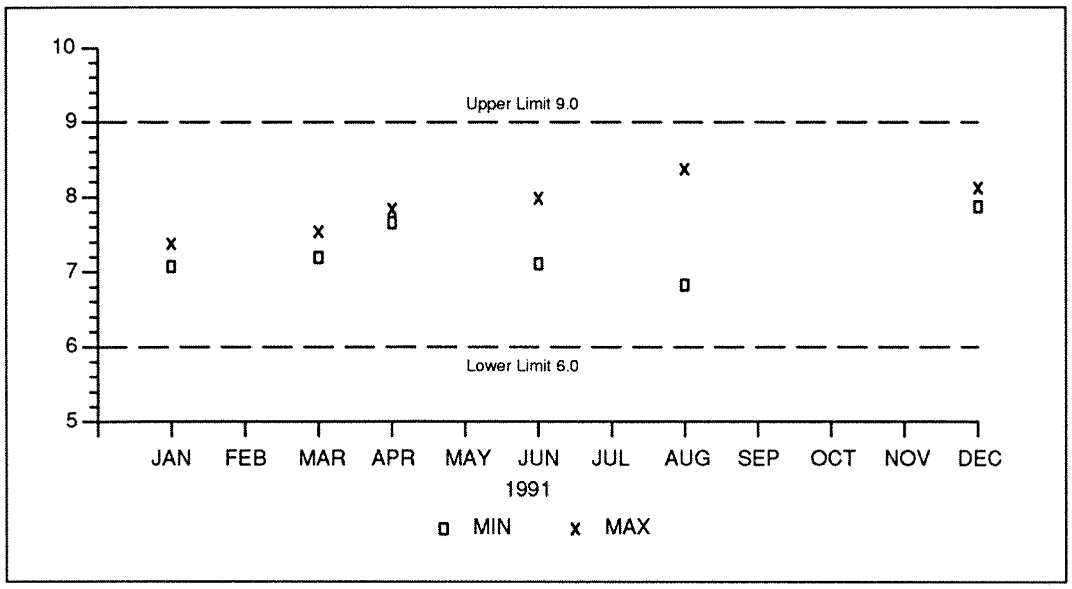


Figure C - 5.24

pH
(standard units)

Outfall 001

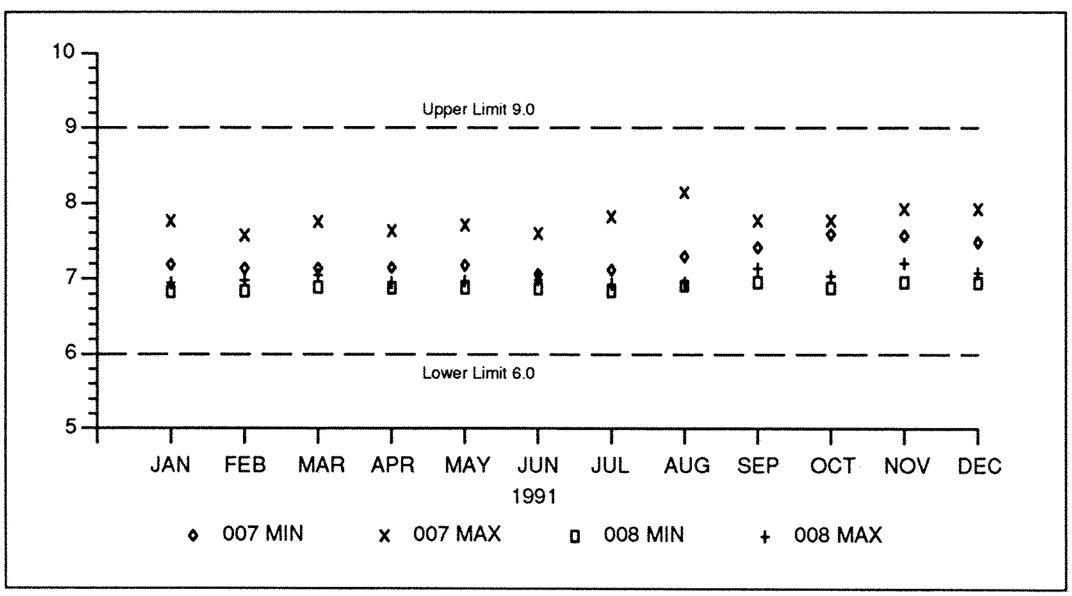


Figure C - 5.25

pH
(standard units)

Outfalls 007 and 008

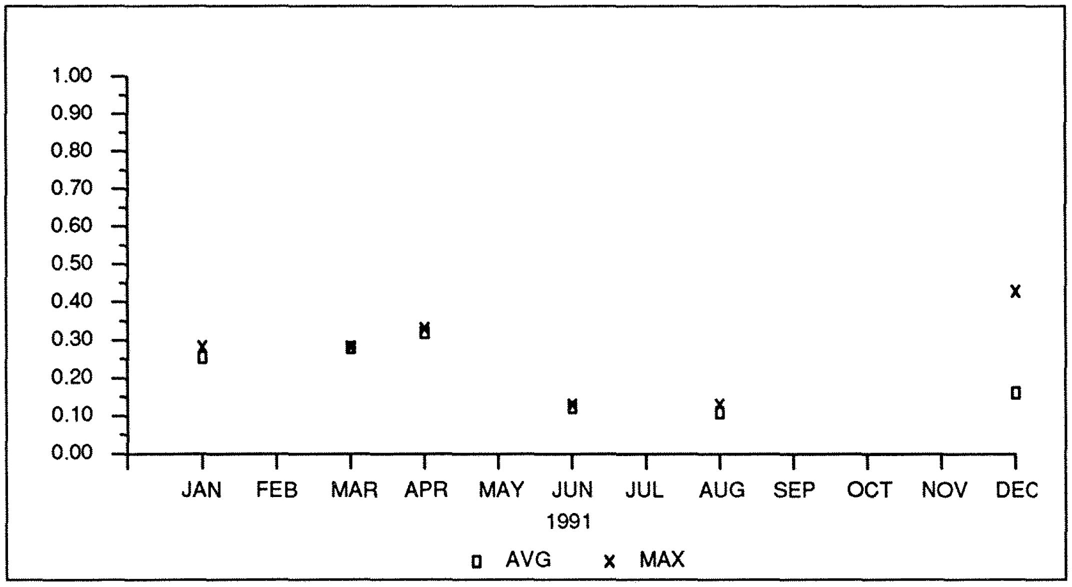


Figure C - 5.26

DISCHARGE RATE (MGD)

Outfall 001

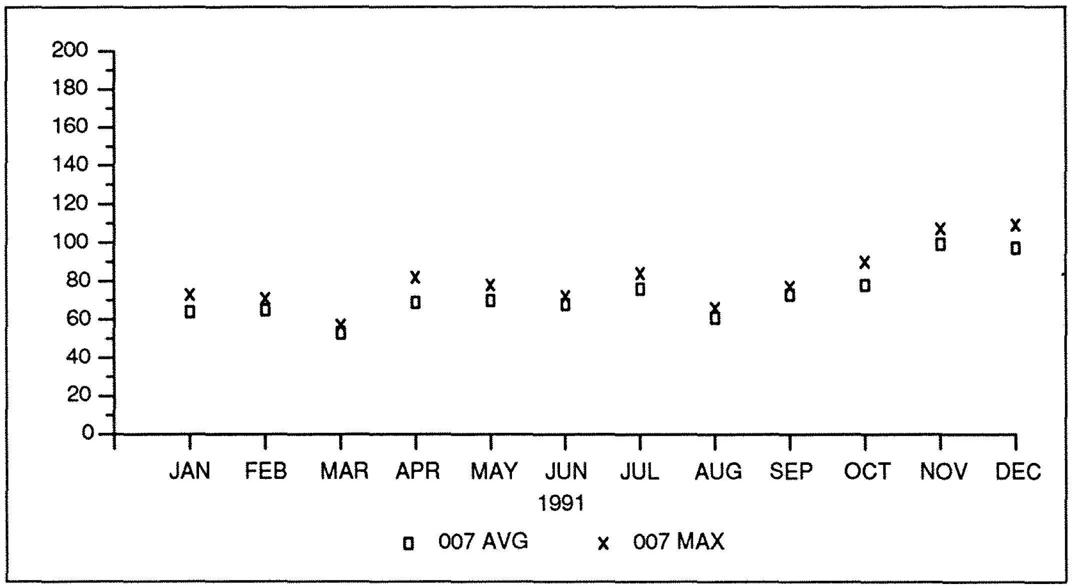


Figure C - 5.27

DISCHARGE RATE (GPD x 1000)

Outfall 007

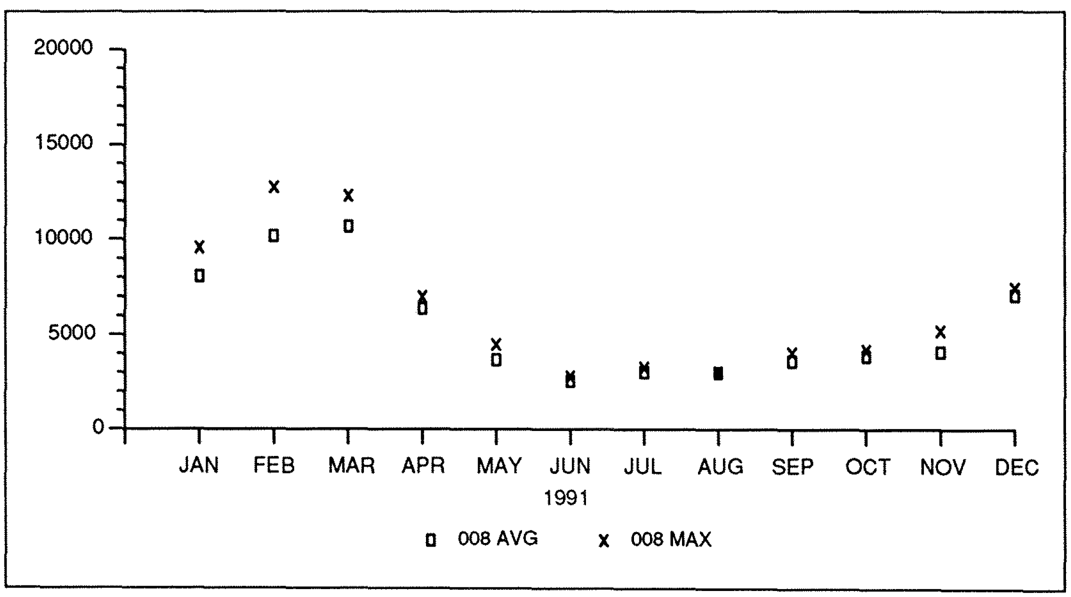


Figure C - 5.28

DISCHARGE RATE (GPD)

Outfall 008

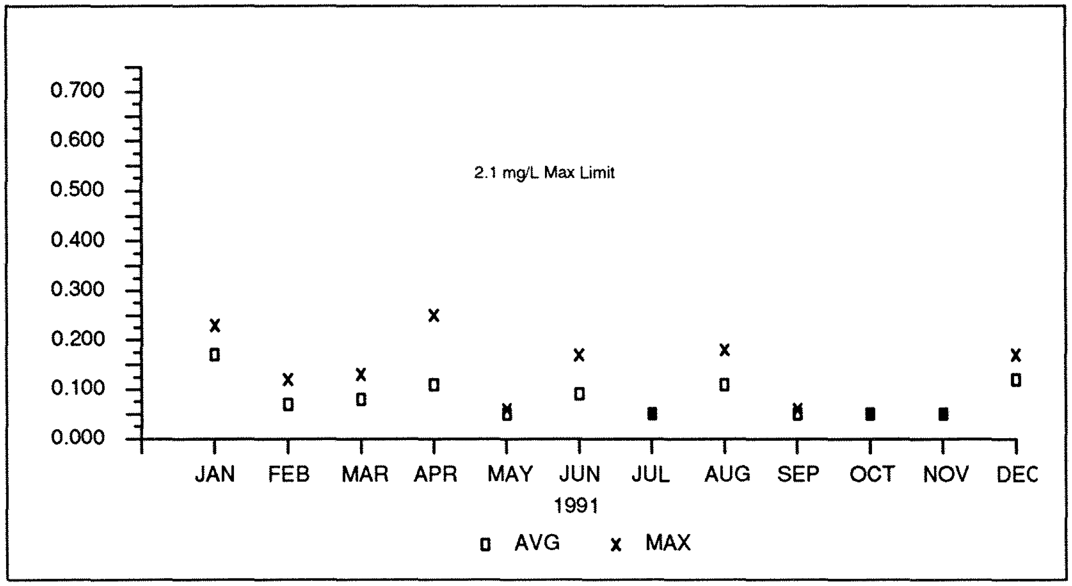


Figure C - 5.29

FLOW-WEIGHTED AVERAGES (mg/L)

Ammonia

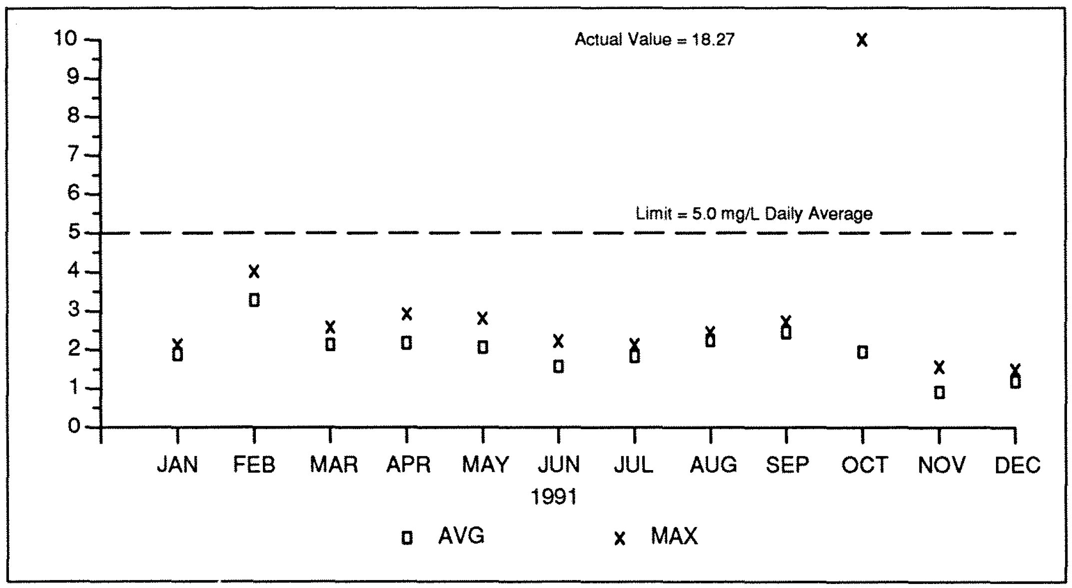


Figure C - 5.30

FLOW-WEIGHTED AVERAGES (mg/L)

Biochemical Oxygen Demand-5

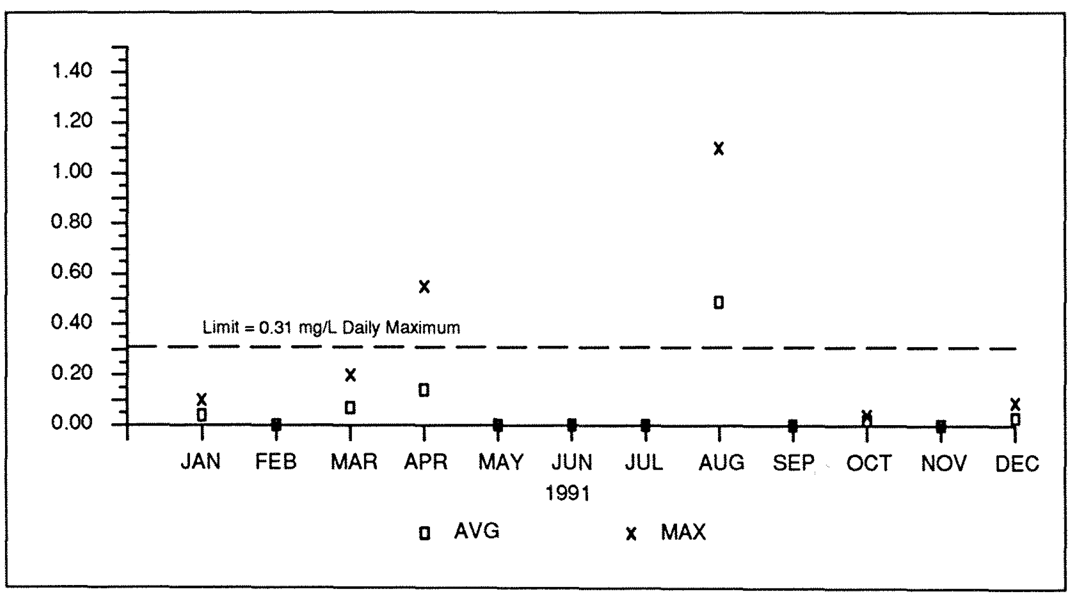


Figure C - 5.31

FLOW-WEIGHTED AVERAGES (mg/L)

Iron

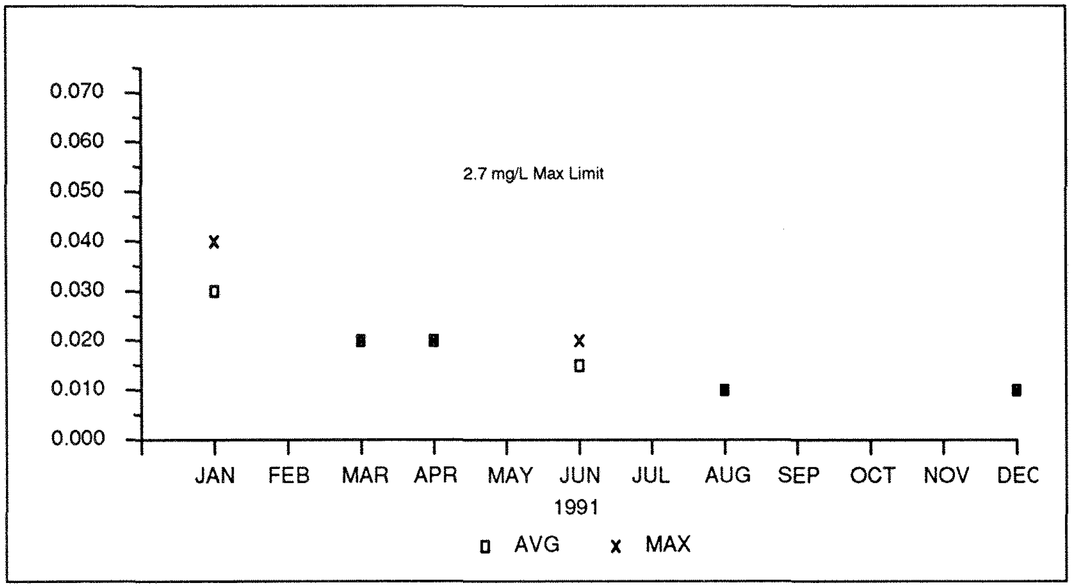


Figure C - 5.32

NICKEL
(mg/L)

Outfall 001

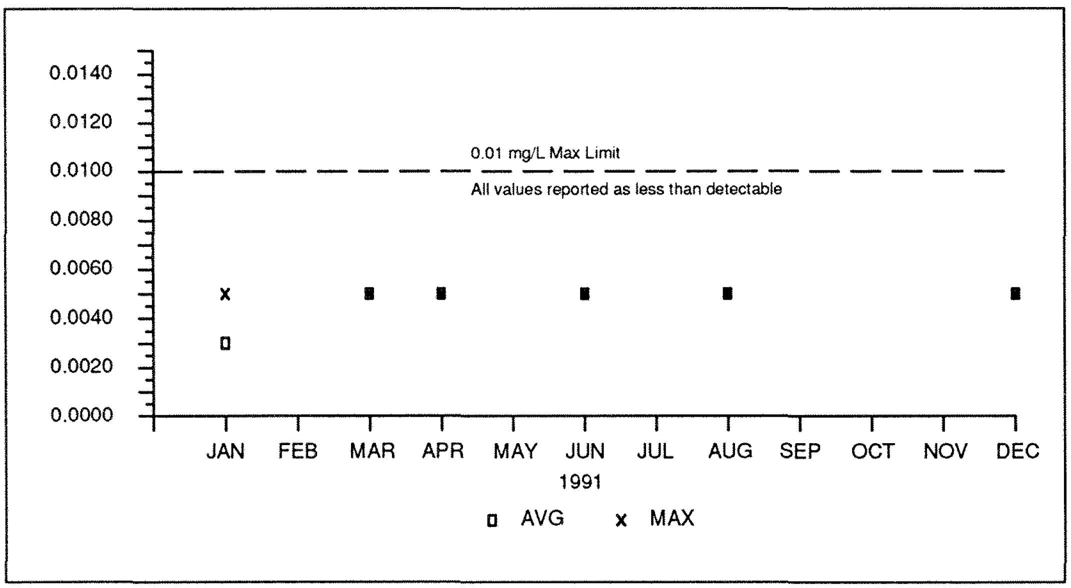


Figure C - 5.33

TRICHLOROFLUOROMETHANE
(mg/L)

Outfall 001

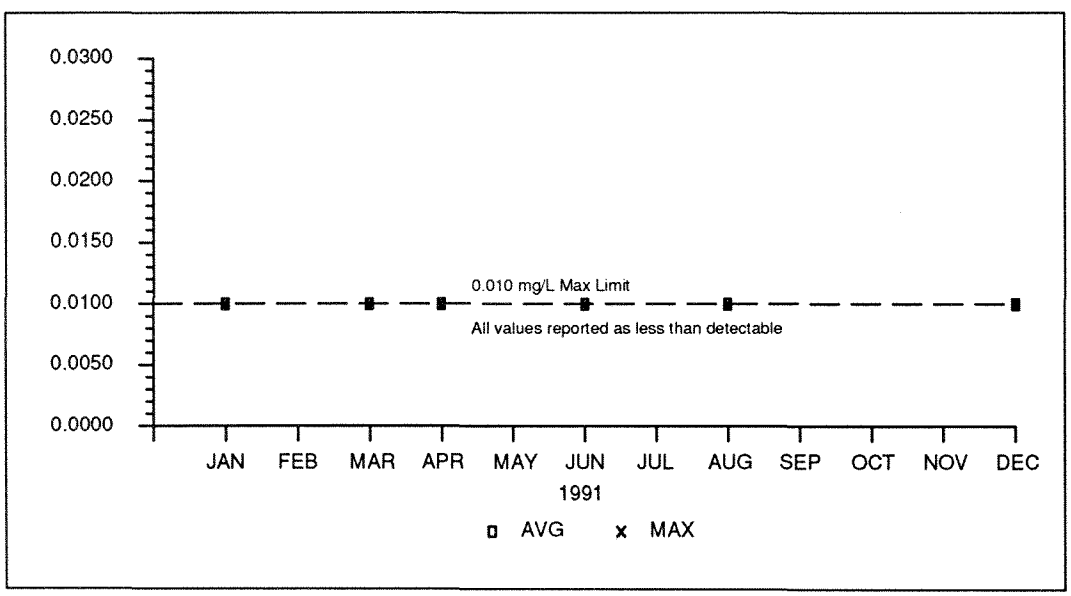


Figure C - 5.34

3,3-DICHLOROBENZIDINE
(mg/L)

Outfall 001

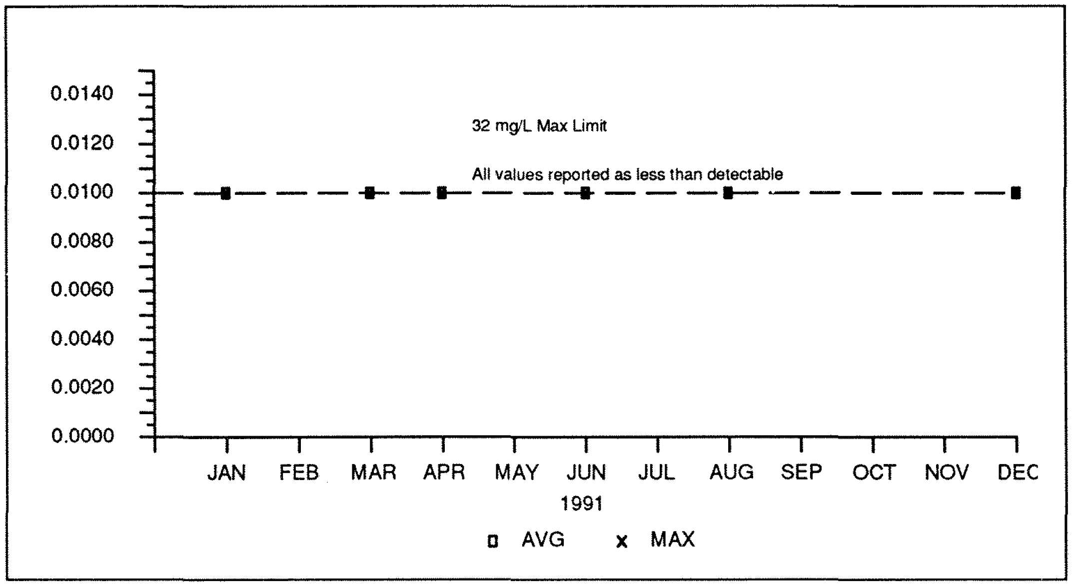


Figure C - 5.35

TRIBUTYL PHOSPHATE
(mg/L)

Outfall 001

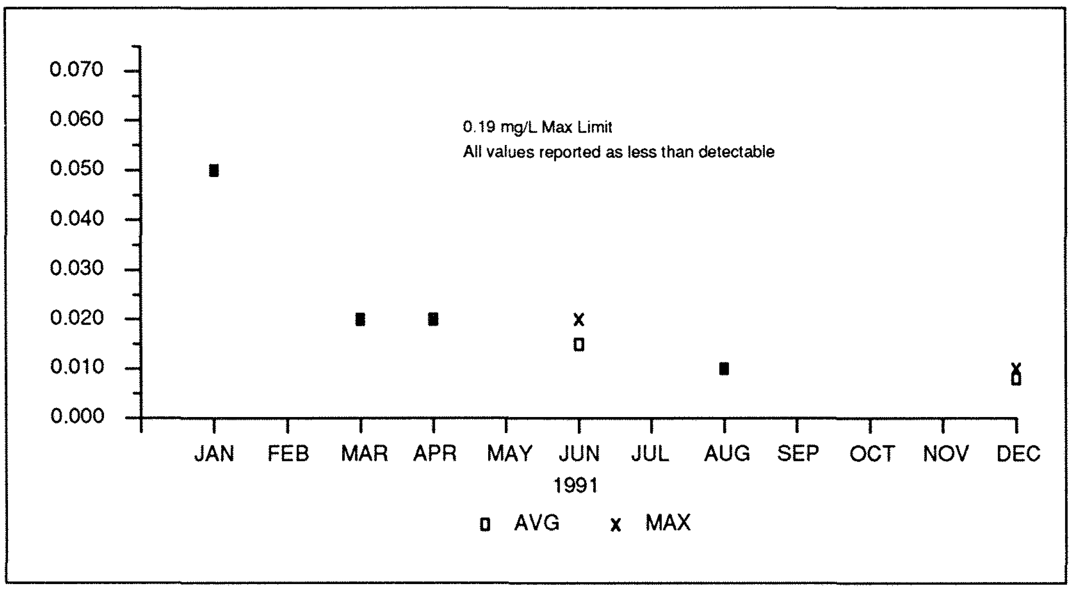


Figure C - 5.36

VANADIUM
(mg/L)

Outfall 001

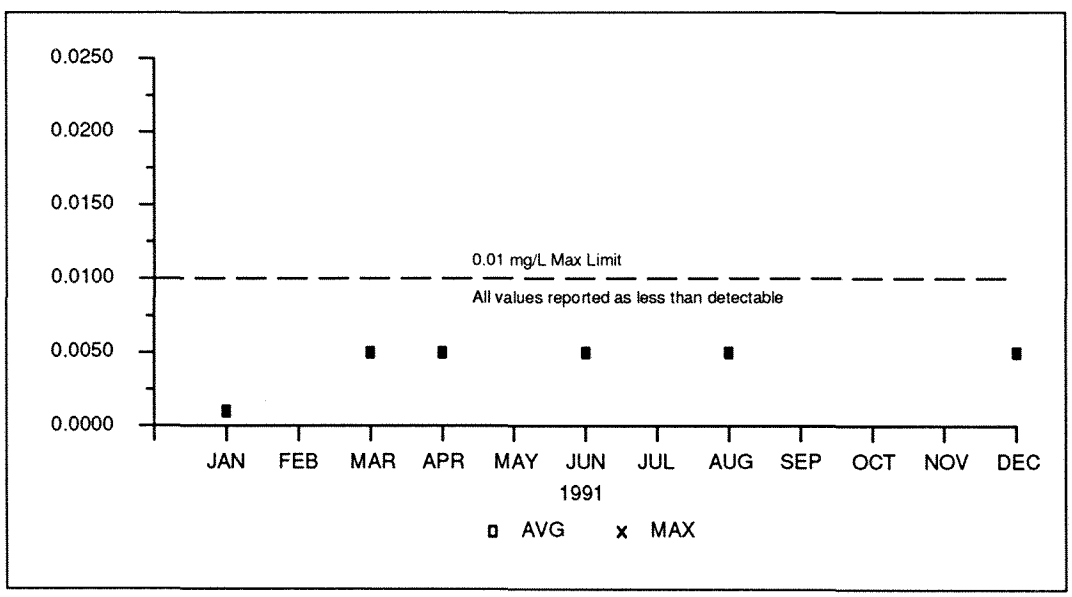


Figure C - 5.37

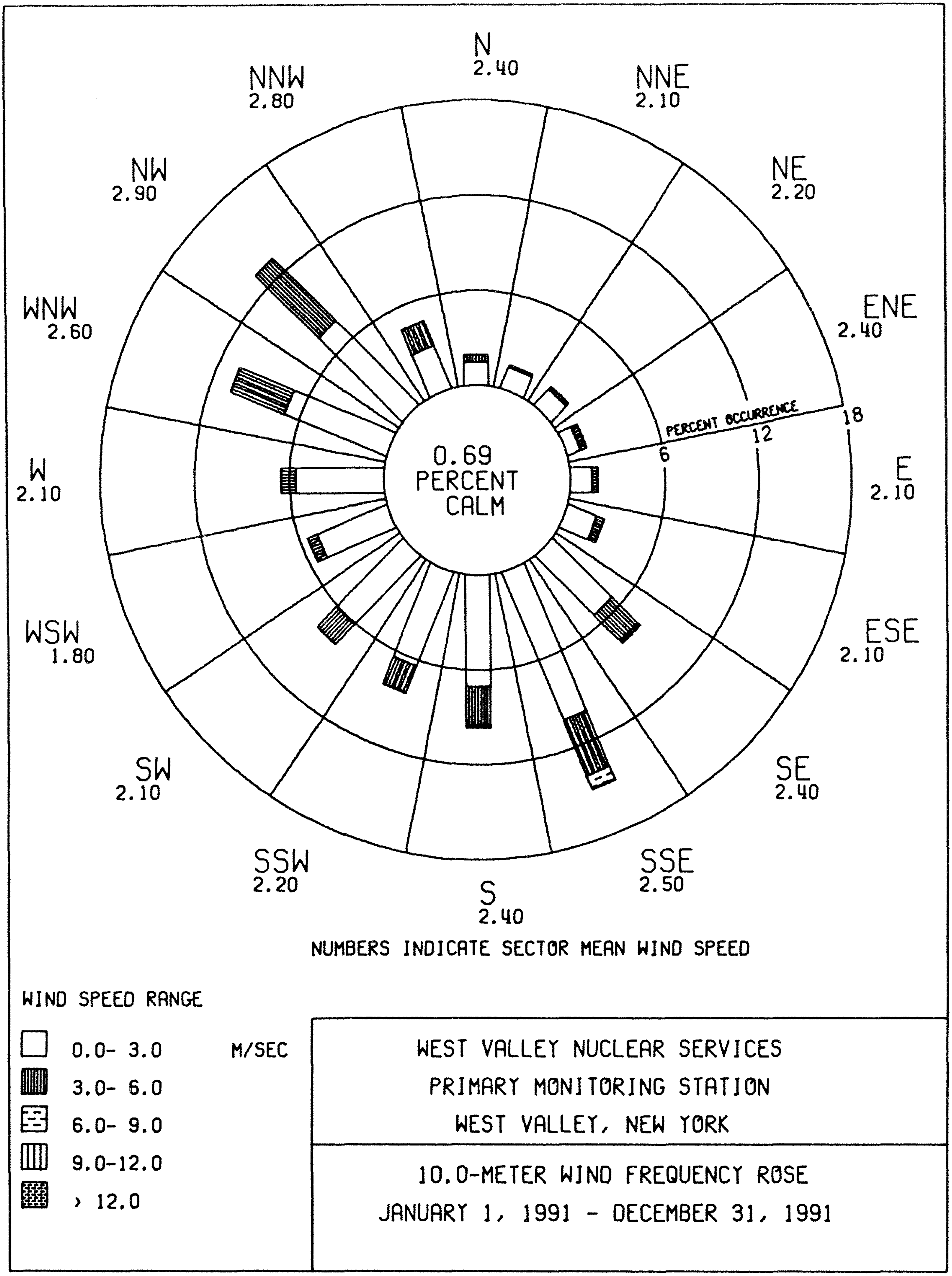
DICHLORODIFLUOROMETHANE
(mg/L)

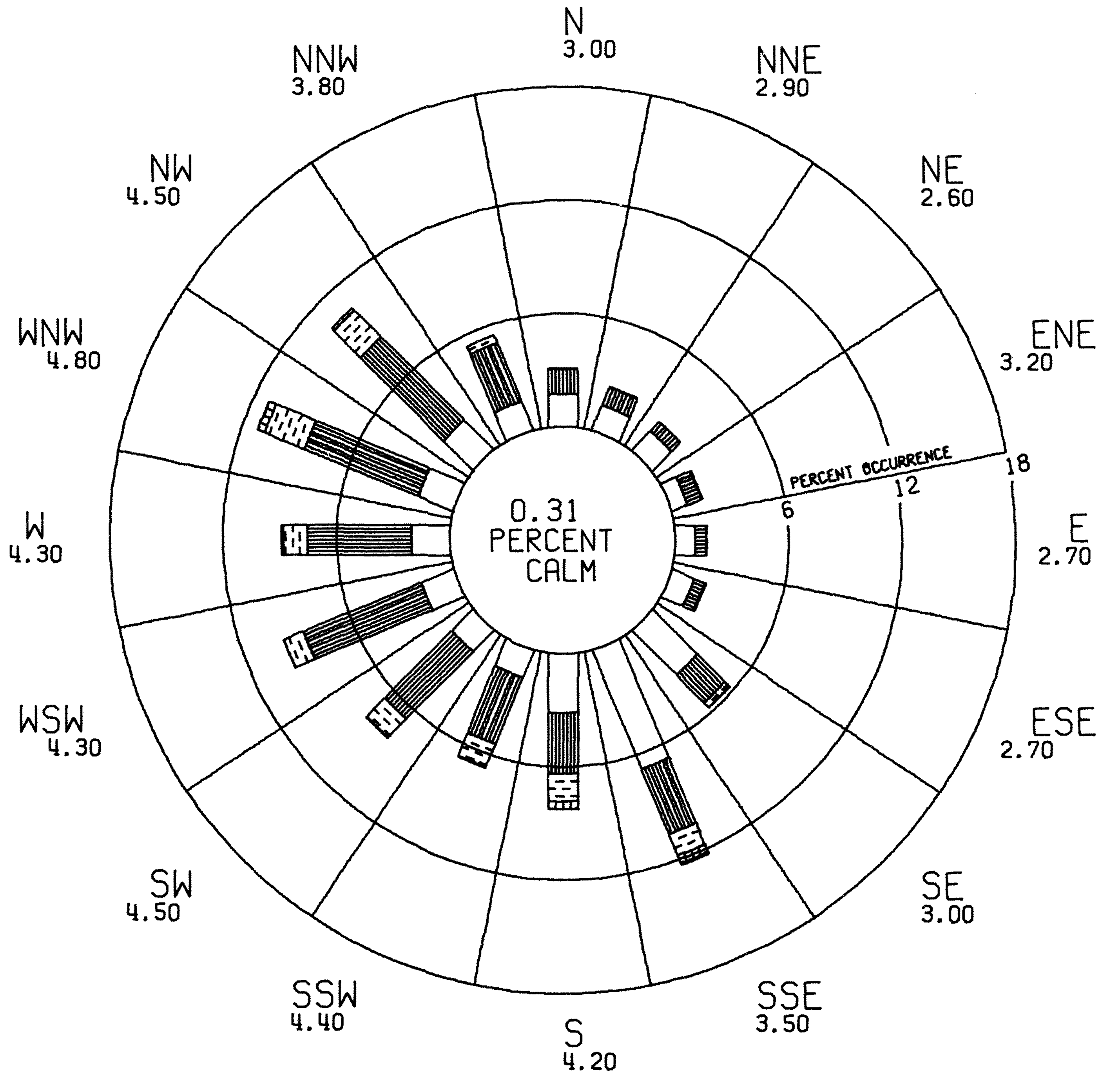
Outfall 001

On-site Meteorological Tower and Rain Gage

Appendix C - 6

Summary of Meteorological Data


N
2.40
NNE
2.10
NE
2.20
ENE
2.40
E
2.10
ESE
2.10
SE
2.40
SSE
2.50
S
2.40
SSW
2.20
SW
2.10
WSW
1.80
W
2.10
WNW
2.60
NW
2.90
NNW
2.80
PERCENT OCCURRENCE
6
12
18
0.69
PERCENT
CALM
NUMBERS INDICATE SECTOR MEAN WIND SPEED
WIND SPEED RANGE
0.0- 3.0 M/SEC
3.0- 6.0
6.0- 9.0
9.0-12.0
› 12.0
WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK
10.0-METER WIND FREQUENCY ROSE
JANUARY 1, 1991 - DECEMBER 31, 1991



NUMBERS INDICATE SECTOR MEAN WIND SPEED

WIND SPEED RANGE

- 0.0- 3.0 M/SEC
- 3.0- 6.0
- 6.0- 9.0
- 9.0-12.0
- › 12.0

WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK

60.0-METER WIND FREQUENCY ROSE
JANUARY 1, 1991 - DECEMBER 31, 1991

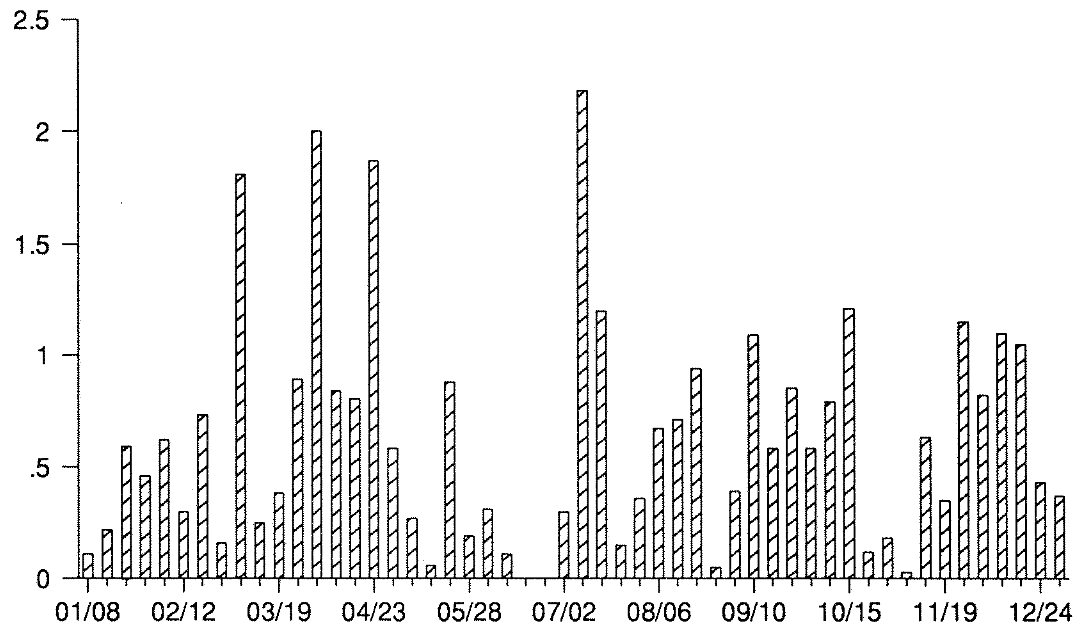


Figure C-6.3

1991 Weekly Total Rainfall (inches)

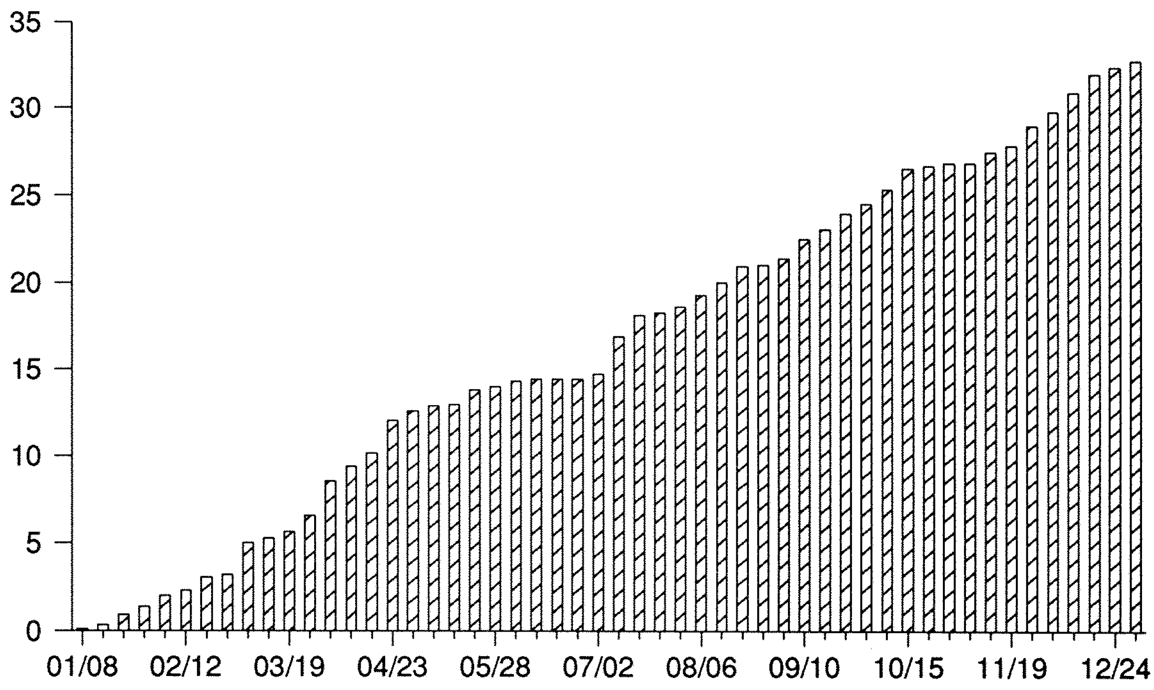


Figure C-6.4

1991 Cumulative Total Rainfall (inches)

Table C - 6.1
1991 Site Rainfall Collection Data (inches) for Week Ending:

JAN 08	0.11	*APR 09*	0.84	*JUL 09*	2.18	*OCT 08*	0.79
JAN 15	0.22	*APR 16*	0.80	*JUL 16*	1.20	*OCT 15*	1.21
JAN 22	0.59	*APR 23*	1.87	*JUL 23*	0.15	*OCT 22*	0.12
JAN 29	0.46	*APR 30*	0.58	*JUL 30*	0.36	*OCT 29*	0.18
FEB 05	0.62	*MAY 07*	0.27	*AUG 06*	0.67	*NOV 05*	0.03
FEB 12	0.30	*MAY 14*	0.06	*AUG 13*	0.71	*NOV 12*	0.63
FEB 19	0.73	*MAY 21*	0.88	*AUG 20*	0.94	*NOV 19*	0.35
FEB 26	0.16	*MAY 28*	0.19	*AUG 27*	0.05	*NOV 26*	1.15
MAR 05	1.81	*JUN 06*	0.31	*SEP 03*	0.39	*DEC 03*	0.82
MAR 12	0.25	*JUN 11*	0.11	*SEP 10*	1.09	*DEC 10*	1.10
MAR 19	0.38	*JUN 18*	0.00	*SEP 17*	0.58	*DEC 17*	1.05
MAR 26	0.89	*JUN 25*	0.00	*SEP 24*	0.85	*DEC 24*	0.43
APR 02	2.00	*JUL 02*	0.30	*OCT 01*	0.58	*DEC 31*	0.37

On-screen Review of Tritium Sample Counts

Appendix D

Summary of Quality Assurance Crosscheck Analyses

Table D - 1

Comparison of Radiological Concentrations in Crosscheck Samples
between the West Valley Demonstration Project
and the Environmental Measurements Laboratory (EML)
Quality Assessment Program (QAP) 34

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed By
BE-7	Air	5.30E+01	5.85E+01	1.10	Yes	TI
MN-54	Air	4.80E+00	5.81E+00	1.21	Pass	TI
CO-57	Air	5.82E+00	6.22E+00	1.07	Yes	TI
CO-60	Air	5.14E+00	6.07E+00	1.18	Yes	TI
SR-90	Air	7.89E-02	6.70E-02	.85	Yes	TI
CS-137	Air	4.53E+00	5.81E+00	1.28	Pass	TI
CE-144	Air	5.22E+01	5.70E+01	1.09	Yes	TI
PU-239	Air	1.54E-01	8.50E-02	.55	Pass	TI
AM-241	Air	1.01E-01	5.90E-02	.58	Pass	TI
K-40	Soil	3.74E+02	3.37E+02	.90	Yes	TI
CS-137	Soil	1.50E+02	1.87E+02	1.25	Pass	TI
PU-238	Soil	1.15E+01	7.03E+00	.61	Pass	TI
PU-239	Soil	3.40E+00	8.88E-01	.26	No	TI
U(BQ)	Soil	5.94E+01	7.62E+01	1.28	Pass	TI
K-40	Veg	1.15E+03	1.39E+03	1.21	Pass	TI
SR-90	Veg	1.86E+02	1.18E+02	.63	Pass	TI
CS-137	Veg	6.76E+01	8.73E+01	1.29	Pass	TI
H-3	Water	3.61E+02	3.37E+02	.93	Yes	EL
MN-54	Water	2.13E+02	2.26E+02	1.06	Yes	EL
CO-57	Water	2.30E+02	2.38E+02	1.03	Yes	EL
CO-60	Water	2.01E+02	2.01E+02	1.00	Yes	EL
SR-90	Water	8.63E+00	8.51E+00	.99	Yes	EL
CS-137	Water	1.69E+02	1.79E+02	1.06	Yes	EL
PU-239	Water	7.73E-01	6.30E-01	.82	Yes	TI
AM-241	Water	1.19E+00	8.10E-01	.68	Pass	TI
U(µg)	Water	1.72E-02	3.80E-02	2.21	No	TI

Units for air filters = pCi/filter; soil and vegetation = pCi/g; water = pCi/mL

Uranium units as listed in the table. Samples analyzed by the Environmental Laboratory (EL) or Teledyne Isotopes (TI).

Acceptance limits of reported to actual ratio: 0.8 to 1.2 within warning limits; 0.5 to 1.5 within control limits (pass).

Table D - 2

Comparison of Radiological Concentrations in Crosscheck Samples

between the West Valley Demonstration Project
and the Environmental Measurements Laboratory (EML)
Quality Assessment Program (QAP) 35

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed By
BE-7	Air	5.38E+01	4.70E+01	.87	Yes	TI
MN-54	Air	2.43E+01	2.23E+01	.92	Yes	TI
CO-57	Air	1.66E+01	1.61E+01	.97	Yes	TI
CO-60	Air	2.30E+01	2.01E+01	.87	Yes	TI
CS-137	Air	2.80E+01	2.55E+01	.91	Yes	TI
CE-144	Air	5.08E+01	4.40E+01	.87	Yes	TI
PU-239	Air	8.40E-02	8.20E-02	.98	Yes	TI
AM-241	Air	1.04E-01	1.10E-01	1.06	Yes	TI
U(BQ)	Air	7.83E-02	4.03E+00	51.47	No	TI
K-40	Soil	4.30E+02	4.60E+02	1.07	Yes	TI
SR-90	Soil	3.78E+00	3.70E+00	.98	Yes	TI
CS-137	Soil	3.12E+02	3.65E+02	1.17	Yes	TI
PU-239	Soil	7.35E+00	3.30E+00	.45	No	TI
U(μg)	Soil	2.28E+00	1.60E+01	7.02	No	TI
K-40	Veg	9.92E+02	1.47E+03	1.48	Pass	TI
SR-90	Veg	4.39E+02	4.07E+02	.93	Yes	TI
CS-137	Veg	2.71E+01	4.07E+01	1.50	Pass	TI
PU-239	Veg	3.65E-01	3.40E-01	.93	Yes	TI
H-3	Water	1.00E+02	9.99E+01	1.00	Yes	TI
MN-54	Water	1.03E+02	1.06E+02	1.03	Yes	TI
CO-57	Water	1.66E+02	1.78E+02	1.07	Yes	TI
CO-60	Water	2.91E+02	2.91E+02	1.00	Yes	TI
SR-90	Water	1.01E+01	8.95E+00	.89	Yes	EL
CS-137	Water	4.60E+01	4.63E+01	1.01	Yes	TI
CE-144	Water	2.26E+02	3.26E+02	1.44	Pass	TI
PU-239	Water	5.10E-01	4.80E-01	.94	Yes	TI
AM-241	Water	5.70E-01	1.40E-01	.25	No	TI
U(μg)	Water	3.70E-02	3.70E+01	1000.00	No	TI

Units for air filters = pCi / filter; soil and vegetation = pCi / g; water = pCi / mL

Uranium units as listed in the table. Samples analyzed by the Environmental Laboratory (EL) or Teledyne Isotopes (TI).

Acceptance limits of reported to actual ratio: 0.8 to 1.2 within warning limits; 0.5 to 1.5 within control limits (pass).

Table D - 3

Comparison of Radiological Concentrations in Crosscheck Samples

between the West Valley Demonstration Project and the Environmental Protection Agency's Environmental Monitoring Systems Laboratory (EMSL)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By
PE-A (April 1991)	Alpha	Water	54.0	35.33	Pass	EL
	Ra-226	Water	8.0	6.23	Pass	TI
	Ra-228	Water	15.2	10.00	Pass	TI
	U(Nat)	Water	29.8	32.00	Yes	TI
PE-B (April 1991)	Beta	Water	115.0	104.00	Yes	EL
	Sr-89	Water	28.0	22.33	Yes	TI
	Sr-90	Water	26.0	17.00	No	TI
	Cs-134	Water	24.0	23.67	Yes	EL
	Cs-137	Water	25.0	27.33	Yes	EL
PE-A (Oct 1991)	Alpha	Water	82.0	60.33	Yes	EL
	Ra-226	Water	22.0	18.33	Yes	TI
	Ra-228	Water	22.2	18.00	Yes	TI
	U(Nat)	Water	13.5	13.00	Yes	TI
PE-B (Oct 1991)	Beta	Water	65.0	54.33	Yes	EL
	Sr-89	Water	10.0	10.33	Yes	TI
	Sr-90	Water	10.0	7.33	Yes	TI
	Co-60	Water	20.0	31.67	No	EL
	Cs-134	Water	10.0	12.67	Yes	EL
	Cs-137	Water	11.0	23.00	No	EL
GAM (Feb 1991)	Co-60	Water	40.0	44.33	Yes	EL
	Zn-65	Water	149.0	154.00	Yes	EL
	Ru-106	Water	186.0	203.67	Yes	EL
	Cs-134	Water	8.0	12.33	Yes	EL
	Cs-137	Water	8.0	9.33	Yes	EL
	Ba-133	Water	75.0	76.67	Yes	EL
GAM (June 1991)	Co-60	Water	10.0	11.33	Yes	EL
	Zn-65	Water	108.0	104.33	Yes	EL
	Ru-106	Water	149.0	132.67	Yes	EL
	Cs-134	Water	15.0	15.00	Yes	EL
	Cs-137	Water	14.0	14.00	Yes	EL
	Ba-133	Water	62.0	58.33	Yes	EL
TRW (Feb 1991)	H-3	Water	4418.0	3745.33	Pass	EL
TRW (June 1991)	H-3	Water	12480.0	12030.00	Yes	EL

continued on next page

Table D - 3 *(concluded)*

Comparison of Radiological Concentrations in Crosscheck Samples

between the West Valley Demonstration Project and the Environmental Protection Agency's Environmental Monitoring Systems Laboratory (EMSL)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By
AF (March 1991)	Alpha	Filter	25.0	27.67	Yes	EL
	Beta	Filter	124.0	135.33	No	EL
	Sr-90	Filter	40.0	35.33	Yes	TI
	Cs-137	Filter	40.0	46.33	Pass	EL
AF (August 1991)	Alpha	Filter	25.0	28.33	Yes	EL
	Beta	Filter	92.0	100.33	Yes	EL
	Sr-90	Filter	30.0	30.67	Yes	TI
	Cs-137	Filter	30.0	26.67	Yes	EL
Milk (April 1991)	Sr-89	Milk	32.0	16.00	No	TI
	Sr-90	Milk	32.0	21.33	No	TI
	I-131	Milk	60.0	52.33	Pass	TI
	Cs-137	Milk	49.0	48.67	Yes	TI
	Total K	Milk	1650.0	1456.67	No	TI
Milk (Sept 1991)	Sr-89	Milk	25.0	17.00	Pass	TI
	Sr-90	Milk	25.0	19.33	Yes	TI
	I-131	Milk	108.0	116.67	Yes	TI
	Cs-137	Milk	30.0	28.67	Yes	TI
	Total K	Milk	1740.0	1499.67	No	TI
ABW (May 1991)	Alpha	Water	24.0	15.67	Pass	EL
	Beta	Water	46.0	44.67	Yes	EL
ABW (Sept 1991)	Alpha	Water	10.0	7.00	Yes	EL
	Beta	Water	20.0	20.33	Yes	EL
PUW (August 1991)	Pu-239	Water	19.4	20.00	Yes	TI

Units for water and milk = pCi / L; air = pCi / filter.

Samples analyzed by the Environmental Laboratory (EL) or Teledyne Isotopes (TI) as indicated.

Explanation of Codes:

PE-A : Performance Evaluation (Alpha)
PE-B: Performance Evaluation (Beta)
GAM: Gamma in water
TRW: Tritium in water
AF: Air filter
MILK: Milk sample
ABW: Alpha and beta in water
PUW: Plutonium in water

Acceptance limits are defined for individual analytes and matrices by EMSL and differ from crosscheck to crosscheck. ***Yes*** *indicates acceptable results.* ***Pass*** *indicates results between warning and control limits.* ***No*** *indicates results were outside control limits.*

Table D - 4

Comparison of Water Quality Parameters in Crosscheck Samples

between the West Valley Demonstration Project and the Environmental Protection Agency 1991 Discharge Monitoring Report (DMR) Quality Assurance Program #11 for the National Pollutant Discharge Elimination System

Analyte	Units	Actual (EPA)	Reported (WVNS)	Accept?	Analyzed By
Aluminum	µg/L	3200	3620	Check	E&E
Arsenic	µg/L	200	185	Yes	E&E
Beryllium	µg/L	130	152	Yes	E&E
Cadmium	µg/L	190	236	No	E&E
Chromium	µg/L	410	470	Check	E&E
Cobalt	µg/L	180	220	No	E&E
Copper	µg/L	730	864	No	E&E
Iron	µg/L	1000	1070	Yes	A/PC
Lead	µg/L	47.9	50.5	Yes	E&E
Manganese	µg/L	920	1110	No	E&E
Mercury	µg/L	3.4	3.32	Yes	E&E
Nitrate	µg/L	430	519	No	E&E
Selenium	µg/L	86	71.6	Yes	E&E
Vanadium	µg/L	4600	5540	No	E&E
Zinc	µg/L	110	135	No	E&E
pH	µg/L	5.52	5.53	Yes	EL
Tot.Suspended Solids	mg/L	23.9	18.8	Yes	EL
Oil and Grease	mg/L	17	14.8	Yes	E&E
Ammonia-N	mg/L	4.2	4.3	Yes	EL
Nitrate-N	mg/L	10	8.58	Yes	E&E
Tot.OrganicCarbons	mg/L	25.9	24.6	Yes	EL
BOD-5	mg/L	41.4	42.7	Yes	EL
Cyanide	mg/L	.53	.569	Yes	E&E
Phenolics	mg/L	.0146	.023	Yes	E&E

Samples were analyzed by Ecology & Environment, Inc. (E&E), the Analytical and Physical Chemistry Laboratory (A/PC), or the Environmental Laboratory (EL) as indicated in the table. ***Check*** *indicates a result within control limits but outside warning limits.* ***No*** *indicates a result outside control limits. All* ***Check*** *or* ***No*** *results were metals analyses conducted by E&E. The problem was addressed by WVNS Quality Assurance and was traced to a problem with matrix matching. A duplicate sample was submitted for reanalysis and results were then acceptable.*

Table D - 5

Comparison of Water Quality Parameters in Crosscheck Samples

between the West Valley Demonstration Project and the New York State Department of Health (NYSDOH)

Analyte:	Units	Actual (NYSDOH)	Reported (WVNS)	Accept?	Analyzed By
BOD-5	mg/L	29.5	28.9	Yes	EL
		67.7	73.1	Yes	EL
		52.8	41.7	Yes	EL
		20.2	15.1	Yes	EL
Total Suspended Solids	mg/L	87.0	88.7	Yes	EL
		28.4	28.4	Yes	EL
		38.1	38.2	Yes	EL
		57.3	57.0	Yes	EL
pH		2.53	2.43	Yes	EL
		7.00	7.06	Yes	EL
		2.54	2.42	Pass	EL
		8.41	8.51	Yes	EL
NH-3	mg/L	1.49	1.41	Yes	EL
		2.57	2.61	Yes	EL
		2.23	NR	No	EL
		4.64	NR	No	EL

*Acceptable range determined by NYSDOH. **Pass** indicates results within control limits but outside of warning limits. The first two results for each analyte were part of the January crosscheck. The second two results were part of the July crosscheck. The results for ammonia-nitrogen were transmitted on the wrong line of the form and were recorded as a **No Response** by NYSDOH.*

Table D - 6
Comparison of the West Valley Demonstration Project's Thermoluminescent Dosimeters (TLDs) to the Co-located Nuclear Regulatory Commission (NRC) TLDs in 1991

1st Quarter

NRC TLD#	*WVDP TLD#*	*NRC mR/90days*	*WVDP mR/Qtr*	*WVDP/NRC Ratio*	*Accept ?*
2	22	16.9	20.4	1.21	Pass
3	5	17.7	21.0	1.19	Yes
4	7	17.4	19.4	1.11	Yes
5	9	19.4	19.3	.99	Yes
7	14	18.3	21.1	1.15	Yes
8	15	17.7	19.7	1.11	Yes
9	25	34.3	33.9	.99	Yes
11	24	1180.0	1345.3	1.14	Yes

2nd Quarter

NRC TLD#	*WVDP TLD#*	*NRC mR/93days*	*WVDP mR/Qtr*	*WVDP/NRC Ratio*	*Accept ?*
2	22	Missing	17.0	NA	NA
3	5	16.6	18.6	1.12	Yes
4	7	18.6	16.5	.89	Yes
5	9	20.9	16.8	.80	Yes
7	14	17.4	19.0	1.09	Yes
8	15	18.0	16.8	.93	Yes
9	25	36.3	31.7	.87	Yes
11	24	910.0	1259.1	1.38	Pass

3rd Quarter

NRC TLD#	*WVDP TLD#*	*NRC mR/90days*	*WVDP mR/Qtr*	*WVDP/NRC Ratio*	*Accept ?*
2	22	17.8	18.6	1.04	Yes
3	5	19.5	21.1	1.08	Yes
4	7	18.9	18.0	.95	Yes
5	9	20.7	17.0	.82	Yes
7	14	20.2	18.7	.93	Yes
8	15	18.4	17.5	.95	Yes
9	25	35.0	33.1	.95	Yes
11	24	977.0	1135.2	1.16	Yes

4th Quarter

NRC TLD#	*WVDP TLD#*	*NRCmR/90days*	*WVDPmR/Qtr*	*WVDP/NRC Ratio*	*Accept ?*
2	22	NA	21.3	NA	NA
3	5	NA	23.9	NA	NA
4	7	NA	21.1	NA	NA
5	9	NA	21.0	NA	NA
7	14	NA	24.2	NA	NA
8	15	NA	22.1	NA	NA
9	25	NA	36.0	NA	NA
11	24	NA	1292.8	NA	NA

*Acceptable range of WVDP / NRC = 0.8 to 1.2. **Pass** = 0.5 to 1.5. **N/A** - not available. Fourth quarter TLD information for the NRC had not yet been processed at the time of report preparation.*

Checking a Total Organic Carbon Analyzer Run

Appendix E

Summary of Groundwater Monitoring Data

Table E - 1
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0301	UP (1)									
WNW0301	UP (2)	7.43	641			<3.39E-09	3.31±2.57E-09	<1.00E-07		
WNW0301	UP (3)	7.32	630	1.0	0.016	<4.24E-09	4.90±2.99E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0301	UP (4)	7.44	731	1.6	0.013	<6.84E-09	5.46±2.72E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0301	UP (5)	7.18	665	1.5	0.010	<5.44E-09	<2.71E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0301	UP (6)	7.12	834	1.6	0.031	<6.66E-09	4.23±2.74E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0301	UP (7)	7.00	695	1.6	0.014	<4.77E-09	<2.70E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0301	UP (8)	7.22	933	2.8	<0.005	<4.88E-09	4.90±3.14E-09	<1.00E-07	<2.31E-08	<1.92E-08
WNW0401	UP (1)									
WNW0401	UP (2)	6.38	2205			<1.67E-08	1.33±0.47E-08	<1.00E-07		
WNW0401	UP (3)	6.93	1176	1.9	0.046	<1.59E-08	4.53±3.38E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0401	UP (4)	6.91	2120	8.0	0.044	<1.06E-08	<3.47E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0401	UP (5)	6.18	1006	10.0	0.013	<4.79E-09	6.73±3.13E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0401	UP (6)	6.94	1160	2.6	<0.005	<6.39E-09	6.99±3.15E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0401	UP (7)	6.83	1143	<1.0	0.007	<5.24E-09	6.30±4.32E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0401	UP (8)	6.51	928	2.9	0.006	<5.01E-09	<5.08E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0403	UP (1)									
WNW0403	UP (2)	6.97	603			<3.62E-09	2.82±2.47E-09	<1.00E-07		
WNW0403	UP (3)	6.86	688	3.5	0.022	<3.84E-09	<2.99E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0403	UP (4)	6.93	844	1.9	0.015	<3.51E-09	3.53±3.17E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0403	UP (5)	6.69	749	18.0	0.015	<3.34E-09	4.23±2.61E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0403	UP (6)	7.08	751	2.5	<0.005	<4.96E-09	6.92±2.91E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0403	UP (7)	6.88	641	<1.0	0.005	<1.28E-09	3.78±2.92E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0403	UP (8)	6.90	553	4.2	<0.005	<2.35E-09	<2.53E-09	<1.00E-07	<3.40E-08	2.49±0.95E-08
WNWNB1S	UP (1)									
WNWNB1S	UP (2)	6.32	468			<1.40E-09	<2.43E-09	<1.00E-07		
WNWNB1S	UP (3)	6.11	551	3.0	0.011	<2.26E-09	<2.31E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNWNB1S	UP (4)	6.54	580	7.9	0.006	<2.68E-09	3.36±2.45E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNWNB1S	UP (5)	6.54	719	2.6	0.009	<4.96E-09	4.31±2.45E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNWNB1S	UP (6)	6.91	647	21.0	0.007	<2.11E-09	4.20±2.46E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNWNB1S	UP (7)	6.91	712	3.2	0.021	<1.54E-09	4.30±2.38E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNWNB1S	UP (8)	6.11	625	5.3	<0.005	<1.87E-09	3.14±2.60E-09	1.19±0.78E-07	<3.40E-08	<3.35E-08
WNW0201	DOWN - B (1)									
WNW0201	DOWN - B (2)	6.23	705			<3.19E-09	5.39±0.59E-08	<1.00E-07		
WNW0201	DOWN - B (3)	6.00	882	21.0	0.022	<5.29E-09	7.16±0.71E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0201	DOWN - B (4)	6.83	1100	4.8	0.021	<8.28E-09	4.49±0.58E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0201	DOWN - B (5)	6.11	526	3.2	0.026	<3.82E-09	2.94±0.45E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0201	DOWN - B (6)	6.38	974	1.9	<0.005	1.58±1.39E-08	5.09±0.68E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0201	DOWN - B (7)	6.32	1087	61.0	0.011	<5.26E-09	2.83±0.75E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0201	DOWN - B (8)	6.45	776	3.1	0.006	<3.82E-09	1.16±0.58E-08	<1.00E-07	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW8613A	DOWN - B (1)									
WNW8613A	DOWN - B (2)	7.04	653			<1.76E-09	<2.52E-09	<1.00E-07		
WNW8613A	DOWN - B (3)	6.93	609	4.2	0.033	<2.95E-09	3.33±2.75E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8613A	DOWN - B (4)	6.85	676	10.0	0.016	<3.87E-09	4.94±2.71E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8613A	DOWN - B (5)	6.66	649	1.7	0.017	<4.35E-09	4.37±2.49E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8613A	DOWN - B (6)	6.69	636	<1.0	0.011	<2.86E-09	5.65±3.15E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8613A	DOWN - B (7)	6.63	635	9.4	0.013	<7.05E-10	3.34±2.28E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW8613A	DOWN - B (8)	6.67	560	40.0	0.014	<2.16E-09	<2.55E-09	1.22±0.78E-07	<2.31E-08	<2.19E-08
WNW8613B	DOWN - B (1)									
WNW8613B	DOWN - B (2)	6.39	377			<6.64E-10	2.78±2.53E-09	<1.00E-07		
WNW8613B	DOWN - B (3)	6.31	509	6.5	0.009	<1.63E-09	4.29±2.72E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8613B	DOWN - B (4)	6.00	642	3.8	0.035	<2.06E-09	2.82±2.28E-09	<1.00E-07	<2.83E-08	4.18±1.23E-08
WNW8613B	DOWN - B (5)	6.02	571	3.2	0.013	<2.83E-09	5.25±2.90E-09	<1.00E-07	<3.67E-08	<3.08E-08
WNW8613B	DOWN - B (6)	6.15	487	<1.0	0.021	<1.60E-09	5.50±2.93E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8613B	DOWN - B (7)	6.02	397	5.7	0.015	<1.42E-09	7.24±2.74E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW8613B	DOWN - B (8)	6.28	972	12.0	0.006	<4.04E-09	6.75±3.45E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW8613C	DOWN - B (1)									
WNW8613C	DOWN - B (2)	8.30	323			2.35±1.97E-09	3.44±2.20E-09	<1.00E-07		
WNW8613C	DOWN - B (3)	8.05	312	54.0	0.017	<2.28E-09	3.24±2.45E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8613C	DOWN - B (4)	7.45	369	2.0	0.007	<1.26E-09	4.97±2.48E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8613C	DOWN - B (5)	7.41	512	4.1	0.006	<3.01E-09	5.77±2.94E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8613C	DOWN - B (6)	7.37	593	<1.0	0.009	<3.06E-09	5.86±3.12E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8613C	DOWN - B (7)	7.28	614	15.0	0.014	<3.63E-09	6.95±2.89E-09	<1.00E-07	<2.31E-08	<2.67E-08
WNW8613C	DOWN - B (8)	7.33	595	<1.0	0.012	3.57±3.30E-09	3.48±2.67E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNSP008	DOWN - C (1)	6.98	1051	2.4	0.012	<5.77E-09	5.42±0.58E-08	5.43±0.21E-06	<2.88E-08	<3.11E-08
MNSP008	DOWN - C (2)	7.01	949	18.0	0.024	<4.22E-09	4.49±0.54E-08	5.26±0.21E-06	<2.88E-08	<2.99E-08
WNSP008	DOWN - C (3)	6.87	817	3.5	0.014	<5.27E-09	4.71±0.54E-08	4.17±0.18E-06	<2.88E-08	<2.99E-08
WNSP008	DOWN - C (4)	6.73	985	2.2	0.038	<7.23E-09	2.00±0.44E-08	4.91±0.22E-06	<3.59E-08	<3.18E-08
WNSP008	DOWN - C (5)	6.78	975	3.1	0.035	<6.78E-09	4.12±0.58E-08	4.99±0.22E-06	<2.83E-08	<3.08E-08
WNSP008	DOWN - C (6)	6.96	886	3.1	0.021	<7.16E-09	3.34±0.52E-08	3.94±0.18E-06	<2.83E-08	<3.08E-08
WNSP008	DOWN - C (7)	6.92	922	3.2	0.006	<4.89E-09	3.32±0.53E-08	4.36±0.19E-06	<3.40E-08	<3.35E-08
WNSP008	DOWN - C (8)	6.68	790	7.1	0.013	<3.39E-09	4.99±0.85E-08	2.87±0.15E-06	<2.31E-08	<1.92E-08
WNW0103	DOWN - C (1)	12.22	9240	290.0	0.200	<3.36E-07	1.05±0.57E-07	2.65±0.84E-07	3.19±1.80E-08	<3.11E-08
WNW0103	DOWN - C (2)	12.52	18580			<1.10E-07	1.08±0.91E-07	4.44±0.85E-07	<3.59E-08	<3.18E-08
WNW0103	DOWN - C (3)	12.43	16040	830.0	0.038	2.37±1.84E-07	3.24±1.09E-07	1.66±0.12E-06	<2.83E-08	<3.08E-08
WNW0103	DOWN - C (4)	12.28	14715	420.0	0.140	<1.38E-07	9.66±6.35E-08	7.36±0.88E-07	<2.83E-08	<3.08E-08
WNW0103	DOWN - C (5)	12.10	11380	815.0	0.022	<1.23E-07	1.20±0.63E-07	3.56±0.90E-07	<3.45E-08	<3.64E-08
WNW0103	DOWN - C (6)	12.21	20500	558.0	0.082	<2.48E-07	<9.77E-08	3.08±0.83E-07	<2.31E-08	<2.19E-08
WNW0103	DOWN - C (7)	10.60	3025	79.8	0.029	<3.04E-08	8.11±7.62E-08	1.14±0.80E-07	<3.40E-08	<3.35E-08
WNW0103	DOWN - C (8)	11.77	8620	330.0	0.016	<7.80E-08	2.10±0.96E-07	1.84±0.82E-07	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0104	DOWN - C (1)	7.25	858	<1.0	<0.005	<2.42E-09	7.96±0.22E-07	1.27±0.10E-06	<3.59E-08	<3.18E-08
WNW0104	DOWN - C (2)	7.25	849	3.8	0.014	<3.59E-09	8.32±0.22E-07	1.05±0.09E-06	<2.88E-08	<3.11E-08
WNW0104	DOWN - C (3)	7.31	852	12.0	<0.005	<1.96E-09	8.12±0.21E-07	8.05±0.94E-07	<2.88E-08	<3.11E-08
WNW0104	DOWN - C (4)	7.08	855	<1.0	0.016	<3.25E-09	6.56±0.21E-07	8.19±0.96E-07	<2.83E-08	<3.08E-08
WNW0104	DOWN - C (5)	7.01	938	1.0	0.013	<6.97E-09	1.29±0.03E-06	7.95±0.96E-07	<3.97E-08	<4.13E-08
WNW0104	DOWN - C (6)	7.07	999	1.7	<0.005	<1.06E-08	9.72±0.26E-07	9.72±0.90E-07	<2.83E-08	<3.08E-08
WNW0104	DOWN - C (7)	6.89	1008	<1.0	<0.005	<4.59E-09	1.43±0.04E-06	1.33±0.15E-06	<3.40E-08	<3.35E-08
WNW0104	DOWN - C (8)	6.99	1007	1.7	<0.010	<3.84E-09	2.16±0.04E-06	8.72±0.92E-07	<3.40E-08	<3.35E-08
WNW0111	DOWN - C (1)	6.82	596		0.017	<4.03E-09	4.34±0.07E-06	5.17±0.18E-06	<2.88E-08	<3.05E-08
WNW0111	DOWN - C (2)	6.57	542			<4.89E-09	4.00±0.07E-06	4.16±0.12E-06	<3.59E-08	<2.99E-08
WNW0111	DOWN - C (3)	6.47	477	13.5	0.098	<2.37E-09	2.03±0.03E-06	2.14±0.14E-06	<2.83E-08	<3.10E-08
WNW0111	DOWN - C (4)	6.45	693	9.2	0.098	9.17±7.62E-09	3.49±0.05E-06	5.88±0.23E-06	<2.31E-08	<3.08E-08
WNW0111	DOWN - C (5)	6.49	807	10.6	0.114	<4.21E-09	7.17±0.06E-06	2.87±0.16E-06	<3.40E-08	<2.19E-08
WNW0111	DOWN - C (6)	6.30	746	7.7	0.077	4.84±4.11E-09	6.37±0.06E-06	1.38±0.11E-06	<3.40E-08	<3.35E-08
WNW0111	DOWN - C (7)	6.47	772	7.8	0.051	<3.66E-09	5.68±0.06E-06	1.44±0.12E-06	<3.40E-08	<3.35E-08
WNW0111	DOWN - C (8)	5.98	805	6.5	0.041	<4.25E-09	6.50±0.06E-06	3.69±0.18E-06	<3.40E-08	<3.35E-08
WNW0203	DOWN - C (1)									
WNW0203	DOWN - C (2)	6.66	1730			<1.51E-08	3.91±0.61E-08	<1.00E-07		
WNW0203	DOWN - C (3)	6.66	257	4.3	0.043	<3.17E-08	4.33±0.66E-08	<1.00E-07	<2.86E-08	<3.25E-08
WNW0203	DOWN - C (4)	6.44	2570	1.8	0.049	<8.84E-07	1.76±0.81E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0203	DOWN - C (5)	6.44	874	3.5	0.033	<2.54E-08	2.24±0.50E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0203	DOWN - C (6)	6.42	827	1.9	<0.005	<6.95E-09	1.21±0.48E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0203	DOWN - C (7)	6.23	2510	9.2	0.019	<1.30E-08	3.97±0.95E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0203	DOWN - C (8)	6.48	2160	3.7	0.019	<1.12E-08	1.18±0.80E-08	<1.00E-07	2.85±1.50E-08	<3.35E-08
WNW0205	DOWN - C (1)									
WNW0205	DOWN - C (2)	6.71	1616			<6.69E-09	3.26±2.78E-09	<1.00E-07		
WNW0205	DOWN - C (3)	6.33	2110	17.0	0.041	<2.00E-08	5.99±4.14E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0205	DOWN - C (4)	6.30	3520	11.0	0.120	<4.75E-08	8.24±4.83E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0205	DOWN - C (5)	6.25	4055	27.0	0.063	<2.45E-08	<1.74E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0205	DOWN - C (6)	6.55	2140	5.4	0.042	1.66±1.22E-08	1.45±0.76E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0205	DOWN - C (7)	6.42	1732	3.5	0.023	<7.69E-09	5.09±3.38E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0205	DOWN - C (8)	6.42	3400	4.8	0.020	<8.99E-09	<1.54E-08	<1.00E-07	<3.40E-08	<3.35E-08
WNW0305	DOWN- C (1)									
WNW0305	DOWN - C (2)	7.23	2480			<1.39E-08	4.59±1.72E-08	<1.00E-07		
WNW0305	DOWN - C (3)	6.68	2335	1.5	0.044	<2.95E-08	1.13±0.71E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0305	DOWN - C (4)	6.92	2400	2.0	0.035	<7.76E-09	<7.12E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0305	DOWN - C (5)	6.93	1808	2.0	0.066	<1.80E-08	<1.56E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0305	DOWN - C (6)	6.88	1613	2.6	0.006	<8.01E-09	7.76±6.87E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0305	DOWN - C (7)	6.87	1272	2.6	0.014	<5.27E-09	<7.93E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0305	DOWN - C (8)	7.08	1161	3.6	0.012	<7.05E-09	<7.13E-09	<1.00E-07	3.50±2.13E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 1 (continued)

Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0307	DOWN - C (1)									
WNW0307	DOWN - C (2)	6.81	2565			<6.79E-09	1.31±0.81E-08	<1.00E-07		
WNW0307	DOWN - C (3)	6.77	2200	2.8	0.057	<3.21E-08	1.19±0.45E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW0307	DOWN - C (4)	7.02	1510	3.2	0.048	<1.79E-08	7.12±3.33E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0307	DOWN - C (5)	6.75	1378	2.6	0.033	<6.64E-09	6.26±3.03E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0307	DOWN - C (6)	6.85	1223	3.2	<0.005	<5.01E-09	9.97±4.26E-09	<1.00E-07	<3.97E-08	2.63±1.08E-08
WNW0307	DOWN - C (7)	6.75	1023		0.007	<5.05E-09	7.07±7.06E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0307	DOWN - C (8)	7.06	903	3.0	0.005	<2.99E-09	<5.08E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0406	DOWN - C (1)									
WNW0406	DOWN - C (2)	7.21	580			<4.57E-09	3.38±2.68E-09	3.32±0.15E-06		
WNW0406	DOWN - C (3)	7.21	582	23.0	<0.005	<2.75E-09	5.58±2.90E-09	2.78±0.15E-06	<2.88E-08	<2.99E-08
WNW0406	DOWN - C (4)	7.30	582	3.9	0.015	<4.25E-09	2.97±2.91E-09	2.10±0.11E-06	<3.59E-08	<3.18E-08
WNW0406	DOWN - C (5)	7.02	650	4.9	0.019	<5.72E-09	8.87±3.31E-09	2.41±0.14E-06	<3.97E-08	<4.13E-08
WNW0406	DOWN - C (6)	7.06	678	3.8	0.020	7.12±5.22E-09	4.27±2.53E-09	2.44±0.14E-06	<3.40E-08	<3.35E-08
WNW0406	DOWN - C (7)	7.11	715	3.7	0.018	<4.24E-09	5.62±3.21E-09	2.30±0.13E-06	<3.40E-08	<3.35E-08
WNW0406	DOWN - C (8)	6.86	701	11.0	0.024	<3.04E-09	1.02±0.35E-08	2.17±0.14E-06	<2.31E-08	<2.19E-08
WNW0408	DOWN - C (1)									
WNW0408	DOWN - C (2)	7.78	891			<1.85E-08	1.23±0.01E-04	1.14±0.04E-05	<3.59E-08	<3.18E-08
WNW0408	DOWN - C (3)	7.74	974	13.3	0.295	<6.06E-09	9.78±0.02E-05	1.32±0.05E-05	<2.88E-08	<3.11E-08
WNW0408	DOWN - C (4)	7.68	1042	1.6		<9.63E-09	1.37±0.01E-04	1.53±0.05E-05	<2.88E-08	<2.99E-08
WNW0408	DOWN - C (5)	7.59	1072	3.5	0.100	<2.88E-09	1.99±0.01E-04	1.75±0.06E-05	<3.40E-08	<3.35E-08
WNW0408	DOWN - C (6)	7.26	1111	2.7	0.073	<2.75E-09	1.61±0.01E-04	1.79±0.06E-05	<3.40E-08	<3.35E-08
WNW0408	DOWN - C (7)	7.44	1141	4.0	0.062	<4.81E-09	1.63±0.01E-04	2.41±0.08E-05	<2.31E-08	<2.19E-08
WNW0408	DOWN - C (8)	7.07	1138	2.2	0.052	<3.93E-09	1.66±0.01E-04	1.61±0.05E-05	<3.40E-08	<3.35E-08
WNW0501	DOWN - C (1)									
WNW0501	DOWN - C (2)	7.39	774			<1.60E-08	8.85±0.08E-05	7.82±0.29E-06		
WNW0501	DOWN - C (3)	7.41	843	14.9	0.074	<4.60E-09	5.80±0.02E-05	7.05±0.28E-06	<3.40E-08	<3.35E-08
WNW0501	DOWN - C (4)	7.24	997	1.8	0.148	<9.31E-09	7.08±0.02E-05	9.64±0.33E-06	<2.88E-08	<2.99E-08
WNW0501	DOWN - C (5)	7.25	977	2.4	0.019	<3.03E-09	1.04±0.01E-04	9.43±0.35E-06	<3.40E-08	<3.35E-08
WNW0501	DOWN - C (6)	7.17	979	2.7	0.027	<4.58E-09	1.04±0.01E-04	8.53±0.34E-06	<3.40E-08	<3.35E-08
WNW0501	DOWN - C (7)	7.29	949	5.6	0.028	<3.13E-09	1.14±0.01E-04	9.87±0.36E-06	<2.83E-08	<3.08E-08
WNW0501	DOWN - C (8)	7.08	944	1.4	0.018	8.37±7.77E-09	1.13±0.01E-04	9.26±0.34E-06	<3.40E-08	<3.35E-08
WNW0502	DOWN - C (1)									
WNW0502	DOWN - C (2)	7.37	767			<1.93E-08	2.02±0.04E-05	1.97±0.12E-06		
WNW0502	DOWN - C (3)	7.22	786	12.9	0.268	<5.04E-09	1.43±0.01E-05	2.03±0.13E-06	<2.88E-08	<3.11E-08
WNW0502	DOWN - C (4)	7.29	896	1.7		<6.11E-09	1.80±0.01E-05	2.74±0.14E-06	<3.59E-08	<3.18E-08
WNW0502	DOWN - C (5)	7.30	926	2.2	<0.010	<3.17E-09	3.29±0.01E-05	2.99±0.16E-06	<2.83E-08	<3.08E-08
WNW0502	DOWN - C (6)	7.13	926	2.9	0.016	<3.14E-09	3.37±0.01E-05	2.86±0.16E-06	<2.31E-08	<2.19E-08
WNW0502	DOWN - C (7)	7.31	922	7.6	0.014	<4.41E-09	3.43±0.01E-05	3.26±0.17E-06	<3.40E-08	<3.35E-08
WNW0502	DOWN - C (8)	7.05	903	1.6	0.018	<5.08E-09	3.82±0.02E-05	4.17±0.19E-06	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep rnumber is indicated in parenthesis next to the hydraulic position.

Table E - 1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0602	DOWN - C (1)									
WNW0602	DOWN - C (2)	6.30	570			<2.66E-09	5.55±2.75E-09	6.17±0.24E-06		
WNW0602	DOWN - C (3)	6.32	530	7.4	0.011	<3.01E-09	2.64±0.45E-08	4.54±0.21E-06	<2.88E-08	<2.99E-08
WNW0602	DOWN - C (4)	6.39	550	7.7	0.027	<5.36E-09	1.76±0.37E-08	6.49±0.12E-06	<2.83E-08	<3.08E-08
WNW0602	DOWN - C (5)	6.70	545	11.0	0.040	<4.66E-09	2.27±0.43E-08	9.38±0.35E-06	<3.97E-08	<4.13E-08
WNW0602	DOWN - C (6)	6.61	551	4.7	0.013	<1.96E-09	1.10±0.34E-08	1.41±0.05E-05	<3.40E-08	<3.35E-08
WNW0602	DOWN - C (7)	6.74	554	2.9	<0.005	<2.16E-09	6.78±3.19E-09	1.32±0.05E-05	<3.40E-08	<3.35E-08
WNW0602	DOWN - C (8)	6.31	566	7.3	0.018	<2.61E-09	2.83±0.48E-08	6.95±0.28E-06	<3.40E-08	<3.35E-08
WNW0603	DOWN - C (1)									
WNW0603	DOWN - C (2)	6.34	632			<3.90E-09	1.04±0.34E-08	1.00±0.71E-07		
WNW0603	DOWN - C (3)	6.51	625	9.4	0.013	<3.86E-09	9.13±3.51E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0603	DOWN - C (4)	6.51	866	1.7	0.005	<9.31E-09	6.64±2.98E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0603	DOWN - C (5)	6.60	916	1.1	<0.005	<1.18E-08	3.27±3.04E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0603	DOWN - C (6)	6.66	906	3.6	<0.005	<6.10E-09	<3.92E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0603	DOWN - C (7)	6.50	952	4.0	<0.005	4.94±4.84E-09	<4.14E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0603	DOWN - C (8)	6.22	1004	2.8	<0.005	7.48±6.91E-09	<5.23E-09	<1.00E-07	<2.31E-08	<1.92E-08

Table E -1 is continued on the next page.

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E -1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos\cm@25^{O}C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0604	DOWN- C (1)									
WNW0604	DOWN - C (2)	6.44	532			<1.32E-09	2.78±2.43E-09	<1.00E-07		
WNW0604	DOWN - C (3)	6.40	476	45.0	0.012	<1.65E-09	2.73±2.56E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0604	DOWN - C (4)	6.34	570	4.4	0.013	<5.27E-09	5.54±2.59E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0604	DOWN - C (5)	6.19	524	3.9	0.014	<4.39E-09	4.88±2.72E-09	<1.00E-07	<3.45E-08	<3.64E-08
WNW0604	DOWN - C (6)	6.24	528	4.2	<0.005	3.75±2.78E-09	<2.62E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0604	DOWN - C (7)	6.04	577	11.0	0.008	<3.38E-09	3.17±2.63E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0604	DOWN - C (8)	5.94	592	5.4	<0.005	<2.43E-09	5.61±3.01E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0701	DOWN - C (1)	7.50	723	7.1	<0.005	<4.45E-09	<2.37E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0701	DOWN - C (2)	7.50	692	4.3	0.018	3.51±3.07E-09	2.79±2.56E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0701	DOWN - C (3)	7.52	620	37.0	0.077	<2.71E-09	<2.41E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0701	DOWN - C (4)	7.37	679	2.0	0.006	<2.76E-09	<2.25E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0701	DOWN - C (5)	7.46	630	1.6	<0.005	<3.24E-09	2.48±2.34E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0701	DOWN - C (6)	7.50	687	3.4	<0.005	<4.23E-09	3.83±2.67E-09	2.17±0.79E-07	<2.83E-08	<3.08E-08
WNW0701	DOWN - C (7)	7.19	771	16.0	0.006	<2.68E-09	4.53±2.52E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0701	DOWN - C (8)	7.21	840	5.9	<0.005	<3.05E-09	<2.91E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0706	DOWN - C (1)	6.65	696	7.5	0.009	<1.72E-09	9.37±3.21E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0706	DOWN - C (2)	6.63	603	6.6	0.037	<2.51E-09	6.41±2.78E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0706	DOWN - C (3)	6.67	977	48.0	0.013	<3.25E-09	7.45±3.07E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0706	DOWN - C (4)	6.56	754	6.4	0.012	<7.18E-09	7.24±3.01E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0706	DOWN - C (5)	6.66	590	3.6	0.020	<3.42E-09	7.35±3.05E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0706	DOWN - C (6)	6.83	1045	5.6	0.006	<4.74E-09	7.31±3.51E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0706	DOWN - C (7)	6.49	496	14.0	0.007	<1.28E-09	2.38±2.18E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0706	DOWN - C (8)	6.80	493	5.1	0.009	<2.14E-09	3.19±2.79E-09	<1.00E-07	<2.31E-08	<2.67E-08
WNW8605	DOWN - C (1)	6.83	685		0.011	<6.46E-09	2.66±0.02E-05	1.42±0.05E-05	<3.59E-08	<3.18E-08
WNW8605	DOWN - C (2)	6.85	776		0.011	8.35±8.19E-09	3.16±0.02E-05	1.59±0.05E-05	<3.59E-08	<3.18E-08
WNW8605	DOWN - C (3)	6.59	524	15.1	0.033	6.82±4.24E-09	6.25±0.09E-06	7.08±0.29E-06	<2.88E-08	3.18±1.05E-08
WNW8605	DOWN - C (4)	6.54	920			1.99±1.31E-08	1.71±0.01E-05	9.10±0.32E-06	<2.83E-08	<3.08E-08
WNW8605	DOWN - C (5)	6.59	1028	12.8	0.041	9.14±6.70E-09	2.81±0.02E-05	6.28±0.26E-06	<2.83E-08	<3.08E-08
WNW8605	DOWN - C (6)	6.52	865	13.8	0.057	<5.77E-09	2.17±0.02E-05	4.20±0.20E-06	<2.31E-08	<2.19E-08
WNW8605	DOWN - C (7)	6.72	888	12.0	0.026	<5.36E-09	2.28±0.02E-05	4.56±0.25E-06	<2.83E-08	<2.83E-08
WNW8605	DOWN - C (8)	6.49	1016	10.2	0.011	2.74±1.24E-08	3.77±0.02E-05	1.55±0.05E-05	<3.40E-08	<3.35E-08
WNW8606	DOWN - C (1)	6.77	1750	3.6	0.011	<2.67E-09	8.88±5.83E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW8606	DOWN - C (2)	6.70	2200	3.7	0.030	<6.58E-09	<6.00E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW8606	DOWN - C (3)	6.70	1932	3.3	0.022	<8.09E-09	7.27±6.32E-09	<1.00E-07	<2.88E-08	3.17±1.05E-08
WNW8606	DOWN - C (4)	6.47	2090	2.4	0.960	<3.08E-08	5.58±4.19E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8606	DOWN - C (5)	6.27	4580	3.6	0.047	<1.94E-08	<1.54E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW8606	DOWN - C (6)	6.54	2280	5.8	0.016	<1.06E-08	<6.86E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8606	DOWN - C (7)	6.65	2065	2.9	0.016	<4.60E-09	1.12±0.68E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW8606	DOWN - C (8)	6.37	2365	6.4	0.018	<1.06E-08	<8.29E-09	<1.00E-07	<2.31E-08	<2.19E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E-1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos\cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW8607	DOWN - C (1)	6.53	579	1.2	0.006	3.69±3.41E-09	1.01±0.23E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW8607	DOWN - C (2)	6.31	568	7.1	0.015	3.24±2.84E-09	1.32±0.26E-08	1.22±0.72E-07	<3.59E-08	<3.18E-08
WNW8607	DOWN - C (3)	6.11	608	3.7	<0.005	<4.30E-09	2.02±0.31E-08	<1.00E-07	<3.25E-08	<3.15E-08
WNW8607	DOWN - C (4)	6.36	793	<1.0	<0.005	<7.28E-09	9.13±3.62E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8607	DOWN - C (5)	6.92	650	3.2	<0.005	<4.18E-09	9.64±3.35E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8607	DOWN - C (6)	6.25	710	14.0	<0.005	<3.44E-09	7.07±3.00E-09	1.88±0.79E-07	<3.40E-08	<3.35E-08
WNW8607	DOWN - C (7)	6.33	842	3.9	0.017	<5.38E-09	9.65±3.50E-09	<1.00E-07	<3.40E-08	<3.39E-08
WNW8607	DOWN - C (8)	6.15	951	20.0	<0.005	<4.12E-09	1.03±0.37E-08	1.02±0.77E-07	<2.31E-08	<2.19E-08
WNW8608	DOWN - C (1)	6.87	497	3.8	0.007	<1.85E-09	9.33±2.21E-09	4.03±1.16E-07	<2.88E-08	<3.11E-08
WNW8608	DOWN - C (2)	6.78	560	15.0	0.010	<3.70E-09	1.23±0.25E-08	4.70±0.80E-07	<2.88E-08	<2.99E-08
WNW8608	DOWN - C (3)	6.91	527	7.2	0.013	<2.28E-09	6.82±2.23E-09	5.10±1.04E-07	<2.83E-08	<3.08E-08
WNW8608	DOWN - C (4)	6.66	489	3.6	0.011	<2.58E-09	6.42±3.17E-09	7.13±0.94E-07	<3.97E-08	<4.13E-08
WNW8608	DOWN - C (5)	6.42	635	6.7	0.015	<3.47E-09	9.38±3.14E-09	1.14±0.16E-06	<3.97E-08	<4.13E-08
WNW8608	DOWN - C (6)	6.63	646	5.7	0.005	<2.67E-09	7.89±3.06E-09	1.63±0.11E-06	<2.83E-08	<3.08E-08
WNW8608	DOWN - C (7)	6.68	696	6.1	0.008	<1.69E-09	1.61±0.38E-08	1.34±0.10E-06	<3.40E-08	<3.35E-08
WNW8608	DOWN - C (8)	6.54	695	7.9	0.007	<3.23E-09	1.12±0.35E-08	1.54±0.11E-06	<3.40E-08	<3.35E-08
WNW8609	DOWN - C (1)	7.22	672	1.0	0.017	<3.68E-09	2.70±0.10E-07	1.56±0.11E-06	<2.88E-08	<3.11E-08
WNW8609	DOWN - C (2)	7.15	679	3.1	0.025	<3.06E-09	2.41±0.10E-07	1.35±0.10E-06	<2.88E-08	<3.11E-08
WNW8609	DOWN - C (3)	7.24	687	16.0	0.008	<3.87E-09	2.52±0.10E-07	1.19±0.11E-06	<2.88E-08	<3.11E-08
WNW8609	DOWN - C (4)	7.04	684	2.0	0.011	<2.92E-09	2.69±0.13E-07	1.23±0.11E-06	<2.88E-08	<2.99E-08
WNW8609	DOWN - C (5)	6.99	699	4.6	0.014	<7.41E-09	2.85±0.13E-07	1.81±0.13E-06	<2.83E-08	<3.08E-08
WNW8609	DOWN - C (6)	7.17	711	5.4	0.011	<4.13E-09	1.65±0.10E-07	2.07±0.12E-06	<3.97E-08	<4.13E-08
WNW8609	DOWN - C (7)	7.15	728	<1.0	0.024	<2.55E-09	2.48±0.13E-07	1.91±0.12E-06	<2.31E-08	<2.19E-08
WNW8609	DOWN - C (8)	6.93	722	8.1	0.011	<4.51E-09	2.78±0.13E-07	2.10±0.12E-06	<3.40E-08	<3.35E-08
WNDMPNE	DOWN - D (1)	7.37	482	3.3	<0.005	<1.48E-09	1.80±0.08E-07	8.75±6.59E-07	<2.88E-08	<3.11E-08
WNDMPNE	DOWN - D (2)	7.20	498	4.5	0.014	<2.11E-09	1.61±0.08E-07	4.40±0.91E-07	<2.88E-08	<3.11E-08
WNDMPNE	DOWN - D (3)	7.28	510	8.3	0.009	<1.90E-09	1.87±0.08E-07	<1.00E-07	<2.88E-08	<2.99E-08
WNDMPNE	DOWN - D (4)	7.05	695	3.7	0.023	<6.53E-09	1.91±0.11E-07	3.60±0.89E-07	<2.83E-08	<3.08E-08
WNDMPNE	DOWN - D (5)	7.32	786	4.7	0.026	<4.00E-09	2.28±0.12E-07	6.58±0.94E-07	<2.83E-08	<3.08E-08
WNDMPNE	DOWN - D (6)	7.40	788	4.5	0.013	<2.90E-09	1.38±0.09E-07	6.20±0.85E-07	<2.83E-08	<3.08E-08
WNDMPNE	DOWN - D (7)	7.54	707	4.8	0.009	<2.06E-09	1.32±0.09E-07	3.80±0.84E-07	< 3.4E-08	<3.35E-08
WNDMPNE	DOWN - D (8)	7.05	648	7.8	0.009	<2.32E-09	2.11±0.11E-07	3.71±0.89E-07	<2.31E-08	<1.92E-08
WNGSEEP	DOWN - D (1)	6.44	606	1.0	0.020	<2.20E-09	3.13±1.65E-09	6.05±0.88E-07	<2.88E-08	<3.11E-08
WNGSEEP	DOWN - D (2)	6.52	581	19.0	0.021	<2.20E-09	3.13±1.65E-09	6.13±0.78E-07	<2.88E-08	<2.99E-08
WNGSEEP	DOWN - D (3)	6.32	551	12.0	0.011	<2.03E-09	3.36±1.94E-09	4.16±0.86E-07	<3.97E-08	<4.13E-08
WNGSEEP	DOWN - D (4)	6.14	591	2.0	0.023	<4.43E-09	4.65±2.72E-09	4.98±0.79E-07	<3.47E-08	<3.61E-08
WNGSEEP	DOWN - D (5)	6.14	659	2.0	0.035	<3.44E-09	4.70±2.96E-09	8.14±0.87E-07	<2.83E-08	<3.08E-08
WNGSEEP	DOWN - D (6)	6.40	718	1.3	0.033	<5.18E-09	2.35±0.45E-08	1.09±0.09E-06	<2.83E-08	<3.08E-08
WNGSEEP	DOWN - D (7)	6.40	722	<1.0	0.013	<3.53E-09	3.74±2.80E-09	9.33±0.92E-07	< 3.4E-08	<3.35E-08
WNGSEEP	DOWN - D (8)	6.20	748	3.4	0.010	<2.80E-09	6.28±3.10E-09	1.08±0.10E-06	<2.91E-08	3.70±1.53E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E -1 (continued)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos\cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0105	DOWN - D (1)	7.15	980	<1.0	0.010	<4.03E-09	9.84±3.29E-09	8.72±0.94E-07	<2.88E-08	<3.11E-08
WNW0105	DOWN - D (2)	7.13	970	4.1	0.018	<5.66E-09	1.47±0.39E-08	2.29±0.65E-07	<2.88E-08	<3.11E-08
WNW0105	DOWN - D (3)	7.17	946	11.0	0.024	<6.07E-09	3.69±3.03E-09	8.91±0.96E-07	<2.88E-08	<3.11E-08
WNW0105	DOWN - D (4)	7.14	945	<1.0	0.023	<4.01E-09	9.15±3.96E-09	9.18±0.99E-07	<3.59E-08	<3.18E-08
WNW0105	DOWN - D (5)	7.08	921	1.2	0.014	<4.87E-09	5.73±3.03E-09	1.36±0.11E-06	<2.83E-08	<3.08E-08
WNW0105	DOWN - D (6)	7.22	914	1.8	0.015	<6.03E-09	3.52±2.91E-09	1.39±0.10E-06	<3.40E-08	<3.35E-08
WNW0105	DOWN - D (7)	6.84	918	<1.0	0.010	5.04±4.94E-09	6.66±3.13E-09	1.27±0.10E-06	<2.31E-08	<2.19E-08
WNW0105	DOWN - D (8)	6.85	937	3.5	0.009	<4.15E-09	8.49±4.37E-09	1.34±0.10E-06	<2.31E-08	<2.05E-08
WNW0106	DOWN - D (1)	6.93	1458	4.4	0.018	<8.19E-09	8.51±3.68E-09	1.63±0.11E-06	<2.88E-08	<2.99E-08
WNW0106	DOWN - D (2)	7.13	1421	5.3	0.037	<7.53E-09	8.38±3.84E-09	1.43±0.10E-06	<2.88E-08	<3.11E-08
WNW0106	DOWN - D (3)	6.95	1262	4.0	0.038	<1.60E-08	6.67±3.33E-09	1.03±0.09E-06	<2.88E-08	<3.11E-08
WNW0106	DOWN - D (4)	7.07	1175	1.1	0.038	<1.38E-08	9.29±3.48E-09	1.13±0.11E-06	<2.83E-08	<3.08E-08
WNW0106	DOWN - D (5)	6.81	993	2.2	0.040	<9.94E-09	<2.96E-09	2.52±0.15E-06	<3.97E-08	<4.13E-08
WNW0106	DOWN - D (6)	7.00	958	2.8	0.019	<1.01E-08	5.71±3.26E-09	3.23±0.16E-06	<3.40E-08	<3.35E-08
WNW0106	DOWN - D (7)	6.70	953	4.7	0.023	<4.64E-09	4.93±4.51E-09	3.38±0.16E-06	<2.31E-08	<3.20E-08
WNW0106	DOWN - D (8)	6.86	929	3.8	0.014	6.46±5.97E-09	6.89±4.50E-09	4.09±0.19E-06	<2.31E-08	3.00±0.77E-08
WNW0116	DOWN - D (1)	7.29	1167	3.6	<0.005	<6.22E-09	1.55±0.40E-08	1.45±0.11E-06	<2.88E-08	<3.11E-08
WNW0116	DO WN-D (2)	7.37	1036	3.3	0.021	<4.78E-09	9.41±3.53E-09	1.58±0.10E-06	<2.88E-08	<3.11E-08
WNW0116	DOWN - D (3)	7.10	952	3.5	0.024	<6.14E-09	1.55±0.40E-08	1.04±0.10E-06	<2.83E-08	<3.08E-08
WNW0116	DOWN - D (4)	6.99	894	1.4	0.014	<1.23E-08	4.54±0.59E-08	9.65±1.00E-07	<2.83E-08	3.43±0.98E-08
WNW0116	DOWN - D (5)	6.87	920	2.5	0.025	<6.93E-09	4.81±0.61E-08	1.21±0.11E-06	<3.97E-08	<4.13E-08
WNW0116	DOWN - D (6)	7.03	972	2.3	0.012	<8.25E-09	4.27±0.58E-08	9.01±0.89E-07	<3.97E-08	<4.13E-08
WNW0116	DOWN - D (7)	6.80	1021	3.7	0.020	<5.33E-09	7.28±0.72E-08	6.72±1.52E-07	<2.31E-08	<2.19E-08
WNW0116	DOWN - D (8)	7.09	1025	7.1	0.013	<2.82E-09	6.14±0.67E-08	8.88±0.96E-07	<2.31E-08	<1.92E-08
WNW0207	DOWN - D (1)									
WNW0207	DOWN - D (2)	6.32	746			<4.71E-09	<2.82E-09	<1.00E-07		
WNW0207	DOWN - D (3)	6.03	600	51.0	0.019	<3.44E-09	<2.64E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0207	DOWN - D (4)	6.55	940	13.0	0.011	<1.99E-08	5.05±3.00E-09	<1.00E-07	<3.43E-08	<3.11E-08
WNW0207	DOWN - D (5)	6.60	1737	2.7	0.015	<1.93E-08	<3.11E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0207	DOWN - D (6)	6.70	955	2.4	<0.005	<6.99E-09	<4.26E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0207	DOWN - D (7)	6.55	965	85.0	<0.005	<5.14E-09	<3.11E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0207	DOWN - D (8)	6.93	958	3.4	<0.005	<4.58E-09	<5.25E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0601	DOWN - D (1)									
WNW0601	DOWN - D (2)	6.31	418			1.53±1.50E-09	1.91±0.10E-07	<1.00E-07		
WNW0601	DOWN - D (3)	6.63	335	7.4	0.022	<2.11E-09	1.18±0.08E-07	<1.00E-07	<3.97E-08	<4.41E-07
WNW0601	DOWN - D (4)	5.19	701	4.8	0.032	<2.46E-09	7.72±0.66E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW0601	DOWN - D (5)	6.41	461	2.9	0.020	<1.63E-09	1.57±0.09E-07	<1.00E-07	<2.83E-08	<3.08E-08
WNW0601	DOWN - D (6)	6.62	534	4.1	<0.005	<2.92E-09	2.41±0.12E-07	<1.00E-07	<2.83E-08	<3.08E-08
WNW0601	DOWN - D (7)	6.16	517	11.0	0.016	<1.41E-09	9.91±0.75E-08	<1.00E-07	<3.40E-08	<3.35E-08
WNW0601	DOWN - D (8)	6.09	503	6.6	0.011	<1.02E-09	5.27±0.56E-08	<1.00E-07	2.20±1.28E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E -1 (continued)

Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos\cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0605	DOWN - D (1)									
WNW0605	DOWN - D (2)	6.64	531			2.50±2.19E-09	2.91±0.13E-07	<4.58E-07		
WNW0605	DOWN - D (3)	6.95	399	6.1	0.009	<2.25E-09	1.74±0.10E-07	<1.00E-07	<3.97E-08	<4.13E-08
WNW0605	DOWN - D (4)	7.42	492	2.2	0.012	<5.15E-09	3.18±0.46E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0605	DOWN - D (5)	7.38	600	1.9	0.029	<5.52E-09	5.61±0.01E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0605	DOWN - D (6)	7.26	717	2.4	<0.005	<4.41E-09	7.07±0.70E-08	1.89±0.79E-07	<2.83E-08	<3.08E-08
WNW0605	DOWN - D (7)	7.02	593	3.8	0.012	3.27±2.87E-09	1.00±0.08E-07	<1.00E-07	<3.40E-08	<3.35E-08
WNW0605	DOWN - D (8)	6.57	510	4.9	0.019	<2.23E-09	3.11±0.13E-07	<1.00E-07	<2.31E-08	<2.19E-08
WNW0801	DOWN - D (1)	6.86	837	3.5	0.006	<3.47E-09	<1.16E-08	1.36±0.10E-06	<2.88E-08	<3.11E-08
WNW0801	DOWN - D (2)	6.81	834	4.8	0.022	<4.67E-09	1.80±0.10E-07	1.04±0.09E-06	<2.88E-08	<3.11E-08
WNW0801	DOWN - D (3)	6.70	888	3.2	0.009	3.14±3.08E-09	2.31±0.12E-07	7.29±0.92E-07	<2.88E-08	<2.99E-08
WNW0801	DOWN - D (4)	6.67	914	3.7	0.023	<5.06E-09	2.26±0.12E-07	3.42±0.88E-07	<2.83E-08	<3.56E-08
WNW0801	DOWN - D (5)	6.43	928	4.2	0.027	<9.05E-09	2.04±0.12E-07	1.03±0.10E-06	<2.83E-08	<3.08E-08
WNW0801	DOWN - D (6)	6.77	1002	2.8	0.038	<5.54E-09	1.29±0.09E-07	9.97±0.91E-07	<3.97E-08	<4.13E-08
WNW0801	DOWN - D (7)	6.46	1038	4.6	<0.005	7.76±6.80E-09	1.98±0.12E-07	8.89±0.87E-07	<2.31E-08	<2.19E-08
WNW0801	DOWN - D (8)	6.54	1033	3.2	0.010	<7.72E-09	2.17±0.12E-07	8.72±0.87E-07	2.33±0.85E-08	<3.35E-08
WNW0802	DOWN - D (1)	7.16	272	1.6	<0.005	<9.12E-10	<1.93E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0802	DOWN - D (2)	6.50	158	1.6	0.009	<5.27E-10	3.08±2.31E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0802	DOWN - D (3)	6.62	141	2.6	0.007	<1.79E-09	3.59±2.61E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0802	DOWN - D (4)	6.92	225	<1.0	0.017	<1.87E-09	<2.20E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0802	DOWN - D (5)	6.85	452	2.2	0.020	<4.11E-09	4.92±2.81E-09	2.59±0.90E-07	<3.97E-08	<4.13E-08
WNW0802	DOWN - D (6)	7.19	625	2.9	<0.005	1.14±0.72E-08	8.70±3.20E-09	7.48±0.87E-07	N/A	N/A
WNW0802	DOWN - D (7)	6.73	819	1.6	0.010	1.21±0.82E-08	3.64±2.94E-09	9.24±0.89E-07	<2.31E-08	<2.19E-08
WNW0802	DOWN - D (8)	6.81	896	2.7	0.006	<6.90E-09	4.15±2.97E-09	1.16±0.10E-06	<2.31E-08	<2.19E-08
WNW0803	DOWN - D (1)	7.01	1103	2.0	0.006	<4.79E-09	6.90±3.15E-09	1.42±0.11E-06	<2.88E-08	<3.11E-08
WNW0803	DOWN - D (2)	6.91	1167	2.4	0.047	<1.20E-08	8.46±3.53E-09	1.34±0.10E-06	<3.59E-08	<3.18E-08
WNW0803	DOWN - D (3)	6.90	1272	32.0	0.028	<1.10E-08	4.63±3.39E-09	9.70±0.98E-07	<3.47E-08	<3.66E-08
WNW0803	DOWN - D (4)	6.78	1284	1.6	0.028	<1.25E-08	4.34±3.49E-09	1.01±0.10E-06	<3.59E-08	<3.18E-08
WNW0803	DOWN - D (5)	6.65	1168	2.3	0.028	<7.73E-09	5.27±3.41E-09	1.36±0.11E-06	<3.97E-08	<4.13E-08
WNW0803	DOWN - D (6)	7.02	1108	3.4	0.026	<1.33E-08	7.79±3.51E-09	1.02±0.09E-06	<3.97E-08	<4.13E-08
WNW0803	DOWN - D (7)	6.63	1082	1.0	0.010	<4.26E-09	8.55±4.48E-09	1.17±0.10E-06	<2.91E-08	<2.83E-08
WNW0803	DOWN - D (8)	6.72	1076	3.3	0.008	<5.70E-09	8.89±5.87E-09	1.38±0.10E-06	<2.31E-08	<2.06E-08
WNW0804	DOWN - D (1)	6.83	659	2.4	0.008	<3.03E-09	2.07±0.42E-08	4.15±0.86E-07	<2.88E-08	<3.11E-08
WNW0804	DOWN - D (2)	6.66	553	17.0	0.041	<2.21E-09	1.79±0.38E-08	4.65±0.78E-07	<2.88E-08	<2.99E-08
WNW0804	DOWN - D (3)	6.74	640	2.7	0.019	<3.28E-09	2.06±0.42E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW0804	DOWN - D (4)	6.60	698	3.1	0.036	<3.92E-09	2.04±0.44E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0804	DOWN - D (5)	6.42	797	2.3	0.024	<7.34E-09	2.00±0.43E-08	5.21±0.90E-07	<2.83E-08	<3.08E-08
WNW0804	DOWN - D (6)	6.76	879	2.5	<0.005	<4.63E-09	2.14±0.43E-08	5.87±0.90E-07	<3.97E-08	<4.13E-08
WNW0804	DOWN - D (7)	6.36	807	<1.0	<0.005	8.71±5.69E-09	2.00±0.42E-08	5.29±0.85E-07	<3.40E-08	<3.35E-08
WNW0804	DOWN - D (8)	6.47	767	3.8	0.007	5.07±4.69E-09	1.95±0.43E-08	6.81±0.86E-07	<2.31E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E -1 (concluded)
Contamination Indicator Parameters for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	pH	Conductivity μmhos\cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha μCi/mL	Gross Beta μCi/mL	Tritium μCi/mL	Cs-137 μCi/mL	Co-60 μCi/mL
WNW8603	DOWN - D (1)	7.42	983	<1.0	<0.005	<5.14E-09	2.51±0.41E-08	1.08±0.10E-06	<2.88E-08	<3.11E-08
WNW8603	DOWN - D (2)	7.37	962	2.3	0.010	<4.85E-09	2.08±0.37E-08	8.48±0.83E-07	<2.88E-08	3.30±1.05E-08
WNW8603	DOWN - D (3)	7.37	942	14.0	<0.005	<1.67E-09	1.61±0.33E-08	6.91±0.90E-07	<2.88E-08	<3.11E-08
WNW8603	DOWN - D (4)	7.18	931	1.7	0.017	6.05±5.93E-09	9.42±3.31E-09	8.34±0.73E-07	<2.88E-08	<2.99E-08
WNW8603	DOWN - D (5)	7.36	916	<1.0	0.027	<3.38E-08	1.14±0.44E-08	1.11±0.15E-06	<2.83E-08	<3.08E-08
WNW8603	DOWN - D (6)	7.23	929	1.2	0.008	<4.80E-09	1.74±0.39E-08	1.14±0.09E-06	<2.83E-08	<3.08E-08
WNW8603	DOWN - D (7)	7.36	971	<1.0	<0.005	<5.23E-09	1.39±0.60E-08	9.94±0.96E-07	<2.31E-08	<2.19E-08
WNW8603	DOWN - D (8)	7.10	990	2.9	<0.005	8.38±7.04E-09	1.55±0.65E-08	1.09±0.09E-06	<2.31E-08	<1.92E-08
WNW8604	DOWN - D (1)	7.36	946	<1.0	<0.005	<6.19E-09	9.82±0.22E-07	1.13±0.10E-06	<2.88E-08	<3.11E-08
WNW8604	DOWN - D (2)	7.32	928	<1.0	0.018	<4.76E-09	1.10±0.02E-06	1.16±0.08E-06	<2.88E-08	<2.99E-08
WNW8604	DOWN - D (3)	7.33	921	11.0	<0.005	<2.75E-09	1.09±0.02E-06	8.73±0.95E-07	<2.88E-08	<3.11E-08
WNW8604	DOWN - D (4)	7.25	923	1.2	0.010	<7.15E-09	1.26±0.03E-06	7.29±0.93E-07	<2.88E-08	<2.99E-08
WNW8604	DOWN - D (5)	7.29	941	3.7	0.029	<1.25E-08	1.50±0.03E-06	9.06±0.75E-07	<3.21E-08	<3.97E-08
WNW8604	DOWN - D (6)	7.19	1024	3.5	0.033	<3.90E-09	1.42±0.03E-06	8.47±0.95E-07	<3.13E-08	<3.01E-08
WNW8604	DOWN - D (7)	7.08	1024	7.7	0.029	<3.61E-09	1.46±0.03E-06	6.98±1.00E-07	<2.83E-08	<3.08E-08
WNW8604	DOWN - D (8)	7.21	1110	1.6	<.010	<4.01E-09	1.97±0.04E-06	5.00±0.22E-06	<3.40E-08	<3.35E-08
WNW8612	DOWN - D (1)	7.54	746	<1.0	0.015	<4.23E-09	<1.51E-09	2.57±0.14E-06	<2.88E-08	<3.11E-08
WNW8612	DOWN - D (2)	7.50	753	3.6	0.033	<4.61E-09	1.65±1.59E-09	2.88±0.15E-06	<2.88E-08	<3.11E-08
WNW8612	DOWN - D (3)	7.46	756	7.6	0.030	<9.65E-09	2.23±2.11E-09	2.05±0.13E-06	<2.88E-08	<3.11E-08
WNW8612	DOWN - D (4)	7.34	757	<1.0	0.025	<4.92E-09	<2.05E-09	1.93±0.13E-06	<2.83E-08	<3.08E-08
WNW8612	DOWN - D (5)	7.31	770	1.2	0.029	<2.72E-09	<2.28E-09	2.18±0.14E-06	<3.97E-08	<4.13E-08
WNW8612	DOWN - D (6)	7.38	773	1.5	0.015	<7.84E-09	<2.56E-09	1.90±0.12E-06	<3.40E-08	<3.35E-08
WNW8612	DOWN - D (7)	7.39	778	<1.0	0.022	5.97±5.84E-09	<2.59E-09	2.10±0.13E-06	<2.58E-08	<2.67E-08
WNW8612	DOWN - D (8)	7.24	781	3.4	0.017	<4.11E-09	3.12±2.77E-09	2.02±0.13E-06	<2.31E-08	<2.06E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to hydraulic position.

Table E - 2
Contamination Indicator Parameters for the Till-Sand Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0302	UP (1)									
WNW0302	UP (2)	7.11	1302			<3.95E-09	3.79±3.06E-09	<1.00E-07		
WNW0302	UP (3)	7.15	1395	8.2	0.021	<1.09E-08	5.57±3.12E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0302	UP (4)	7.05	1437	<1.0	0.022	<3.09E-08	<3.93E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0302	UP (5)	6.98	1436	<1.0	0.018	<1.70E-08	<5.68E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0302	UP (6)	7.05	1443	1.4	0.024	<7.11E-09	5.18±4.82E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0302	UP (7)	7.01	1400	7.6	0.008	<4.91E-09	<4.20E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0302	UP (8)	7.01	1378	3.3	<0.005	<6.82E-09	<5.28E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0402	UP (1)									
WNW0402	UP (2)	7.50	977			<8.62E-09	2.26±0.45E-08	<1.00E-07		
WNW0402	UP (3)	7.15	1080	1.1	0.020	<3.95E-09	1.42±0.37E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0402	UP (4)	7.23	1092	1.6	0.023	<2.31E-08	<3.67E-09	<1.00E-07	<2.88E-08	4.32±1.05E-08
WNW0402	UP (5)	6.69	1030	0.6	0.015	<1.52E-08	<5.33E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0402	UP (6)	7.32	1068	2.3	<0.005	<7.03E-09	7.30±4.89E-09	1.15±0.79E-07	<2.83E-08	<3.08E-08
WNW0402	UP (7)	7.13	1126	14.0	0.009	<5.88E-09	<5.13E-09	<1.00E-07	<2.31E-08	<2.67E-08
WNW0402	UP (8)	6.99	1134	1.8	<0.005	<4.23E-09	<5.55E-09	<1.00E-07	<2.31E-08	<1.92E-08
WNW0404	UP (1)									
WNW0404	UP (2)	8.31	221			<6.02E-10	3.79±2.33E-09	<1.00E-07		
WNW0404	UP (3)	8.06	255	<1.0	<0.005	<2.04E-09	<2.31E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0404	UP (4)	7.91	262	<1.0	<0.005	<1.32E-09	<2.36E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0404	UP (5)	7.24	260	15.0	0.009	<2.15E-09	<2.20E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0404	UP (6)	7.97	256	<1.0	<0.005	<1.27E-09	3.91±2.66E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0404	UP (7)	7.91	241	1.6	0.007	<1.37E-09	3.88±2.74E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0404	UP (8)	7.84	249	2.1	<0.005	<1.10E-09	<2.34E-09	<1.00E-07	<3.40E-08	1.12±0.74E-08
WNW0202	DOWN - B (1)									
WNW0202	DOWN - B (2)	12.61	3220			<4.88E-09	6.00±0.64E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0202	DOWN - B (3)	12.12	2320	3.2	0.025	5.08±3.72E-09	4.75±0.56E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0202	DOWN - B (4)	11.89	1492	2.0	0.026	<8.64E-09	4.46±0.57E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW0202	DOWN - B (5)	11.96	1825	2.1	0.022	<5.01E-09	1.72±0.39E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW0202	DOWN - B (6)	11.87	1184	2.8	<0.005	9.88±7.91E-09	3.88±0.58E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0202	DOWN - B (7)	11.53	1284	<1.0	<0.005	<2.85E-09	1.84±0.46E-08	<1.00E-07	<2.91E-08	<2.83E-08
WNW0202	DOWN - B (8)	12.07	1178	2.6	<0.005	<1.85E-09	2.09±0.53E-08	<1.00E-07	<3.40E-08	<3.35E-08
WNW0204	DOWN - B (1)									
WNW0204	DOWN - B (2)	8.96	451			<2.56E-09	<2.30E-09	<1.00E-07		
WNW0204	DOWN - B (3)	9.07	468	1.5	<0.005	<1.95E-09	1.97±0.38E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0204	DOWN - B (4)	8.86	493	2.1	0.028	<3.81E-09	<2.88E-09	<1.00E-07	<2.86E-08	<3.04E-08
WNW0204	DOWN - B (5)	8.83	486	5.7	0.017	<4.19E-09	<2.53E-09	<1.00E-07	<2.83E-08	3.60±1.32E-08
WNW0204	DOWN - B (6)	8.69	502	1.1	0.016	<2.34E-09	5.08±2.53E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0204	DOWN - B (7)	8.50	519	4.9	<0.005	<1.88E-09	5.02±3.01E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0204	DOWN - B (8)	8.40	529	1.8	<0.005	<1.88E-09	3.10±2.76E-09	1.57±0.79E-07	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 2 (concluded)
Contamination Indicator Parameters for the Till-Sand Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0206	DOWN - B (1)									
WNW0206	DOWN - B (2)	7.76	473			<2.38E-09	5.30±2.62E-09	<1.00E-07		
WNW0206	DOWN - B (3)	7.84	544	2.2	0.016	<2.24E-09	2.67±0.43E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW0206	DOWN - B (4)	7.76	552	2.7	0.023	<5.84E-09	4.79±2.62E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0206	DOWN - B (5)	7.73	541	1.2	0.034	<4.68E-09	<2.57E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0206	DOWN - B (6)	7.68	555	<1.0	0.021	<3.44E-09	3.97±2.42E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0206	DOWN - B (7)	7.43	573	<1.0	<0.005	<2.77E-09	<2.47E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0206	DOWN - B (8)	7.52	586	2.8	<0.005	<2.05E-09	3.29±2.81E-09	3.47±0.84E-07	<3.40E-08	<3.35E-08
WNW0208	DOWN - B (1)									
WNW0208	DOWN - B (2)	7.88	325			<2.17E-09	4.73±2.53E-09	<1.00E-07		
WNW0208	DOWN - B (3)	7.92	313	1.9	<0.005	<2.27E-09	<2.18E-09	<1.00E-07	<2.88E-08	3.28±0.93E-08
WNW0208	DOWN - B (4)	7.39	312	1.5	0.006	<2.80E-09	<2.61E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0208	DOWN - B (5)	7.79	293	1.1	0.009	<1.92E-09	3.25±2.48E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0208	DOWN - B (6)	7.89	296	1.4	<0.005	<1.94E-09	<2.33E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0208	DOWN - B (7)	7.63	291	<1.0	<0.005	<1.47E-09	<2.47E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0208	DOWN - B (8)	7.80	307	3.6	<0.005	2.39±2.21E-09	<2.58E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0905	DOWN - B (1)									
WNW0905	DOWN - B (2)	6.85	1659			<2.64E-08	4.39±3.75E-09	3.84±0.87E-07	<2.83E-08	<3.08E-08
WNW0905	DOWN - B (3)	6.71	1666	45.0	0.006	<3.34E-08	1.23±0.43E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0905	DOWN - B (4)	6.83	1655	1.9	0.008	<4.49E-08	6.79±3.62E-09	<1.00E-07	<3.23E-08	<3.13E-08
WNW0905	DOWN - B (5)	6.80	1661	3.4	0.015	<1.11E-08	6.40±4.74E-09	2.06±0.86E-07	<2.83E-08	<3.08E-08
WNW0905	DOWN - B (6)	6.71	1650	<1.0	0.006	<1.80E-08	7.75±5.00E-09	2.67±0.83E-07	<3.45E-08	<3.64E-08
WNW0905	DOWN - B (7)	6.97	1641	74.0	0.012	<8.30E-09	<5.42E-09	1.90±1.39E-07	<2.31E-08	<2.19E-08
WNW0905	DOWN - B (8)	6.61	1623	84.0	<0.005	<7.56E-09	1.16±0.80E-08	4.02±0.84E-07	<2.31E-08	<2.19E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 3
Contamination Indicator Parameters for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0405	UP (1)									
WNW0405	UP (2)	7.36	905			<6.11E-09	3.22±3.05E-09	1.23±0.47E-07		
WNW0405	UP (3)	7.31	795	3.6	0.017	<6.42E-09	7.58±3.28E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0405	UP (4)	7.25	733	2.5	0.011	<8.14E-09	<3.06E-09	<1.00E-07	<4.13E-08	<3.97E-08
WNW0405	UP (5)	7.17	1050	3.0	0.010	<1.17E-08	3.51±2.98E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0405	UP (6)	7.13	1045	2.6	<0.005	2.19±1.16E-08	1.06±0.34E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0405	UP (7)	7.03	974	2.2	<0.005	<5.24E-09	4.79±3.28E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0405	UP (8)	7.08	1000	3.3	<0.005	1.19±0.81E-08	6.77±3.35E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0704	UP (1)	6.39	1124	28.2	0.029	<9.90E-09	2.55±0.51E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW0704	UP (2)	6.23	1056	44.0	0.030	<9.86E-09	2.79±0.50E-08	<1.00E-07	<2.88E-08	<3.11E-08
WNW0704	UP (3)	6.53	1123	110.0	0.047	<1.31E-08	1.36±0.40E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0704	UP (4)	6.17	1150	33.0	0.033	<1.09E-08	2.43±0.48E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW0704	UP (5)	6.25	1026	32.0	0.033	<8.72E-09	2.04±0.44E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0704	UP (6)	6.43	1042	26.0	0.024	<8.76E-09	2.29±0.58E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0704	UP (7)	6.15	1042	20.0	0.037	<6.76E-09	1.49±0.40E-08	1.50±1.41E-07	<2.31E-08	<3.16E-08
WNW0704	UP (8)	6.53	1112	27.0	0.047	<4.06E-09	2.06±0.72E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW0707	UP (1)	7.01	391	13.2	<0.005	<1.84E-09	6.27±2.80E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0707	UP (2)	6.82	262	8.5	0.015	<1.38E-09	2.80±2.26E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0707	UP (3)	6.72	303	24.0	0.008	<2.29E-09	<2.81E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0707	UP (4)	7.24	509	6.0	0.027	<4.11E-09	4.00±2.48E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0707	UP (5)	6.90	531	4.9	0.007	<3.75E-09	5.21±2.83E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0707	UP (6)	6.96	567	<1.0	<0.005	<3.68E-09	8.82±3.08E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0707	UP (7)	6.87	596	5.4	0.006	<3.69E-09	7.65±3.12E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0707	UP (8)	7.20	476	5.5	<0.005	<6.78E-10	<2.68E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1008C	UP (1)									
WNW1008C	UP (2)	7.33	542			<2.62E-09	<2.29E-09	<1.00E-07		
WNW1008C	UP (3)	7.61	541	5.0		<3.44E-09	<3.04E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1008C	UP (4)	7.51	458	4.9	0.006	<4.59E-09	5.72±2.70E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1008C	UP (5)	7.54	481	8.6	0.011	<3.49E-09	<2.56E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1008C	UP (6)	7.37	510	3.1	<0.005	<3.24E-09	<2.49E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1008C	UP (7)	7.40	521	10.0	0.008	<1.38E-09	2.69±2.24E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1008C	UP (8)	7.27	539	4.9		<1.90E-09	<2.22E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0109	DOWN - B (1)	7.65	628	<1.0	<0.005	<2.57E-09	4.21±2.75E-09	9.24±0.93E-07	<3.59E-08	<3.18E-08
WNW0109	DOWN - B (2)	7.32	678	6.7	0.006	<3.05E-09	<2.66E-09	6.93±0.80E-07	<2.86E-08	<3.04E-08
WNW0109	DOWN - B (3)	7.19	694	2.9	0.019	<4.41E-09	3.00±2.81E-09	3.54±0.86E-07	<2.83E-08	<4.12E-08
WNW0109	DOWN - B (4)	7.36	706	<1.0	<0.005	<6.50E-09	<2.65E-09	6.41±0.92E-07	<2.88E-08	<2.99E-08
WNW0109	DOWN - B (5)	7.11	648	2.3	<0.005	4.52±4.17E-09	5.49±2.52E-09	6.91±0.90E-07	<3.97E-08	<4.13E-08
WNW0109	DOWN - B (6)	7.42	648	1.4	<0.005	4.33±2.99E-09	<2.17E-09	7.15±0.85E-07	<3.40E-08	<3.35E-08
WNW0109	DOWN - B (7)	7.04	670	<1.0	<0.005	<2.71E-09	4.05±2.83E-09	6.14±0.83E-07	<2.31E-08	<2.19E-08
WNW0109	DOWN - B (8)	7.33	656	2.3	<0.005	<3.27E-09	6.56±2.89E-09	5.26±0.86E-07	<2.31E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 3 (continued)
Contamination Indicator Parameters for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0110	DOWN - B (1)	7.49	518	<1.0	0.021	5.60±3.81E-09	3.27±2.60E-09	5.72±0.92E-07	<2.88E-08	<3.11E-08
WNW0110	DOWN - B (2)	7.46	562	24.0	<0.005	<1.45E-09	5.03±2.72E-09	7.02±0.77E-07	<2.88E-08	<2.99E-08
WNW0110	DOWN - B (3)	7.26	590	1.4	<0.005	<3.88E-09	3.44±2.51E-09	5.13±0.88E-07	<2.83E-08	<3.08E-08
WNW0110	DOWN - B (4)	7.38	586	<1.0	<0.005	<4.99E-09	<2.79E-09	7.12±0.71E-07	<2.88E-08	<2.99E-08
WNW0110	DOWN - B (5)	7.24	566	3.4	0.006	6.76±4.88E-09	2.97±2.73E-09	7.36±0.90E-07	<3.97E-08	<4.13E-08
WNW0110	DOWN - B (6)	7.46	620	1.0	<0.005	6.94±6.44E-09	5.10±2.92E-09	8.46±0.88E-07	<2.83E-08	<3.08E-08
WNW0110	DOWN - B (7)	7.13	600	<1.0	<0.005	<2.74E-09	4.27±2.81E-09	6.40±0.84E-07	<2.31E-08	<2.19E-08
WNW0110	DOWN - B(8)	7.44	670	2.6	<0.005	<3.37E-09	3.06±2.84E-09	7.01±0.85E-07	<3.40E-08	<3.35E-08
WNW0115	DOWN - B (1)	7.72	482	1.8	<0.005	3.22±2.71E-09	7.04±2.90E-09	3.94±0.88E-07	<2.88E-08	<3.11E-08
WNW0115	DOWN - B (2)	7.85	498	2.2	0.013	<2.93E-09	3.42±2.47E-09	5.16±0.79E-07	<2.88E-08	<2.99E-08
WNW0115	DOWN - B (3)	7.73	452	1.6	0.017	<2.50E-09	3.05±0.46E-08	1.63±0.83E-07	<2.88E-08	<2.99E-08
WNW0115	DOWN - B (4)	7.62	480	<1.0	0.045	<2.36E-09	<2.76E-09	1.07±0.84E-07	<2.88E-08	<2.99E-08
WNW0115	DOWN - B (5)	7.54	484	1.1	0.010	<1.73E-10	4.25±1.98E-09	5.14±0.90E-07	<3.97E-08	<4.13E-08
WNW0115	DOWN - B (6)	7.74	472	3.8	<0.005	<2.85E-09	<2.39E-09	5.07±0.84E-07	<2.83E-08	<3.08E-08
WNW0115	DOWN - B (7)	7.40	479	1.5	<0.005	<2.55E-09	2.98±2.45E-09	4.24±1.18E-07	<2.31E-08	<2.19E-08
WNW0115	DOWN - B (8)	7.45	487	34.0	0.017	<2.79E-09	4.42±3.58E-09	5.28±0.85E-07	<2.31E-08	<1.92E-08
WNW0702	DOWN - B (1)	7.46	1093	3.5	<0.005	8.97±6.48E-09	5.41±3.02E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0702	DOWN - B (2)	7.40	1063	4.9	0.021	<6.03E-09	4.55±3.24E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0702	DOWN - B (3)	7.43	1030	5.8	<0.005	<5.67E-09	5.02±3.01E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0702	DOWN - B (4)	7.10	1045	1.4	0.007	1.22±1.12E-08	3.96±2.71E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0702	DOWN - B (5)	7.32	1053	2.3	0.008	<8.66E-09	4.53±3.01E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0702	DOWN - B (6)	7.27	1028	3.6	<0.005	<6.85E-09	4.24±2.86E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0702	DOWN - B (7)	7.04	963	5.8	0.006	<2.60E-09	3.06±2.34E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0702	DOWN - B (8)	7.48	1015	3.3	<0.005	5.70±4.79E-09	5.21±2.95E-09	3.41±1.44E-07	<2.31E-08	<2.19E-08
WNW0703	DOWN - B (1)	7.47	855	<1.0	<0.005	<3.41E-09	6.52±2.66E-09	<1.00E-07	<2.88E-08	3.43±1.05E-08
WNW0703	DOWN - B (2)	7.42	861	4.4	0.007	<4.46E-09	6.38±2.75E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0703	DOWN - B (3)	7.45	807	41.0	0.090	<5.71E-09	<2.84E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0703	DOWN - B (4)	7.20	807	<1.0	<0.005	<4.30E-09	3.20±2.61E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0703	DOWN - B (5)	7.20	873	3.9	<0.005	<6.68E-09	3.79±2.87E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0703	DOWN - B (6)	7.36	874	7.4	<0.005	9.88±8.39E-09	6.30±3.12E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0703	DOWN - B (7)	7.02	865	1.3	0.006	<6.14E-09	4.34±2.90E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0703	DOWN - B (8)	7.00	798	2.2	<0.005	<3.70E-09	<2.97E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0705	DOWN - B (1)	7.68	436	2.4	<0.005	<2.14E-09	3.71±2.57E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0705	DOWN - B (2)	6.93	306	13.0	0.011	<1.65E-09	3.32±2.45E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0705	DOWN - B (3)	7.47	415	35.0	0.130	<2.83E-09	<2.39E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0705	DOWN - B (4)	7.11	469	2.0	0.011	<3.25E-09	1.03±0.32E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW0705	DOWN - B (5)	7.22	532	6.2	<0.005	3.62±3.35E-09	3.88±2.47E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0705	DOWN - B (6)	7.22	517	<1.0	<0.005	<3.10E-09	6.94±2.96E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0705	DOWN - B (7)	7.02	628	22.0	0.013	<5.11E-09	9.69±3.40E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0705	DOWN - B (8)	7.46	613	6.0	<0.005	<1.39E-09	4.36±2.60E-09	<1.00E-07	<2.31E-08	<2.19E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 3 (continued)
Contamination Indicator Parameters for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0904	DOW N - B (1)									
WNW0904	DOWN - B (2)	7.55	671			<6.57E-09	<2.83E-09	<1.00E-07		
WNW0904	DOWN - B (3)	7.43	721	48.0	0.012	<4.47E-09	5.05±2.96E-09	<1.00E-07	<2.83E-08	<3.11E-08
WNW0904	DOWN - B (4)	7.27	819	3.0	0.006	<1.47E-09	2.51±2.12E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0904	DOWN - B (5)	7.23	889	4.3	<0.005	<5.40E-09	3.42±2.89E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0904	DOWN - B (6)	7.25	868	3.6	<0.005	1.08±0.75E-08	5.55±3.25E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0904	DOWN - B (7)	7.24	928	1.1	<0.005	<3.46E-09	4.42±2.66E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0904	DOWN - B (8)	7.07	950	13.0	0.010	<4.08E-09	5.56±3.00E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1101B	DOWN - B (1)									
WNW1101B	DOWN - B (2)	7.30	884			<6.23E-09	5.23±2.70E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1101B	DOWN - B (3)	7.19	890	3.8	<0.005	<4.90E-09	<2.84E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1101B	DOWN - B (4)	7.03	921	2.0	0.007	<1.20E-08	5.65±2.98E-09	<1.00E-07	<2.88E-08	3.31±1.05E-08
WNW1101B	DOWN - B (5)	7.08	976	1.3	<0.005	<1.11E-08	5.44±3.43E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1101B	DOWN - B (6)	7.08	999	2.8	<0.005	<7.34E-09	6.54±3.20E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101B	DOWN - B (7)	7.01	1032	4.4	<0.005	3.70±3.63E-09	9.45±4.71E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101B	DOWN - B (8)	6.72	1133		<0.005	7.99±7.38E-09	2.92±0.76E-08	<1.00E-07	<2.31E-08	<1.92E-08
WNW1106B	DOWN - B (1)									
WNW1106B	DOWN - B (2)	7.36	837			8.92±6.44E-09	4.94±3.09E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW1106B	DOWN - B (3)	7.22	805	3.7	0.005	<7.89E-09	3.53±2.93E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1106B	DOWN - B (4)	7.29	795	3.1	<0.005	1.01±0.95E-08	6.92±2.72E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1106B	DOWN - B (5)	7.08	592	1.6	<0.005	<5.78E-09	3.40±3.06E-09	<1.00E-07	<2.83E-08	4.53±1.76E-08
WNW1106B	DOWN - B (6)	7.35	793	2.0	<0.005	8.33±7.03E-09	6.04±2.75E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1106B	DOWN - B (7)	7.09	781	2.1	0.012	<3.85E-09	3.23±2.68E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1106B	DOWN - B (8)	6.92	774	<1.0	<0.005	<3.82E-09	4.52±2.85E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1109B	DOWN - B (1)									
WNW1109B	DOWN - B (2)	7.83	435			5.25±3.37E-09	3.75±2.45E-09	2.48±0.73E-07	<2.88E-08	<2.99E-08
WNW1109B	DOWN - B (3)	7.58	426	1.4	<0.005	<1.92E-09	<2.31E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1109B	DOWN - B (4)	7.69	425	14.0	0.022	<3.31E-09	<2.87E-09	1.98±0.86E-07	<2.83E-08	<3.08E-08
WNW1109B	DOWN - B (5)	7.63	440	1.2	<0.005	<3.90E-09	4.99±3.00E-09	2.86±1.24E-07	<2.83E-08	<3.08E-08
WNW1109B	DOWN - B (6)	7.47	449	3.4	<0.005	<2.68E-09	5.31±2.47E-09	2.60±1.21E-07	<3.40E-08	<3.35E-08
WNW1109B	DOWN - B (7)	7.45	440	2.0	0.009	<2.09E-09	<2.66E-09	2.30±1.19E-07	<2.31E-08	<2.19E-08
WNW1109B	DOWN - B (8)	7.31	452		<0.005	<1.57E-09	<2.57E-09	5.29±0.84E-07	<2.31E-08	<2.67E-08
WNW0107	DOWN - C (1)	7.40	947	<1.0	0.006	<3.25E-09	7.77±3.09E-09	1.85±0.12E-06	<2.88E-08	<3.11E-08
WNW0107	DOWN - C (2)	7.31	970	6.8	<0.005	<5.74E-09	8.87±3.06E-09	1.27±0.09E-06	<3.59E-08	<3.18E-08
WNW0107	DOWN - C (3)	7.10	936	1.4	<0.005	<5.61E-09	4.65±3.04E-09	9.80±0.98E-07	<2.88E-08	<3.11E-08
WNW0107	DOWN - C (4)	7.21	944	<1.0	<0.005	<7.65E-09	<3.24E-09	9.82±1.00E-07	<2.88E-08	<2.99E-08
WNW0107	DOWN - C (5)	7.16	985	<1.0	<0.005	7.41±6.84E-09	3.83±2.69E-09	1.07±0.10E-06	<2.83E-08	<3.08E-08
WNW0107	DOWN - C (6)	7.16	968	5.6	<0.005	<8.41E-09	3.76±2.99E-09	1.02±0.09E-06	<5.51E-08	<5.74E-08
WNW0107	DOWN - C (7)	6.98	979	<1.0	<0.005	<2.79E-09	8.65±4.23E-09	1.02±0.09E-06	<3.40E-08	<3.35E-08
WNW0107	DOWN - C (8)	6.99	1022	13.0	<0.005	6.01±5.58E-09	<2.62E-09	8.01±0.91E-07	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicaied in parenthesis next to the hydraulic position.

Table E - 3 (continued)
Contamination Indicator Parameters for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0108[b]	DOWN - C (1)	7.34	846	25.0	<0.005	<2.24E-09	4.05±2.74E-09	<1.00E-07	<2.88E-08	3.55±1.04E-08
WNW0108	DOWN - C (2)	7.18	836	4.2	0.005	<3.66E-09	4.89±2.67E-09	<1.00E-07	<3.25E-08	<2.37E-08
WNW0108	DOWN - C (3)	7.20	809	2.4	0.009	<4.95E-09	4.64±2.95E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW0108	DOWN - C (4)	7.27	894	<1.0	<0.005	<6.08E-09	<2.64E-09	<1.00E-07	<3.97E-08	1.03±0.64E-09
WNW0108	DOWN - C (5)	7.59	843	<1.0	<0.005	<3.07E-09	5.22±2.70E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0108	DOWN - C (6)	7.42	768	1.3	<0.005	5.46±4.64E-09	7.16±3.05E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0108	DOWN - C (7)	7.22	842	<1.0	<0.005	<4.80E-09	5.41±3.02E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0108	DOWN - C (8)	6.84	947	2.8	<0.005	<4.22E-09	6.88±3.37E-09	1.24±0.75E-07	<2.31E-08	<1.92E-08
WNW0114	DOWN - C (1)	7.50	548	<1.0	0.013	3.51±2.95E-09	3.91±2.42E-09	2.69±0.88E-07	<2.88E-08	<3.11E-08
WNW0114	DOWN - C (2)	7.44	564	5.3	<0.005	<2.93E-09	4.27±2.43E-09	4.94±0.77E-07	<2.88E-08	<3.11E-08
WNW0114	DOWN - C (3)	7.22	553	1.6	<0.005	<3.68E-09	<2.74E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0114	DOWN - C (4)	7.31	558			<3.55E-09	<2.47E-09	1.45±0.86E-07	<3.59E-08	<3.18E-08
WNW0114	DOWN - C (5)	7.25	544	<1.0	0.006	<2.82E-09	4.53±2.63E-09	2.86±0.89E-07	<3.97E-08	<4.13E-08
WNW0114	DOWN - C (6)	7.56	556	1.1	<0.005	5.04±4.28E-09	5.63±2.87E-09	5.31±0.84E-07	<3.40E-08	<3.35E-08
WNW0114	DOWN - C (7)	7.03	580	5.1	<0.005	7.22±4.27E-09	<2.41E-09	3.82±0.83E-07	<3.48E-08	<3.35E-08
WNW0114	DOWN - C (8)	7.15	598	10.0	<0.005	1.00±0.57E-08	2.58±2.57E-09	4.52±0.84E-07	<2.31E-08	3.09±2.87E-08
WNW0409	DOWN - C (1)									
WNW0409	DOWN - C (2)	8.19	319			<1.13E-09	8.71±2.91E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0409	DOWN - C (3)	8.08	329	3.4	<0.005	<2.00E-09	1.88±0.37E-08	<1.00E-07	<2.88E-08	3.17±0.93E-08
WNW0409	DOWN - C (4)	7.81	399	<1.0	<0.005	<3.19E-09	7.47±2.65E-09	<1.00E-07	<2.88E-08	3.51±0.93E-08
WNW0409	DOWN - C (5)	7.73	407	<1.0	<0.005	<5.03E-09	7.84±3.05E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0409	DOWN - C (6)	7.77	415	1.4	<0.005	3.36±2.41E-09	7.31±3.04E-09	<1.00E-07	<3.45E-08	<3.64E-08
WNW0409	DOWN - C (7)	7.62	399	<1.0	<0.005	<1.81E-09	1.06±0.34E-08	<1.00E-07	1.98±1.93E-08	<2.19E-08
WNW0409	DOWN - C (8)	7.30	399	1.6	<0.005	<1.79E-09	7.18±3.09E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1102B	DOWN - C (1)									
WNW1102B	DOWN - C (2)	7.17	625			<2.26E-09	2.91±2.74E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1102B	DOWN - C (3)	7.29	595	1.5	<0.005	<4.14E-09	2.88±2.70E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1102B	DOWN - C (4)	7.35	585	1.2	0.010	<3.71E-09	<3.06E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1102B	DOWN - C (5)	7.18	596	<1.0	<0.005	<4.68E-09	<2.84E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1102B	DOWN - C (6)	7.24	610	2.3	<0.005	<3.21E-09	6.76±2.76E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1102B	DOWN - C (7)	7.22	709	13.0	0.007	8.02±6.30E-09	<2.54E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1102B	DOWN - C (8)	6.67	735	7.8	0.010	<2.19E-09	<2.70E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1103B	DOWN - C (1)									
WNW1103B	DOWN - C (2)	7.15	654			4.47±3.46E-09	6.25±3.00E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW1103B	DOWN - C (3)	7.29	671	6.6	<0.005	<3.26E-09	<2.56E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1103B	DOWN - C (4)	7.44	676	13.0	<0.005	<5.98E-09	1.43±0.34E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW1103B	DOWN - C (5)	7.25	692	<1.0	<0.005	5.26±4.21E-09	5.16±2.97E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1103B	DOWN - C (6)	7.33	718	1.8	0.008	5.28±4.23E-09	6.16±2.95E-09	<1.16E-07	<3.40E-08	<3.35E-08
WNW1103B	DOWN - C (7)	7.12	713	4.1	0.008	<3.39E-09	5.98±3.02E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1103B	DOWN - C (8)	6.85	720		0.009	<3.28E-09	3.59±3.01E-09	<1.00E-07	<3.40E-08	<3.35E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.
b) Sample collected 3/1/91

Table E - 3 (concluded)
Contamination Indicator Parameters for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW1104B	DOWN - C (1)									
WNW1104B	DOWN - C (2)	7.50	705			5.52±3.99E-09	4.46±2.60E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW1104B	DOWN - C (3)	7.27	680	4.8	<0.005	3.92±3.85E-09	2.92±0.47E-08	<1.00E-07	<2.88E-08	<2.94E-08
WNW1104B	DOWN - C (4)	7.34	760	3.4	<0.005	<3.76E-09	1.04±0.29E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW1104B	DOWN - C (5)	7.28	659	10.0	<0.005	<4.93E-09	1.04±0.37E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1104B	DOWN - C (6)	7.20	662	2.7	0.011	4.88±3.62E-09	5.19±2.77E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1104B	DOWN - C (7)	7.48	653	5.3	<0.005	<3.39E-09	4.34±2.74E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1104B	DOWN - C (8)	7.06	636	<1.0	<0.005	<3.27E-09	<2.70E-09	<1.00E-07	<2.31E-08	<2.72E-08
WNW1105A	DOWN - C (1)									
WNW1105A	DOWN - C (2)	7.03	826			6.45±4.15E-09	4.43±2.58E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW1105A	DOWN - C (3)	7.40	825	2.9	<0.005	4.15±3.85E-09	4.15±2.85E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1105A	DOWN - C (4)	7.45	837	3.3	<0.005	<4.79E-09	7.44±3.28E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1105A	DOWN - C (5)	6.95	582	2.8	<0.005	<2.44E-09	5.15±2.90E-09	<1.00E-07	<2.83E-08	<3.60E-08
WNW1105A	DOWN - C (6)	7.23	834	2.3	<0.005	3.63±3.56E-09	6.18±2.97E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1105A	DOWN - C (7)			4.4	<0.005	<4.46E-09	1.12±0.37E-08	<1.15E-07	<2.31E-08	<2.19E-08
WNW1105A	DOWN - C (8)									
WNW1105B	DOWN - C (1)									
WNW1105B	DOWN - C (2)	6.98	894			1.11±0.69E-08	4.48±2.93E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1105B	DOWN - C (3)	7.23	946	2.6	<0.005	<6.50E-09	6.38±3.18E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1105B	DOWN - C (4)	7.29	942	5.0	<0.005	<8.02E-09	3.02±2.51E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1105B	DOWN - C (5)	7.27	917	2.1	<0.005	<6.62E-09	2.55±0.48E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1105B	DOWN - C (6)	7.14	931	16.0	<0.005	<5.79E-09	8.17±2.95E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1105B	DOWN - C (7)	6.92	953	1.7	0.006	7.44±5.85E-09	3.29±2.99E-09	1.28±1.19E-07	<2.31E-08	<2.19E-08
WNW1105B	DOWN - C (8)	7.35	744		<0.005	<4.01E-09	<2.98E-09	<1.00E-07	<2.31E-08	<1.92E-08
WNW1111A	DOWN - C (1)									
WNW1111A	DOWN - C (2)	7.13	981			1.02±1.00E-08	5.30±2.80E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1111A	DOWN - C (3)	6.94	956	1.1	<0.005	<7.36E-09	5.92±3.31E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1111A	DOWN - C (4)	7.08	954	1.7	<0.005	<1.33E-08	<3.15E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1111A	DOWN - C (5)	6.77	983	1.6	<0.005	1.69±1.19E-09	5.87±2.88E-09	1.75±1.19E-07	<2.83E-08	<3.08E-08
WNW1111A	DOWN - C (6)	7.01	991	2.1	<0.005	<7.71E-09	8.36±3.15E-09	<1.12E-07	<3.40E-08	<4.49E-08
WNW1111A	DOWN - C (7)	7.11	1068	4.4	<0.005	<7.04E-09	5.13±4.09E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1111A	DOWN - C (8)	6.72	1154	<1.0	<0.005	9.85±8.27E-09	<5.46E-09	1.39±0.79E-07	<2.31E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 4
Contamination Indicator Parameters for the Lacustrine Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0901	UP (1)									
WNW0901	UP (2)	7.93	359			1.62±1.58E-09	6.51±2.76E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0901	UP (3)	7.84	383	3.9	0.009	<2.46E-09	6.22±2.88E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0901	UP (4)	7.70	370	1.2	0.012	2.81±2.60E-09	5.40±2.53E-09	<1.00E-07	<2.83E-08	3.43±0.98E-08
WNW0901	UP (5)	7.73	365	9.9	<0.005	<2.22E-09	6.29±2.79E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0901	UP (6)	7.46	367	<1.0	<0.005	<1.86E-09	8.26±3.17E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0901	UP (7)	7.73	375	20.0	0.005	<1.65E-09	7.67±2.95E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0901	UP (8)	7.37	372	2.9	<0.005	<1.77E-09	7.13±3.21E-09	3.20±1.37E-07	<2.31E-08	<2.19E-08
WNW0902	UP (1)									
WNW0902	UP (2)	8.52	406			<1.88E-09	6.62±2.94E-09	<1.00E-07		
WNW0902	UP (3)	9.88	347	<1.0	0.020	<3.15E-09	3.60±2.68E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0902	UP (4)	8.14	420	<1.0	0.013	4.17±3.52E-09	7.19±2.89E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0902	UP (5)	8.25	419	1.8	0.021	<3.09E-09	2.74±2.52E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0902	UP (6)	8.09	433	1.6	<0.005	<2.29E-09	4.40±2.87E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0902	UP (7)	7.87	425	16.0	<0.005	<3.35E-09	4.71±2.74E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0902	UP (8)	7.92	428	2.2	<0.005	<1.94E-09	<2.72E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1001	UP (1)									
WNW1001	UP (2)	8.39	362			<1.22E-09	8.94±2.95E-09	<1.00E-07		
WNW1001	UP (3)	7.90	406	2.3	0.015	<3.42E-09	6.75±2.84E-09	<1.00E-07	<2.83E-08	<3.18E-08
WNW1001	UP (4)	7.75	393	3.6	0.015	<2.39E-09	7.32±2.69E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1001	UP (5)	7.78	391	8.1	0.014	<2.22E-09	5.74±2.46E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1001	UP (6)	7.70	408	<1.0	0.007	4.65±3.72E-09	5.42±3.02E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1001	UP (7)	7.65	443	3.0	0.019	<1.84E-09	5.97±2.61E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1001	UP (8)	7.39	426	24.0	0.019	<1.82E-09	3.31±2.54E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1008B	UP (1)									
WNW1008B	UP (2)	7.63	253			<1.18E-09	4.30±2.64E-09	<1.00E-07		
WNW1008B	UP (3)	7.52	281	2.0	0.011	<2.30E-09	<2.73E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1008B	UP (4)	7.31	289	1.4	0.018	<1.40E-09	9.52±2.87E-09	<1.00E-07	<2.83E-08	3.43±0.98E-08
WNW1008B	UP (5)	7.58	377	1.9	0.012	<2.22E-09	4.38±2.31E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1008B	UP (6)	7.48	344	3.3	<0.005	<1.96E-09	4.44±2.74E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1008B	UP(7)	7.51	390	6.7	0.007	<1.09E-09	<2.03E-09	<1.00E-07	<2.31E-08	<2.99E-08
WNW1008B	UP (8)	7.51	429	3.0	<0.005	<2.07E-09	3.03±2.52E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0903	DOWN - B (1)									
WNW0903	DOWN - B (2)	9.26	410			<1.29E-09	1.09±0.33E-08	<1.00E-07		
WNW0903	DOWN - B (3)	9.03	469	59.0	0.098	<4.10E-09	4.36±2.80E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW0903	DOWN - B (4)	8.62	508	13.0	0.008	<3.58E-09	6.66±2.80E-09	<1.00E-07	<2.83E-08	9.95±6.15E-09
WNW0903	DOWN - B (5)	8.31	582	1.7	0.007	<2.83E-09	9.39±3.19E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0903	DOWN - B (6)	7.74	664	3.8	<0.005	<5.32E-09	1.07±0.34E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW0903	DOWN - B (7)	8.41	749	3.4	<0.005	<4.36E-09	6.74±3.09E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW0903	DOWN - B (8)	7.30	747	2.4	<0.005	<3.48E-09	<3.09E-09	2.27±1.39E-07	<2.31E-08	<2.19E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 4 (continued)
Contamination Indicator Parameters for the Lacustrine Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW1002	DOWN - B (1)									
WNW1002	DOWN - B (2)	7.37	774			<2.25E-09	4.05±2.95E-09	<1.00E-07		
WNW1002	DOWN - B (3)	7.24	803	6.4	<0.005	<8.91E-09	<2.97E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1002	DOWN - B (4)	7.19	807	1.3	<0.005	<9.66E-09	5.39±2.92E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1002	DOWN - B (5)	7.33	826	2.0	0.010	<6.78E-09	6.29±2.90E-09	<1.00E-07	<3.97E-08	1.37±0.52E-08
WNW1002	DOWN - B (6)	7.18	820	2.6	<0.005	<4.62E-09	4.04±3.10E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1002	DOWN - B (7)	7.15	840	5.1	0.009	<3.82E-09	<3.92E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1002	DOWN - B (8)	6.88	863	4.7	<0.005	<2.36E-09	6.64±5.09E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1003	DOWN - B (1)									
WNW1003	DOWN - B (2)	8.36	414			<1.35E-09	1.16±0.34E-08	<1.00E-07		
WNW1003	DOWN - B (3)	7.84	419	4.4	0.011	<2.36E-09	<2.94E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1003	DOWN - B (4)	7.77	414	2.4	0.007	<1.82E-09	5.39±2.50E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1003	DOWN - B (5)	7.85	416	1.7	0.011	<2.37E-09	4.88±2.56E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1003	DOWN - B (6)	7.62	417	2.7	<0.005	<2.77E-09	3.49±2.68E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1003	DOWN - B (7)	7.54	429		0.015	<7.07E-10	<2.00E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1003	DOWN - B (8)	7.43	421	<1.0	0.008	<1.37E-09	4.21±2.80E-09	<1.00E-07	<2.03E-08	<2.19E-08
WNW1004	DOWN - B (1)									
WNW1004	DOWN - B (2)	7.67	455			<1.39E-09	1.05±0.30E-08	<1.00E-07		
WNW1004	DOWN - B (3)	7.53	450	1.9	0.008	<3.95E-09	<2.89E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1004	DOWN - B (4)	7.58	454	2.2	<0.005	<3.48E-09	5.87±2.62E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1004	DOWN - B (5)	7.67	449	1.4	<0.005	<3.24E-09	<2.22E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1004	DOWN - B (6)	7.53	447	2.4	<0.005	<2.78E-09	<2.79E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1004	DOWN - B (7)	7.33	457	3.5	0.008	<2.70E-09	3.90±2.69E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1004	DOWN - B (8)	7.17	442	<1.0	<0.005	<2.17E-09	4.27±2.78E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101C	DOWN - B (1)									
WNW1101C	DOWN - B (2)	7.55	546			<2.30E-09	1.18±0.35E-08	<1.00E-07	<2.88E-08	<3.11E-08
WNW1101C	DOWN - B (3)	7.54	540	1.9	0.022	<2.64E-09	1.17±0.34E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1101C	DOWN - B (4)	7.49	562	2.8	0.007	<3.37E-09	1.93±0.40E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW1101C	DOWN - B (5)	7.47	538	2.5	<0.005	<3.41E-09	1.34±0.36E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1101C	DOWN - B (6)	7.56	526	2.2	<0.005	<3.00E-09	1.05±0.33E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101C	DOWN - B (7)	7.31	556	3.4	0.008	<1.86E-09	4.98±2.97E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1101C	DOWN - B (8)	7.26	561	<1.0	<0.005	<3.14E-09	4.46±2.97E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0407[b]	DOWN - C (2)								<1.70E-06	<1.68E-06

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to hydraulic position.
b) No other samples available - dry

Table E - 4 (concluded)
Contamination Indicator Parameters for the Lacustrine Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW1103C	DOWN - C (1)									
WNW1103C	DOWN - C (2)	7.74	1383			<4.03E-09	1.79±0.18E-07		<5.80E-08	7.89±4.60E-08
WNW1103C	DOWN - C (3)					<6.05E-09	7.23±1.20E-08	<1.00E-07	<1.47E-07	<1.60E-07
WNW1103C	DOWN - C (4)					<7.17E-09	4.96±1.38E-08	<1.00E-07	<1.99E-07	<2.07E-07
WNW1103C	DOWN - C (5)					<3.90E-09	3.65±0.68E-08	<1.00E-07	<5.66E-08	<6.16E-08
WNW1103C	DOWN - C (6)					<4.06E-09	1.03±0.11E-07	<1.14E-07	<4.27E-08	<4.05E-08
WNW1103C	DOWN - C (7)							2.64±1.39E-07		
WNW1103C	DOWN - C (8)							<1.00E-07	<5.02E-07	<4.76E-06
WNW1104C	DOWN - C (1)									
WNW1104C	DOWN - C (2)									
WNW1104C	DOWN - C (3)					<1.18E-08	1.58±0.52E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1104C	DOWN - C (4)					<1.14E-08	1.26±0.37E-08	<1.00E-07	<2.88E-08	<2.99E-08
WNW1104C	DOWN - C (5)					1.03±0.95E-08	1.47±0.82E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1104C	DOWN - C (6)					<1.08E-08	1.15±0.61E-08	<1.00E-07	<3.40E-08	<3.35E-08
WNW1104C	DOWN - C (7)					1.03±0.95E-08	1.50±0.66E-08	3.63±1.26E-07	<2.31E-08	<2.19E-08
WNW1104C	DOWN - C (8)					<6.78E-09	1.59±0.68E-08	<1.00E-07	<2.31E-08	<1.92E-08
WNW8610	DOWN - C (1)	8.25	763	4.6	<0.005	<1.48E-09	6.39±2.48E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8610	DOWN - C (2)	7.59	801	12.0	0.008	<2.99E-09	8.83±2.70E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8610	DOWN - C (3)	8.30	713	1.4	<0.005	<5.04E-09	4.80±2.23E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW8610	DOWN - C (4)	8.05	692	2.3	<0.005	<3.13E-09	<2.85E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8610	DOWN - C (5)	7.99	777	1.4	0.006	<6.34E-09	8.88±3.51E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8610	DOWN - C (6)	7.91	776	8.4	<0.005	<4.11E-09	6.95±3.06E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8610	DOWN - C (7)	8.09	723	<1.0	<0.005	<3.83E-09	5.45±2.97E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8610	DOWN - C (8)	7.69	723	10.0	<0.005	<2.92E-09	7.13±3.21E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW8611	DOWN - C (1)	7.53	856	1.2	<0.005	<5.13E-09	5.83±2.40E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW8611	DOWN - C (2)	7.62	938	8.7	0.010	<5.26E-09	4.94±2.29E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW8611	DOWN - C (3)	7.92	882	13.0	<0.005	<3.28E-09	2.90±2.06E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW8611	DOWN - C (4)	7.65	913	1.1	<0.005	<9.07E-09	<2.89E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8611	DOWN - C (5)	7.48	908			<3.94E-09	5.57±2.81E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8611	DOWN - C (6)	7.40	934	1.7	0.020	<7.08E-09	6.57±3.22E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW8611	DOWN - C (7)	7.24	924	<1.0	<0.005	<2.92E-09	<3.75E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW8611	DOWN - C (8)	7.44	889	1.9	<0.005	8.44±6.10E-09	<2.88E-09	<1.00E-07	<2.31E-08	<2.19E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E - 5
Contamination Indicator Parameters for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0908	UP (1)									
WNW0908	UP (2)	6.79	2810			<1.58E-07	1.30±0.57E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0908	UP (3)	6.81	2780	18.0	0.006	<1.16E-08	1.18±1.04E-08	<1.00E-07	<3.43E-08	<3.11E-08
WNW0908	UP (4)	6.58	2700	2.0	<0.005	<7.68E-08	1.62±0.50E-08	<1.00E-07	<3.59E-08	<3.18E-08
WNW0908	UP (5)	6.65	2570	2.8	<0.005	<1.72E-08	1.87±1.55E-08	<1.00E-07	<3.97E-08	<4.13E-08
WNW0908	UP (6)							<1.00E-07		
WNW0908	UP (7)									
WNW0908	UP (8)									
WNW1005	UP (1)									
WNW1005	UP (2)	7.37	714			<2.44E-09	4.43±2.95E-09	1.91±1.08E-07		
WNW1005	UP (3)	7.19	702	2.2	<0.005	<7.69E-09	3.68±2.89E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1005	UP (4)	7.19	702	18.0	0.006	<7.71E-09	3.78±2.68E-09	<1.00E-07	2.88±1.85E-08	<3.08E-08
WNW1005	UP (5)	7.19	724	1.9	<0.005	<7.37E-09	4.73±2.62E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1005	UP (6)	7.06	763	<1.0	<0.005	<9.54E-09	6.22±3.39E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1005	UP (7)	8.77[b]	775	4.5	0.010	7.79±7.23E-09	3.92±2.90E-09	<1.33E-07	<2.31E-08	<2.19E-08
WNW1005	UP (8)	6.92	838	9.3	<0.005	<4.88E-09	<3.12E-09	<1.37E-07	<2.31E-08	<2.19E-08
WNW1008C	UP (1)									
WNW1008C	UP (2)	7.33	542			<2.62E-09	<2.29E-09	<1.00E-07		
WNW1008C	UP (3)	7.61	541	5.0		<3.44E-09	<3.04E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1008C	UP (4)	7.51	458	4.9	0.006	<4.59E-09	5.72±2.70E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1008C	UP (5)	7.54	481	8.6	0.011	<3.49E-09	<2.56E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1008C	UP (6)	7.37	510	3.1	<0.005	<3.24E-09	<2.49E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW1008C	UP (7)	7.40	521	10.0	0.008	<1.38E-09	2.69±2.24E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1008C	UP (8)	7.27	539	4.9		<1.90E-09	<2.22E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0906	DOWN - B (1)									
WNW0906	DOWN - B (2)	7.23	700			<3.33E-09	4.16±2.82E-09	<1.00E-07		
WNW0906	DOWN - B (3)	7.38	695	26.0	0.073	<4.57E-09	<3.15E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0906	DOWN - B (4)	7.29	674	6.6	0.011	<4.94E-09	7.61±3.00E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0906	DOWN - B (5)	7.26	761	4.4	<0.005	<5.88E-09	<2.76E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0906	DOWN - B (6)									
WNW0906	DOWN - B (7)									
WNW0906	DOWN - B (8)									

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to hydraulic position.
b) Apparent analytical outlier

Table E - 5 (continued)
Contamination Indicator Parameters for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW0907	DOWN - B (1)									
WNW0907	DOWN - B (2)	7.27	417			5.19±4.55E-09	8.56±3.27E-09	<1.00E-07		
WNW0907	DOWN - B (3)	7.22	755	49.0	0.006	<6.70E-09	6.79±2.97E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW0907	DOWN - B (4)	7.13	743	1.5	<0.005	<7.53E-09	5.00±2.97E-09	<1.00E-07	<3.97E-08	1.24±0.47E-08
WNW0907	DOWN - B (5)	7.03	751	6.2	<0.005	<6.95E-09	<2.81E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW0907	DOWN - B (6)	6.98	790	<1.0	<0.005	1.87±1.20E-08	5.66±3.32E-09	<1.00E-07	<3.97E-08	<4.13E-08
WNW0907	DOWN - B (7)					<2.09E-09	<2.54E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW0907	DOWN - B (8)									
WNW1006	DOWN - B (1)									
WNW1006	DOWN - B (2)	6.96	2180			<2.16E-08	<2.98E-08	<1.00E-07		
WNW1006	DOWN - B (3)	6.69	2300	31.0		<1.05E-07	<5.23E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1006	DOWN - B (4)	6.58	2230	15.0	<0.005	<1.69E-08	1.01±0.37E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1006	DOWN - B (5)	6.78	2140	<1.0	<0.005	<2.49E-08	<8.45E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1006	DOWN - B (6)	6.73	2205		<0.005	<2.42E-08	<5.79E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1006	DOWN - B (7)	6.69	2105	2.7	<0.005	<8.74E-09	1.00±0.74E-08	<1.00E-07	<3.40E-08	<3.35E-08
WNW1006	DOWN - B (8)	6.70	2045	3.8	<0.005	<1.02E-08	9.65±8.01E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1007	DOWN - B (1)									
WNW1007	DOWN - B (2)	6.80	1375			6.41±5.62E-09	4.02±2.90E-09	<1.00E-07		
WNW1007	DOWN - B (3)	6.92	1404	1.5	<0.005	<1.75E-08	<4.00E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1007	DOWN - B (4)	7.05	1693	12.0	0.130	<2.23E-08	1.05±0.41E-08	<1.00E-07	3.67±2.60E-08	<3.08E-08
WNW1007	DOWN - B (5)	6.92	1671	5.2		<4.17E-08	1.40±0.41E-08	<1.00E-07	<2.83E-08	<3.08E-08
WNW1007	DOWN - B (6)	6.90	1559	5.2	<0.005	<9.32E-09	7.60±5.82E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1007	DOWN - B (7)	6.75	1386	9.6	<0.005	<1.00E-08	7.61±6.15E-09	<1.00E-07	<3.40E-08	<4.53E-08
WNW1007	DOWN - B (8)	6.55	1550	3.3	<0.005	1.29±1.08E-08	<6.20E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101A	DOWN - B (1)									
WNW1101A	DOWN - B 92)	7.15	710			5.11±3.69E-09	<2.59E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1101A	DOWN - B (3)	7.22	651	2.7	<0.005	<2.64E-09	<2.67E-09	<1.00E-07	<2.88E-08	<3.11E-08
WNW1101A	DOWN - B (4)	7.24	640	1.8	0.004	<5.52E-09	3.53±2.99E-09	<1.00E-07	<2.83E-08	3.28±0.98E-08
WNW1101A	DOWN - B (5)	7.01	751	1.0	0.010	<4.69E-09	3.70±3.08E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1101A	DOWN - B (6)	7.24	757	32.0	<0.005	4.89±3.91E-09	<2.49E-09	<1.15E-07	2.57±2.45E-08	<2.19E-08
WNW1101A	DOWN - B (7)	7.26	843	3.6	<0.005	9.74±7.65E-09	<3.06E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1101A	DOWN - B (8)	6.81	1022	<1.0	<0.005	<4.71E-09	4.85±3.16E-09	<1.00E-07	<2.31E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to hydraulic position.

Table E - 5 (continued)
Contamination Indicator Parameters for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW1106A	DOWN - B (1)									
WNW1106A	DOWN - B (2)	7.02	887			8.29±6.42E-09	6.22±3.23E-09	4.48±0.75E-07	<3.59E-08	<3.18E-08
WNW1106A	DOWN - B (3)	7.08	814	2.4	<0.005	<3.62E-09	4.96±3.05E-09	5.12±0.88E-07	<2.83E-08	<3.08E-08
WNW1106A	DOWN - B (4)	7.43	793	1.8	<0.005	<5.93E-09	6.82±2.68E-09	2.89±0.87E-07	<2.88E-08	<2.99E-08
WNW1106A	DOWN - B (5)	7.15	823	2.2	<0.005	5.82±4.66E-09	8.16±3.29E-09	7.59±1.37E-07	<2.83E-08	<3.08E-08
WNW1106A	DOWN - B (6)	7.50	834	2.7	0.018	<8.14E-09	8.11±3.49E-09	4.09±1.23E-07	<2.31E-08	<2.19E-08
WNW1106A	DOWN - B (7)	7.19	944	1.4	<0.005	<7.74E-09	9.29±3.52E-09	3.96±1.28E-07	<3.40E-08	<3.35E-08
WNW1106A	DOWN - B (8)	6.71	1118	<1.0		7.43±5.95E-09	7.22±3.56E-09	8.01±0.86E-07	<3.40E-08	<3.35E-08
WNW1108A	DOWN - B (1)									
WNW1108A	DOWN - B (2)	7.03	1946			<7.80E-09	8.53±3.68E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1108A	DOWN - B (3)	7.14	1484	1.3	<0.005	<9.26E-09	3.30±3.28E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1108A	DOWN - B (4)	7.23	1449	2.4	0.027	<1.29E-08	4.45±3.99E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1108A	DOWN - B (5)	6.98	1500	2.3	<0.005	<9.83E-09	<5.77E-09	<1.18E-07	<2.83E-08	4.74±2.74E-08
WNW1108A	DOWN - B (6)	6.90	1442	2.3	<0.005	<1.10E-08	<5.28E-09	<1.00E-07	<2.83E-08	3.75±1.46E-08
WNW1108A	DOWN - B (7)					<8.19E-09	2.24±2.05E-08	<1.00E-07	<2.31E-08	<2.19E-08
WNW1108A	DOWN - B (8)									
WNW1109A	DOWN - B (1)									
WNW1109A	DOWN - B (2)	7.50	700			7.05±4.37E-09	9.84±3.24E-09	2.95±0.76E-07	<2.88E-08	<2.99E-08
WNW1109A	DOWN - B (3)	7.22	771	3.3	<0.005	<3.51E-09	6.65±3.10E-09	1.57±0.83E-07	<3.97E-08	<4.13E-08
WNW1109A	DOWN - B (4)	7.21	744	4.3	0.023	1.58±0.88E-08	<3.13E-09	1.03±0.86E-07	<2.88E-08	<2.99E-08
WNW1109A	DOWN - B (5)	6.99	860	2.1	<0.005	1.16±1.13E-08	6.87±3.54E-09	3.48±1.25E-07	<3.97E-08	<4.13E-08
WNW1109A	DOWN - B (6)	6.89	857	4.8	<0.005	<4.31E-09	7.67±2.89E-09	4.80±1.27E-07	<3.40E-08	<3.35E-08
WNW1109A	DOWN - B (7)	6.84	854	1.9	<0.005	6.46±6.00E-09	4.29±3.13E-09	3.66±1.24E-07	<2.31E-08	<2.19E-08
WNW1109A	DOWN - B (8)	6.85	819		<0.005	<3.89E-09	6.87±3.09E-09	5.24±0.83E-07	<2.31E-08	<2.19E-08
WNW1102A	DOWN - C (1)									
WNW1102A	DOWN - C (2)	7.18	824			<4.11E-09	6.50±2.80E-09	<1.00E-07	<2.88E-08	3.28±0.93E-08
WNW1102A	DOWN - C (3)	7.22	753	7.0	0.007	<4.29E-09	3.54±2.86E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1102A	DOWN - C (4)	7.31	805	6.3	<0.005	<7.09E-09	<3.25E-09	1.30±0.86E-07	<3.59E-08	<3.18E-08
WNW1102A	DOWN - C (5)	6.52	876	2.3	<0.005	<1.22E-08	6.26±3.59E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1102A	DOWN - C (6)	7.12	903	2.2	<0.005	<9.51E-09	<5.19E-09	<1.18E-07	<3.40E-08	<3.35E-08
WNW1102A	DOWN - C (7)	7.13	933	3.5	0.006	<8.58E-09	6.58±3.26E-09	<1.20E-07	<3.40E-08	<3.35E-08
WNW1102A	DOWN - C (8)	6.85	1114	13.0	<0.005	<4.11E-09	8.48±5.69E-09	1.88±0.78E-07	<2.31E-08	<1.92E-08

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to hydraulic position.

Table E - 5 (concluded)

Contamination Indicator Parameters for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	pH	Conductivity µmhos/cm@25°C	TOC mg/L	TOX mg/L	Gross Alpha µCi/mL	Gross Beta µCi/mL	Tritium µCi/mL	Cs-137 µCi/mL	Co-60 µCi/mL
WNW1103A	DOWN - C (1)									
WNW1103A	DOWN - C (2)	7.04	821			<4.63E-09	6.71±3.19E-09	1.57±0.73E-07	<2.88E-08	<2.99E-08
WNW1103A	DOWN - C (3)	7.23	814	3.2	<0.005	<4.28E-09	<2.76E-09	2.34±0.84E-07	<2.83E-08	<3.08E-08
WNW1103A	DOWN - C (4)	7.21	869	5.7	<0.005	1.37±1.12E-08	1.07±0.32E-08	2.91±0.86E-07	<2.88E-08	<2.99E-08
WNW1103A	DOWN - C (5)	7.03	842	1.6	0.009	<9.31E-09	5.84±3.38E-09	3.62±0.81E-07	<3.45E-08	<3.84E-08
WNW1103A	DOWN - C (6)	7.19	899	3.1	<0.005	<6.82E-09	6.74±3.17E-09	6.58±1.34E-07	<2.31E-08	<2.19E-08
WNW1103A	DOWN - C (7)	6.97	916	4.0	<0.005	<5.61E-09	1.04±0.38E-08	5.44±1.30E-07	<3.40E-08	<3.35E-08
WNW1103A	DOWN - C (8)	6.81	958			<5.91E-09	4.76±3.19E-09	4.27±0.82E-07	<2.31E-08	<1.92E-08
WNW1104A	DOWN - C (1)									
WNW1104A	DOWN - C (2)	7.22	627			<3.71E-09	3.06±2.67E-09	<1.00E-07	<2.88E-08	<2.99E-08
WNW1104A	DOWN - C (3)	7.31	608	1.4	0.005	<5.29E-09	4.09±2.86E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1104A	DOWN - C (4)	7.52	654	2.6	<0.005	<5.34E-09	8.86±3.42E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1104A	DOWN - C (5)	7.34	624	2.4	<0.005	7.50±4.43E-09	6.43±3.00E-09	<1.00E-07	<2.83E-08	<3.08E-08
WNW1104A	DOWN - C (6)	7.14	645	2.5	0.012	<3.26E-09	4.91±2.66E-09	2.34±1.20E-07	<2.58E-08	5.24±2.25E-08
WNW1104A	DOWN - C (7)	7.19	673	3.1	<0.005	<4.62E-09	4.81±2.87E-09	<1.19E-07	<3.40E-08	<3.35E-08
WNW1104A	DOWN - C (8)	7.10	685	<1.0	<0.005	<3.48E-09	4.46±2.81E-09	1.88±0.78E-07	<3.40E-08	<3.35E-08
WNW1107A	DOWN - C (1)									
WNW1107A	DOWN - C (2)	6.60	1305			<1.53E-08	9.01±3.93E-09	2.52±0.08E-05	<2.88E-08	<2.99E-08
WNW1107A	DOWN - C (3)	6.46	1390	21.0	0.051	<1.28E-08	9.72±3.99E-09	2.88±0.09E-05	<3.59E-08	<3.18E-08
WNW1107A	DOWN - C (4)	6.56	1520	22.5	0.097	<4.93E-08	1.58±0.49E-08	2.95±0.09E-05	<2.88E-08	<2.99E-08
WNW1107A	DOWN - C (5)	6.35	1319	22.0	0.081	<1.31E-08	6.12±6.00E-09	2.76±0.09E-05	<3.97E-08	<4.13E-08
WNW1107A	DOWN - C (6)	6.50	1213	18.0	0.085	6.98±6.84E-09	8.88±4.54E-09	2.57±0.09E-05	<3.40E-08	<3.35E-08
WNW1107A	DOWN - C (7)	6.63	1161	13.0	0.072	<7.86E-09	<4.65E-09	2.46±0.08E-05	<2.31E-08	<2.19E-08
WNW1107A	DOWN - C (8)	6.30	1233		0.021	<8.61E-09	<5.67E-09	2.02±0.07E-05	<2.31E-08	<2.19E-08
WNW1110A	DOWN - C (1)									
WNW1110A	DOWN - C (2)	6.99	1407			<1.11E-08	8.80±3.84E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1110A	DOWN - C (3)	6.86	1368	1.6	<0.005	<2.34E-08	6.33±3.93E-09	<1.00E-07	<3.59E-08	<3.18E-08
WNW1110A	DOWN - C (4)	7.01	1376	6.6	<0.005	<2.44E-08	1.26±0.44E-08	<1.00E-07	<9.70E-07	<4.13E-08
WNW1110A	DOWN - C (5)	6.75	1470	7.7	0.006	<1.20E-08	<5.86E-09	<1.19E-07	<3.97E-08	<4.13E-08
WNW1110A	DOWN - C (6)	6.83	1572	2.2	<0.005	<1.70E-08	7.75±5.87E-09	<1.00E-07	<3.40E-08	<3.35E-08
WNW1110A	DOWN - C (7)	7.04	1668	5.1	<0.005	<1.26E-08	8.65±4.88E-09	<1.00E-07	<2.31E-08	<2.19E-08
WNW1110A	DOWN - C (8)									

a) General position in geologic unit. Sample rep number is indicated in parenthesis next to the hydraulic position.

Table E-6a
Groundwater Quality Parameters (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0301	UP	May-91	130	18	*3.00	0.17	230	<1	<0.005
WNW0301	UP	Nov-91	130	17	2.40	<0.05	240	<1	<0.005
WNW0401	UP	May-91	330	21	*3.00	<0.05	170	<1	0.009
WNW0401	UP	Nov-91	170	18	5.40	<0.05	160	<1	<0.005
WNW0403	UP	May-91	180	48	*9.00	<0.05	140	<1	0.011
WNW0403	UP	Nov-91	54	22	12.00	<0.05	110	<1	<0.005
WNWNB1S	UP	Jun-91	29	<2[c]	*9.00	<0.05	180	<1	0.006
WNWNB1S	UP	Dec-91	120	24	5.00	<0.05	83	<1	<0.005
WNW0201	DOWN - B	May-91	190	35	*2.00	<0.05	190	<1	0.033
WNW0201	DOWN - B	Nov-91	100	24	0.47	<0.05	290	<1	<0.005
WNW8613A	DOWN - B	Jun-91	80	<2[c]	*1.00	<0.05	190	<1	0.005
WNW8613A	DOWN - B	Dec-91	66	35	2.60	<0.05	180	<1	<0.005
WNW8613B	DOWN - B	Jun-91	110	<2[c]	*2.00	<0.05	85	<1	<0.005
WNW8613B	DOWN - B	Dec-91	50	230	5.60	<0.05	100	<1	<0.005
WNW8613C	DOWN - B	Jun-91	4.3	<2[c]	*0.90	<0.05	160	<1	<0.005
WNW8613C	DOWN - B	Dec-91	25	100	5.80	<0.05	300	<1	<0.005
WNW0103[b]	DOWN - C	May-91	400	240	*0.07	28.29	<1	2200	0.210
WNW0103	DOWN - C	Dec-91	298	80	3.82	20.30	<1	<1	0.052
WNW0104	DOWN - C	May-91	120	34	*1.00	<0.05	180	<1	0.024
WNW0104	DOWN - C	Dec-91	166	36	1.30	<0.03	210	<1	0.003
WNW0111	DOWN - C	Jun-91	36	56	<0.02	0.52	229	<1	0.003
WNW0111	DOWN - C	Dec-91	16	230	5.71	1.08	201	<1	0.002
WNW0203	DOWN - C	May-91	720	50	*2.00	<0.05	130	<1	0.005
WNW0203	DOWN - C	Nov-91	510	35	1.10	<0.05	250	<1	<0.005
WNW0205	DOWN - C	May-91	1200	120	*0.06	<0.05	110	<1	0.010
WNW0205	DOWN - C	Nov-91	980	70	0.14	<0.05	110	<1	<0.005
WNW0305	DOWN - C	May-91	735	47	*0.40	0.17	160	<1	0.009
WNW0305	DOWN - C	Nov-91	240	28	0.12	<0.05	220	<1	<0.005

a) General position in geologic unit
b) Hydroxide alkalinity (as mgCaCO3/L) at location WNW0103 = 12,800 in May and 8,360 in December
c) Apparent analytical outlier
** Nitrate-N only*

Table E-6a (continued)
Groundwater Quality Parameters (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0307	DOWN - C	May-91	480	34	*0.60	0.17	140	<1	0.014
WNW0307	DOWN - C	Nov-91	170	24	0.31	0.11	170	<1	<0.005
WNW0406	DOWN - C	May-91	13	96	*2.00	0.48	180	<1	<0.005
WNW0406	DOWN - C	Nov-91	18	110	3.90	0.46	230	<1	0.009
WNW0408	DOWN - C	Jun-91	218	27	0.75	<0.03	181	<1	0.003
WNW0408	DOWN - C	Dec-91	207	24	0.15	<0.03	182	<1	<0.002
WNW0501	DOWN - C	Jun-91	191	26	2.24	<0.03	157	<1	<0.002
WNW0501	DOWN - C	Dec-91	145	20	2.29	<0.03	195	<1	0.002
WNW0502	DOWN - C	Jun-91	155	27	4.42	<0.03	170	<1	<0.004
WNW0502	DOWN - C	Dec-91	139	26	4.82	<0.03	180	<1	<0.002
WNW0602	DOWN - C	May-91	17	54	*0.10	0.17	220	<1	0.006
WNW0602	DOWN - C	Nov-91	15	43	0.07	0.13	220	<1	<0.005
WNW0603	DOWN - C	May-91	12	69	*0.40	<0.05	390	<1	<0.005
WNW0603	DOWN - C	Nov-91	8.2	240	0.16	<0.05	350	<1	<0.005
WNW0604	DOWN - C	May-91	88	100	*<0.01	1.00	160	<1	0.010
WNW0604	DOWN - C	Nov-91	20	61	<0.05	1.24	200	<1	<0.005
WNW0701	DOWN - C	Jun-91	1.7	190	*0.20	0.20	160	<1	0.011
WNW0701	DOWN - C	Dec-91	2.6	210	<0.05	0.20	450	<1	<0.005
WNW0706	DOWN - C	Jun-91	8.6	130	*3.00	<0.05	270	<1	0.007
WNW0706	DOWN - C	Dec-91	6.7	100	2.20	<0.05	120	<1	<0.005
WNW8605	DOWN - C	Jun-91	67	52	<0.02	1.79	251	<1	<0.002
WNW8605	DOWN - C	Dec-91	51	223	<0.05	1.61	268	<1	0.002
WNW8606	DOWN - C	May-91	660	120	*0.50	<0.05	95	<1	<0.005
WNW8606	DOWN - C	Nov-91	650	75	0.16	<0.05	120	<1	<0.005
WNW8607	DOWN - C	May-91	27	120	*5.00	<0.05	140	<1	0.005
WNW8607	DOWN - C	Nov-91	14	280	8.30	<0.05	210	<1	<0.005
WNW8608	DOWN - C	May-91	17	100	*1.00	1.74	130	<1	0.005
WNW8608	DOWN - C	Nov-91	23	130	3.50	1.18	210	<1	<0.005
WNW8609	DOWN - C	May-91	39	38	*7.00	<0.05	200	<1	0.026
WNW8609	DOWN - C	Nov-91	47	36	4.00	<0.05	260	<1	<0.005

a) General position in geologic unit

** Nitrate-N only*

Table E-6a (concluded)
Groundwater Quality Parameters (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNSP008	DOWN - C	May-91	100	80	*0.10	<0.05	270	<1	0.007
WNSP008	DOWN - C	Nov-91	81	35	0.13	<0.05	250	<1	<0.005
WNW0105	DOWN - D	May-91	130	220	*1.00	<0.05	190	<1	0.011
WNW0105	DOWN - D	Nov-91	140	36	1.05	<0.05	230	<1	<0.005
WNW0106	DOWN - D	May-91	110	170	*0.10	<0.05	250	<1	<0.005
WNW0106	DOWN - D	Nov-91	120		<0.05	<0.05	270	<1	<0.005
WNW0116	DOWN - D	May-91	110	62	*1.00	<0.05	230	<1	<0.005
WNW0116	DOWN - D	Nov-91	190	31	1.50	<0.05	200	<1	<0.005
WNW0207	DOWN - D	May-91	66	40	*<0.01	0.10	510	<1	0.011
WNW0207	DOWN - D	Nov-91	4.0	28	0.05	0.08	500	<1	<0.005
WNW0601	DOWN - D	May-91	27	63	*0.40	<0.05	100	<1	<0.005
WNW0601	DOWN - D	Nov-91	28	130	0.21	<0.05	80	<1	<0.005
WNW0605	DOWN - D	May-91	29	73	*0.40	<0.05	170	<1	<0.005
WNW0605	DOWN - D	Nov-91	29	110	0.29	<0.05	92	<1	<0.005
WNW0801	DOWN - D	May-91	150	32	*0.90	<0.05	160	<1	<0.005
WNW0801	DOWN - D	Nov-91	200	27	1.10	<0.05	200	<1	<0.005
WNW0802	DOWN - D	May-91	4.0	20	*<0.01	<0.05	81	<1	0.006
WNW0802	DOWN - D	Nov-91	140	33	<0.05	0.13	220	<1	<0.005
WNW0803	DOWN - D	May-91	55	230	*<0.01	<0.05	420	<1	0.005
WNW0803	DOWN - D	Nov-91	110	120	0.42	<0.05	175	<1	<0.005
WNW0804	DOWN - D	May-91	46	72	*0.02	<0.05	200	<1	0.010
WNW0804	DOWN - D	Nov-91	75	84	1.00	<0.05	190	<1	<0.005
WNW8603	DOWN - D	May-91	130	35	*2.00	<0.05	190	<1	<0.005
WNW8603	DOWN - D	Nov-91	180	28	1.90	<0.05	200	<1	<0.005
WNW8604	DOWN - D	May-91	130	34	*1.00	<0.05	200	<1	<0.010
WNW8604	DOWN - D	Dec-91	180	37	1.31	<0.03	198	<1	<0.002
WNW8612	DOWN - D	May-91	68	87	*<0.01	<0.05	230	<1	<0.010
WNW8612	DOWN - D	Nov-91	78	63	<0.05	<0.05	220	<1	<0.005
WNDMPNE	DOWN - D	May-91	88	33	*1.00	<0.05	180	<1	<0.005
WNDMPNE	DOWN - D	Nov-91	62	79	0.84	0.05	140	<1	<0.005
WNGSEEP	DOWN - D	May-91	71	60	*0.50	<0.05	120	<1	0.010

a) General position in geologic unit

** Nitrate-N only*

Table E-6b

Groundwater Quality Metals (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Calcium		Magnesium		Sodium		Potassium		Iron		Manganese	
			Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.
WNW0301	UP	May-91	110	110	12	9.4	23	24	3.1	1.3	25	<0.05	0.66	0.20
WNW0301	UP	Nov-91	120	120	14	12	34	39	4.5	1.8	20	0.10	0.49	0.06
WNW0401	UP	May-91	140	130	32	13	72	77	7.8	1.8	130	0.16	3.00	0.05
WNW0401	UP	Nov-91	76	110	10	11	50	75	3.6	1.7	16	0.03	0.36	0.04
WNW0403	UP	May-91	120	120	24	9.2	33	33	6.3	1.5	91	<0.05	1.7	<0.01
WNW0403	UP	Nov-91	71	74	10	5.9	14	16	5.6	1.2	28	0.35	0.42	<0.01
WNWNB1S	UP	Jun-91	87	93	9.7	9.8	22	23	2.5	1.4	3.1	0.04	0.05	0.01
WNWNB1S	UP	Dec-91	52	53	7.0	6.0	53	59	3.2	1.6	9.2	0.20	0.11	<0.01
WNW0201	DOWN - B	May-91	130	120	14	12	63	65	5.4	4.6	12	<0.05	0.59	0.43
WNW0201	DOWN - B	Nov-91	98	84	9.4	8.1	42	38	3.5	3.7	0.41	0.07	0.63	0.72
WNW8613A	DOWN - B	Jun-91	85	90	18	14	13	15	6.8	5.6	30	0.53	1.3	0.10
WNW8613A	DOWN - B	Dec-91	81	83	16	14	14	17	5.3	3.4	24	2.0	1.1	0.06
WNW8613B	DOWN - B	Jun-91	64	68	20	11	18	21	9.0	3.4	80	0.44	3.6	0.26
WNW8613B	DOWN - B	Dec-91	130	140	23	20	19	22	7.0	4.8	46	1.0	1.9	0.19
WNW8613C	DOWN - B	Jun-91	60	70	8.6	9.5	4.1	5.1	4.8	5.8	3.3	0.1	0.18	0.10
WNW8613C	DOWN - B	Dec-91	120	80	29	13	25	28	7.8	4.4	61	0.2	1.9	0.01
WNW0103	DOWN - C	May-91	24	26	0.9	1.2	7000	6200	6.3	7.3	4.4	4.8	0.18	0.23
WNW0103	DOWN - C	Dec-91	27	24	0.7	0.5	3160	2640	1.2	1.1	6.1	6.4	0.52	0.52
WNW0104	DOWN - C	May-91	110	100	16	15	42	44	2.3	2.7	2.1	0.05	0.19	0.09
WNW0104	DOWN - C	Dec-91	112	112	17	16	49	49	2.0	1.9	1.3	0.03	0.10	0.08
WNW0111	DOWN - C	Jun-91	84	91	12	13	24	24	7.0	7.7	1.1	1.0	4.3	4.6
WNW0111	DOWN - C	Dec-91	117	115	16	15	19	19	7.3	7.7	0.40	0.02	8.6	8.4
WNW0203	DOWN - C	May-91	250	260	27	27	200	200	3.8	3.6	2.9	0.59	0.56	0.55
WNW0203	DOWN - C	Nov-91	190	190	20	20	180	180	4.5	4.9	1.4	0.53	0.12	0.12
WNW0205	DOWN - C	May-91	160	130	63	18	540	580	15	5.8	310	0.31	8.6	1.5
WNW0205	DOWN - C	Nov-91	90	89	12	12	570	570	5.0	5.4	0.34	0.15	0.73	0.72
WNW0305	DOWN - C	May-91	190	190	20	20	225	220	3.8	3.7	4.2	0.95	1.8	2.0
WNW0305	DOWN - C	Nov-91	82	89	8.9	8.7	110	120	3.5	2.8	5.4	0.26	0.96	0.92
WNW0307	DOWN - C	May-91	98	92	15	9.1	210	200	4.6	2.2	51	0.08	3.2	1.2
WNW0307	DOWN - C	Nov-91	49	48	5.6	4.8	97	100	2.6	2.0	6.1	0.13	0.54	0.32

a) General position in geologic unit

Table E-6b (continued)
Groundwater Quality Metals (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.
WNW0406	DOWN - C	May-91	93	90	13	11	10	9.8	2.2	1.6	11	<0.05	2.7	2.6
WNW0406	DOWN - C	Nov-91	110	100	16	13	12	12	4.4	2.1	16	0.07	3.4	2.8
WNW0408	DOWN - C	Jun-91	113	124	19	20	47	47	3.2	3.3	2.9	0.80	0.26	0.34
WNW0408	DOWN - C	Dec-91	116	110	22	20	56	56	5.1	3.5	12	0.02	0.32	0.11
WNW0501	DOWN - C	Jun-91	120	116	18	15	33	32	2.8	1.4	12	0.01	0.27	0.02
WNW0501	DOWN - C	Dec-91	110	106	16	14	44	43	3.3	2.0	8.1	0.02	0.20	0.02
WNW0502	DOWN - C	Jun-91	103	106	16	15	29	31	2.8	1.2	12	0.01	0.24	0.01
WNW0502	DOWN - C	Dec-91	103	108	15	15	34	35	2.7	1.6	8.7	0.14	0.14	0.01
WNW0602	DOWN - C	May-91	90	86	16	11	6.7	6.4	3.6	1.4	38	0.07	8.1	7.1
WNW0602	DOWN - C	Nov-91	87	90	13	11	7.1	7.8	4.4	1.5	18	0.03	6.8	5.8
WNW0603	DOWN - C	May-91	160	140	25	21	5.6	4.8	1.8	1.6	2.9	0.13	0.47	0.40
WNW0603	DOWN - C	Nov-91	160	180	23	27	5.3	6.4	2.4	1.5	2.9	<0.03	0.37	0.40
WNW0604	DOWN - C	May-91	69	70	11	11	6.7	6.8	1.0	0.8	3.0	3.0	18	17
WNW0604	DOWN - C	Nov-91	77	76	12	12	5.4	5.6	0.9	1.0	4.6	5.0	21	21
WNW0701	DOWN - C	Jun-91	140	84	26	15	16	13	2.0	0.9	5.7	0.55	0.49	0.19
WNW0701	DOWN - C	Dec-91	140	140	24	23	16	17	2.2	1.5	3.5	0.09	0.36	0.30
WNW0706	DOWN - C	Jun-91	140	130	27	17	4.4	8.0	4.0	1.6	38	1.1	1.3	0.15
WNW0706	DOWN - C	Dec-91	86	84	15	12	3.1	3.6	4.8	1.4	18	0.33	0.42	0.01
WNW8605	DOWN - C	Jun-91	88	97	13	14	57	60	10	11	4.0	4.6	9.7	11
WNW8605	DOWN - C	Dec-91	101	102	15	15	77	77	10	10	4.2	4.3	12	12
WNW8606	DOWN - C	May-91	91	91	12	12	380	380	4.6	4.5	0.23	0.22	1.3	1.3
WNW8606	DOWN - C	Nov-91	63	61	7.8	7.6	430	420	3.5	3.6	0.14	0.14	0.34	0.34
WNW8607	DOWN - C	May-91	96	97	12	12	16	16	2.8	2.8	0.09	0.05	0.05	0.05
WNW8607	DOWN - C	Nov-91	160	160	20	20	15	15	5.6	6.4	<0.03	<0.03	0.17	0.17
WNW8608	DOWN - C	May-91	71	74	9.8	9.1	10	10	2.0	2.0	6.7	0.06	7.5	7.8
WNW8608	DOWN - C	Nov-91	110	110	13	13	13	14	3.2	3.4	1.4	0.10	7.6	8.1
WNW8609	DOWN - C	May-91	110	110	15	14	11	11	1.4	1.5	0.19	0.05	<0.01	<0.01
WNW8609	DOWN - C	Nov-91	120	120	16	16	11	11	1.7	2.0	0.06	<0.03	0.02	0.02
WNSP008	DOWN - C	May-91	110	110	14	15	57	58	1.4	1.4	0.31	0.06	2.2	2.2
WNSP008	DOWN - C	Nov-91	90	100	12	12	60	59	1.9	1.6	0.10	0.05	1.4	1.5

a) General position in geologic unit

Table E-6b (concluded)
Groundwater Quality Metals (mg/L) for the Sand and Gravel Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.
WNW0105	DOWN - D	May-91	120	120	19	19	36	36	1.2	1.3	4.6	0.10	2.8	2.7
WNW0105	DOWN - D	Nov-91	115	120	18	19	36	37	1.2	1.6	6.5	0.06	2.4	2.4
WNW0106	DOWN - D	May-91	180	150	35	23	53	56	7.6	3.8	58	0.33	9.5	6.3
WNW0106	DOWN - D	Nov-91	120	110	20	18	38	39	3.8	2.4	14	0.06	5.4	4.6
WNW0116	DOWN - D	May-91	100	100	13	13	56	58	2.4	1.5	6.9	0.38	1.5	1.2
WNW0116	DOWN - D	Nov-91	100	110	15	14	61	59	2.1	1.2	7.8	0.13	2.5	0.99
WNW0207	DOWN - D	May-91	180	170	36	30	7.7	7.2	3.5	1.4	26	0.59	1.5	1.3
WNW0207	DOWN - D	Nov-91	140	150	29	30	7.0	8.0	2.2	1.4	4.8	0.17	1.2	1.3
WNW0601	DOWN - D	May-91	56	51	10	7.3	16	15	2.3	1.0	12	0.09	0.41	<0.01
WNW0601	DOWN - D	Nov-91	66	65	19	9.1	16	16	7.8	1.4	56	0.04	1.4	0.01
WNW0605	DOWN - D	May-91	80	70	17	14	13	13	3.2	2.5	6.4	<0.05	0.16	0.06
WNW0605	DOWN - D	Nov-91	62	68	8.3	8.8	16	19	2.2	1.9	2.7	0.03	0.05	<0.01
WNW0801	DOWN - D	May-91	97	97	12	12	65	65	1.9	1.8	0.94	<0.05	0.52	0.50
WNW0801	DOWN - D	Nov-91	120	120	14	14	64	64	2.1	2.1	0.12	<0.03	0.80	0.79
WNW0802	DOWN - D	May-91	37	39	2.7	2.8	3.1	3.7	0.8	0.7	0.19	0.24	0.13	0.29
WNW0802	DOWN - D	Nov-91	130	130	9.7	9.5	32	32	1.4	1.4	0.43	0.40	1.6	1.7
WNW0803	DOWN - D	May-91	210	210	40	40	23	22	1.4	1.4	0.57	<0.05	0.12	0.11
WNW0803	DOWN - D	Nov-91	160	160	30	30	21	22	1.7	1.5	0.44	0.14	0.15	0.16
WNW0804	DOWN - D	May-91	110	110	13	13	22	22	2.0	1.5	2.2	<0.05	0.21	0.12
WNW0804	DOWN - D	Nov-91	100	100	12	12	30	33	2.8	1.5	5.7	0.26	0.15	0.02
WNW8603	DOWN - D	May-91	120	120	20	20	32	33	1.7	1.8	<0.05	<0.05	<0.01	<0.01
WNW8603	DOWN - D	Nov-91	130	120	20	19	38	38	2.2	2.2	<0.03	0.24	0.01	0.01
WNW8604	DOWN - D	May-91	120	120	19	19	38	37	2.3	2.2	0.21	0.09	0.03	0.03
WNW8604	DOWN - D	Dec-91	119	119	19	19	46	45	2.3	2.3	0.05	0.03	0.02	0.02
WNW8612	DOWN - D	May-91	110	100	24	23	12	12	1.0	1.1	0.74	0.62	0.09	0.09
WNW8612	DOWN - D	Nov-91	100	100	22	22	13	13	0.8	0.9	0.62	0.54	0.09	0.09
WNDMPNE	DOWN - D	May-91	86	93	11	12	27	30	<0.7	<0.7	1.1	0.37	0.14	0.16
WNDMPNE	DOWN - D	Nov-91	80	82	11	11	22	22	1.7	2.1	0.31	0.21	1.0	1.00
WNGSEEP	DOWN - D	May-91	79	0.1	12	16	17	1.6	1.8	1.6	0.07	0.07	<0.01	<0.01
WNGSEEP	DOWN - D	Nov-91	87	0.1	13	24	24	1.6	1.5	1.6	<0.03	<0.03	<0.01	<0.01

a) General position in geologic unit

Table E-7a
Groundwater Quality Parameters (mg/L) for the Till-Sand Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0302	UP	May-91	370	20	*1.00	<0.05	250	<1	<0.005
WNW0302	UP	Nov-91	280	23	1.40	<0.05	250	<1	<0.005
WNW0402	UP	May-91	220	42	*<0.01	<0.05	220	<1	0.014
WNW0402	UP	Nov-91	220	24	<0.05	<0.05	220	<1	<0.005
WNW0404	UP	May-91	66	33	*0.03	<0.05	110	<1	0.012
WNW0404	UP	Nov-91	<1.0[c]	18	0.12	<0.05	80	10	<0.005
WNW0202[b]	DOWN - B	May-91	32	30	*<0.01	1.12	<1	44	0.007
WNW0202	DOWN - B	Nov-91	16	26	<0.05	0.57	<1	24	<0.005
WNW0204	DOWN - B	May-91	130	28	*<0.01	0.18	165	<1	0.010
WNW0204	DOWN - B	Nov-91	65	25	<0.05	0.14	130	<1	<0.005
WNW0206	DOWN - B	May-91	49	33	*0.02	0.06	160	<1	<0.005
WNW0206	DOWN - B	Nov-91	64	28	<0.05	0.08	180	<1	<0.005
WNW0208	DOWN - B	May-91	2.6	16	*<0.01	<0.05	140	<1	<0.005
WNW0208	DOWN - B	Nov-91	<1.0	12	<0.05	0.21	140	<1	<0.005
WNW0905	DOWN - B	Jun-91	12	500	*<0.20	0.07	410	<1	0.006
WNW0905	DOWN - B	Dec-91	12	230	<0.05	0.10	430	<1	<0.005

a) General position in geologic unit
b) Hydroxide alkalinity (as mgCaCoO3/L) at location WNW0202 = 416 in May and 130 in November
c) Apparent analytical outlier
** Nitrate-N only*

Table E-7b
Groundwater Quality Metals (mg/L) for the Till-Sand Unit

Location Code	Hydraulic Position[a]	Date	Calcium		Magnesium		Sodium		Potassium		Iron		Manganese	
			Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.
WNW0302	UP	May-91	170	160	21	20	85	81	1.8	1.7	0.73	<0.05	0.06	0.03
WNW0302	UP	Nov-91	150	150	19	18	88	85	1.8	2.1	0.63	<0.03	0.05	0.04
WNW0402	UP	May-91	150	140	26	26	27	28	2.1	1.7	2.7	1.5	0.15	0.15
WNW0402	UP	Nov-91	140	150	25	26	26	29	2.6	2.0	4.8	0.78	0.16	0.12
WNW0404	UP	May-91	37	39	6.0	6.0	8.2	8.4	2.1	1.8	2.3	0.70	0.05	0.03
WNW0404	UP	Nov-91	30	29	5.8	5.6	8.2	8.4	1.1	1.7	0.24	<0.03	0.01	0.01
WNW0202	DOWN - B	May-91	130	92	<0.5	<0.5	44	39	48	42	0.05	<0.05	<0.01	<0.01
WNW0202	DOWN - B	Nov-91	51	54	0.3	<0.2	27	28	21	24	0.42	<0.03	<0.01	<0.01
WNW0204	DOWN - B	May-91	68	67	14	14	11	11	2.7	2.7	1.2	0.15	0.07	0.05
WNW0204	DOWN - B	Nov-91	68	67	14	14	11	11	2.5	3.0	0.33	0.07	0.06	0.05
WNW0206	DOWN - B	May-91	78	73	17	16	13	11	2.4	2.2	1.5	0.24	0.19	0.17
WNW0206	DOWN - B	Nov-91	76	76	16	16	11	11	1.2	1.4	0.73	0.37	0.19	0.20
WNW0208	DOWN - B	May-91	40	37	9.4	9.0	15	14	0.8	0.8	0.35	<0.05	0.06	0.06
WNW0208	DOWN - B	Nov-91	38	37	9.1	8.9	15	15	1.3	1.8	0.31	0.04	0.07	0.07
WNW0905	DOWN - B	Jun-91	225	225	75	77	10	10	3.5	3.5	2.1	1.8	0.66	0.63
WNW0905	DOWN - B	Dec-91	240	250	82	84	12	12	4.7	4.8	2.7	2.0	0.70	0.72

a) General position in geologic unit

Table E-8a
Groundwater Quality Parameters (mg/L) for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0405	UP	May-91	26	160	*0.80	<0.05	250	<1	0.005
WNW0405	UP	Nov-91	22	310	3.60	<0.05	210	<1	<0.005
WNW0704	UP	Jun-91	3.1	140	*<0.20	0.62	450	<1	<0.005
WNW0704	UP	Dec-91	4.4	240	3.50	<0.05	350	<1	<0.005
WNW0707	UP	Jun-91	7.3	110	*2.00	0.09	340	<1	0.012
WNW0707	UP	Dec-91	6.3	71	0.69	<0.05	120	<1	<0.005
WNW1008C	UP	Jun-91	28	<2	*<0.10	0.08	220	<1	<0.005
WNW1008C	UP	Dec-91	34	16	<0.05	0.05	220	<1	<0.005
WNW0109	DOWN - B	May-91	2.6	110	*0.30	<0.05	220	<1	0.012
WNW0109	DOWN - B	Nov-91	3.7	150	0.06	0.06	200	<1	<0.005
WNW0110	DOWN - B	May-91	1.7	100	*0.20	<0.05	210	<1	<0.005
WNW0110	DOWN - B	Nov-91	<1.0	160	0.13	0.07	220	<1	<0.005
WNW0115	DOWN - B	May-91	6.8	120	*0.10	<0.05	180	<1	0.009
WNW0115	DOWN - B	Nov-91	7.9	120	<0.05	0.13	550	<1	<0.005
WNW0702	DOWN - B	Jun-91	2.2	380	*0.60	<0.05	230	<1	0.012
WNW0702	DOWN - B	Dec-91	2.3	340	0.11	0.09	200	<1	0.008
WNW0703	DOWN - B	Jun-91	2.1	230	*<0.20	0.08	170	<1	0.009
WNW0703	DOWN - B	Dec-91	1.8	240	<0.05	<0.05	160	<1	<0.005
WNW0705	DOWN - B	Jun-91	4.0	48	*0.10	<0.05	230	<1	0.010
WNW0705	DOWN - B	Dec-91	8.2	25	0.13	<0.05	110	<1	<0.005
WNW0904	DOWN - B	Jun-91	7.3	180	*0.60	0.07	230	<1	0.014
WNW0904	DOWN - B	Dec-91	14	170	0.29	0.19	300	<1	<0.005
WNW1101B	DOWN - B	Jun-91	4.6	260	<0.10	0.07	270	<1	<0.005
WNW1101B	DOWN - B	Dec-91	2.3	290	0.74	<0.05	260	<1	0.016
WNW1106B	DOWN - B	Jun-91	3.6	140	<0.10	0.17	290	<1	<0.005
WNW1106B	DOWN - B	Dec-91	3.2	160	<0.05	0.07	290	<1	<0.010
WNW1109B	DOWN - B	Jun-91	2.6	63	*0.10	0.12	160	<1	0.013
WNW1109B	DOWN - B	Dec-91	3.8	56	<0.05	0.11	180	<1	<0.010
WNW0107	DOWN - C	May-91	4.2	280	*0.10	<0.05	220	<1	<0.005
WNW0107	DOWN - C	Nov-91	2.6	310	0.09	0.07	240	<1	<0.005

a) General position in geologic unit

** Nitrate-N only*

Table E-8a (concluded)
Groundwater Quality Parameters (mg/L) for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity	Carbonate Alkalinity	Phenols
WNW0108	DOWN - C	May-91	4.2	330	*0.70	<0.05	180	<1	0.028
WNW0108	DOWN - C	Dec-91	3.3	330	0.35	<0.05	200	<1	<0.008
WNW0114	DOWN - C	May-91	5.1	110	*0.10	<0.05	210	<1	<0.010
WNW0114	DOWN - C	Nov-91	22	82	0.16	<0.05	220	<1	<0.005
WNW0409	DOWN - C	May-91	3.5	76	*0.10	0.11	130	<1	<0.005
WNW0409	DOWN - C	Nov-91	<1.0	55	0.22	0.07	120	<1	<0.005
WNW1102B	DOWN - C	Jun-91	<1.0	46	<0.10	0.06	280	<1	<0.005
WNW1102B	DOWN - C	Dec-91	<1.0	110	0.09	<0.05	300	<1	<0.010
WNW1103B	DOWN - C	Jun-91	2.7	85	0.15	0.05	300	<1	<0.005
WNW1103B	DOWN - C	Dec-91	1.3	130	0.41	<0.05	310	<1	0.039
WNW1104B	DOWN - C	Jun-91	3.6	120	0.12	<0.05	220	<1	<0.005
WNW1104B	DOWN - C	Dec-91	1.7	200	0.80	<0.05	230	<1	<0.010
WNW1105A	DOWN - C	Jun-91	3.0	260	0.90	<0.05	160	<1	<0.005
WNW1105B	DOWN - C	Jun-91	3.0	300	*1.00	0.06	160	<1	<0.005
WNW1105B	DOWN - C	Dec-91	2.7	290	0.90	0.06	170	<1	<0.010
WNW1111A	DOWN - C	Jun-91	3.6	170	2.60	<0.05	410	<1	<0.005
WNW1111A	DOWN - C	Dec-91	2.0	300	<0.05	<0.05	400	<1	0.014

a) General position in geologic unit

** Nitrate-N only*

Table E-8b
Groundwater Quality Metals (mg/L) for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.
WNW0405	UP	May-91	110	110	20	18	48	45	2.7	2.7	0.15	<0.05	0.06	0.06
WNW0405	UP	Nov-91	150	150	25	25	35	34	3.1	3.3	0.16	0.03	0.03	0.02
WNW0704	UP	Jun-91	170	175	28	27	12	14	4.6	4.3	4.6	0.17	12	13
WNW0704	UP	Dec-91	160	170	23	24	7.6	7.6	2.9	2.6	0.97	0.03	3.2	2.5
WNW0707	UP	Jun-91	140	78	32	12	4.6	6.9	6.1	1.7	64	1.1	2.1	0.24
WNW0707	UP	Dec-91	60	55	17	8.5	3.1	3.1	6.4	1.5	41	<0.03	0.62	<0.01
WNW1008C	UP	Jun-91	77	83	1.8[b]	19	12	14	1.6	1.2	0.43	0.03	0.21	0.20
WNW1008C	UP	Dec-91	70	74	17	17	13	14	0.9	1.0	0.47	0.04	0.16	0.13
WNW0109	DOWN - B	May-91	100	100	22	22	19	18	2.6	1.8	5.1	0.23	0.15	<0.01
WNW0109	DOWN - B	Nov-91	72	96	17	21	12	17	1.4	1.8	3.5	0.03	0.07	0.03
WNW0110	DOWN - B	May-91	76	83	21	23	19	19	2.1	2.2	0.51	<0.05	0.01	<0.01
WNW0110	DOWN - B	Nov-91	98	100	28	29	18	19	2.6	6.9	2.8	<0.03	0.14	0.02
WNW0115	DOWN - B	May-91	89	67	19	11	16	19	5.1	2.6	26	0.39	0.49	0.02
WNW0115	DOWN - B	Nov-91	110	68	39	12	15	16	10	2.0	83	0.18	1.3	0.14
WNW0702	DOWN - B	Jun-91	130	130	33	33	44	48	4.5	3.4	9.1	0.47	0.21	0.08
WNW0702	DOWN - B	Dec-91	140	140	31	31	38	38	2.6	2.7	0.26	<0.03	0.01	<0.01
WNW0703	DOWN - B	Jun-91	100	110	22	24	17	17	2.4	2.2	2.9	<0.05	0.26	0.20
WNW0703	DOWN - B	Dec-91	120	120	25	24	18	20	2.2	2.8	5.7	<0.03	0.17	0.07
WNW0705	DOWN - B	Jun-91	72	69	11	10	3.2	3.6	1.7	1.4	2.1	<0.03	0.12	0.09
WNW0705	DOWN - B	Dec-91	44	70	6.7	9.0	2.6	3.2	1.6	1.3	4.1	<0.03	0.06	0.04
WNW0904	DOWN - B	Jun-91	100	100	36	32	18	22	5.0	2.9	17	1.4	0.38	0.16
WNW0904	DOWN - B	Dec-91	120	120	37	36	21	24	3.9	2.4	11	0.17	0.23	0.07
WNW1101B	DOWN - B	Jun-91	120	160	37	46	29	38	2.8	4.6	0.05	<0.03	0.04	<0.01
WNW1101B	DOWN - B	Dec-91	120	100	36	31	25	23	4.9	3.6	0.74	<0.03	0.04	0.01
WNW1106B	DOWN - B	Jun-91	91	92	36	39	23	26	3.4	2.8	3.3	<0.03	0.26	0.29
WNW1106B	DOWN - B	Dec-91	88	86	34	32	23	21	3.7	4.1	2.8	<0.03	0.08	0.02
WNW1109B	DOWN - B	Jun-91	44	48	14	15	11	11	2.2	1.8	1.7	0.04	0.11	0.08
WNW1109B	DOWN - B	Dec-91	53	51	17	16	12	12	3.0	1.6	4.8	<0.03	0.12	0.06
WNW0107	DOWN - C	May-91	150	140	34	33	19	20	3.1	2.9	0.09	0.08	0.04	0.08
WNW0107	DOWN - C	Nov-91	130	130	34	34	23	23	2.4	2.6	0.11	0.12	0.10	0.06

a) General position in geologic unit
b) Apparent analytical outlier

Table E-8b (concluded)
Groundwater Quality Metals (mg/L) for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.
WNW0108	DOWN - C	May-91	140	120	33	30	27	27	2.9	2.7	0.48	<0.05	0.02	0.02
WNW0108	DOWN - C	Dec-91	120	140	32	34	25	27	1.6	2.8	0.96	<0.03	0.03	<0.01
WNW0114	DOWN - C	May-91	89	90	15	15	12	14	1.8	1.7	0.33	<0.05	0.02	0.02
WNW0114	DOWN - C	Nov-91	91	93	14	15	6.8	8.2	1.6	1.8	0.29	0.20	0.07	0.02
WNW0409	DOWN - C	May-91	45	47	12	10	21	21	5.7	6.1	6.5	0.13	0.11	<0.01
WNW0409	DOWN - C	Nov-91	45	42	11	9.5	18	19	6.6	6.5	6.7	2.0	0.08	0.03
WNW1102B	DOWN - C	Jun-91	66	63	30	27	13	12	2.0	1.6	0.46	0.04	0.03	0.01
WNW1102B	DOWN - C	Dec-91	64	93	25	34	12	14	2.4	2.6	1.9	0.03	0.04	<0.01
WNW1103B	DOWN - C	Jun-91	75	76	35	36	23	24	2.6	2.5	0.10	<0.03	0.05	0.07
WNW1103B	DOWN - C	Dec-91	76	74	35	34	22	22	2.2	2.3	0.10	0.09	0.01	<0.01
WNW1104B	DOWN - C	Jun-91	77	76	26	27	27	27	2.4	2.4	<0.03	<0.03	0.10	0.13
WNW1104B	DOWN - C	Dec-91	74	71	25	24	24	23	1.4	1.4	<0.03	<0.03	0.06	0.07
WNW1105A	DOWN - C	Jun-91	100	95	23	22	23	22	1.9	1.8	<0.03	<0.03	0.09	0.10
WNW1105B	DOWN - C	Jun-91	100	100	26	26	32	34	2.1	2.2	0.05	0.04	0.34	0.33
WNW1105B	DOWN - C	Dec-91	92	89	23	22	31	29	1.8	1.8	0.20	<0.03	0.18	0.02
WNW1111A	DOWN - C	Jun-91	120	120	56	57	14	14	2.4	2.4	0.12	<0.03	0.12	0.19
WNW1111A	DOWN - C	Dec-91	140	140	64	65	16	16	3.1	3.3	0.11	0.12	0.04	0.05

a) General position in geologic unit

Table E-9a
Groundwater Quality Parameters (mg/L) for the Lacustrine Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0901	UP	Jun-91	12	4	*<0.20	0.50	180	<1	0.013
WNW0901	UP	Dec-91	12	6	<0.05	0.62	170	<1	<0.005
WNW0902	UP	Jun-91	21	<2	*<0.20	0.55	190	<1	0.008
WNW0902	UP	Dec-91	21	<2	<0.05	0.58	190	<1	<0.005
WNW1001	UP	Jun-91	32	<2	*<0.10	0.36	160	<1	<0.005
WNW1001	UP	Dec-91	35	2	<0.05	0.55	170	<1	<0.005
WNW1008B	UP	Jun-91	43	<2	*<0.10	0.32	140	<1	0.011
WNW1008B	UP	Dec-91	42	5	<0.05	0.37	87	<1	<0.005
WNW0903	DOWN - B	Jun-91	3.9	120	*3.30	0.46	140	<1	0.007
WNW0903	DOWN - B	Dec-91	2.7	160	<0.05	0.55	270	<1	<0.005
WNW1002	DOWN - B	Jun-91	1.5	130	*<0.10	0.66	340	<1	
WNW1002	DOWN - B	Dec-91	<1.0	150	<0.05	0.76	370	<1	<0.005
WNW1003	DOWN - B	Jun-91	14	7	*0.10	0.49	240	<1	0.013
WNW1003	DOWN - B	Dec-91	12	6	<0.05	0.54	210	<1	<0.005
WNW1004	DOWN - B	Jun-91	1.9	22	*<0.10	0.47	230	<1	<0.005
WNW1004	DOWN - B	Dec-91	1.1	15	<0.05	0.52	230	<1	<0.005
WNW1101C	DOWN - B	Jun-91	1.6	92	*<0.10	0.27	180	<1	<0.005
WNW1101C	DOWN - B	Dec-91	1.3	120	<0.05	0.13	190	<1	<0.010
WNW8610	DOWN - C	May-91	3.4	110	*<0.00	0.28	250	<1	0.010
WNW8610	DOWN - C	Nov-91	<1.0	120	<0.05	0.27	280	<1	<0.005
WNW8611	DOWN - C	May-91	2.6	240	*0.03	<0.05	270	<1	<0.010
WNW8611	DOWN - C	Nov-91	1.2	240	0.20	<0.05	260	<1	<0.005

a) General position in geologic unit

** Nitrate-N only*

Table E-9b
Groundwater Quality Metals (mg/L) for the Lacustrine Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss
WNW0901	UP	Jun-91	31	32	9.0	8.9	24	26	5.8	5.9	4.0	0.12	0.20	0.13
WNW0901	UP	Dec-91	37	32	9.7	8.4	30	28	6.7	6.5	3.3	0.15	0.18	0.13
WNW0902	UP	Jun-91	38	38	14	14	26	26	4.1	4.2	2.4	0.06	0.17	0.13
WNW0902	UP	Dec-91	42	40	13	36	28	29	3.6	3.4	0.95	0.31	0.13	0.07
WNW1001	UP	Jun-91	31	31	8.8	7.9	38	42	5.3	5.0	6.0	0.40	0.17	0.09
WNW1001	UP	Dec-91	31	32	8.4	8.1	40	44	4.6	5.2	3.7	0.16	0.11	0.09
WNW1008B	UP	Jun-91	32	36	7.4	8.6	29	34	5.0	4.4	0.60	2.5	0.32	0.35
WNW1008B	UP	Dec-91	39	38	9.0	8.5	39	40	4.4	4.6	2.2	0.90	0.20	0.17
WNW0903	DOWN - B	Jun-91	190	67	99	28	34	36	19	5.1	240	<0.05	3.7	0.23
WNW0903	DOWN - B	Dec-91	96	76	41	33	40	42	8.9	4.8	27	0.07	0.56	0.16
WNW1002	DOWN - B	Jun-91	83	88	35	37	32	35	2.7	2.7	3.2	0.62	0.09	0.05
WNW1002	DOWN - B	Dec-91	90	90	38	38	36	35	2.3	2.2	1.0	0.84	0.06	0.06
WNW1003	DOWN - B	Jun-91	95	26	31	7.0	7.2	51	1.8	3.9	1.5	0.06	0.03	0.17
WNW1003	DOWN - B	Dec-91	27	27	7.3	7.2	52	55	3.9	4.1	1.3	0.07	0.22	0.20
WNW1004	DOWN - B	Jun-91	43	45	14	17	48	29	5.9	3.7	21	0.07	0.48	0.07
WNW1004	DOWN - B	Dec-91	44	44	17	17	28	28	2.2	2.0	0.89	0.38	0.06	0.06
WNW1101C	DOWN - B	Jun-91	58	51	14	10	27	27	9.1	8.8	8.5	<0.03	0.30	0.18
WNW1101C	DOWN - B	Dec-91	64	59	15	11	24	28	6.9	5.9	14	0.17	0.32	0.10
WNW8610	DOWN - C	May-91	53	37	34	31	63	66	5.2	4.9	11	0.17	0.32	0.05
WNW8610	DOWN - C	Nov-91	59	32	38	33	69	70	5.5	4.9	10	0.14	0.30	0.03
WNW8611	DOWN - C	May-91	88	86	30	29	63	63	3.2	3.2	3.2	0.09	0.09	0.02
WNW8611	DOWN - C	Nov-91	80	74	31	30	67	66	3.0	2.5	4.6	0.08	0.09	0.01

a) General position in geologic unit

Table E-10a
Groundwater Quality Parameters (mg/L) for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity (as mgCaCO3/L)	Carbonate Alkalinity (as mgCaCO3/L)	Phenols
WNW0908	UP	Jun-91	4.8	1000	*<0.20	<0.05	360	<1	0.009
WNW1005	UP	Jun-91	2.6	37	*<0.10	<0.05	370	<1	<0.005
WNW1005	UP	Dec-91	2.9	85	<0.05	<0.05	370	<1	<0.005
WNW1008C	UP	Jun-91	28	<2	*<0.10	0.08	220	<1	<0.005
WNW1008C	UP	Dec-91	34	16	<0.05	0.05	220	<1	<0.005
WNW0906	DOWN - B	Jun-91	9.9	110	*1.00	<0.05	230	<1	0.010
WNW0907	DOWN - B	Jun-91	2.0	37	*<0.20	<0.05	320	<1	0.013
WNW1006	DOWN - B	Jun-91	2.9	1000	*<0.10	0.06	320	<1	0.007
WNW1006	DOWN - B	Dec-91	2.3	310	<0.05	0.14	360	<1	<0.005
WNW1007	DOWN - B	Jun-91	9.8	690	*0.20	0.05	320	10	0.028
WNW1007	DOWN - B	Dec-91	4.6	550	0.00		340	<1	<0.005
WNW1101A	DOWN - B	Jun-91	2.0	130	*<0.10	<0.05	<1[b]	<1	<0.005
WNW1101A	DOWN - B	Dec-91	2.4	330	0.08	<0.05	220	<1	0.013
WNW1106A	DOWN - B	Jun-91	4.6	160	0.13	0.05	290	<1	<0.005
WNW1106A	DOWN - B	Dec-91	3.8	190	<0.05	0.56	310	<1	<0.010
WNW1108A	DOWN - B	Jun-91	3.2	560	*<0.10	0.11	310	<1	0.030
WNW1109A	DOWN - B	Jun-91	1.7	220	*0.30	<0.05	190	<1	<0.005
WNW1109A	DOWN - B	Dec-91	1.6	180	0.09	<0.05	220	<1	<0.010
WNW1102A	DOWN - C	Jun-91	3.6	240	0.20	<0.05	250	<1	<0.005
WNW1102A	DOWN - C	Dec-91	3.0	360	<0.05	<0.05	270	<1	<0.010
WNW1103A	DOWN - C	Jun-91	2.7	140	0.50	<0.05	340	<1	<0.005
WNW1103A	DOWN - C	Dec-91	2.6	190	<0.05	<0.05	510	<1	<0.010
WNW1104A	DOWN - C	Jun-91	3.6	110	0.81	<0.05	220	<1	<0.005
WNW1104A	DOWN - C	Dec-91	7.0	130	0.14	0.07	220	<1	<0.010
WNW1107A	DOWN - C	Jun-91	8.3	260	*<0.10	0.56	580	<1	<0.005
WNW1107A	DOWN - C	Dec-91	7.0	150	<0.05	0.14	460	<1	0.015
WNW1110A	DOWN - C	Jun-91	4.1	420	*<0.10	0.07	460	<1	<0.005

a) General position in geologic unit
b) Apparent analytical outlier
** Nitrate-N only*

Table E-10b
Groundwater Quality Metals (mg/L) for the Weathered Lavery Till Unit

Location Code	Hydraulic Position[a]	Date	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.
WNW0908	UP	Jun-91	440	460	150	160	21	22	6.8	7.7	0.33	<0.05	0.26	0.24
WNW1005	UP	Jun-91	44	110	18	35	25	8.1	4.6	1.6	9.4	<0.03	0.21	<0.01
WNW1005	UP	Dec-91	110	110	37	37	10	11	3.2	3.3	4.5	0.13	0.12	0.06
WNW1008C	UP	Jun-91	77	83	1.8	19	12	14	1.6	1.2	0.43	0.03	0.21	0.20
WNW1008C	UP	Dec-91	70	74	17	17	13	14	0.9	1.0	0.47	0.04	0.16	0.13
WNW0906	DOWN - B	Jun-91	77	81	30	31	20	21	3.1	2.9	3.4	0.48	0.18	0.25
WNW0907	DOWN - B	Jun-91	94	100	39	41	8.9	9.3	2.4	2.6	0.27	<0.05	0.02	0.04
WNW1006	DOWN - B	Jun-91	340	320	140	130	20	20	4.0	3.8	0.08	0.39	0.42	0.59
WNW1006	DOWN - B	Dec-91	290	300	120	120	19	20	3.6	4.2	0.14	0.06	0.30	0.19
WNW1007	DOWN - B	Jun-91	220	240	74	80	18	20	13	9.0	20	0.72	0.82	0.63
WNW1007	DOWN - B	Dec-91	190	200	69	72	17	18	4.4	6.5	4.4	0.05	0.19	0.07
WNW1101A	DOWN - B	Jun-91	82	86	23	24	9.2	9.4	1.7	1.9	<0.03	<0.03	0.20	0.23
WNW1101A	DOWN - B	Dec-91	120	110	29	29	12	11	1.6	2.2	0.07	<0.03	0.05	0.10
WNW1106A	DOWN - B	Jun-91	110	110	38	41	13	16	3.4	3.9	0.04	<0.03	0.28	0.39
WNW1106A	DOWN - B	Dec-91	130	130	47	47	14	14	3.6	3.8	0.08	0.03	0.08	0.04
WNW1108A	DOWN - B	Jun-91	170	180	62	69	18	20	3.9	3.8	5.1	0.10	0.23	0.18
WNW1109A	DOWN - B	Jun-91	100	100	26	27	10	11	3.9	4.0	0.12	0.05	0.36	0.35
WNW1109A	DOWN - B	Dec-91	110	110	28	28	10	11	2.6	2.6	0.17	<0.03	0.03	0.02
WNW1102A	DOWN - C	Jun-91	110	110	38	39	8.6	8.8	2.7	2.8	<0.03	<0.03	0.17	0.14
WNW1102A	DOWN - C	Dec-91	150	150	52	51	11	12	3.5	3.0	0.40	0.04	0.04	0.05
WNW1103A	DOWN - C	Jun-91	100	110	43	44	13	13	2.7	2.3	1.6	0.07	0.10	0.03
WNW1103A	DOWN - C	Dec-91	120	260	47	89	12	16	2.7	3.8	2.0	<0.03	0.14	<0.01
WNW1104A	DOWN - C	Jun-91	84	99	23	30	9.1	10	2.2	1.8	0.14	<0.03	0.09	0.07
WNW1104A	DOWN - C	Dec-91	89	94	24	26	12	12	2.2	2.3	0.25	<0.03	0.07	0.08
WNW1107A	DOWN - C	Jun-91	180	190	71	74	9.7	9.3	2.8	2.9	0.64	0.55	12	16
WNW1107A	DOWN - C	Dec-91	120	120	50	50	8.9	9.0	2.3	2.1	0.08	<0.03	2.8	2.9
WNW1110A	DOWN - C	Jun-91	150	140	96	90	28	27	4.2	4.0	0.09	<0.03	0.16	0.15

a) General position in geologic unit

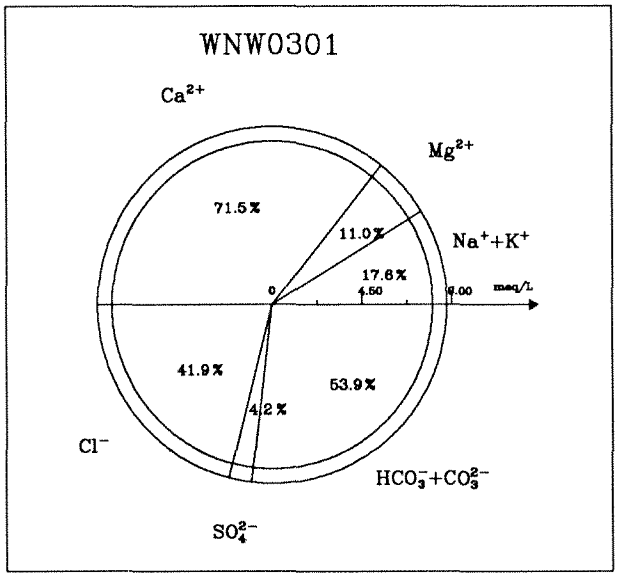
Table E - 11
Typical Practical Quantitation Limits (PQL) for Appendix IX Volatile Organic Compunds (μg/L)

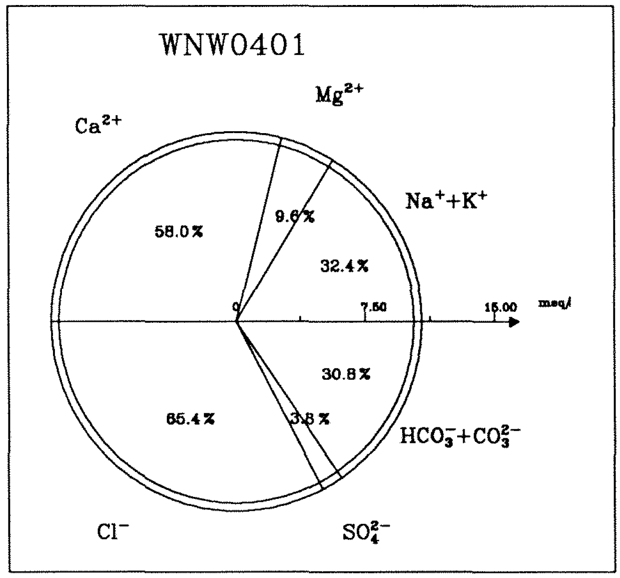
COMPOUND	PQL	COMPOUND	PQL
Acetone	<10	2-Hexanone	<10
Acetonitrile	<1000	Isobutanol	<100
Acrolein	<100	Methacrylonitrile	<5.0
Acrylonitrile	<100	2-Butanone	<10
Allyl Chloride	<10	Methylene Bromide	<5.0
Benzene	<5.0	Methylene Chloride	<5.0
Bromomethane	<10	Methyl Iodide	<5.0
Bromodichloromethane	<5.0	Methyl Methacrylate	<5.0
Bromoform	<5.0	4-Methyl-2-pentanone	<10
cis-1,3-Dichloropropene	<5.0	2-Picoline	<1000
Carbon Tetrachloride	<5.0	Pentachloroethane	<5.0
Chlorobenzene	<5.0	Propionitrile	<10
Chloroethane	<10	Pyridine	<1000
Chloroform	<5.0	Styrene	<5.0
Chloromethane	<10	trans-1,3-Dichloropropene	<5.0
Chloroprene	<5.0	trans-1,4-Dichloro-2-butene	<5.0
Carbon Disulfide	<5.0	1,1,1-Trichloroethane	<5.0
Dibromochloromethane	<5.0	1,1,1,2-Tetrachloroethane	<5.0
1,2-Dibromo-3-Chloropropane	<10	1,1,2-Trichloroethane	<5.0
1,2-Dibromoethane	<5.0	1,1,2,2-Tetrachloroethane	<5.0
1,1-Dichloroethane	<5.0	Trichlorofluoromethane	<5.0
1,2-Dichloroethane	<5.0	1,2,3-Trichloropropane	<5.0
Dichlorodifluoromethane	<5.0	Tetrachloroethene	<5.0
1,1-Dichloroethene	<5.0	Toluene	<5.0
1,2-Dichloroethene (Total)	<5.0	Trichloroethene	<5.0
1,2-Dichloropropane	<5.0	Vinyl Acetate	<10
1,4-Dioxane	<150	Vinyl Chloride	<10
Ethylbenzene	<5.0	Xylene (M&P)	<5.0
Ethyl Methacrylate	<5.0	Xylene (O)	<5.0

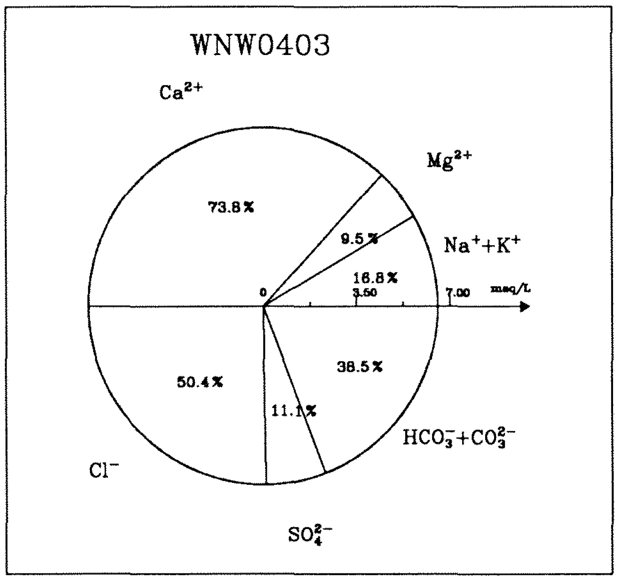
Table E - 12
1,1,1-Trichloroethane (1,1,1-TCA) and 1,1-Dichloroethane (1,1-DCA) for Selected Groundwater Monitoring Locations

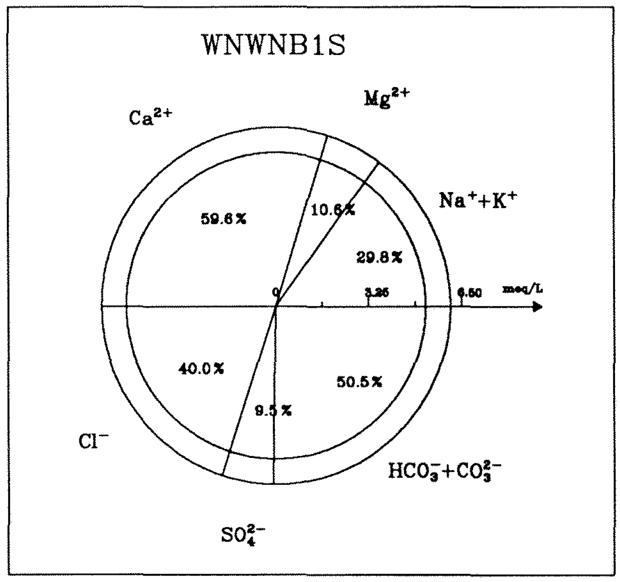
Location Code	Sample Rep	Sample Date	1,1,1-TCA (µg/L)	1,1-DCA (µg/L)
WNGSEEP	1	01/15/91	12.8	<5
	2	02/25/91	8	<5
	3	04/15/91	6.5	<5
	4	05/15/91	5.1	<5
	5	07/10/91	6.0	<5
	6	08/21/91	5.5	<5
	7	10/09/91	<5	<5
	8	11/21/91	6.5	<5
WNW8609	1	01/14/91	<5	6.6
	2	02/21/91	<5	6
	3	04/17/91	<5	7
	4	05/15/91	<5	6.0
	5	07/10/91	<5	5.5
	6	08/19/91	<5	7.5
	7	10/07/91	<5	<5
	8	11/18/91	<5	7.5
WNW8612	1	01/14/91	<5	12.8
	2	02/20/91	<5	10
	3	04/17/91	<5	7
	4	05/15/91	<5	13.0
	5	07/09/91	<5	15.5
	6	08/19/91	<5	16.5
	7	10/07/91	<5	<5
	8	11/21/91	<5	<5

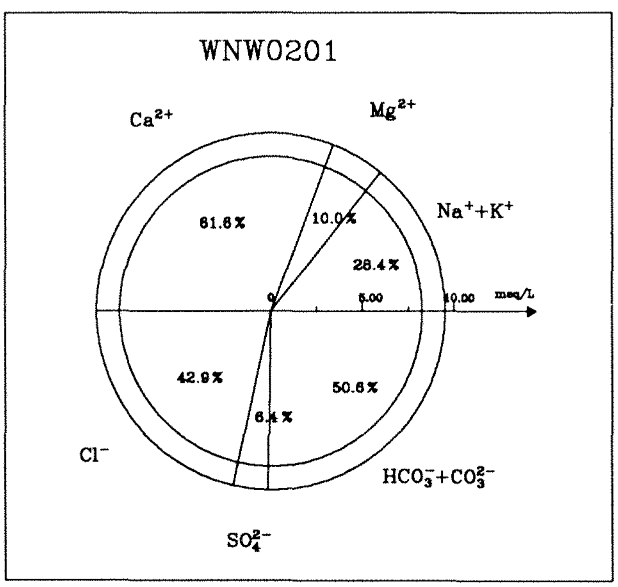
Figure E - 1
Groundwater Quality Plots for Sand and Gravel Wells











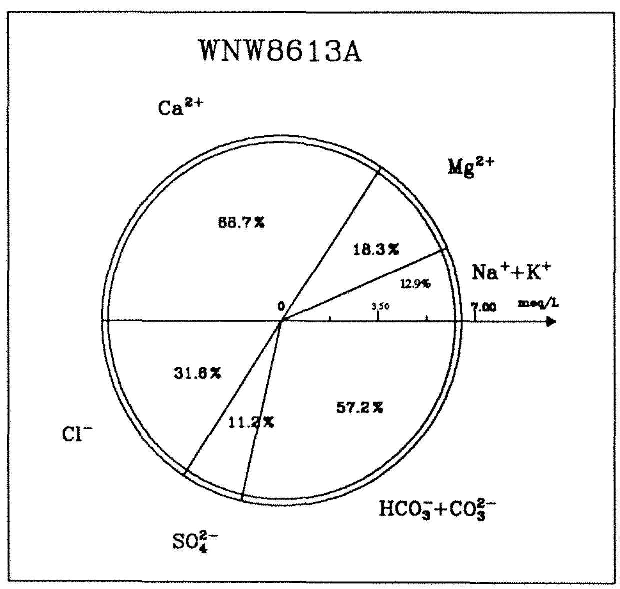


Figure E -1 *(continued)*
Groundwater Quality Plots for Sand and Gravel Wells

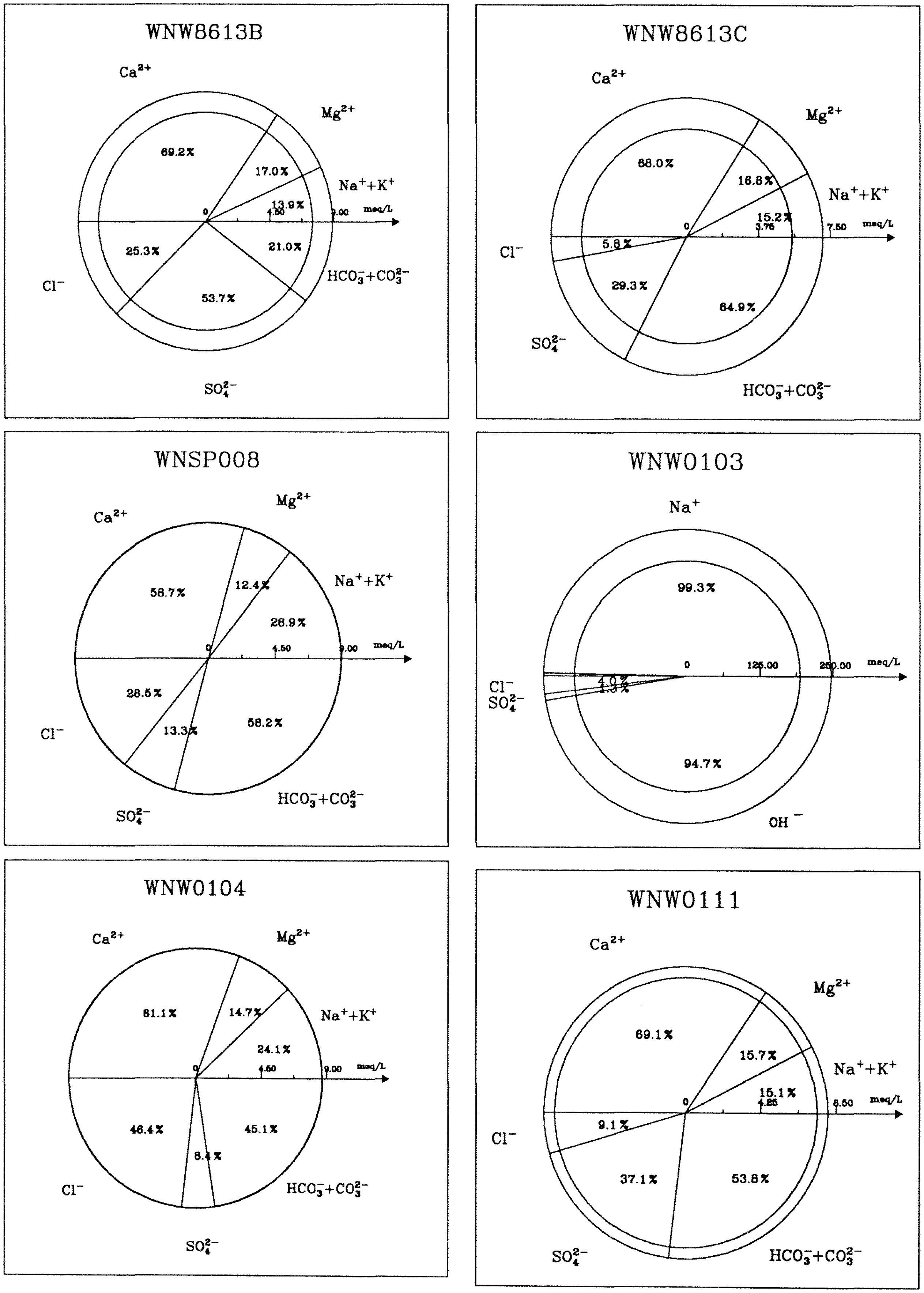


Figure E - 1 (continued)
Groundwater Quality Plots for Sand and Gravel Wells

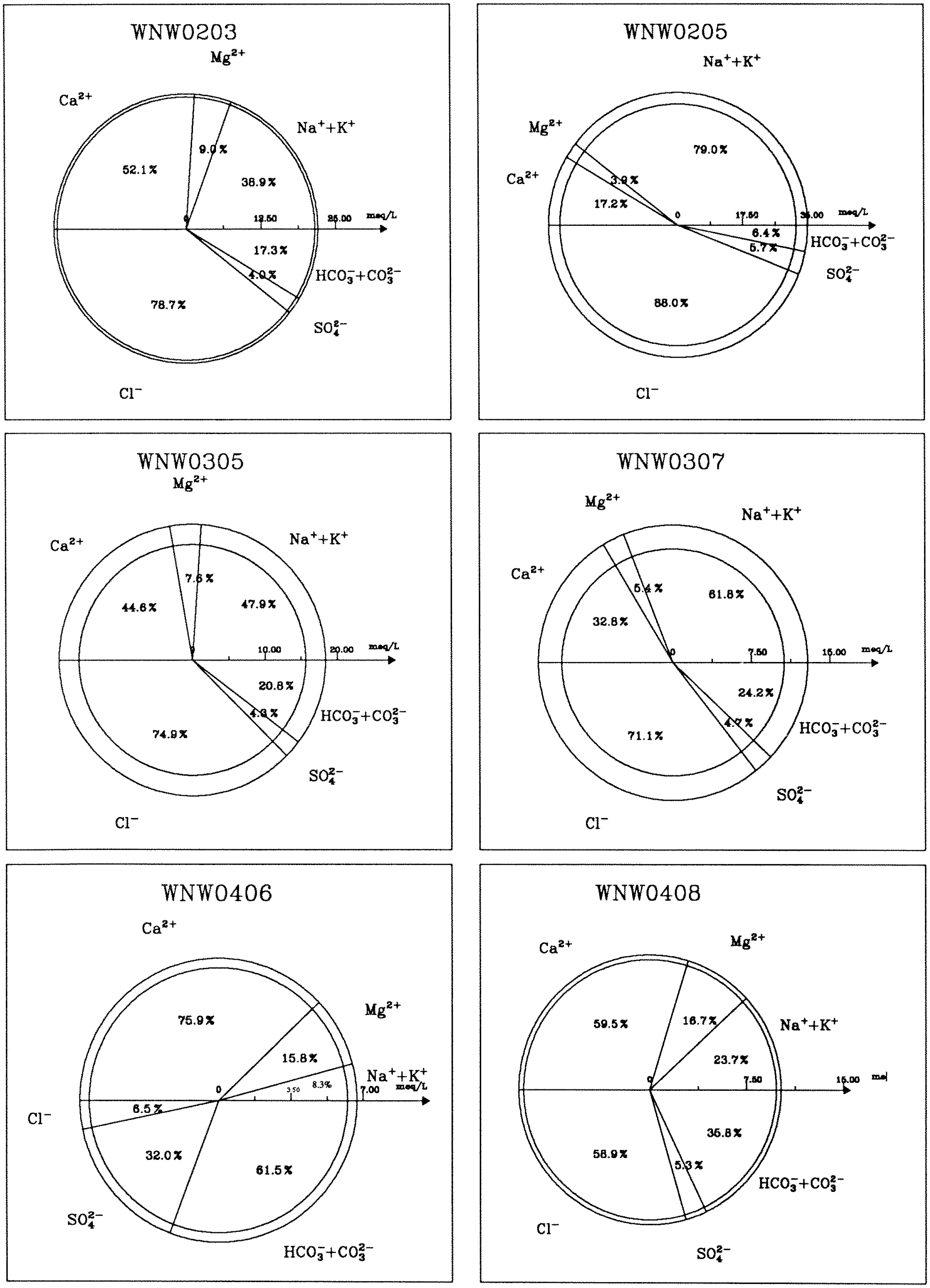
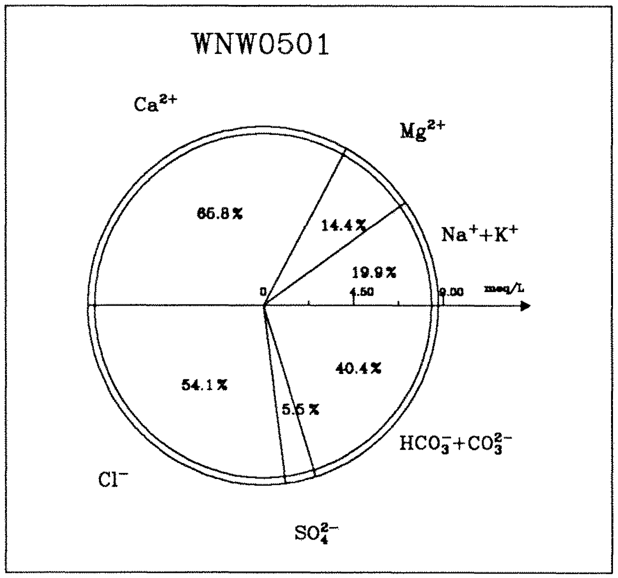
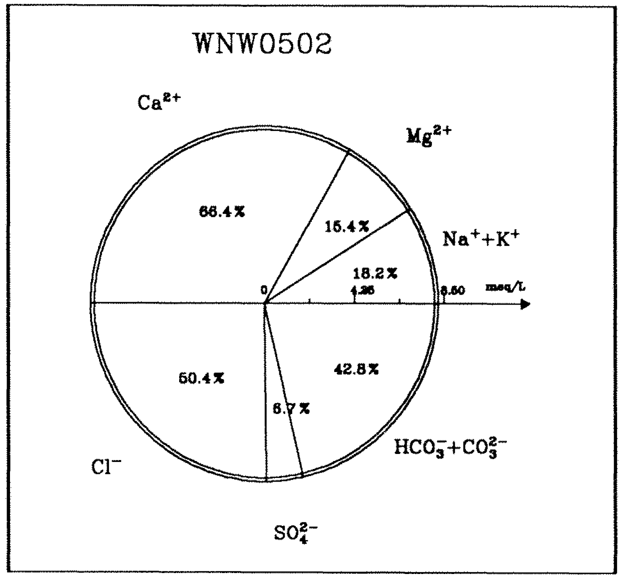
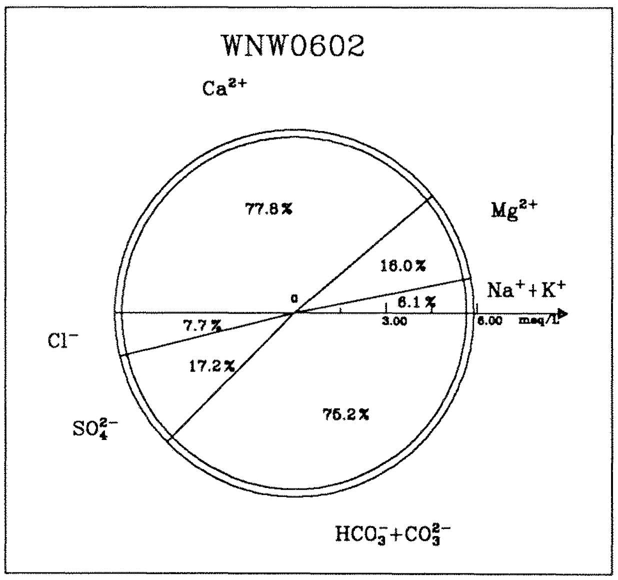
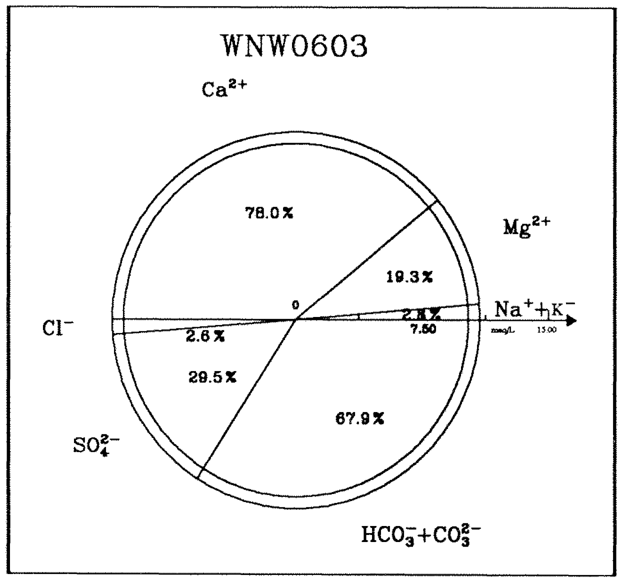


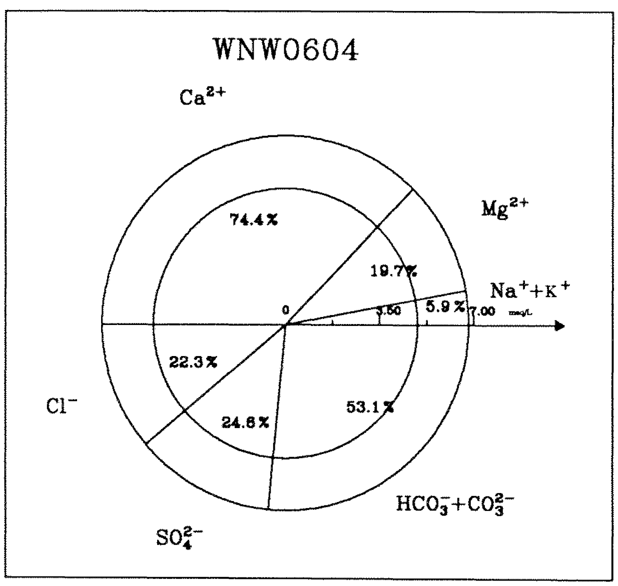
Figure E - 1 (continued)
Groundwater Quality Plots for Sand and Gravel Wells











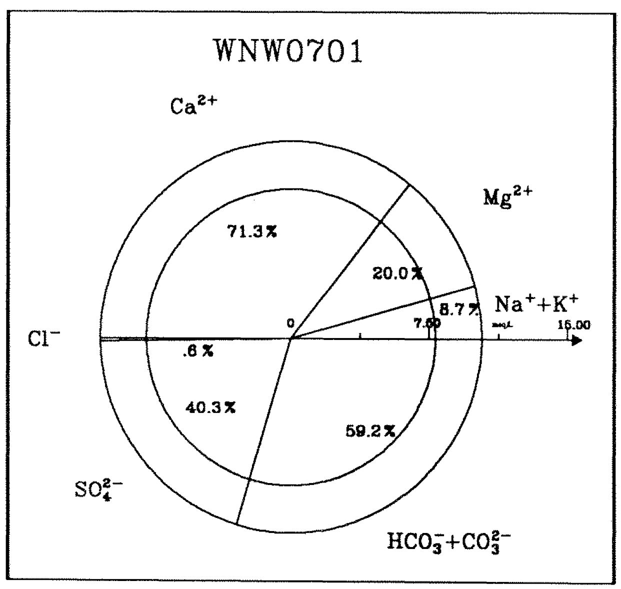


Figure E - 1 (continued)
Groundwater Quality Plots for Sand and Gravel Wells

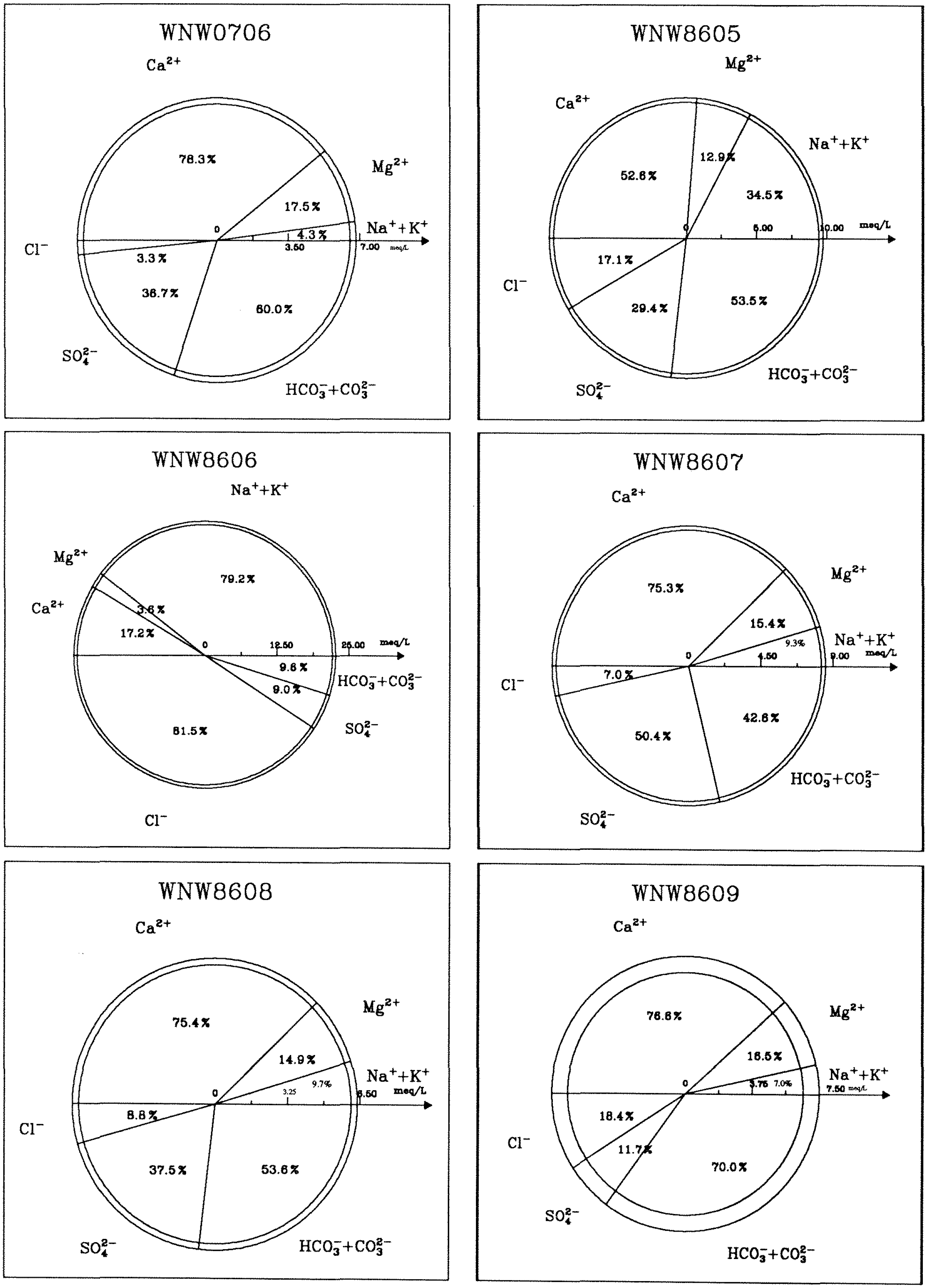


Figure E - 1 *(continued)*
Groundwater Quality Plots for Sand and Gravel Wells

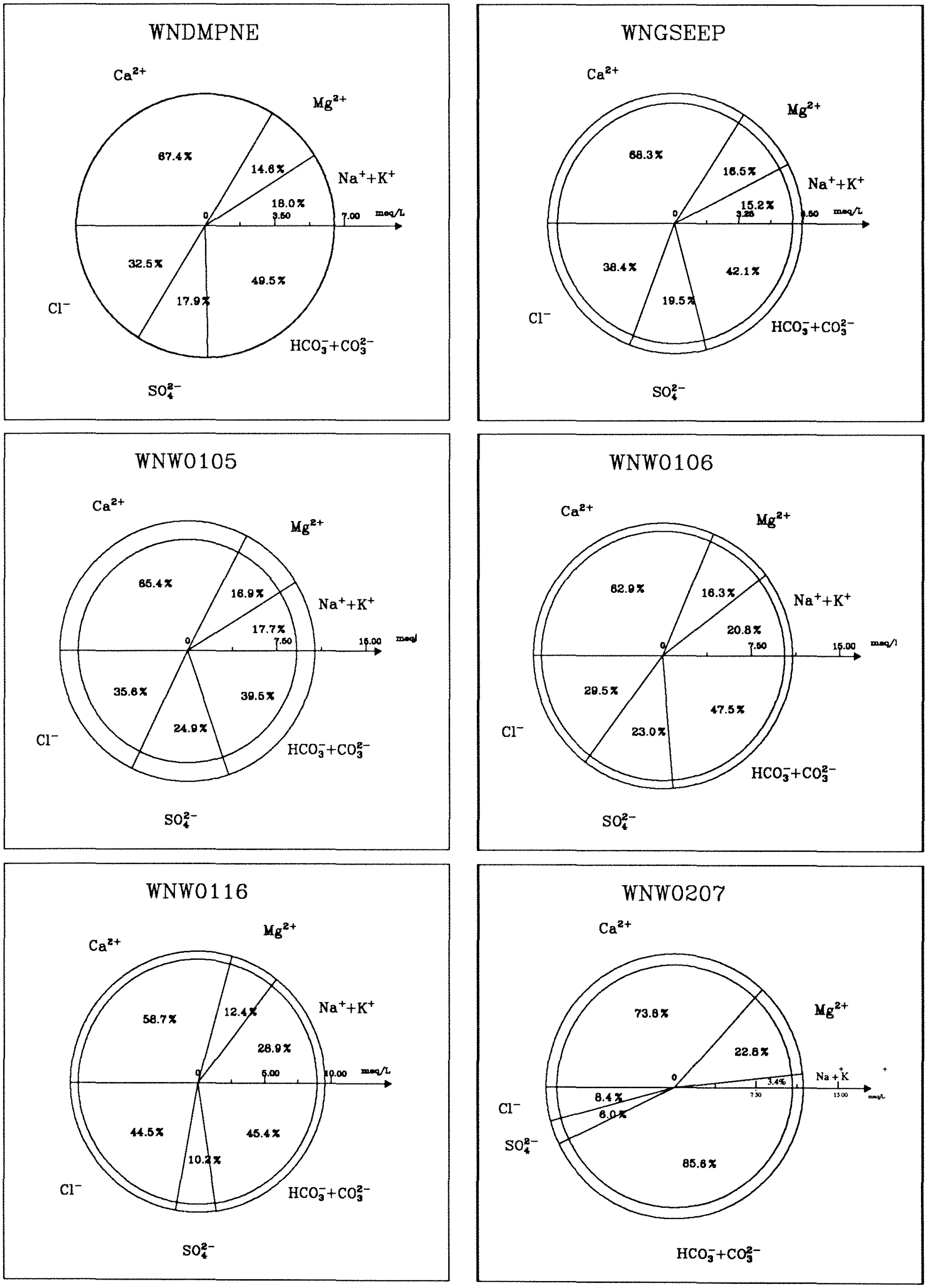


Figure E - 1 *(continued)*
Groundwater Quality Plots for Sand and Gravel Wells

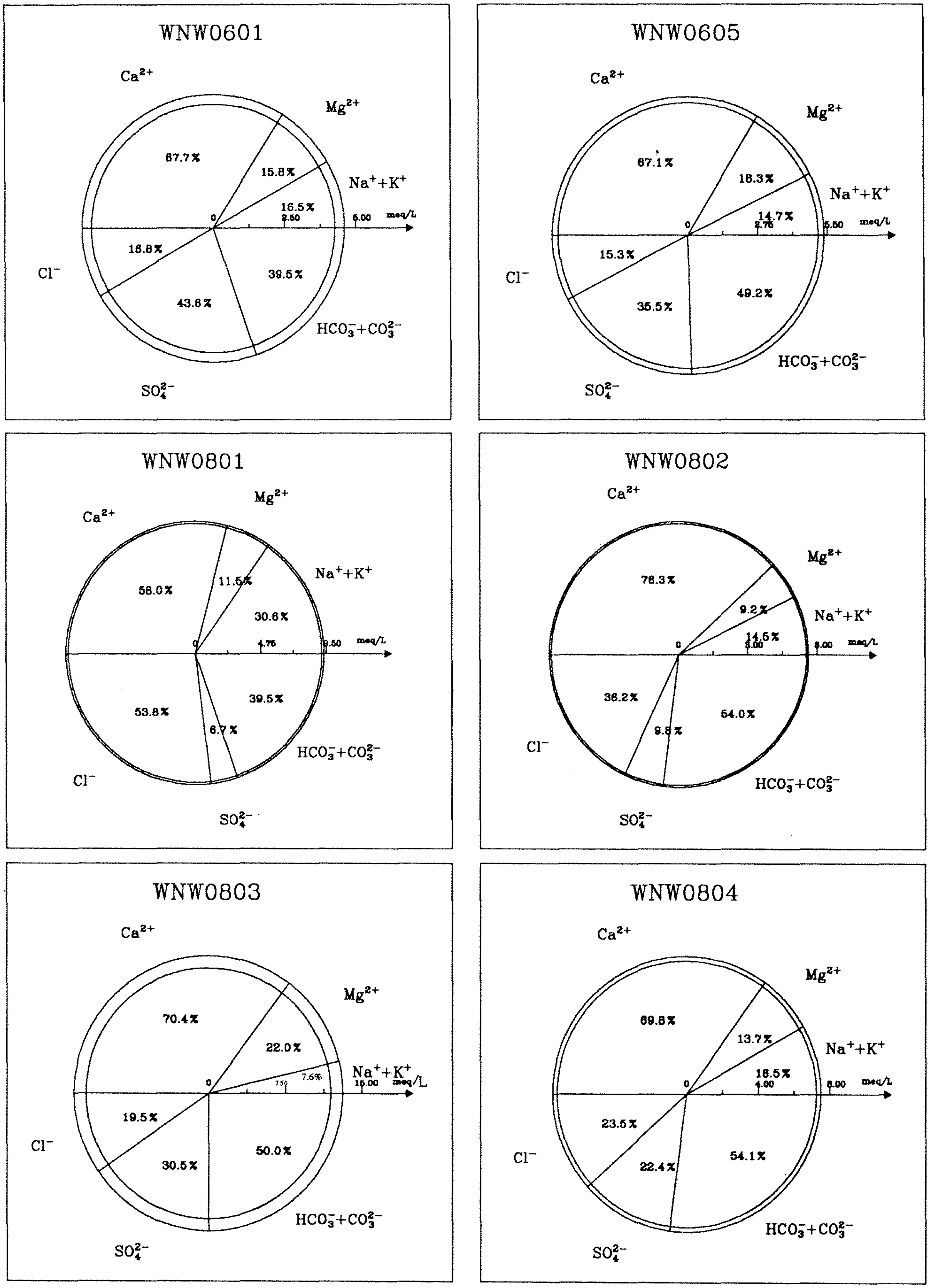
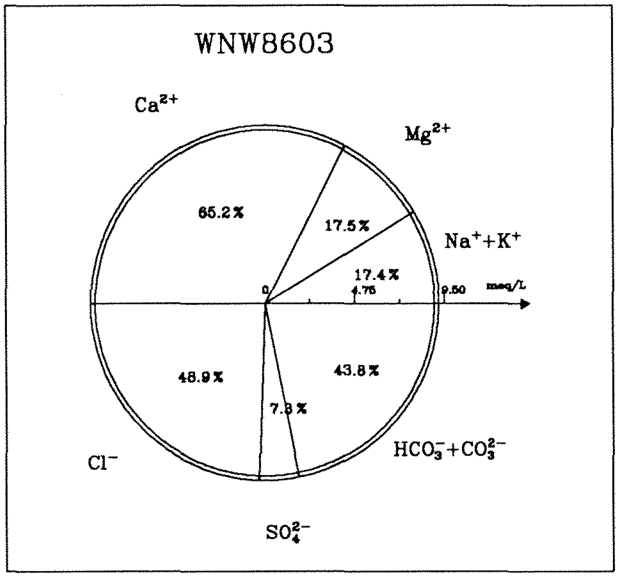
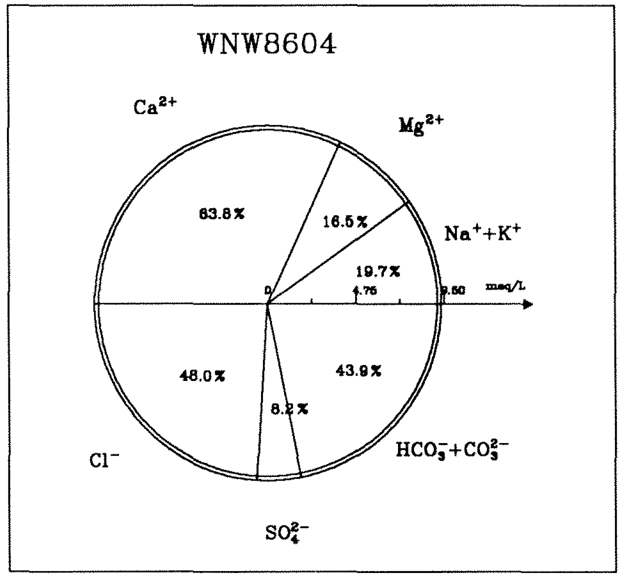


Figure E - 1 (concluded)
Groundwater Quality Plots for Sand and Gravel Wells





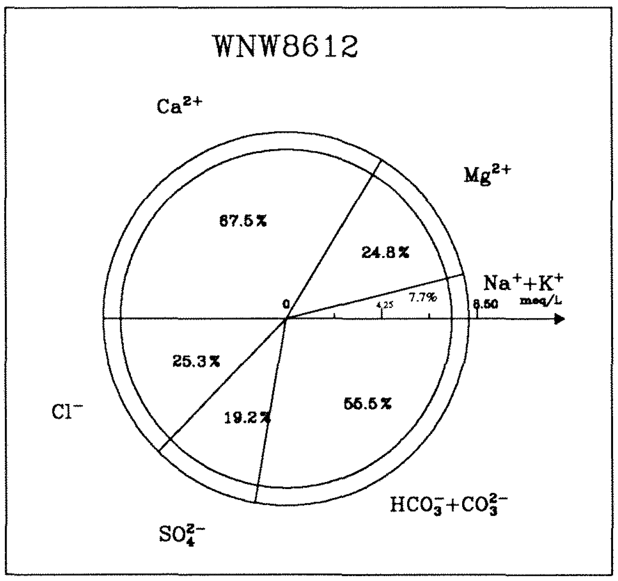


Figure E - 2
Groundwater Quality Plots for the Till-Sand Unit Wells

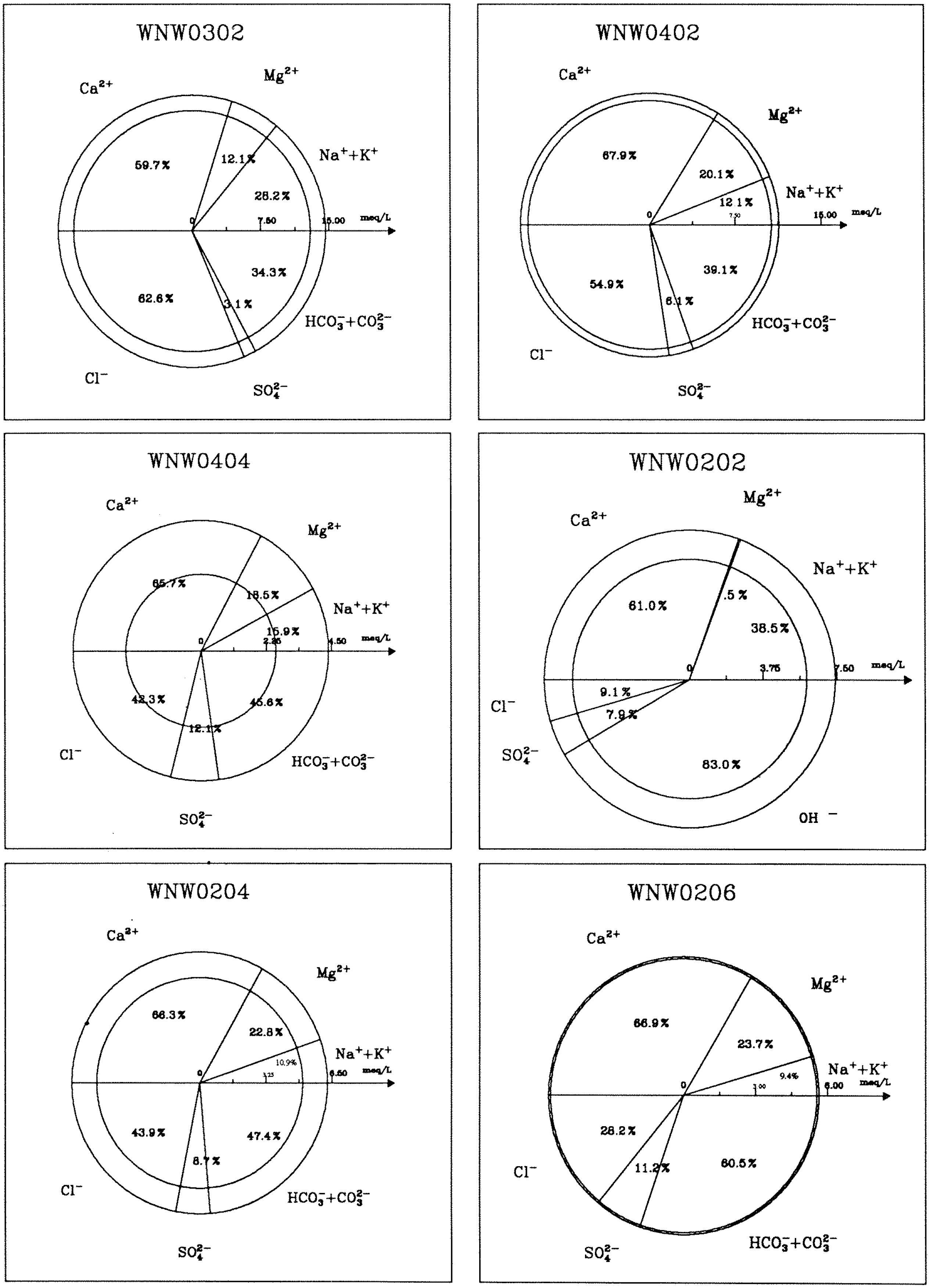
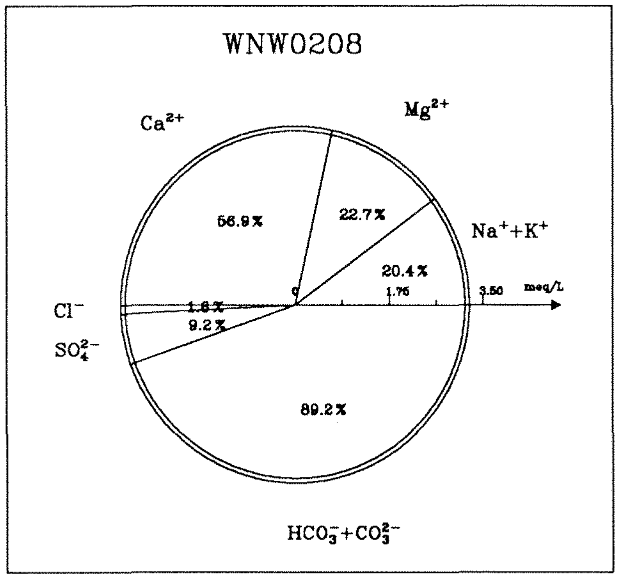


Figure E - 2 (concluded)
Groundwater Quality Plots for the Till-Sand Unit Wells



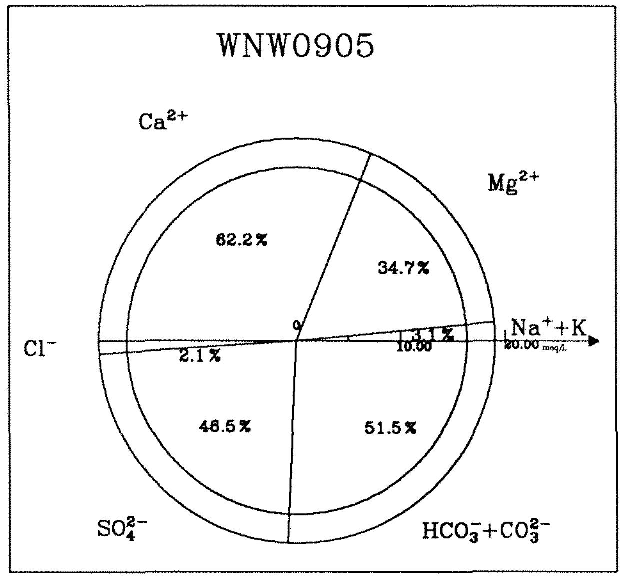


Figure E - 3
Groundwater Quality Plots for the Unweathered Lavery Till Wells

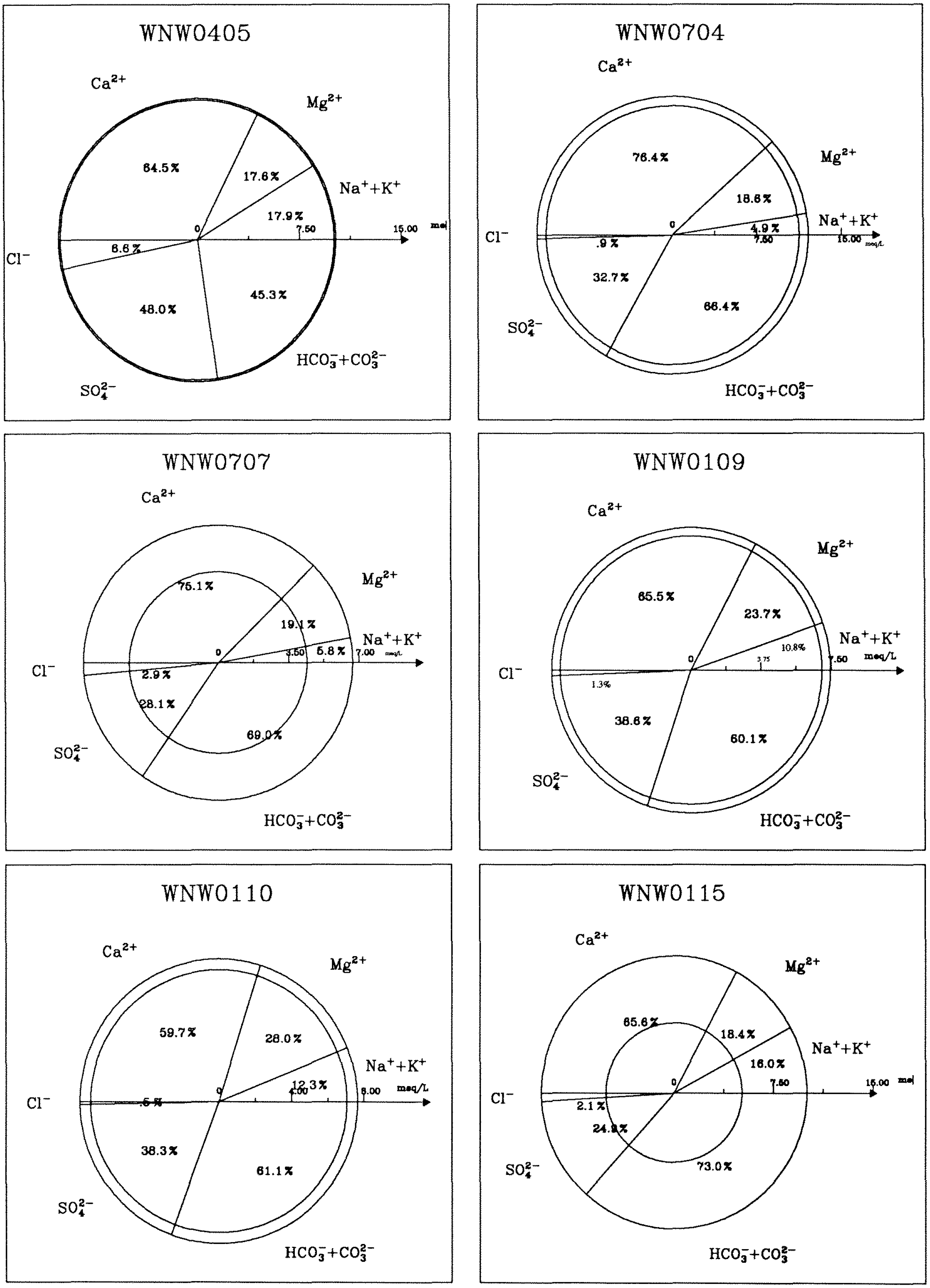


Figure E - 3 (continued)
Groundwater Quality Plots for the Unweathered Lavery Till Wells

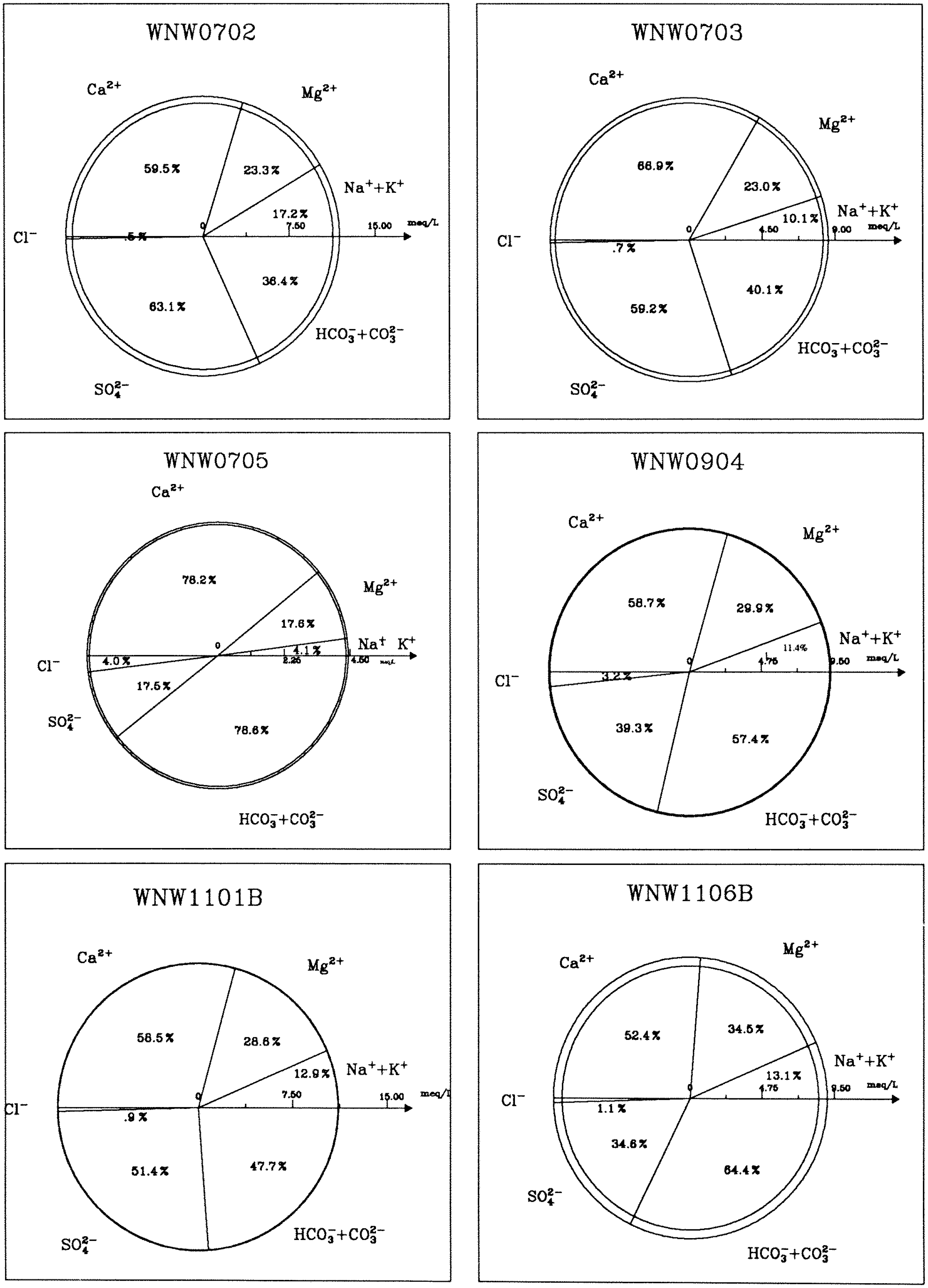


Figure E - 3 *(continued)*
Groundwater Quality Plots for the Unweathered Lavery Till Wells

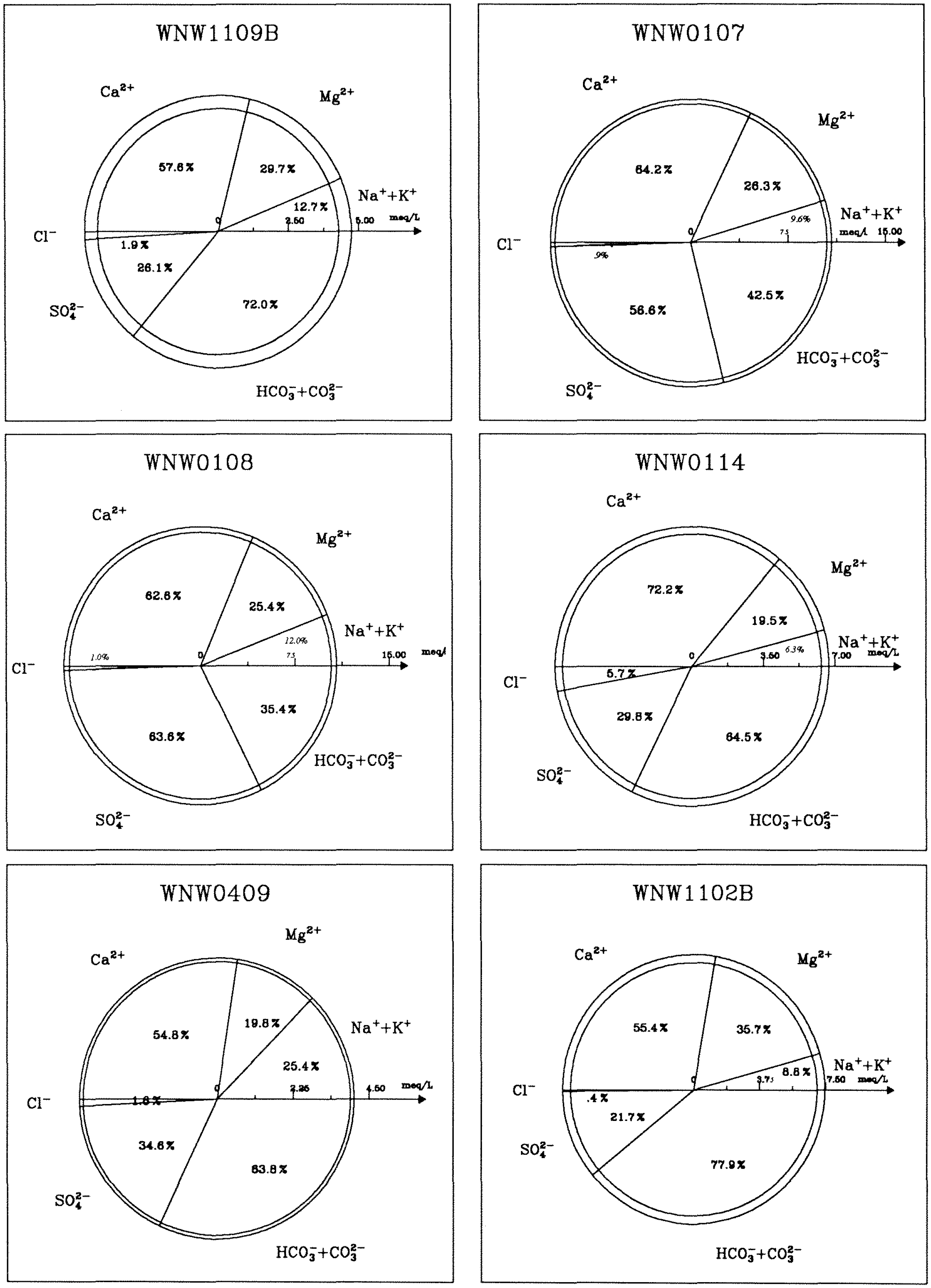
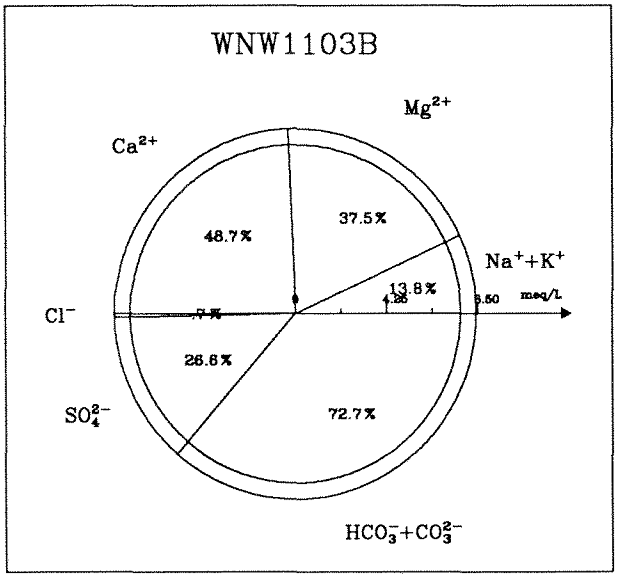
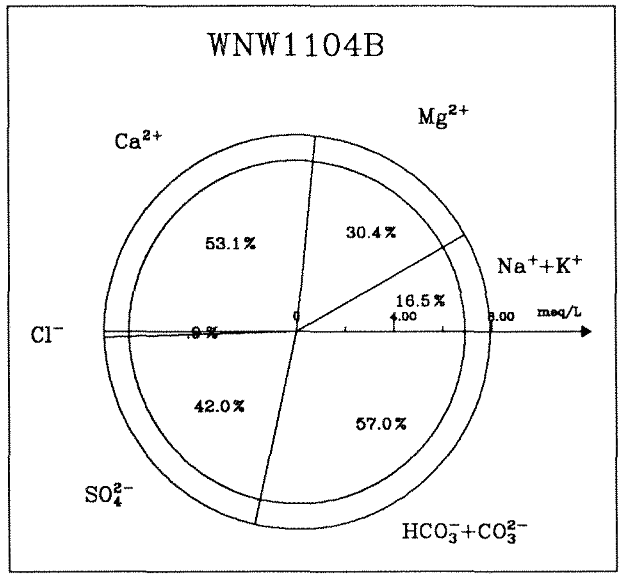
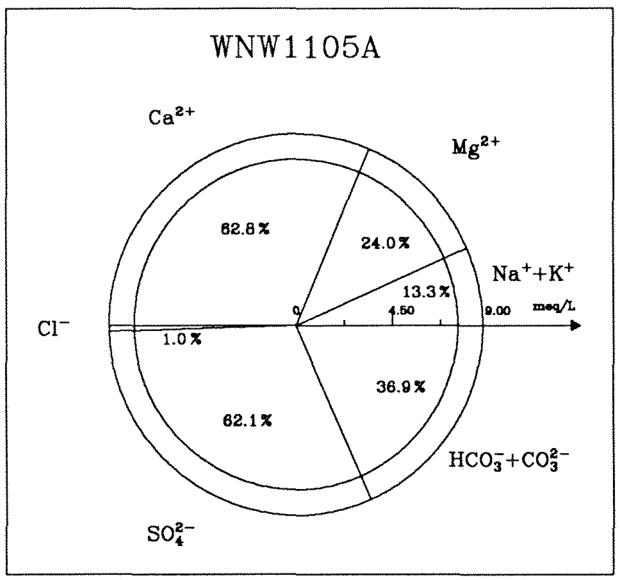
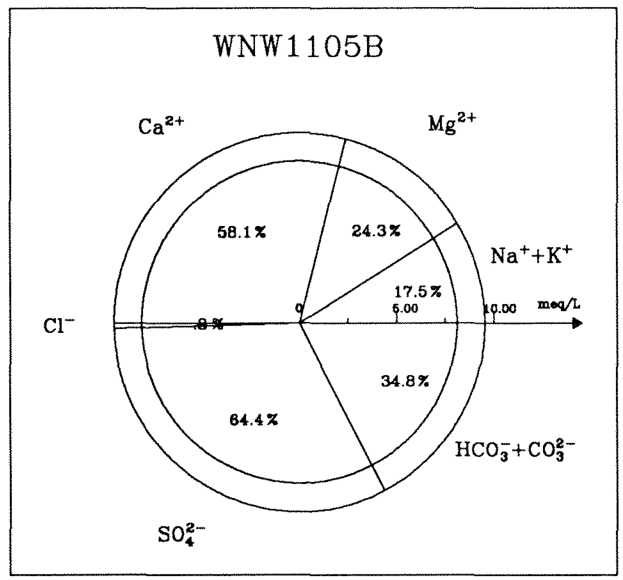


Figure E - 3 (concluded)
Groundwater Quality Plots for the Unweathered Lavery Till Wells









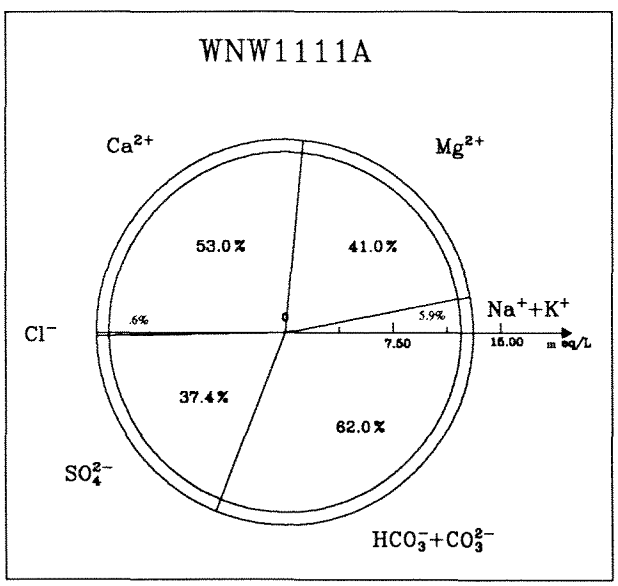


Figure E - 4
Groundwater Quality Plots for the Lacustrine Unit Wells

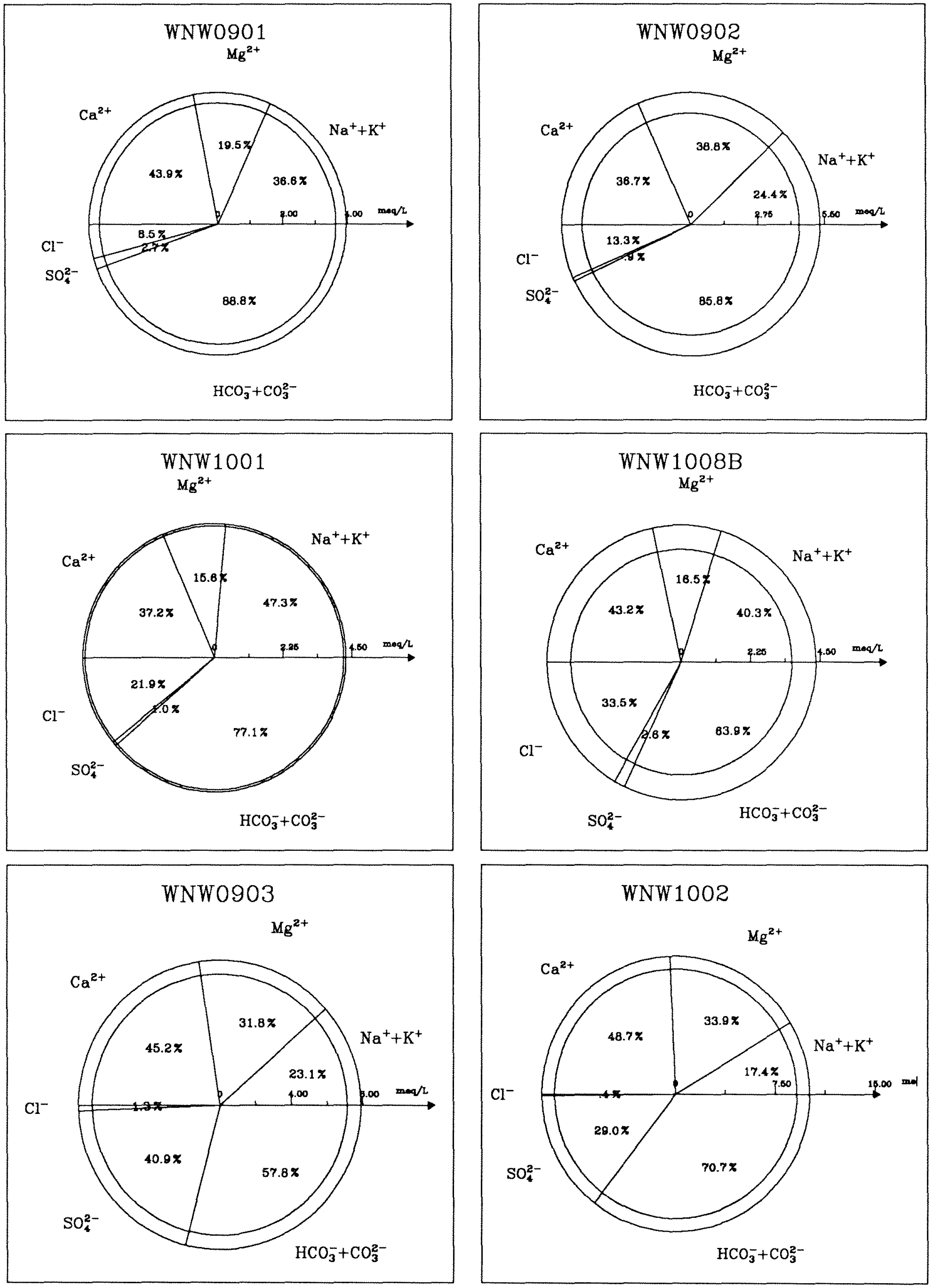


Figure E-4 (concluded)
Groundwater Quality Plots for the Lacustrine Unit Wells

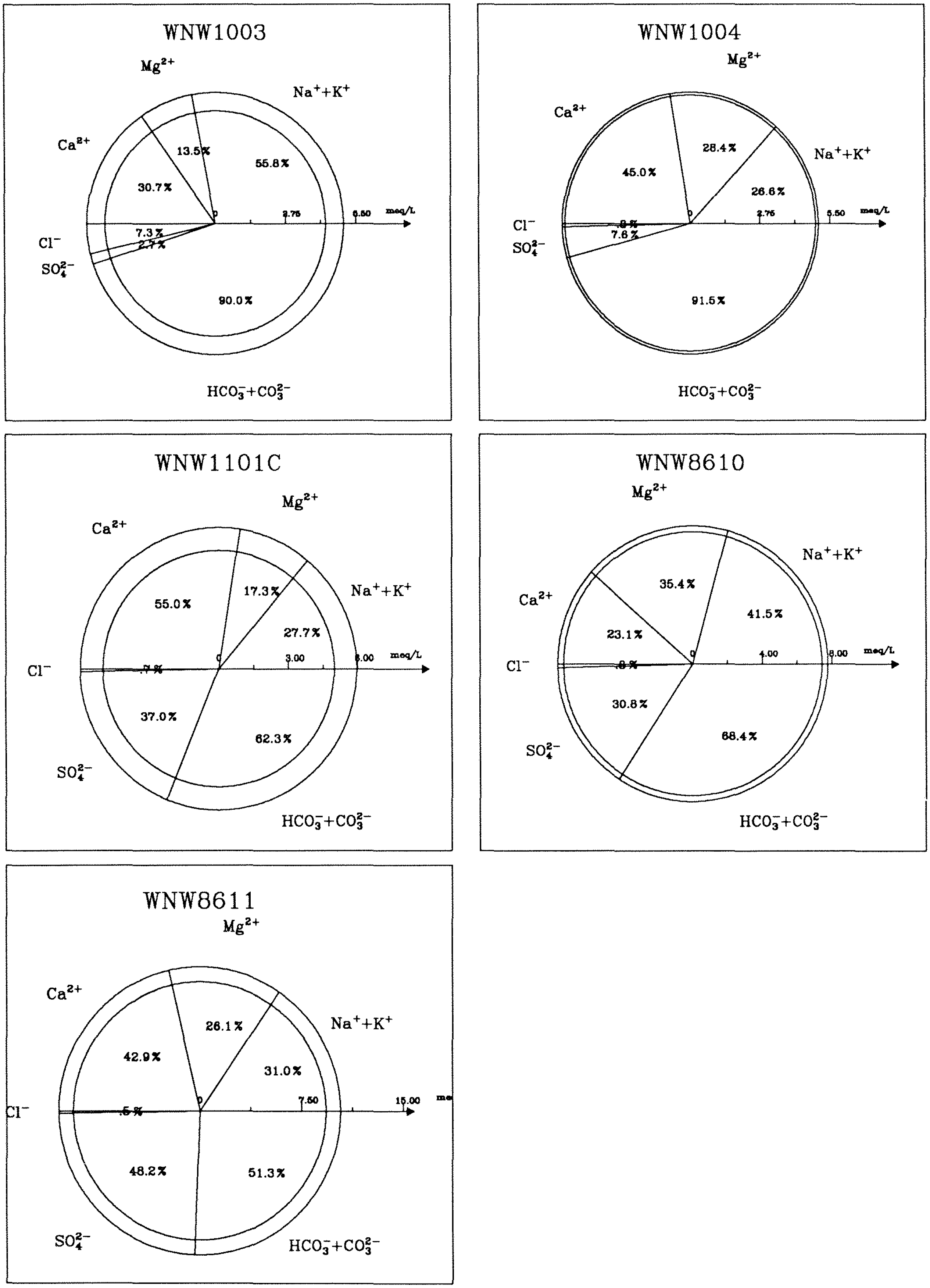


Figure E - 5
Groundwater Quality Plots for the Weathered Lavery Till Wells

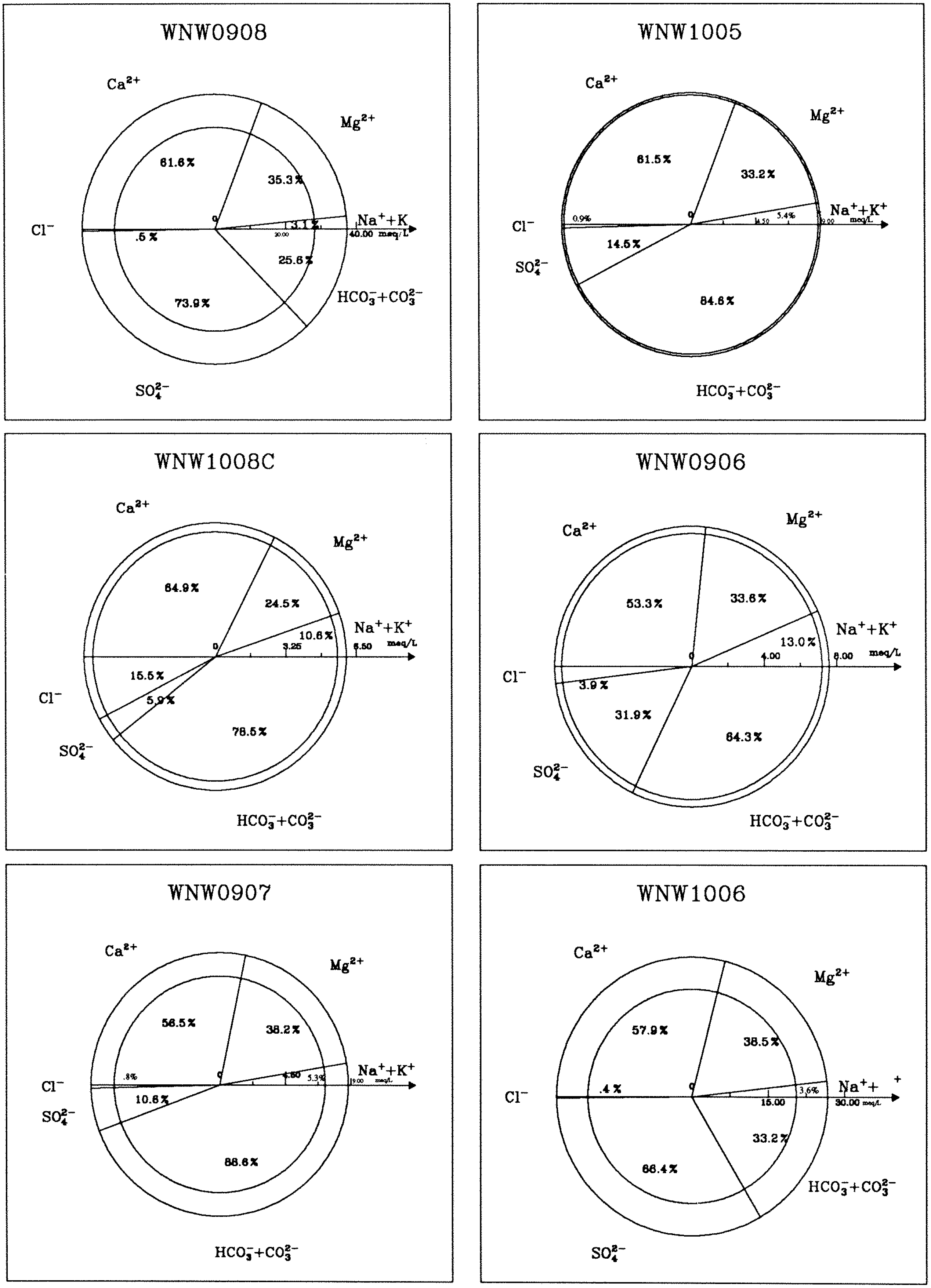


Figure E -5 (continued)
Groundwater Quality Plots for the Weathered Lavery Till Wells

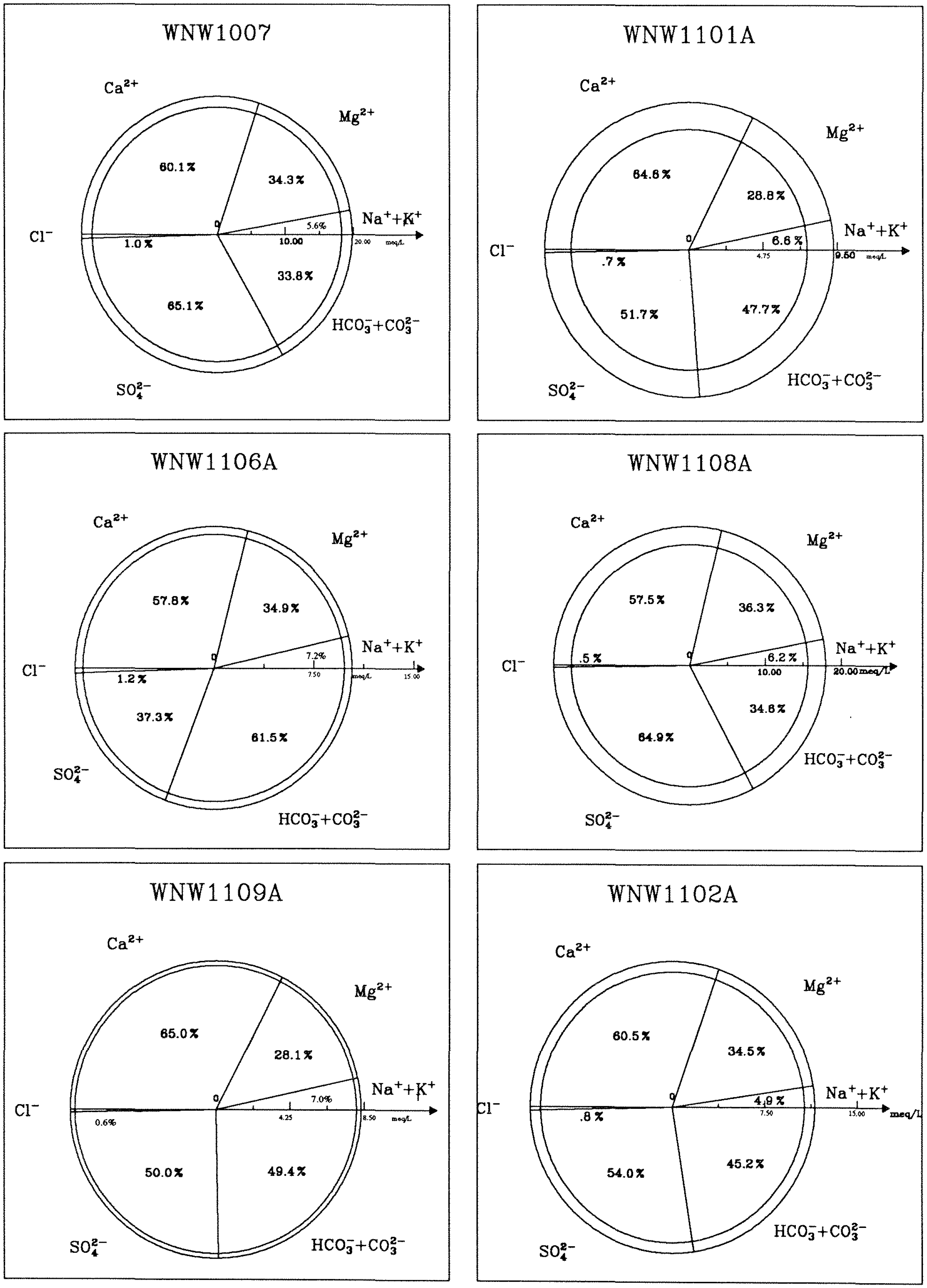
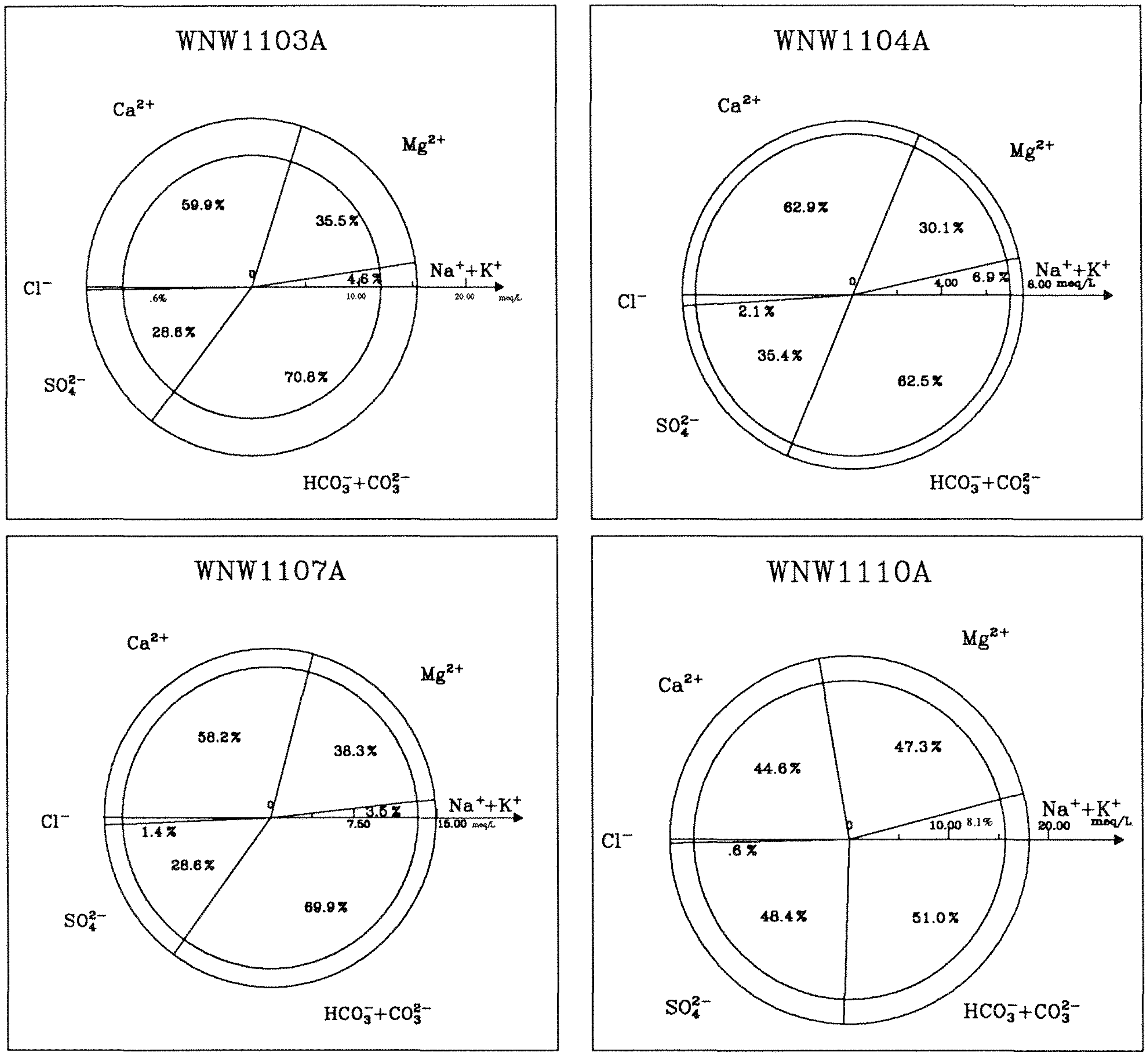


Figure E - 5 (concluded)
Groundwater Quality Plots for the Weathered Lavery Till Wells



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Glossary

ALLUVIUM. Sedimentary material deposited by flowing water such as a river.

ALLUVIAL FAN. A cone-shaped deposit of alluvium made by a stream where it runs out onto a level plain.

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 in an unconfined aquifer at the top of the aquifer is equal to that of the atmosphere.

BACKGROUND RADIATION. Includes both 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.

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.

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%.

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 the detection process.

CURIE (Ci). A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

DETECTION LEVEL. The minimum concentration of a substance that can be measured with a 99% confidence that the analytical concentration is greater than zero.

DERIVED CONCENTRATION GUIDE (DCG). Concentrations of radionuclides in air and water by which a person continuously exposed and inhaling 8400 cubic meters of air or ingesting 730 liters of water per year would receive an annual effective dose equivalent of 100 mrem per year from either mode of exposure. The committed dose equivalent is included in the DCGs for radionuclides with long half-lives. (See Appendix B.)

DISPERSION. The process whereby solutes are spread or mixed as they are transported by groundwater as it moves through sediments.

Glossary

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. Flowing out or forth; an outflow of waste. In this report, effluent refers to the liquid or gaseous waste streams released into the environment from the facility.

EFFLUENT MONITORING. Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

ENVIRONMENTAL MONITORING. The collection and analysis of samples or the direct measurements 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 from DOE sites in order to determine compliance with applicable standards and permit requirements.

EXPOSURE. Subjecting a target (usually living tissue) to radiation.

FALLOUT. Radioactive materials mixed into the earth's atmosphere. Fallout constantly precipitates onto the earth.

GRADIENT. Change in value of one variable with respect to another variable, especially vertical or horizontal distance.

GRAY. A unit of absorbed dose.

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.

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.

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.

Glossary

ISOTOPE. Different forms of the same chemical element that are distinguished by having different numbers of neutrons in the nucleus. An element can have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

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.

LEACHED HULLS. Stainless steel cladding that remains after acid dissolution of spent fuel.

LOW-LEVEL WASTE. Radioactive waste not classified as high-level waste, transuranic waste, spent fuel, or uranium mill tailings (see CLASS A,B,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. The smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

MIXED WASTE. A waste that is both radioactive and hazardous. Also referred to as RADIOACTIVE MIXED WASTE (RMW).

OUTFALL. The end of a drain or pipe that carries wastewater or other effluents into a ditch, pond, or river.

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.

PROGLACIAL LAKE. A lake occupying a basin in front of a glacier; generally in direct contact with the ice.

QUALITY FACTOR. The extent of tissue damage cuased 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 (see **RADIATION DOSE**) are multiplied to obtain a quantity that indicates the degree of biological damage produced by ionizing radiation. The factor is dependent upon radiation type (alpha, beta, gamma, or x-ray) and exposure (internal or external).

Glossary

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 outer dead layer of skin.

BETA RADIATION. Electron 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.

DOSE EQUIVALENT (DE). Also known simply as "dose." A measure of external radiation, dose is the product of the absorbed dose, the quality factor, and any other modifying factors. Dose equivalent is used to compare the biological effects of different kinds of radiation on a common scale. The unit of dose equivalent is the rem or sievert.

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.

EFFECTIVE DOSE EQUIVALENT (EDE). An expression of the health risk of doses of radiation to an individual. Since some organs are more sensitive than others, each organ is given a weighting factor. This tissue-specific weighting factor is multiplied by the organ dose for each organ and the numbers are added together to obtain the effective dose equivalent. The effective dose equivalent includes the COMMITTED EFFECTIVE DOSE EQUIVALENT (from internal deposition of radionuclides) and the dose equivalent (from penetrating radiation from external sources). Units of measurement are rems or sieverts.

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 s00ieverts.

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.

Glossary

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.

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.

SIEVERT. A unit of dose equivalent from the International System of Units. Equal to one joule per kilogram.

SPENT FUEL. Nuclear fuel that has been exposed 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.

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.

UPGRADIENT. Referring to the flow of water or air, it is analogous to upstream. 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.

Acronyms

ANOVA. Analysis of Variance

BEIR. Committee on Biological Effects of Ionizing Radiation

CDDL. Construction and Demolition Debris Landfill (formerly the "cold dump")

CERCLA. Comprehensive Environmental Response, Compensation, and Liability Act

CSS. Cement Solidification System

DCG. Derived Concentration Guide

DE. Dose Equivalent

DOE. Department of Energy

DOE-HQ. Department of Energy, Headquarters Office

DOE-ID. Department of Energy, Idaho Operations

EA. Environmental Assessment

EDE. Effective Dose Equivalent

EE. Environmental Evaluation

EIS. Environmental Impact Statement

ELAP. Environmental Laboratory Accreditation Program

EML. Environmental Measurements Laboratory

EMSL. Environmental Monitoring Systems Laboratory (Las Vegas)

EPA. Environmental Protection Agency

FONSI. Finding of No Significant Impact

FSFCA. Federal and State Facilities Compliance Agreement

FY. Fiscal Year

Acronyms

HLW. High-level Radioactive Waste

ICRP. International Commission on Radiological Protection

INEL. Idaho National Engineering Laboratory

IRTS. Integrated Radwaste Treatment System

LLD. Lower Limit of Detection

LLW. Low-level Radioactive Waste

LLWTF. Low-level Liquid Waste Treatment Facility

LPS. Liquid Pre-treatment System

LWTS. Liquid Waste Treatment System

MDC. Minimum Detectable Concentration

NCRP. National Council on Radiation Protection and Measurements

NDA. Nuclear Regulatory Commission - licensed Disposal Area

NEPA. National Environmental Policy Act

NESHAP. National Emission Standards for Hazardous Air Pollutants

NIST. National Institute of Standards and Technology

NFS. Nuclear Fuel Services Company, Inc.

NOI. Notice of Intent

NRC. Nuclear Regulatory Commission

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

OSR. Operational Safety Requirement

QA. Quality Assurance

Acronyms

QAP. Quality Assurance Program

QC. Quality Control

RCRA. Resource Conservation and Recovery Act

RMW. Radioactive Mixed Waste

SAR. Safety Analysis Report

SARA. Superfund Amendements and Reauthorization Act

SDA. (New York) State-licensed Disposal Area

SI. International System of Units

SPDES. State Pollutant Discharge Elimination System

STS. Supernatant Treatment System

SWMU. Solid Waste Management Unit

SSWMU. Super Solid Waste Management Unit

TLD. Thermoluminescent Dosimeter

USGS. U.S. Geological Survey

WNYNSC. Western New York Nuclear Service Center

WVDP. West Valley Demonstration Project

WVNS. West Valley Nuclear Services Co., Inc.

WVPO. West Valley (DOE) Project Office

Units of Measure

Radioactivity

Symbol	*Name*
Ci	curie
mCi	millicurie (1E-03Ci)
µCi	microcurie (1E-06Ci)
nCi	nanocurie (1E-09 Ci)
pCi	picocurie (1E-12 Ci)
fCi	femtocurie (1E-15Ci)
aCi	attocurie (1E-18 Ci)
Bq	becquerel (27 pCi)

Volume

Symbol	*Name*
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
ppm	parts per million
ppb	parts per billion

Dose

Symbol	*Name*
Sv	sievert (100 rems)
Gy	gray (100 rads)

Time

Symbol	*Name*
y	year
d	day
h	hour
m	minute
s	second

Length

Symbol	*Name*
m	meter
km	kilometer (1E+03)
cm	centimeter (1E-02 m)
mm	millimeter (1E-03 m)
µm	micrometer (1E-06 m)

Area

Symbol	*Name*
ha	hectare (10,000 m^2)

Mass

Symbol	*Name*
g	gram
kg	kilogram (1E+03 g)
mg	milligram (1E-03)
µg	microgram (1E-06 g)
ng	nanogram (1E-09 g)
t	metric ton (10^3 kg)

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