GROUNDWATER PROTECTION PROGRAM

Groundwater Monitoring Program Overview

Groundwater monitoring at the West Valley Demonstration Project (WVDP or Project) complies with all applicable state and federal regulations and meets the requirements of United States (U.S.) Department of Energy (DOE) Order 450.1. Data obtained from the program enable site managers to determine baseline groundwater conditions, facilitate early detection of existing and potential groundwater contamination sources, provide surveillance of these sources, and provide information for decision-making.

The "WVDP Groundwater Protection Management Program Plan" documents the Project's approach to the protection of groundwater from on-site activities. The WVDP's groundwater monitoring program is outlined in the "Groundwater Monitoring Plan," which discusses groundwater characterization, the current groundwater sampling agenda, and compliance with long-term monitoring requirements as identified in the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) and DOE Orders.

Site groundwater is not used for drinking or operational purposes, nor is effluent discharged directly to groundwater. Surveys have determined that no public water supplies are drawn from downstream Cattaraugus Creek. Upgradient of the site, groundwater is used as a public and private drinking water supply by local residents.

Surface Water Hydrology

The 167-acre (68-hectare [ha]) Project site is located within the Western New York Nuclear Service Center (WNYNSC), which comprises approximately 3,338 acres (1,351 ha) and is located near the northern border of Cattaraugus County. The WNYNSC lies within the Cattaraugus Creek watershed, which flows northwestward to Lake Erie. Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC.

The WVDP, which lies within the WNYNSC, is drained by Quarry Creek, Erdman Brook, and Frank's Creek, which flow into Buttermilk Creek. (See Fig. A-1 in Appendix A.) Erdman Brook bisects the WVDP into the north and south plateaus. The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-Licensed Disposal Area (NDA), and the New York State-Licensed Disposal Area (SDA) are located on the south plateau.

Geology

The WNYNSC is situated upon a layered sequence of glacial-age sediments that fill a steep-sided bedrock valley that is composed of interbedded shales and siltstones (Rickard, 1975).

The glacial sediments overlying the bedrock consist of a sequence of three glacial tills of Lavery, Kent, and possibly Olean age. The tills are separated by stratified fluvio-lacustrine deposits (silty or silty/sandy lakebed sediments). On the Project's north plateau, the Lavery till is capped by coarse-grained alluvial-fluvial deposits (sandy/silty/gravelly streambed sediments).

Hydrogeology

The sediments above the Kent till – the Kent recessional sequence, the weathered and unweathered Lavery till, the intra-Lavery till-sand, and the alluvial sand and gravel – are generally regarded as containing all of the potential routes for contaminant migration from the Project via groundwater. (See Figs. 4-1 and 4-2.) Table 4-1 describes each of these units and their distribution beneath the site. The Kent till has a relatively low permeability and does not provide a pathway for contaminant movement from the WVDP; therefore, it is not discussed here.

Hydrologic conditions of the site are more fully described in "Environmental Information Document, Volume III: Hydrology, Part 4" (West Valley Nuclear Services Co. [WVNSCO], March 1996) and in the "RCRA Facility Investigation Report Vol. 1: Introduction and General Site Overview" (WVNSCO and Dames & Moore, July 1997).

Routine Groundwater Monitoring Program

Groundwater Monitoring Program Highlights 1982 Through 2006. Program content is dictated by regulatory requirements in conjunction with current operating practices and historical knowledge of previous site activities.

• Groundwater monitoring at the WVDP began in 1982 and continued to expand through 1992 with the addition of new wells, groundwater seep locations, a french drain outfall, and the NDA interceptor trench sump.

• In 1993, monitoring results indicated elevated gross beta activity in groundwater from the sand and gravel unit on the north plateau. Subsequent investigation of this area delineated a plume of contamination with a southwest to northeast orientation. (See "Monitoring of the Sand and Gravel Unit on the North Plateau" and Figure 4-3 in this chapter for more detail.)

• An RFI expanded characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, provided valuable information regarding groundwater conditions near each SSWMU. Evaluation of these results influenced monitoring program modifications.

• Long-term monitoring needs were the focus of a 1995 groundwater monitoring program evaluation. After a comprehensive assessment, the number of sampling locations was reduced from 91 to 65 and analytical parameters were tailored to each sampling location for a more focused, efficient, and cost-effective program.

• In 1996, several groundwater seep monitoring locations on the northeast edge of the north plateau were added to the monitoring program and the french drain outfall was deleted for groundwater purposes. Five seep locations continue to be monitored.

Table 4-1
Summary of Hydrogeology at the WVDP

Geologic Unit	Description	Groundwater Flow Characteristics	Hydraulic Conductivity	Location
Sand and Gravel	Silty sand and gravel layer composed of older Pleistocene-age glaciofluvial deposits overlain by younger Holocene alluvial deposits	Flow is generally northeast across the plateau toward Frank's Creek, with groundwater near the northwestern and southeastern margins flowing radially outward toward Quarry Creek and Erdman Brook	16.4 ft/day (6E-03 cm/sec) or 200 in/day	North plateau
Lavery Till Sand	Thin, sandy unit of limited areal extent and variable thickness	Flow to the east-southeast toward Erdman Brook	3.8 ft/day (1E-03 cm/sec) or 46 inches/day	Primarily beneath the southeastern portion of the north plateau
Weathered Lavery Till	Upper zone of the Lavery Till exposed at the ground surface; weathered and fractured to a depth of 3–16 ft (0.9–4.9 m); brown in color due to oxidation; contains numerous dessicant cracks and root tubes	Flow has both horizontal and vertical components allowing groundwater to move laterally across the south plateau before moving downward into the unweathered lavery till or discharging to nearby incised stream channels	5E-02 ft/day (2E-05 cm/sec) or 0.6 in/day; the highest conductivities are associated with dense fracture zones found within the upper 7 ft (2 m) of the unit	South plateau
Unweathered Lavery Till	Olive gray silty clay with intermittent lenses of silt and sand; ranges up to 130 ft (40 meters) in thickness	Flow is vertically downward at a relatively slow rate	1E-04 ft/day (3.5E-08 cm/sec) or 0.001 inches/day	Underlies both the north and south plateaus
Kent Recessional Sequence	Interbedded clay and silty clay layers locally overlain by coarser-grained sands and gravels	Flows to the northeast; recharge from the overlying till and from bedrock to the southwest; discharges into Buttermilk Creek	2E-01 ft/day (8E-05 cm/sec) or 2.6 in/day	Underlies entire Project

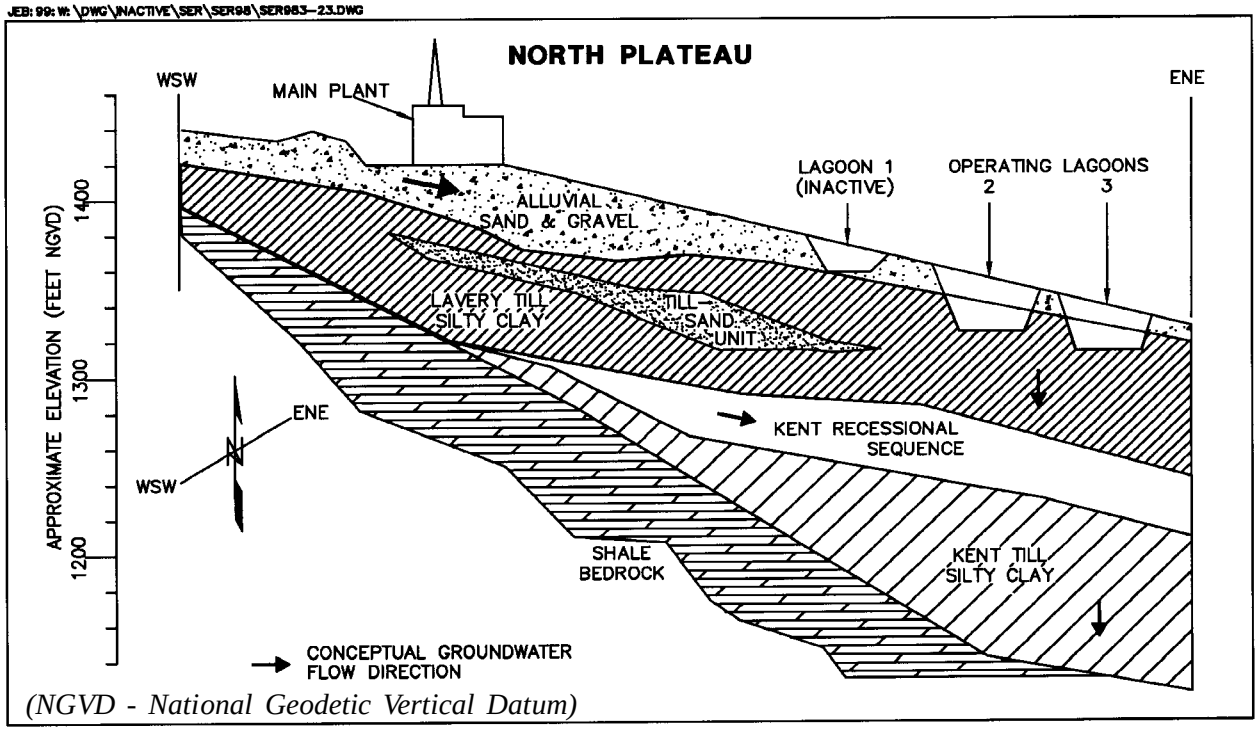

Figure 4-1. Geologic Cross Section Through the North Plateau (Vertical Exaggeration Approx. 2:1)

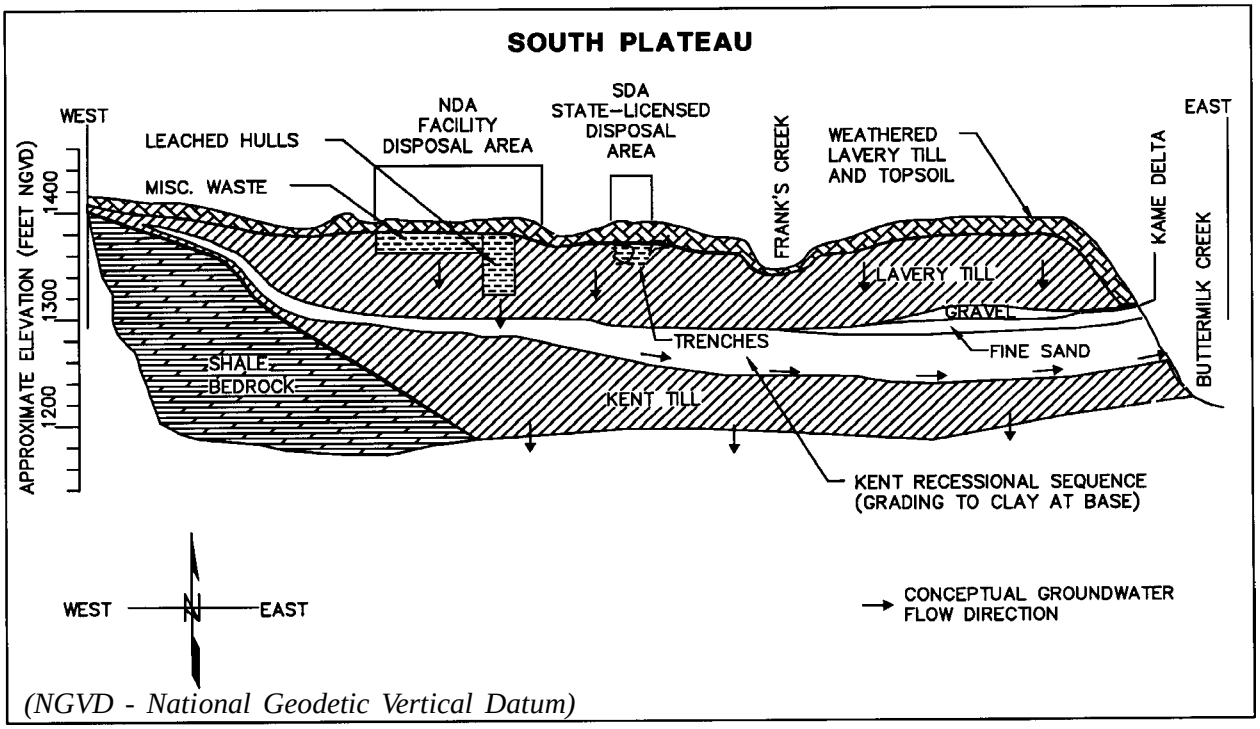

Figure 4-2. Geologic Cross Section Through the South Plateau (Vertical Exaggeration Approx. 2.5:1)

Table 4-2
Groundwater Monitoring Overview by Geographic Area: Monitoring Year 2006

Number of…	Total WVDP	North Plateau	South Plateau	Off-Site Residential
Monitoring Points Sampled - Analytical[a]	79	54	15	10
Monitoring Points - Water Elevations Only	55	39	16	0
Monitoring Events	5	4	4	1
Analyses	1,183	979	158	46
Results	9,933	8,621	1,205	107
Percent of Nondetectable Results	87%	87%	86%	62%
Water Elevation Measurements	464	340	124	0

[a] *Total number includes 69 on-site monitoring points and 10 off-site monitoring points.*

Table 4-3
Groundwater Monitoring Overview by Purpose: Monitoring Year 2006

Number of…	Regulatory/ Waste Management	Environmental Surveillance
Monitoring Points Sampled - Analytical[a]	34	45
Monitoring Points - Water Elevations Only	0	55
Monitoring Events	4	5
Analyses	590	593
Results	5,244	4,689
Percent of Nondetectable Results	86%	87%
Water Elevation Measurements	128	336

NA - Not applicable
[a] *Total number includes 69 on-site points and 10 off-site points*

• Four new groundwater monitoring wells were installed during August 2003 to provide upgradient and downgradient monitoring coverage for the remote-handled waste facility.

• Reductions in analytes or sampling frequencies were implemented at 14 monitoring locations in early 2005.

Groundwater is routinely monitored in the five hydrogeologic units described in Table 4-1. In 2006, a total of 69 on-site groundwater monitoring locations were sampled. These locations included 63 monitoring wells and well points, five groundwater seepage points, and one sump/manhole. Tables 4-2 and 4-3 provide an overview of groundwater monitoring during 2006 organized by geographic area and by monitoring purpose.

Monitoring Well Network. The WVDP groundwater monitoring network is a vital component of the Environment Protection Program implemented under DOE Order 450.1. Many of the routine groundwater monitoring wells were installed to monitor one or more solid waste management units (SWMUs) on the WVDP premises. (See "RCRA §3008(h) Administrative Order on Consent" [the Consent Order] under "Resource Conservation and Recovery Act" in the "Environmental Compliance Summary.")

Table E-1 lists the wells in the network, sorted by the geologic unit, and the analytes measured in 2006. The frequency of monitoring and the constituents measured are a function of regulatory requirements, as well as current operating practices and historical knowledge of previous site activities. Note that monitoring of certain wells, marked by an asterisk, is specified in RFI reports prepared in accordance with the Consent Order for the WVDP.

Groundwater Elevation Monitoring. Potentiometric (water level) measurements are collected from wells in conjunction with the quarterly analytical sampling schedule (Appendix E). Groundwater elevation data are used to produce groundwater contour maps that delineate flow directions and gradients. Long-term trend graphs are used to illustrate variations in groundwater elevations over time, such as seasonal fluctuations. In 2006, water levels were routinely measured in wells listed in Table E-1, as well as at 44 additional locations. (See Figs. A-8 through A-10 in Appendix A.)

Surface water elevation measurements are also taken at 11 locations on the north plateau where the water table in the sand and gravel unit intersects the ground surface, resulting in standing water. These measurements are correlated with groundwater elevations measured at nearby monitoring wells to provide data in areas where monitoring well coverage is sparse or nonexistent.

Analytical Trigger Level Evaluation. A computerized data-screening program uses "trigger levels" – preset conservative values for chemical and radiological concentrations and groundwater elevation measurements – to promptly identify anomalies in monitoring results that may require further investigation. The trigger levels are based on regulatory limits, detection limits, or statistically derived values.

Results of Routine Groundwater Monitoring

Sampling results for radiological and nonradiological analytes are provided in the tables in Appendix E grouped by hydrogeologic unit. The wells in each table or figure are arranged by hydraulic position, from upgradient to downgradient, within the same hydrogeologic unit. Wells identified as "UP" refer to either background wells or wells that are upgradient of WVDP facilities. Wells identified as "DOWN" are

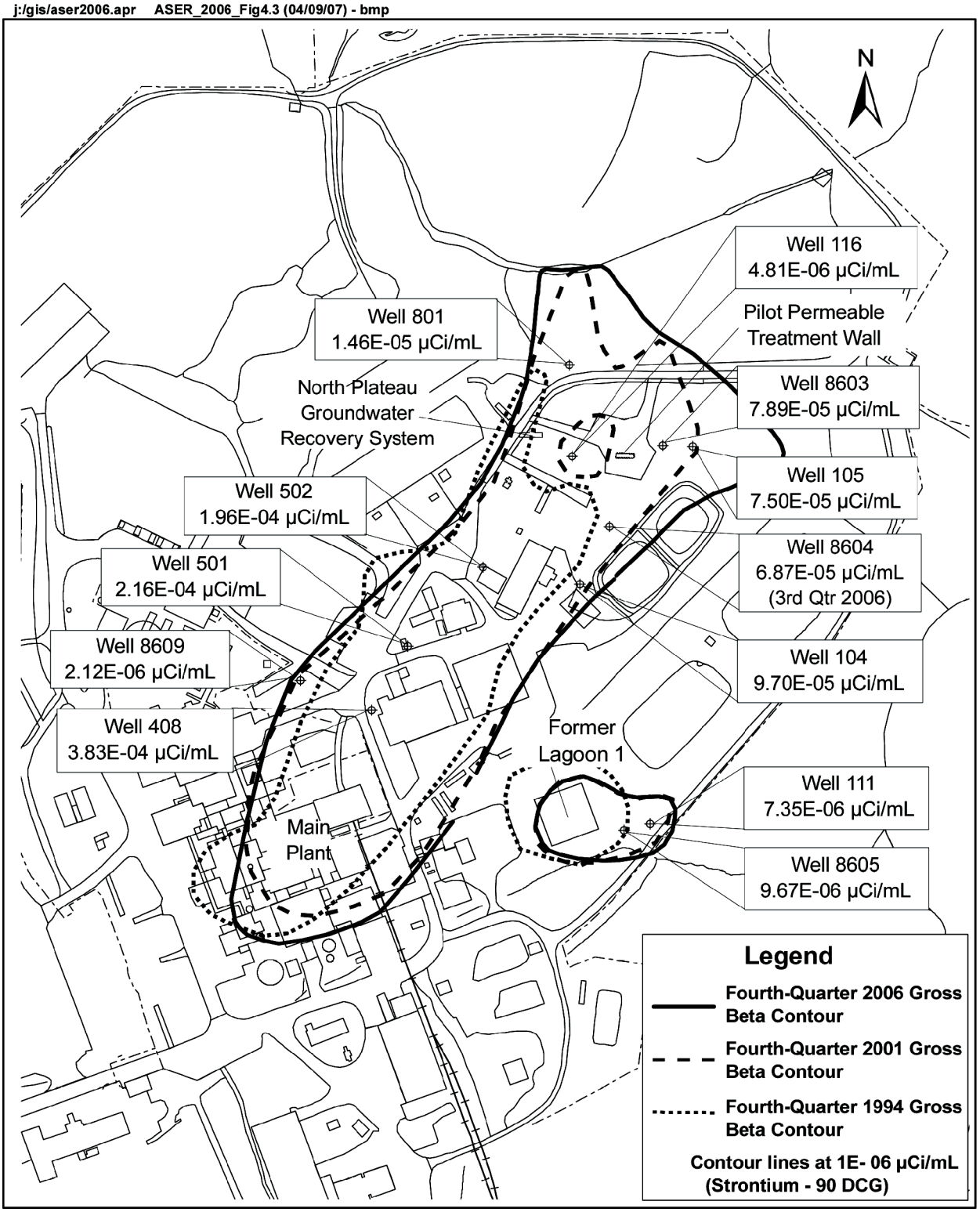

Figure 4-3. North Plateau Gross Beta Plume Area: Fourth-Quarter 2006 Results

Table 4-4
Maximum Concentrations For Radiological Parameters in WVDP Wells

Radionuclide	Regulatory/Waste Management		Environmental Surveillance	
	Well ID	Maximun Concentration (µCi/mL)	Well ID	Maximun Concentration (µCi/mL)
Gross Beta	Well 408	3.83E-04	Well 104	9.70E-05
Strontium-90	Well 408	8.55E-05	Well 8603	3.53E-05
Tritium	WNNDATR	4.27E-06	WP-C	3.57E-05

downgradient of WVDP facilities. Table E-12 lists the practical quantitation limits (PQLs) for monitored organic compounds and metals.

Monitoring the Sand and Gravel Unit on the North Plateau

A total of 40 monitoring locations are routinely sampled in the sand and gravel unit on the north plateau. This total includes 32 monitoring wells, three well points, and five groundwater seepage locations. Results for all sand and gravel monitoring locations can be found in Table E-2 and in Tables E-7 through E-11. A discussion of the more relevant results is provided in the following paragraphs.

Plume on the North Plateau. Elevated gross beta activity was detected in the early 1990s in groundwater from the surficial sand and gravel unit northeast of the building where Nuclear Fuel Services, Inc. reprocessed nuclear fuel (the "Main Plant" on Fig. 4-3). In 1993, elevated gross beta concentrations were detected in surface water near the northeastern edge of the north plateau. Strontium-90 and its daughter product, yttrium-90, were identified as the major isotopic components of the gross beta activity (WVNSCO, 1995). Extensive subsurface investigations delineated the extent of the plume (Fig. 4-3), which continues to be closely monitored. Maximum concentrations of gross beta and strontium-90 in wells are listed in Table 4-4. Gross beta activity was also detected in the area of former lagoon 1, which had been backfilled in 1984. The source of this radiological activity was presumed to be radiologically contaminated sediments from former lagoon 1.

Gross Alpha. Gross alpha concentrations in the sand and gravel unit are typically very low; most are lower than the detection level, with the exception of those from well 8605.

Low concentrations of gross alpha activity detected in groundwater from well 8605 are attributed to its location downgradient of former lagoon 1. Historical gross alpha measurements from well 8605 of 3E-08 microcuries per milliliter (µCi/mL) or greater have been observed, but over the past two years the concentrations have remained below 1E-08 µCi/mL. Well 111, also located downgradient of former lagoon 1, exhibits lower gross alpha concentrations that are close to or within background levels.

Gross Beta and the Strontium-90 Plume. The strontium-90 plume extends from beneath the main plant to the northeast quadrant of the north plateau. The presumed source of the strontium-90 activity can be traced to soils beneath the southwest corner of the main plant. Gross beta activity of ground-

water within and around the plume continues to be monitored closely. Ten monitoring wells within the strontium-90 plume exhibit gross beta concentrations above the DOE derived concentration guide (DCG) for strontium-90 of 1.0E-06 µCi/mL. (See the "Useful Information" section at the end of this report for a discussion of the DOE DCGs, and Table UI-1 for a listing of the DCGs for all radionuclides of interest at the WVDP.)

Two wells (8605 and 111) located downgradient of former lagoon 1 (identified as the source) also exhibit gross beta concentrations above the DOE DCG.

Figure 4-3, which lists gross beta results from the plume area in 2006, plots the edges of the plume area with concentrations exceeding the strontium-90 DCG in 1994, 2001, and 2006. A lengthening and shifting of the contours to the northeast over time can be seen, indicating migration of the plume in conjunction with the direction of groundwater flow.

Groundwater is also monitored along the northeast edge of the north plateau where groundwater seeps from the steep banks of the stream channels incised by Erdman Brook and Frank's Creek. (See Fig. A-9 in Appendix A. See Table E-2 for sampling results.)

Most radiological monitoring results from the north plateau seepage area do not indicate migration of the strontium-90 plume to that distance. Gross beta concentrations from all seep monitoring locations, with the exception of SP11, were close to or within background levels during 2006. However, gross beta concentrations at SP11 have increased from 1999 through 2006. The gross beta activity at SP11 is believed to be attributable to re-infiltration of contaminated water that has surfaced from the strontium-90 groundwater plume upgradient of this location. The levels of this gross beta activity are well below the DOE DCG for strontium-90.

Analytical results from the locations shown in Figure 4-3 are discussed below and the concentration data trends over the last ten years are displayed in Figures 4-4 through 4-7.

Figure 4-4 shows gross beta concentrations in wells 104, 408, 501, 502, and 8609, which are centrally located on the north plateau within the main portion of the plume. As in previous years, groundwater from well 408 continues to exhibit the highest gross beta concentrations of all routine monitoring wells in the plume. Gross beta concentrations in well 408 and wells 104, 501, and 502 increased in 2006 as compared to 2005, after exhibiting steady or decreasing concentrations from 2002 through 2005. The gross beta concentration in well 8609 decreased slightly in 2006 when compared with 2005, but is still relatively high in relation to the historical concentration trend since 1997.

Figure 4-5 shows gross beta concentrations in wells 105, 116, 801, 8603, and 8604. These wells are located further northeast than the preceeding group of wells and are further downgradient from the plume's presumed source beneath the main plant. Groundwater from this group of wells exhibited increases in gross beta concentrations from 2005 to 2006. Groundwater from well 105 showed the steepest increase in concentrations from 1997 through 2006.

Figure 4-6 shows gross beta concentrations at wells 111 and 8605, located downgradient of former lagoon 1. Average gross beta concentrations at these two wells have remained relatively steady over time. Concentrations in 2006 were very similar to those from 2005. (See "Evaluation of Near-Term and Long-Term Plume Management Activities" later in this chapter.)

Tritium. Essentially all sand and gravel well monitoring locations where tritium concentrations have been elevated in the past now exhibit decreasing

trends, as shown in Figure 4-7. The presence of tritium activity on the WVDP north plateau is believed to be mainly residual (i.e., as a result of previous activities on site during the period of fuel reprocessing operations). Over time, the tritium activity has decreased as a result of radiological decay, as well as dilution from groundwater recharge and surface water infiltration. Tritium concentrations at many of these locations are currently close to or within the background range.

A small isolated area of higher tritium concentrations is found northeast of the main plant. This area is monitored by well points WP-A, WP-C, and WP-H (see Table E-2). Historically, elevated levels of tritium have been found in groundwater from wells adjacent to or downgradient of the lagoon system and adjacent to the hardstand and lag storage areas. Well point WP-C contains the highest tritium concentrations of WVDP environmental surveillance wells (see Table 4-4). However, tritium concentrations in groundwater from all these areas are decreasing.

Tritium concentrations in the seeps along the northeast edge of the north plateau are slightly higher than levels in background wells of the sand and gravel unit. Concentrations are similar to those seen in sand and gravel unit wells monitoring the lagoon areas of the north plateau, but are still far below the DOE DCG for tritium.

Results for Volatile and Semivolatile Organic Compounds (VOCs and SVOCs). Many wells within the sand and gravel unit are monitored for VOCs and SVOCs, as required by the Consent Order, which specifies that groundwater conditions upgradient and downgradient of specific site

Table 4-5
Summary of Organic Constituents in WVDP Groundwater Wells

Constituent	Regulatory/Waste Management Monitoring Program	
	Well With the Highest Concentration	Concentration Range (µg/L)
1,1-Dichloroethane	8612	6.9–9.7[a]
1,1,1-Trichloroethane	8612	0.82–1.0[b] (estimated)
1,2-Dichloroethylene (total)	8612	21–27[a]
1,4-Dioxane	111	ND–1.0[b] (estimated)
Dichlorodiflouromethane	8612	2.3–3.4[b] (estimated)
Ethyl benzene	803	ND–1.0[b] (estimated)
Tributyl phosphate	8605	190–280[a]
Trichloroethylene	501	ND–3.0[b] (estimated)
Vinyl chloride	8612	ND–0.4[b] (estimated)
Xylene	803	ND–6.7[b]

ND - Not detected
[a] These values are the lowest or highest of two analytical results reported at these wells during 2006; the values calculated and reported for these wells in Table E-9 is the average of the replicate analyses.
[b] Compounds presented as "estimated" were reported at an estimated concentration less than the minimum detection limit.

SWMUs be monitored. Monitoring at additional wells is used to establish background and upgradient conditions within unaffected areas of the unit, or to monitor conditions downgradient of locations where positive detections of VOCs and/or SVOCs are currently or have previously been reported.

Currently, the only sand and gravel monitoring location with consistent positive detections of VOCs is well 8612, located northeast of the closed construction and demolition debris landfill (CDDL) at the northeast edge of the north plateau. (See Figure A-8 and Table E-8CD.) The presence of VOCs in this area is presumed to be the result of wastes buried in the CDDL. In the past, VOCs were repeatedly detected at a few additional monitoring locations, such as wells 803 and 8609 and seepage monitoring locations GSEEP and SP12 (see Table E-8CD), but recent analytical results from these monitoring locations have not detected those VOCs. In fact, VOCs have not been positively detected at GSEEP since 1993, or at SP12 since 2002, so these monitoring locations are no longer included in the graphs in this chapter. (See Tables E-8CD and E-9CD for 2006 sampling results and Table E-12CD for a list of sampled analytes.) With the exception of the analytes in wells 8612 and a detection of xylene in well 803 during one sampling event in 2006, no VOCs have been detected. The range of organic compounds in selected groundwater monitoring wells showing the maximum concentration is presented in Table 4-5.

1,1-Dichloroethane (1,1-DCA). Concentrations of 1,1-DCA at well 8612 decreased rather steeply from 1995 through 2006 (Fig. 4-8). The compound was not detected at wells 8609, 803, or groundwater seeps GSEEP or SP12 during 2006.

1,1,1-Trichloroethane (1,1,1-TCA). The compound 1,1,1-TCA was detected in well 8612 during 2006 at estimated levels below the PQL (Fig. 4-8), but was not detected in well 803, 8609, or in seep monitoring locations GSEEP or SP12.

Total 1,2-Dichloroethylene (1,2-DCE-t). Positive concentrations of 1,2-DCE-t were first detected at well 8612 in 1995. Concentrations of 1,2-DCE-t increased from 1995 through 2002, but showed an overall decrease from 2002 through 2006 (Fig. 4-8).

Dichlorodifluoromethane (DCDFMeth). DCDFMeth was detected at well 8612 during 2006 at relatively low concentrations near or below the PQL (Fig. 4-8), but was not detected in wells 803, 8609, or seep monitoring locations GSEEP or SP12.

Other VOCs historically detected at one or more of these monitoring locations, such as trans-1,2-dichloroethylene (t-12-dce) and trichloroethylene, were not detected in 2006.

The VOCs 1,1-DCA, DCDFMeth, and 1,1,1-TCA are often found in combination with 1,2-DCE-t. In well 8612, each compound first exhibited an increasing trend that, after several years, was followed by a long-term decreasing trend. It is expected that 1,2-DCE-t will exhibit similar behavior, as indicated by its generally decreasing trend in recent years.

Tributyl Phosphate (TBP). Concentrations of TBP were detected in 2006 groundwater samples from well 8605, near former lagoon 1, at concentrations slightly lower than in 2005 and almost one-half of those in 2004. TBP also was previously detected in well 111, located near well 8605, but at levels much lower than those at well 8605. During 2006, TBP was detected at well 111 at concentrations similar to those reported in 2005. Since 2001, TBP concentrations at well 111 have been fluctuating near the PQL of 10 µg/L. The range of concentrations reported in well 8605 is shown in Table 4-5. Analytical results for SVOCs at other monitoring locations remain nondetectable.

Ongoing detection of TBP in this localized area may be related to previously detected concentrations of iodine-129 and uranium-232 in wells 111 and 8605, as noted in previous Annual Site Environmental Reports. The presence of these contaminants may reflect residual contamination from liquid waste management activities in the former lagoon 1 area during earlier nuclear fuel reprocessing.

Additional monitoring locations are sampled for VOCs and/or SVOCs because they are downgradient of locations that have shown positive results or to comply with the Consent Order. No VOCs or SVOCs have been detected at these locations.

North Plateau Groundwater Recovery System. In 1995, the north plateau groundwater recovery system (NPGRS) was installed to minimize the advance of the gross beta plume. (See Figure 4-3.) The NPGRS consists of three wells that extract contaminated groundwater, which is then treated by ion exchange to remove strontium-90. Treated water is transferred to the lagoon system and is ultimately discharged to Erdman Brook.

The NPGRS operated throughout 2006, processing about 3.31 million gallons (gal) (12.5 million liters [L]) of water. The system has recovered and processed approximately 46 million gal (176 million L) since November 1995.

Permeable Treatment Wall. A pilot-scale permeable treatment wall (PTW) was constructed in 1999 in the sand and gravel unit within the eastern lobe of the north plateau plume to test this passive, in-situ remediation technology. The PTW is a trench that is backfilled with clinoptilolite, a medium selected for its ability to adsorb strontium-90 ions from groundwater. Continued monitoring indicates that strontium-90 concentrations are lower in wells within the PTW, indicating that strontium-90 is being removed from the water that passes through the wall. However, the plume has since encircled and migrated past the PTW test area. The complex geology that exists in the vicinity of the pilot PTW is believed to affect the performance of the wall, and the wall itself may be affecting the pattern of groundwater flow in the plume area. Sufficient data have been obtained to determine the effectiveness of the PTW technology.

Northeast Swamp Drainage Monitoring. Routine radiological sampling continued during 2006 at surface water location WNSWAMP (Appendix C-4[CD]). While gross beta and strontium-90 concentrations continued to fluctuate due to seasonal effects, the annualized average exceeded the DOE DCG during all of CY 2006 (Fig. 4-10). The main source of the elevated strontium-90 is groundwater from the north plateau plume seeping into a ditch upstream of WNSWAMP. (See Figure 4-3 in this Chapter and Figure A-2 in Appendix A.) An estimated 48 million gal (180 million L) of water flowed through this monitoring point during 2006.

The annualized average concentration of strontium-90 in surface water at sampling location WNSWAMP (on the WVDP premises) remained elevated with respect to background. Even so, monitoring downstream at the first point of public access in Cattaraugus Creek, Felton Bridge (location code WFFELBR), continued to show gross beta concentrations that were only slightly higher than those at the Cattaraugus Creek background location at Bigelow Bridge (WFBIGBR). (See also "Northeast Swamp and North Swamp Drainage" in Chapter 2.)

North Plateau Characterization. In late 2006, the DOE submitted to the New York State Department of Environmental Conservation a draft "Sampling and Analysis Plan for Characterization of the North Plateau Plume Area" and a draft "Sampling Plan for Background Subsurface Soil Data on the North Plateau." These plans propose

additional sampling to further characterize and evaluate the north plateau strontium-90 plume area.

Evaluation of Near-Term and Long-Term Plume Management Activities. Alternatives for management of the plume are currently being evaluated. Groundwater monitoring data are being used to evaluate the current conditions of the plume and to model the future plume configuration under differing near-term and long-term scenarios.

Near-term strategies are focused on ways to reduce migration of the downgradient leading edges of the plume, thereby minimizing expansion beyond its current mapped limits and migration into downgradient surface water and seepage points. The proposed management strategies may include implementation of permeable reactive barrier technology, hydraulic barriers such as an interceptor trench, groundwater extraction wells, or a combination of these technologies in various configurations. The implementation of the near-term plume management strategy is integral to the Enhanced Interim End State objective for the WVDP, to manage and minimize off-site contamination while the WVDP Environmental Impact Statement (EIS) is finalized.

Long-term strategies are those that will include the entire plume, with the objective of long-term management and/or remediation. The objective is to contain the plume within its current boundaries so that it can be effectively removed and/or allowed to decay in-place within the WVDP premises. These strategies will be integrated with the near-term plume management options and will be evaluated in the WVDP EIS.

Monitoring on the South Plateau: Weathered Lavery Till and the NDA

In 1990, a trench system was constructed along the northeast and northwest sides of the NDA to collect groundwater that may be contaminated with a mixture of n-dodecane and TBP. (See also "Nuclear Regulatory Commission-Licensed Disposal Area [NDA] Interceptor Trench and Pretreatment System" in Chapter 1.) Monitoring results in 2006 indicated no n-dodecane or TBP in groundwater near the NDA. Groundwater elevations are monitored quarterly in and around the trench to ensure that an inward gradient is maintained, thereby minimizing outward migration of potentially contaminated groundwater.

WNNDATR and Well 909. Gross beta and tritium concentrations in groundwater from sampling location WNNDATR, a sump at the lowest point of the interceptor trench, and from well 909, downgradient of WNNDATR (Fig. A-8 in Appendix A), continued to be elevated with respect to background monitoring locations on the south plateau. WNNDATR contained the highest tritium concentrations reported of the WVDP regulatory compliance groundwater monitoring locations (see Table 4-4). Concentrations were still well below the DOE DCG for tritium.

During 2006, tritium concentrations at WNNDATR were similar to those in 2005, but overall have decreased since 1994. In contrast, gross beta concentrations have increased with time, with even steeper increases observed during 2005 and 2006. Residual activity from historical site operations in the NDA is the presumed source of this gross beta activity. Currently, groundwater passing through the NDA is collected at WNNDATR and is transferred to the low-level waste treatment facility for processing. Interim measures are being planned for the NDA to curb the migration of groundwater at the NDA.

Radiological indicator results at well 909 showed increasing gross beta and tritium concentrations until 1999, when concentrations of both declined. Values have stabilized over the last few years.

Residual soil contamination near well 909 is thought to be the source of the gross beta activity.

In 2006, methods for reducing infiltration of water into the NDA were considered by the DOE. As of early 2007, plans are underway for placing a geomembrane cap on the NDA, building a slurry wall upgradient of the NDA, as well as constructing a system for diverting groundwater and surface water away from the NDA. (See the "NRC-Licensed Disposal Area [NDA]" section in the "Environmental Compliance Summary.")

Additional Monitoring and Investigations

Results of Radioisotopic Sampling. Groundwater samples for radioisotopic analyses are collected regularly from selected monitoring points in the sand and gravel unit and the weathered Lavery till (Table E-11). Strontium-90 concentrations were found to be elevated in monitoring wells in the north plateau plume area, as discussed earlier in this chapter, and also downgradient of the NDA on the south plateau. Concentrations of other radioisotopic analytes remained similar to previous historical results. Most analyses found no detectable concentrations of the other radionuclides.

Historical monitoring and special investigations have detected carbon-14, technetium-99, and iodine-129 at a few locations. One or more of these isotopes have been detected in the sand and gravel unit at wells within the gross beta plume (wells 408, 501, and 502), downgradient of former lagoon 1 (wells 111 and 8605) or in the weathered Lavery till downgradient of the NDA (well 909).

When detected, the nuclides were found at low percentages of their DCGs and they accounted for only a small portion of the gross beta concentrations. Frequent gross beta monitoring provides sufficient surveillance to identify trends in major gross beta constituents. Periodic radioisotopic analyses are effective in tracking those nuclides that contribute only a small fraction of the gross beta activity.

North Plateau Groundwater Quality Early Warning Monitoring. Early-warning monitoring of water recovered by the NPGRS is performed because this water is ultimately discharged offsite via the New York State Pollutant Discharge Elimination System (SPDES)-permitted outfall 001. Semiannual monitoring results from well 502, located directly upgradient of the NPGRS, can be used to identify metals concentrations in groundwater that may affect compliance with the SPDES-permitted effluent limits. Results of sampling for metals at well 502 can be found in Tables E-7 and E-10.

Investigation of Chromium and Nickel in the Sand and Gravel Unit and Evaluation of Corrosion in Groundwater Monitoring Wells. A 1997 and 1998 study of the effect of modifying sampling equipment and methodology on concentrations of chromium and nickel in groundwater samples from the sand and gravel unit noted that such modifications produced decreases in these concentrations. This finding supported the hypothesis (which is documented in the technical literature) that elevated concentrations were not representative of actual groundwater conditions, but were caused by release of metals from subsurface corrosion of stainless-steel well materials (WVNSCO and Dames & Moore, June 1998).

To ensure that the integrity of the monitoring wells is maintained, and to ensure that high-quality samples representative of actual groundwater conditions are collected, wells are periodically inspected for corrosion. Approximately three-fourths of the stainless-steel wells monitoring the sand and gravel unit were internally inspected for corrosion during 2001. At that time, wells with cor-

rosion were cleaned and reinspected to verify that corrosion had been removed. Wells suspected of containing corrosion will be inspected in 2007.

Fuel Receiving and Storage (FRS) Pool Water Infiltration. During mid-2005, water was found trickling into the empty FRS pool during a quarterly inspection. The water had accumulated to approximately four to six inches. The water is directed by a slope in the floor to the deeper stainless-steel-lined cask unloading pool (CUP). Analytical data for the FRS CUP water indicate that groundwater seepage is the source of the water. During periods of high precipitation or snow melt, slight seepage has entered along the south wall. The elevated cesium-137 concentrations are believed to be from residuals that adhered to the FRS walls when the pool was full. Groundwater seeping into the pool is thought to have dissolved some of the cesium. Since the water does not pose operational or safety concerns, it has been left in the CUP under routine monitoring. Currently, the water level in the CUP is measured by facility operators daily.

Off-Site Groundwater Monitoring. Groundwater is used as a potable water supply at off-site private residences near the WVDP. Groundwater samples are collected routinely from nine off-site residential supply wells that represent the closest unrestricted use of groundwater near the Project. Wells are located within 4.3 miles (7 kilometers [km]) of the facility. One additional well, located 18 miles (29 km) south of the site, is used for background purposes. None of the wells draw from groundwater units that underly the site. Additional information is provided in "Drinking Water Monitoring" in Chapter 2.

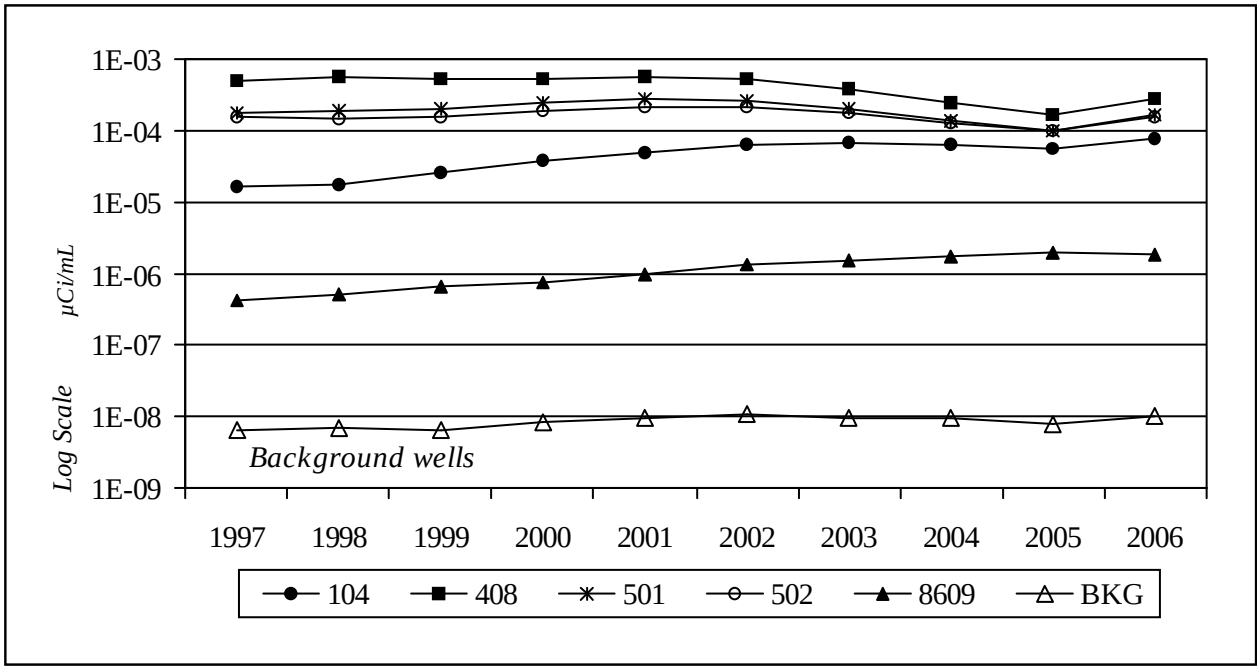

Figure 4-4. Average Annual Gross Beta Concentrations at Locations Closer to the Source of the North Plateau Plume

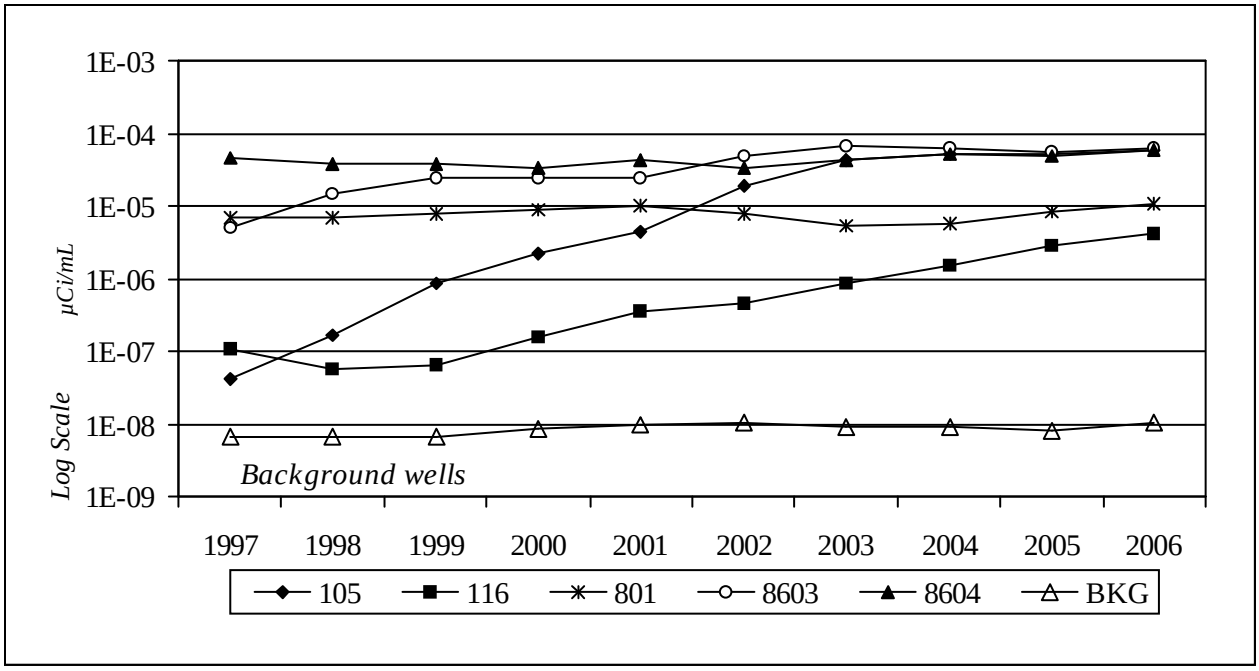

Figure 4-5. Average Annual Gross Beta Concentrations at Locations Closer to the Leading Edges of the North Plateau Plume

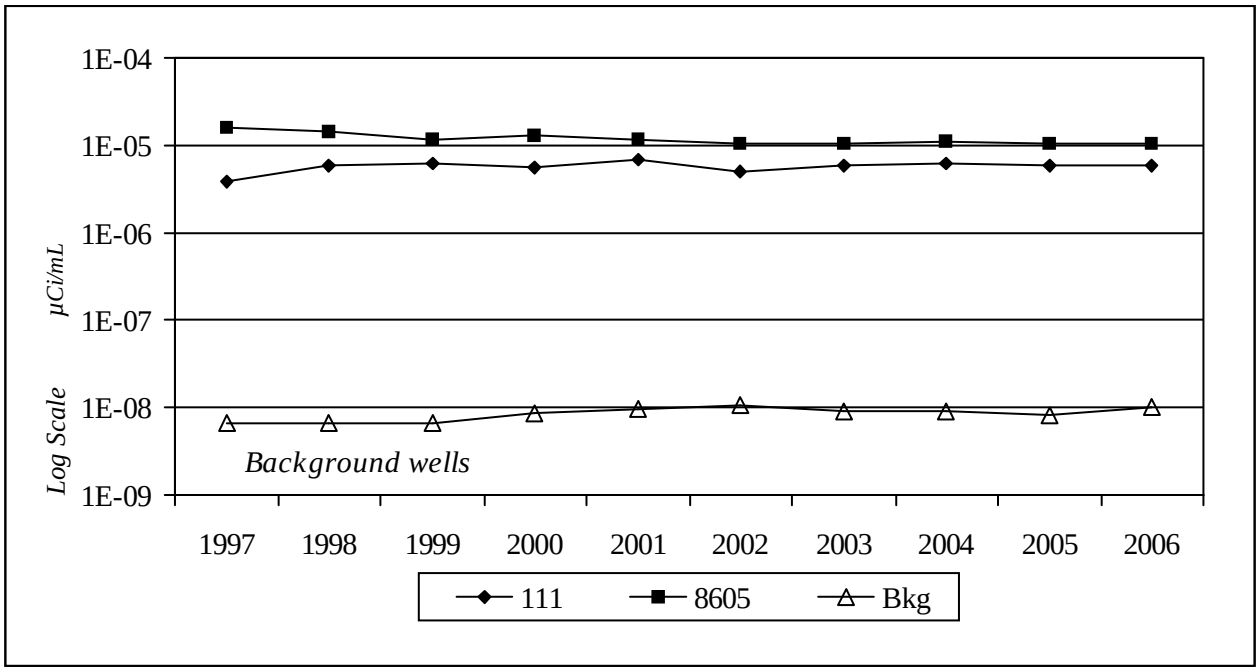

Figure 4-6. Average Annual Gross Beta Concentrations at Locations Near Former Lagoon 1

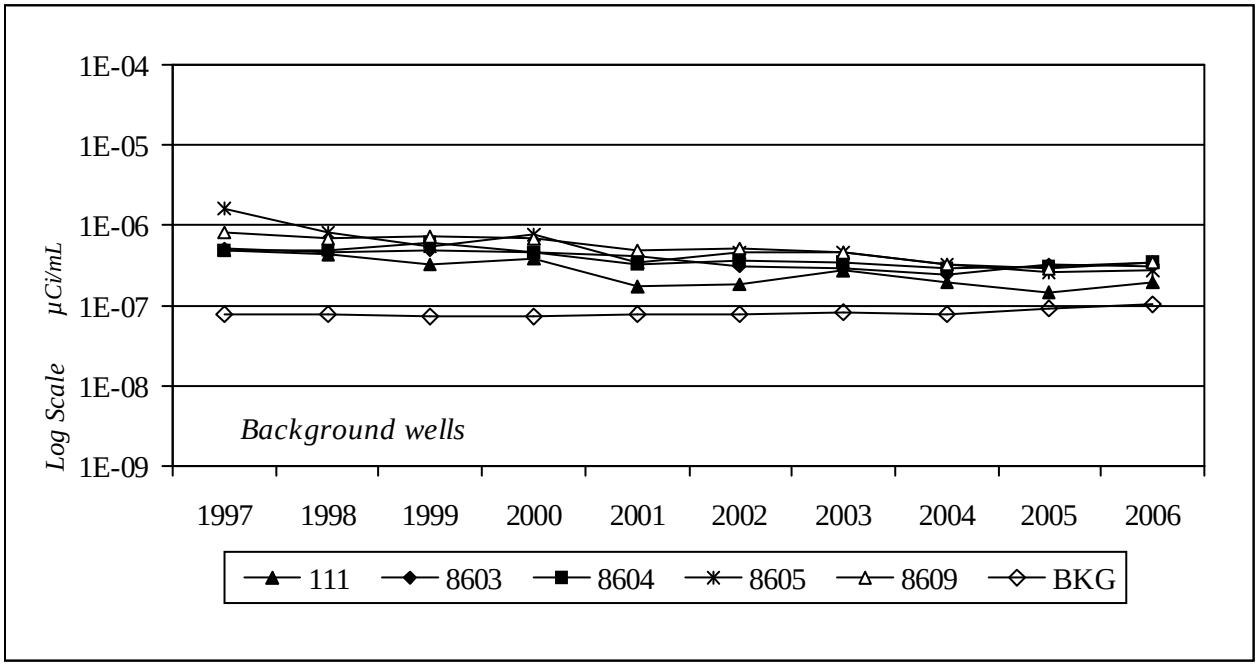

Figure 4-7. Average Annual Tritium Concentrations at Selected Locations in the Sand and Gravel Unit

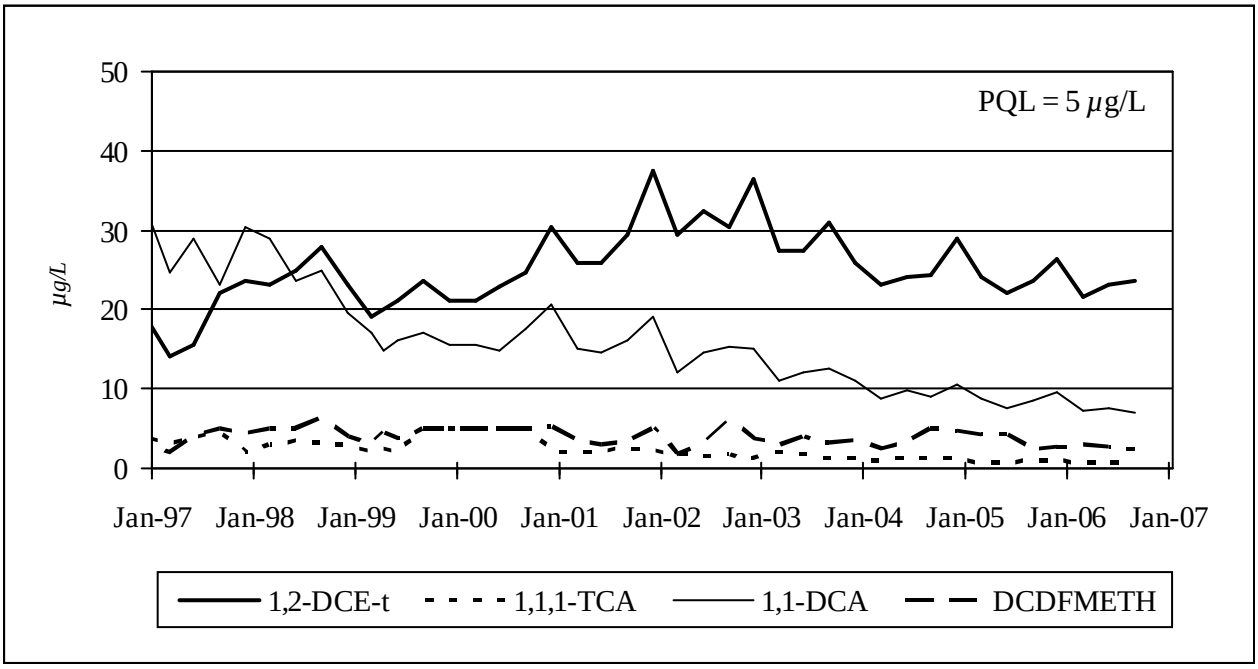

Figure 4-8. Concentrations of 1,2-DCE-t, 1,1,1-TCA, 1,1-DCA, and DCDFMeth at Well 8612 in the Sand and Gravel Unit

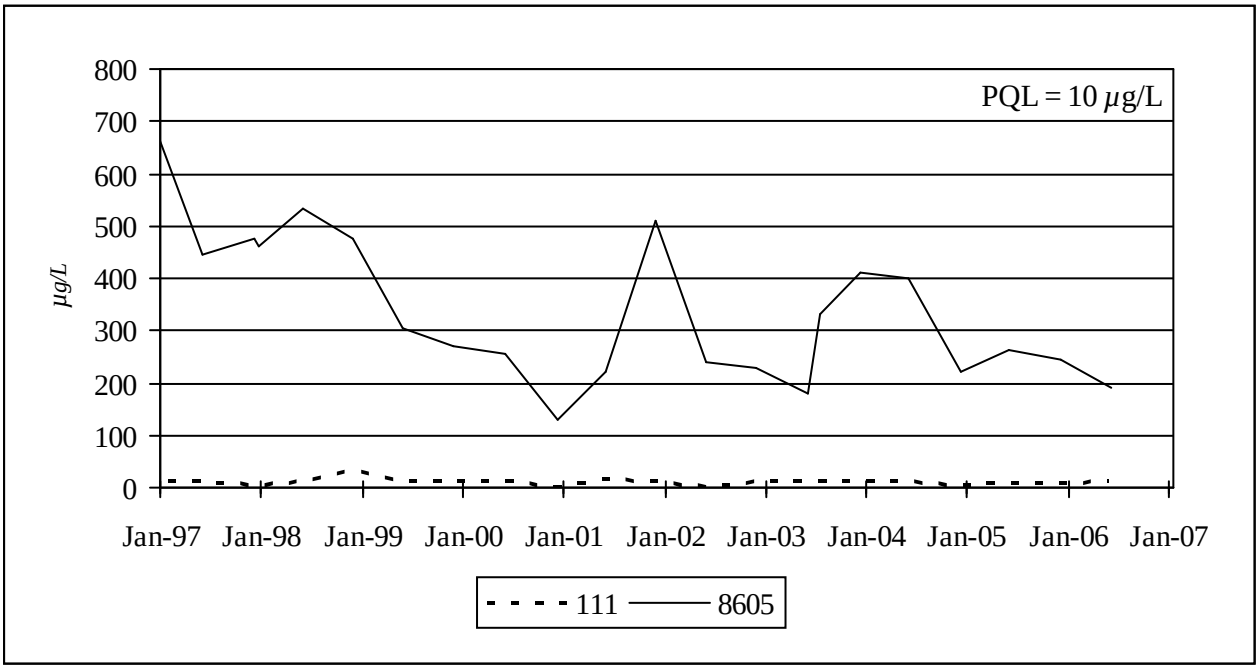

Figure 4-9. Concentrations of Tributyl Phosphate at Selected Locations in the Sand and Gravel Unit

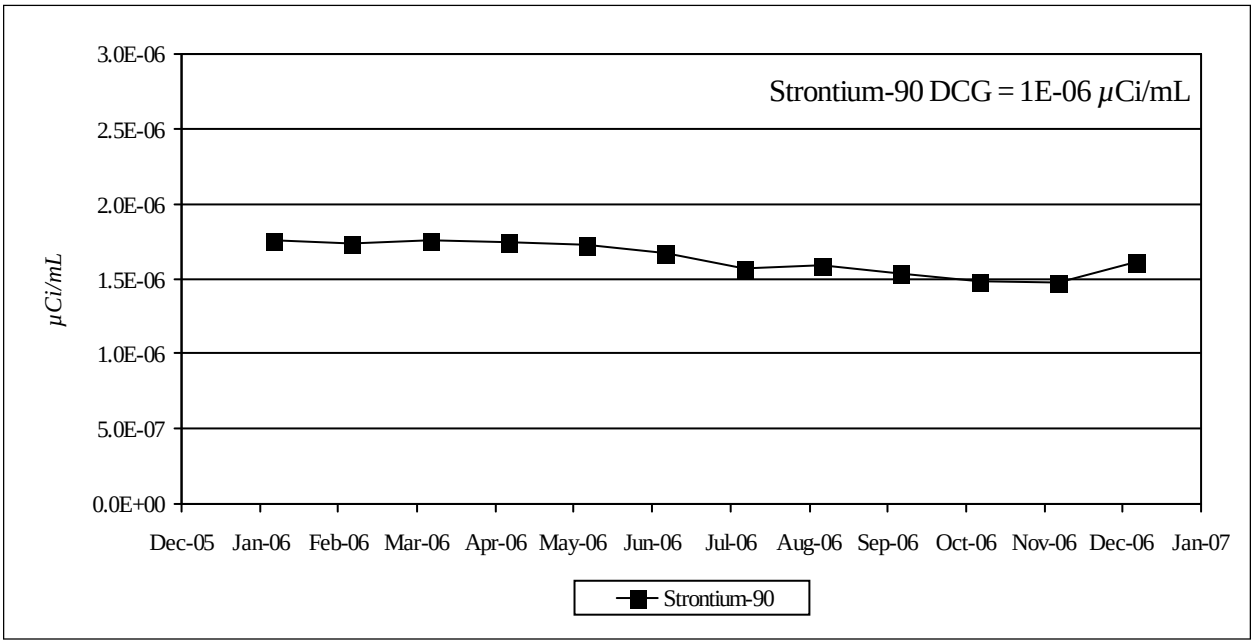

Figure 4-10. Annualized Average Strontium-90 Concentrations at WNSWAMP

Note: DCGs are used as an evaluation tool for results from on-site locations as part of the routine environmental monitoring program. However, DOE DCGs are applicable only at locations where members of the public could be exposed to water containing contaminants, that is, locations outside of the site boundary.

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