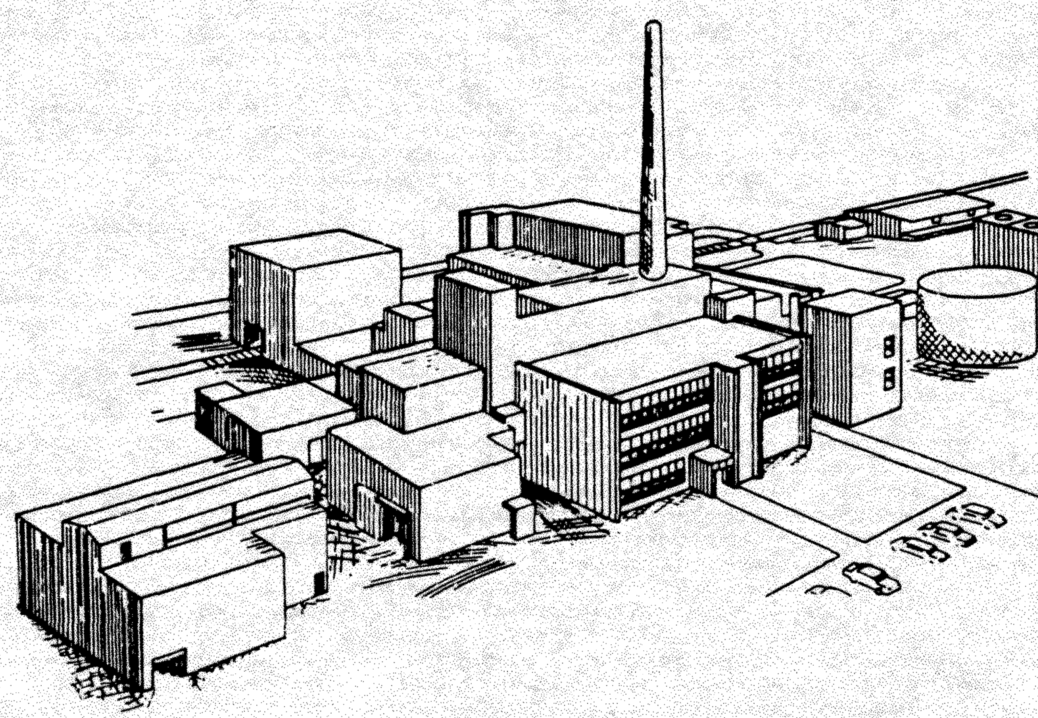
WVDP-040

1986
ENVIRONMENTAL MONITORING REPORT
WEST VALLEY DEMONSTRATION PROJECT

March 1987

West Valley Nuclear Services Company, Inc.



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ENVIRONMENTAL MONITORING REPORT

WEST VALLEY DEMONSTRATION PROJECT

March 1987

Operated for the U.S. Department of Energy

by

West Valley Nuclear Services Company, Inc.

Rock Springs Road

West Valley, New York 14171-0191

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DISCLAIMER

1.0 INTRODUCTION

This report is submitted in accordance with DOE Order 5484.1 and presents a summary of environmental monitoring data collected at the West Valley Demonstration Project (WVDP) from January 1, 1986 through December 31, 1986. The program implemented by West Valley Nuclear Services Company provides data in compliance with DOE guidelines and recommendations which is reported annually in the WVDP-040 series of reports.

On February 26, 1982, the responsibility for operation and maintenance of the former Nuclear Fuel Services, Inc. (NFS) reactor fuel reprocessing facility was transferred to the Department of Energy (DOE). Public Law No. 96-368, enacted in 1980, mandated the demonstration of technology for solidification of the 2.2 million litres (580,000 gallons) of liquid high-level radioactive waste that were produced by commercial fuel reprocessing at the West Valley plant and are now held in underground storage tanks at the facility. The DOE selected West Valley Nuclear Services Company (WVNS) as the contractor to implement the provisions of this law.

When WVNS assumed operational control, NFS was conducting an environmental monitoring program appropriate to the shutdown maintenance operating status of the facility in accordance with Technical Specification 5.1 under NRC License CSF-1. WVNS recognized that the NFS program required substantial change in order to prepare for the high-level waste solidification operations currently scheduled for start-up in October of 1989. Accordingly in 1982, WVNS began to implement a full-scale environmental surveillance program in support of these planned operations and by 1985 had fully implemented this program. As recommended in DOE Order 5484.1, Chapter III, Paragraph 1, this program has provided more than two years of environmental baseline data prior to solidification operations.

During 1986, the environmental surveillance plan was revised in response to suggestions of DOE-ID and DOE-HQ personnel during their environmental monitoring appraisal of May 21-23, 1985. The revisions also reflected Project monitoring experiences to date. The revised plan provides more detailed coverage of on-site waste management areas and monitoring of more nonradiological parameters. The off-site monitoring program also was augmented to include more monitoring stations and additional parameters (both radiological and nonradiological). Also included were changes to the program dictated by revised sampling requirements in the Project's SPDES permit. The revised plan is described in detail in Appendix A which includes a summary of the changes. As this summary indicates, many additions and modifications to procedures, equipment and sampling locations were completed by year's end.

A comprehensive Environmental Evaluation (EE) was published in June, 1984 to initiate the decision-making process for disposal of Project low-level radioactive waste (LLW). The intent of the Project is to phase out the methods used by NFS and replace them with state-of-the-art engineered disposal technology. Based on the review of the EE by the Department of Energy Headquarters and the Idaho Operations Office, the Project staff was directed to assist the DOE with the preparation of an Environmental Assessment which analyzed alternative disposal options more thoroughly than was appropriate in the EE. After extensive review of a draft by DOE, the final EA was published in February 1986. In April of 1986, the Department of Energy approved the LLW disposal EA, and after an appropriate public comment period, issued a Finding of No Significant Impact (FONSI) in August of the same year.

EE's were also prepared in 1985 and 1986 for the major solidification process support systems, including the High Level Waste Vitrification System, Supernatant Treatment System (STS), Cement Solidification System (CSS), and Liquid Waste Treatment System (LWTS). These documents were approved by Project management and submitted to DOE-ID for review and approval.

Although the reprocessing plant is not being used for its original purpose, major portions have been and are being decontaminated for use in support of the vitrification process. This requires continued operation of basic services, including low-level radioactive waste management. Facility operation through 1986 included periodic disposal of low level solid radioactive waste from decontamination and maintenance activity (plant wastes*) in the formerly licensed disposal area. Throughout 1986 liquid wastes resulting from plant activities continued to be processed on-site at the low-level waste treatment facility (LLWT) prior to discharge. Construction was initiated in 1986 on an above-ground storage facility for certain types of low level radioactive wastes. This drum storage cell is located to the southwest of the plant and adjacent to the NRC licensed disposal area.

The WVDP site is located in a rural setting approximately 50 km (30 mi) south of Buffalo, New York (Figure 1-1), at an average elevation of 400 m (1,300 ft) on New York State's western plateau. The plant facilities used by the Project occupy approximately 63 hectares (156 acres) of chain-link fenced area within a 1,350 hectare (3,300 acre) reservation that constitutes the Western New York Nuclear Service Center (WNYNSC). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 km (5 mi) of the plant. Several roads and one railway pass through the Center, but no human habitation, hunting, fishing, or public access are permitted on the WNYNSC.

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek to the north serves as a water recreation area (swimming, canoeing, and fishing). Although limited irrigation of adjacent golf course greens and tree farms is taken from the Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC.

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* Plant wastes are those wastes which result from maintaining the plant in a safe shutdown condition and would have been generated if there were no West Valley Demonstration Project.

The average annual temperature in the region is 7.2°C (45.0°F) with recorded extremes of 37°C (98.6°F) and -42°C (-43.6°F). Rainfall is relatively high, averaging about 104 cm (41 in) per year. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and Lake Ontario to the north. All surface drainage from the WNYNSC is to Buttermilk Creek which flows into Cattaraugus Creek and ultimately into Lake Erie. Regional winds are predominantly from the west and south at over 4 meters per second (9 mph) during most of the year.

The WNYNSC lies within the northern hardwood forest region, and the diversity of its vegetation is typical of the area. Equally divided between forest and open land, the site provides habitats especially attractive to white-tailed deer and the various birds, reptiles, and small mammals indigenous to the region. No endangered species are known to be present on the reservation.

The geology of the site is characterized by glacial deposits of varying thickness in the valley areas, underlain by sedimentary rocks which are exposed in the upper drainage channels in hillsides. The soil is principally silty till consisting of unconsolidated rock fragments, pebbles, sand, and clays. There is an aquifer in the upper 6 m (20 ft) of granular fluvial materials concentrated near the western edge of the site; high ground to the west and the Buttermilk Creek drainage to the east intersect this aquifer, precluding off-site continuity. Several shallow, isolated, water-bearing strata also occur at various other locations within the site boundary but do not appear to be continuous. The zone at which the till meets bedrock forms another aquifer that ranges in depth from 2 m (6 ft) underground on the hillsides to 170 m (560 ft) deep just east of the boundary of the facility exclusion area.

LOCATION OF WESTERN NEW YORK NUCLEAR SERVICE CENTER

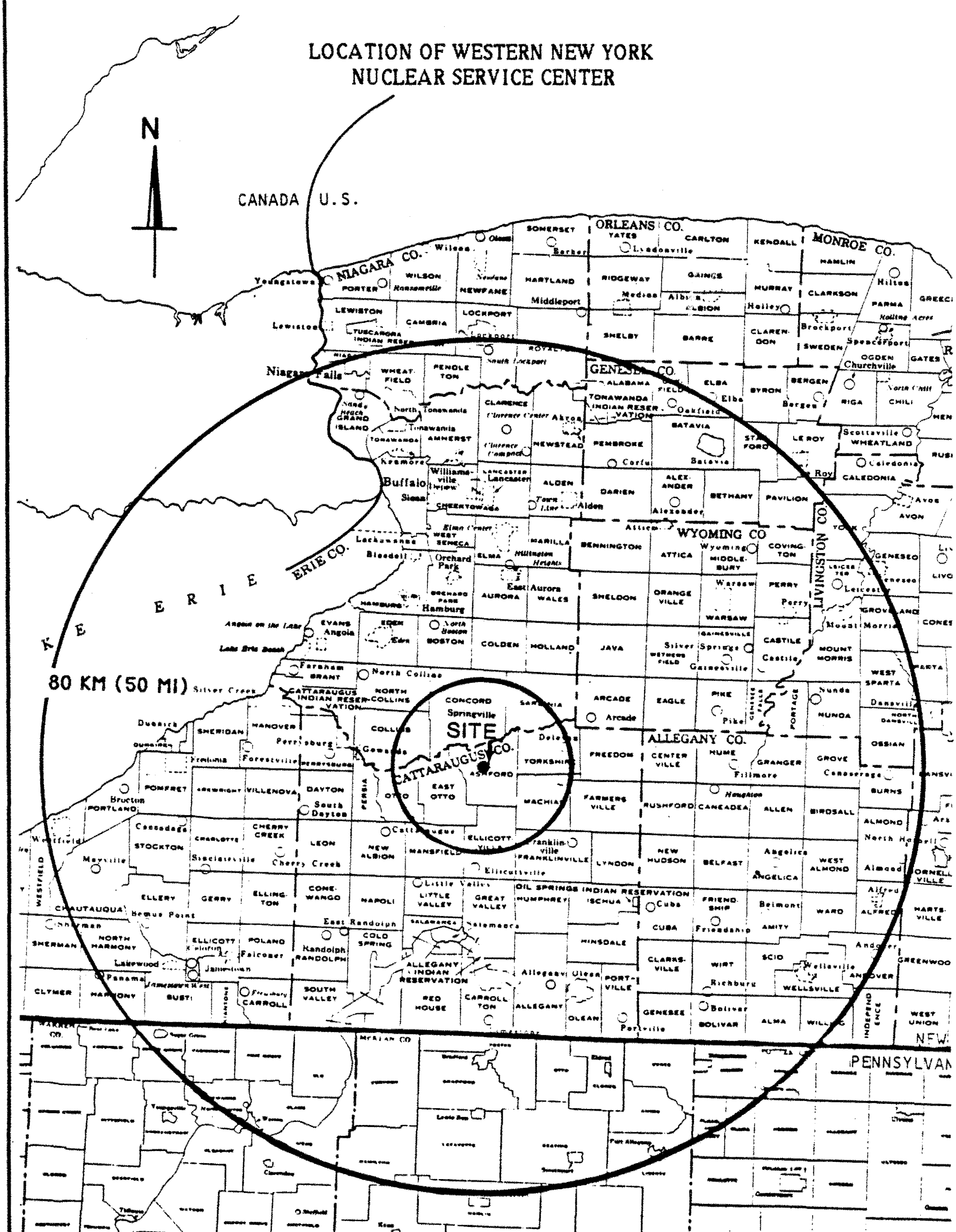


FIGURE 1-1

2.0 SUMMARY

In most environmental media collected from the Project environs, any contributions to the radionuclide concentrations which might have resulted from WVDP activities were too low to be distinguished from radioactivity which occurs naturally or was deposited from global fallout. The accident at Chernobyl (USSR) in April 1986 also added to background radioactivity in environmental media (Roberts, 1986). Radioactivity levels in surface water and in fish directly downstream of the Project are comparable to background concentrations of previous years. The content of radioactivity in venison from a deer collected near the plant (inside the WNYNSC) was comparable to levels in samples from the past several years. Although small amounts of radioactivity were discharged during routine Project activities, radioactivity levels in air and water effluents were well below the concentration guides provided by the DOE orders. A total of 0.0015 curies (0.056 GBq) of particulate radioactivity was discharged to the air, and 0.074 curies (2.7 GBq) of radioactivity, excluding 1.2 curies (44 GBq) of tritium as tritiated water, were released to Buttermilk Creek. The resultant collective and individual dose estimates to the surrounding population from these releases imply negligible consequences with regard to impacts on human health.

The maximum hypothetical effective or whole body dose equivalent an off-site individual at the nearest residence could have received via the air pathway in 1986 from WVDP activities is less than 0.01% of the 40 CFR 61 protection standard of 25 mrem (0.25 mSv) per year. The collective population dose to persons living within 80 km (50 mi) of the site was estimated to be 0.08 person-rem (0.0008 person-sievert). This is equivalent to an average individual dose of 0.00005 millirem (0.0000005 mSv), as compared to approximately 100 millirem (1 mSv) received annually from natural sources.

Concentrations of particulate radioactivity in air measured at the site boundary were statistically no different than those from background samples collected by the Project in 1986 with the exception of Fox Valley for gross alpha activity (see Section 4.3.5). Water from Cattaraugus and Buttermilk Creeks downstream of the site drainage contained three

detectable man-made isotopes (H-3, Sr-90, and Cs-137); however, the average concentrations of radionuclides downstream were not significantly higher than the values in Buttermilk Creek above the site. Buttermilk Creek is not used as a drinking water supply for humans, but the water is accessible to dairy cattle at one location on the creek downstream of the site. Radionuclide concentrations in milk samples from this herd were at or below background levels for all fuel-cycle isotopes. Thermoluminescent dosimeters placed around the WNYNSC perimeter indicated that direct external radiation exposure was within the range expected from natural background in this region and was statistically the same as background measurements at remote locations.

No significant increase in radioactivity over previous years' levels was observed in groundwater monitoring wells on-site and off-site in nearby shallow wells. Continued surface and groundwater monitoring demonstrated that radioactivity associated with organic material (kerosene/tributyl phosphate) which had migrated to a disposal area monitoring well was confined to that immediate area and did not appear in surface water. Monitoring in 1986 confirmed that both the source of this groundwater contamination and effluents from activities designed to eliminate the source remained within the controlled area, and were not identified in adjacent wells or surface runoff water. Several new monitoring wells were installed to provide additional coverage for present and planned operations which have the potential to affect ground water quality.

Chemical water quality measurements indicated no discharges which would adversely affect the receiving waters. During 1986, several water quality measurements exceeded the SPDES permit limits at the discharge point. These excursions were for relatively innocuous parameters, and were of such limited duration and magnitude that they precluded any discernible environmental impacts. Upgraded waste water treatment facilities are now in place, and new permit conditions have been fully implemented. This has resulted in a marked decline in the number of parameters for which excursions were encountered. The few recurring excursions are being addressed by improved operation methods and minor modifications to the treatment systems.

3.0 ENVIRONMENTAL MONITORING PROGRAM - DESCRIPTION AND RESULTS

This report reflects some of the changes in the environmental monitoring network which have been implemented in the past four years to provide an enhanced level of environmental surveillance in anticipation of high-level waste solidification activities. The surveillance program as implemented in 1985, was operated throughout 1986 (including effluent, on-site, and off-site monitoring). A number of new monitoring points as identified in the 1986 program plan were implemented during the year, most of them addressing specifically anticipated requirements for monitoring several new Project activities scheduled for FY87 and FY88. The major pathways for off-site movement of radionuclides are by surface runoff and airborne transport. The environmental monitoring program therefore emphasizes the collection of air and surface water samples. The ingestion and assimilation of radionuclides by game animals and fish that include the WNYNSC in their range is another potentially significant pathway which is monitored by collection and analyses of appropriate specimens. Soil and vegetation radionuclide content is also measured for long-term trends.

In addition to the radiological environmental monitoring program, WVNS participates in the State Pollution Discharge Elimination System (SPDES) and operates under state-issued air and water discharge permits for nonradiological plant effluents. Section 3.2 summarizes nonradiological monitoring in 1986, and Appendix C-5 provides greater detail on these activities. Section 3.3 specifically addresses groundwater monitoring at the Project site.

3.1 Radiological Monitoring

Air, water, and selected biological media were sampled and analyzed to meet Department of Energy and plant Technical Specification monitoring requirements. To provide appropriate reference parameters, several additional sampling points were added in 1986 in support of scheduled Project facilities soon to become operational (see Appendix A-1).

3.1.1 Radioactivity in Air

In 1986, airborne particulate radioactivity was collected continuously by four perimeter air samplers at locations shown in Figure 3-1 and by three remote samplers. The concentrations measured at each of these stations are given in Tables C-2.2.1 through C-2.2.7. Three of the perimeter air samplers, mounted on 4-metre high towers, maintain an average air flow of about 40 litres/min (1.5 ft^3/min) through a 47 mm glass fiber filter. The fourth perimeter air sampler is located on Rock Springs Road near the residence which would be subject to the highest average relative concentration of airborne effluent from a long-term, ground-level release from the plant (AFRSPRD, see Figure 3-1).This fourth perimeter sampler and the three remote samplers all operate with the same air flow rate as the three mounted on towers, but the sampler head is at 1.7 metres above the ground (the height of the average human breathing zone) versus the standard 4 metres. The three remote samplers were located in Great Valley , Springville, and West Valley (Figure 3-2). Concentrations measured at Great Valley (AFGRVAL), 28 km south of the site, are considered to be representative of natural background.

The filters were 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 were made using a low-background gas proportional counter. The average monthly concentrations ranged from 1.0 E-14 to 1.8 E-13 microcuries per millilitre (µCi/ml), or 3.7 E-04 to 6.7 E-03 becquerels per cubic metre (Bq/m^3) of beta activity, and 4.4 E-16 to 2.4 E-15 µCi/ml (1.6 E-05 to 8.9 E-05 Bq/m^3) of alpha activity. Additionally, quarterly composites consisting of 13 weekly filters from each sample station were analyzed. Prior to May of 1986, Cs-137 was not detected in any samples: Sr-90 was detected in three of seven samples, including 2 positive indications from background stations. On May 10, 1986, the fallout from the Chernobyl incident in the Ukraine, USSR, was first detected at the West Valley Demonstration Project. Ruthenium-103, I-131, Cs-134, Cs-136, Cs-137, and La-140 were among the isotopes detected after May 1986, but these isotopes appeared to be in equal concentrations for both near-site and remote air sampler locations. Therefore, although an increased sampling schedule in addition to the routine program was implemented, no evidence of radioactivity in addition to worldwide fallout was detected near the Project in air samples.

In all cases, the measured monthly gross activities were below 3 E-12 µCi/ml (1.1 E-01 Bq/m^3) beta, and 7 E-15 µCi/ml (2.6 E-04 Bq/m^3) alpha, the most limiting DOE concentration guides for any of the isotopes present at WVDP. (The standards and concentration guides for radionuclides of interest at West Valley are reproduced from the DOE orders in Appendix B.) Results of the analyses of perimeter air sample filters are presented in Appendix C-2. For comparison, the 1982, 1983 and 1984 data from the New York State Department of Health indicated a normal background concentration of gross beta activity in air which averaged 2 E-14 µCi/ml (7.4 E-04 Bq/m^3) in Albany, New York (Huang, 1984). Annual data for the three samplers which have been in operation since 1983 are compared in Figure C-2.2. The values average about 1.8 E-14 µCi/ml (6.7 E-04 Bq/m^3) of gross beta activity in air, with an apparent rise in 1986 after May. The annual average gross beta concentration at the Great Valley background station was 1.9 E-14 µCi/ml (7.0 E-04 Bq/m^3) in 1985, but averaged 2.8 E-14 µCi/ml (1.0 E-03 Bq/m^3) in 1986.

At four perimeter locations, three of which are co-located with air samplers, fallout is collected in open pots. The data from these analyses also are presented in Appendix C-2, Table C-2.3.1 and C-2.3.2.

The total quantity of gross alpha and beta radioactivity released each month from the main stack, based on the weekly filter measurements, is shown in Table C-2.1 of Appendix C-2. The results of analyses for specific radionuclides in the four quarterly composites of stack effluent samples are also listed in Table C-2.1.

The main ventilation stack (ANSTACK) sampling system was modified in mid-1984 by adding an alpha monitor and a new isokinetic multiport sampling probe. A high flow rate and multiple nozzles assure a representative sample for both the long-term collection filter and the on-line monitoring system. Variations in concentrations of airborne radioactivity reflect the level of in-cell decontamination activities within the facility (Figure C-2.1). However, at the point of discharge, average radioactivity levels were still below the concentration guides for airborne radioactivity in an unrestricted environment.

Because of the low concentrations, the large volume samples from the plant stack provide the only practical means of determining the amount of specific radionuclides released from the facility.

In November of 1985 a sampling system similar to the main stack system was put on-line to monitor the Cement Solidification System ventilation stack (ANCSSTK). Based on analyses of the weekly samples, no detectable radioactivity was discharged from this point in 1985 (WVDP 1986). The 1986 samples showed a slight increase in gross radioactivity and uranium isotopes, but did not approach any DOE effluent limitations. Two other facilities are routinely monitored for airborne radioactivity releases: the Low-Level Waste Treatment (LLWT) facility, for radioactive water treatment, and the contaminated clothing laundry. The total amount of radioactivity discharged from all three latter facilities is less than 0.3% of the airborne radioactivity released from the site, and is not a significant factor in the airborne pathway in 1986.

Surface soil samples (0 to 5 cm depth) collected in 1982 and 1985 from various locations in the environs around the Project, including the air sampling station locations, were analyzed in 1986 and are reported in Tables C-2.4.1 and C-2.4.2. Two of the nine samples (Dunkirk and Little Valley) are located respectively 48 km West, and 26 km SSW. The remainder are located at their respective air sample station locations. Data from one sediment sample collected in 1982 from Sprague Brook, 16 km NNE, are also included.

3.1.2 Radioactivity in Surface Water and Sediment

Four automatic samplers (Figure C-1.1) collect surface water at points along the site drainage channels. An off-site sampler is located on Cattaraugus Creek (at Felton Bridge) just downstream of the confluence with Buttermilk Creek, the major surface drainage from the WNYNSC (Figure 3-1). This sampler (WFFELBR) continuously removes a small volume of water (approximately 400 ml/hr) from the creek. A stream stage-level chart recorder provides a means of flow-weighting the weekly composite based on relative stream depth. Gross alpha, beta, and tritium analyses are performed each week, and a weighted monthly composite is analyzed for Sr-90 and gamma emitting isotopes.

In addition to the Cattaraugus Creek sampler, three surface water monitoring stations are in service upstream of the Buttermilk Creek/Cattaraugus Creek confluence. These installations collect water from a background location on Buttermilk Creek upstream of the Project (WFBCBKG) and a downstream location at Thomas Corners Road before the confluence with Cattaraugus Creek (WFBCTCB). The third station (WNSP006) is on Franks Creek (also known as Erdman Brook) just upstream of the point where Project site drainage leaves the security area (Figure 3-3). These samplers currently operate in a time composite mode, collecting a 25 ml aliquot every half-hour. The samples are collected biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite of the biweekly sample is analyzed for gamma-emitting isotopes and Sr-90. Quarterly samples from WNSP006 also are analyzed for I-129.

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 than above, presumably because of the small amount of activity from the site which enters via Franks Creek (see Figure C-1.1). However, the average concentrations below the site in Buttermilk and Cattaraugus are not statistically significantly higher than the background (upstream) concentrations. The range of gross beta activity, for example, was 1.5 E-09 to 1.0 E-08 µCi/ml (5.6 E-02 to 3.7 E-01 Bq/L) upstream in Buttermilk Creek at Fox Valley (WFBCBKG), and from 3.2 E-09 to 1.3 E-08 µCi/ml (1.2 E-01 to 4.8 E-01 Bq/L) in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB). The most elevated concentrations in monthly composite water samples from Cattaraugus Creek during 1986 show Sr-90 to be less than 1.3 percent of the DOE derived concentration guide for drinking water. Gross alpha and gamma emitting isotopes were below the detection limit in Cattaraugus Creek water for 7 of 12 and 10 of 12 months respectively (Table C-1.6). A plot of monthly gross beta activity in Cattaraugus Creek for four years is presented in Figure C-1.2. No trend is apparent over this extended period.

Sediments from Buttermilk Creek and Cattaraugus Creek were analyzed for gross activity, Sr-90, gamma-emitting isotopes and transuranic nuclides. The results are comparable to previous analyses during the past three years. Data for 1986 are presented in Table C-1.10. A comparison of 1983, 1985 and 1986 gross beta activity in sediment from Buttermilk Creek is presented in Figure C-1.3. Data for 1984 were not available for this parameter.

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment system through the Lagoon 3 weir (WNSP001, Figure 3-3) into Erdman Brook. There were six batch releases (a total of about 50 million litres) from Lagoon 3 in 1986. The effluent was grab sampled daily during the 47 days of release and analyzed. The total amounts of activity in the effluent are listed in Table C-1.1. Of the activity released from Lagoon 3, 7.7% of the tritium and 2.2% of the other gross radioactivity originated in the New York State disposal area (based on measurements of water transferred in 1986 from the state area to the LLWT) and not from previous or current Project operations (see Table C-1.11).

3.1.3 Radioactivity in the Food Chain

Samples of fish and game animals were collected both near and remote from the site during periods when they would normally be taken by sportsmen for consumption. Milk and beef from cows grazing near the site and at remote locations were also collected and analyzed during 1986. The results of these analyses are presented in Appendix C-3.

Fish samples were taken semiannually during 1986 above the Springville dam from the portion of Cattaraugus Creek which receives WNYNSC drainage (BFFCATC, see Table C-3.4 and Figure

C-3.1). Ten fish were collected from this section of the stream during each period. The Sr-90 content in flesh and skeleton, and gamma emitting isotopes in flesh were determined for each specimen. An equal number of fish samples (BFFCATD) were taken from Cattaraugus Creek below the dam, including species which migrate nearly 40 miles upstream from Lake Erie. These specimens were representative of sport fishing catches in the drainage downstream of the dam at Springville.

Control data are included in this report to permit comparison with the concentrations found in fish taken from site-influenced drainage. For this purpose a similar number of fish were taken from waters that are not influenced by site runoff (BFFCTRL) and their edible portions were analyzed for the same isotopes; these control (natural background) samples were representative of the species collected in Cattaraugus Creek downstream from the WVDP. The concentrations of strontium-90 in the edible flesh of all fish sampled in 1986 show a significant increase compared to 1985 data (WVDP, 1986). The Sr-90 content in the skeleton of fish downstream of the site reversed the downward trend from previous measurements during recent years (Figure C-3.2). The log-normal statistical treatment of the fish data presented in Table C-3.4 is appropriate to the sample type being reported (DOE/EP-0023).

Portions of a single deer from a resident herd on the southeast side of the WNYNSC were analyzed. The concentration of Cs-137 and Sr-90 in deer flesh was a bit higher than the concentration in the previous year's sample (Figure C-3.3). Data from a control, or background, deer sample collected in 1986 from a Chautauqua County location 65 km southwest of the site also indicated an increase in radioactivity, and are shown in Table C-3.2 for comparison.

The concentration of radioactivity in meat from semiannual samples of local beef animals was indistinguishable from the concentration in control samples (Table C-3.2), both showing a detectable level of isotopes associated with recent global fallout.

The dairy cattle milk sampling program in 1986 was expanded considerably over 1985 and previous years. Besides the quarterly composite sample of the maximally exposed herd to the north (BFMREED), an additional quarterly composite of milk from a nearby herd to the northwest (BFMCOBO) and several single samples from the south (BFMWIDR), southwest (BFMHAUR), and two control herds (BFMCTRLN and BFMCTRLS) were collected. Each sample or composite was analyzed for Sr-90, H-3, I-129, and gamma emitting isotopes (Table C-3.1). Strontium-90 in samples from near the site ranged from 2.5 E-09 to 6.9 E-09 µCi/ml (9.3 E-02 to 2.6 E-01 Bq/L) compared to the control samples at 2.2 E-09 µCi/ml (8.1 E-02 Bq/L) and 3.2 E-09 µCi/ml (1.2 E-01 Bq/L). Iodine-129 was not detected in any samples to the lower limit of detection (LLD) of 5 E-10 µCi/ml (1.9 E-02 Bq/L). Cesium-137 and other gamma emitting fuel cycle isotopes were also not detected. Tritium was added to the analyses performed, with all results below the detection limit of 4 E-07 µCi/ml (15 Bq/L).

Based on the samples analyzed in 1986 (Table C-3.3), there was no detectable difference in the concentration of tritium or gamma emitting isotopes in corn, potatoes, or beans grown at near-site and remote locations. Sweet corn from a field over 30 km north of the site showed a barely detectable amount of Cs-137, as compared to corn from a field 8 km north of the site, near Springville, in which Cs-137 was not detectable. Samples of potatoes and green beans from both near the site and remote locations did show an overall difference in Sr-90. The crops from near the site all contained Sr-90 in concentrations slightly above those from remote samples.

In Section 4 of this report, radionuclides present in the human food chain are discussed and their contribution to the potential for radiation exposure of the public is assessed. Although the maximum concentrations of radioactivity found in some biological samples were above background levels, the potential dose associated with consumption of these samples would be far below the protection standards.

3.1.4 Direct Environmental Radiation

The current monitoring year, 1986, was the third full year in which direct penetrating radiation was monitored at WVDP using TL-700 LiF thermoluminescent dosimeters (TLDs). The uncertainty of individual results and averages were acceptable and measured exposure rates were comparable to those of 1985. There were no significant differences in the data collected from the background TLDs (locations 17 and 23) and those on the WNYNSC perimeter (see Figure 3-1 for TLD perimeter locations) for the 1986 reporting period.

Dosimeters used to measure ambient penetrating radiation during 1986 were processed on-site. The system used Harshaw TL-700 lithium fluoride chips which are maintained apart from the occupational dosimetry TLDs as a select group solely for environmental monitoring. The environmental TLD package consists of five TLD chips laminated in a thick card bearing the location I.D. and other information. These cards are placed at each monitoring location for one calendar quarter (3 months) and then processed to obtain the integrated gamma radiation exposure.

Monitoring points are located, as shown on Figures 3-1 and 3-2, around the site perimeter and access road, at the waste disposal area, at the inner facility fence, and at background locations remote from the WVDP site. Appendix C-4 provides a summary of the results for each of the environmental monitoring locations by calendar quarter along with averages for comparison (Table C-4.1).

The quarterly averages and individual location results show very slight differences due to seasonal variation (Figure C-4.1). During the first quarter (January through March) of 1986 the average quarterly exposure was decreased due to snow cover. The second quarter (April to June) average was a bit higher but not enough to attribute a significant exposure to fallout. The third quarter of 1986 (July to September), with no snow cover but relatively high rainfall, had a higher quarterly average. Average rainfall with little snow cover in the fourth quarter (October to December) was expected to yield a quarterly average comparable to the third quarter, but it was significantly higher. These data indicate that seasonal variation in 1986 due to rainfall and snow cover did not have as significant an effect on ambient penetrating radiation measurements around the WVDP site as was noted in 1984 and 1985 (Figure C-4.2). A possible cause of the slight rise in average TLD measurements could be the heavier than average summer rains, which would wash out radionuclides suspended in the atmosphere.

Presumably because of their proximity to the LLW disposal area, the dosimeters at two locations which are not part of the off-site monitoring program (18 and 19 on Figure 3-1) showed a small elevation in radiation exposure compared to the WNYNSC perimeter locations. Location 25, on the public access road through the site north of the facility, also showed a small elevation above background due to the storage of decontamination wastes near location 24 within the site security area.

Location 24 on the north security fence, like locations 18 and 19, is not included in the environmental monitoring program; however, it is a co-location site for a U. S. Nuclear Regulatory Commission (USNRC) TLD (Table D-1.4). This point received an average exposure of 0.91 milliroentgen per hour during 1986. This exposure is primarily attributable to the nearby storage of sealed containers of radioactive components and debris from plant decontamination efforts. The storage area is well within the WNYNSC boundary (as are 18 and 19) and not readily accessible to the public. TLD locations 26 through 30 are located along the Project Security Fence, forming an inner ring of monitoring around the facility area.

3.2 Nonradiological Monitoring

West Valley Demonstration Project effluents are regulated for nonradiological parameters by the New York State Department of Environmental Conservation (NYSDEC). Stationary sources of atmospheric pollutants are authorized by either a permit to construct or a certificate to operate. Liquid effluents are monitored as a requirement of the State Pollution Discharge Elimination System (SPDES) permit issued and enforced by NYSDEC.

3.2.1 Air Discharges

The WVDP presently holds 6 certificates to operate stationary sources and 1 permit to construct a new source of airborne effluents. These permits are for minor sources of regulated pollutants such as particulates, nitric acid mist, and oxides of nitrogen. Monitoring these parameters is not required because of their insignificant concentrations and small mass discharge.

The individual air permits held by the WVDP are identified and described in Table C-5.1.

3.2.2 Aqueous Discharges

The WVDP holds a SPDES permit which identifies the outfalls where liquid effluents are released to Erdman Brook (shown i Figure 3-4 and Figure C-5.1) and specifies the sampling and analytical requirements for each outfall. During 1985, this permit was renewed in a substantially modified form, and 198 is the first full year of operation under these requirements. Three outfalls are identified on the permit. These are comprised of outfall 001, discharge from the low level waste treatment facility; outfall 007, discharge from the sanitary and utility effluent mixing basin; and outfall 008, effluent from the french drain on the perimeter of the low level waste treatment facility storage lagoons. The conditions and requirements of the new SPDES permit are summarized in Table C-5.2.

The most significant features of the SPDES permit are a requirement to report data as flow weighted concentrations and the application of a "net" discharge limit for iron. Tl net limit allows for subtraction of incoming (background) amounts of iron from the values reported in the Project effluent. The flow weighted limits apply to the total discharge of Project effluents but allow maximum credit for dilute waste streams in determining compliance with effluen concentration limits specified in the permit.

3.2.3 Results

The SPDES monitoring data are displayed in Figures C-5.2 through C-5.23. Generally, these data indicate that Project effluents were within permit limits. However, the WVDP reported a total of 33 noncompliance episodes. These are discussed in Appendix C-5.

3.2.4 Pollution Abatement Projects

During 1986, the WVDP completed two pollution control and abatement projects. These were installation of monitoring wells to provide expanded groundwater monitoring coverage of waste management units and closure of the construction and demolition debris landfill.

3.2.4.1 Expanded Groundwater Monitoring

The groundwater monitoring program was expanded to provide monitoring consistent with the minimum technical requirements for groundwater monitoring at RCRA interim status facilities. The units incorporated into the monitoring program are the high level radioactive waste storage tank area, the low level radioactive waste treatment and storage lagoons and the NRC licensed low-level radioactive waste disposal area. The applicability of RCRA to these units is uncertain within the present regulatory postures assumed by DOE and EPA, but the Project considers it prudent to implement additional monitoring to address RCRA concerns pending resolution of the regulatory issues. The details of the expanded monitoring program are discussed in Section 3.3.2.

3.2.4.2 Closure of Landfill

Closure of the on-site nonradioactive construction and demolition debris landfill was accomplished in August 1986, although this facility was removed from active service in 1985. The site was closed in accordance with New York State Department of Environmental Conservation (NYSDEC) requirements for construction and demolition debris landfills following a closure plan (Standish, 1985) which was approved by NYSDEC. Routine inspection and maintenance of the closed facility is required as part of the closure requirements. These activities include checking areas for proper drainage (i.e. no obvious ponding or soil erosion) and cutting the grass planted on the soil and clay cap. Should more extensive maintenance or repair be necessary, it will be described in detail in future environmental reports.

3.3 Groundwater Monitoring Program

3.3.1 Hydrology of the Site

The hydrogeology of the WVDP site has been and continues to be extensively investigated. Appendix E provides a synopsis of the site geology and the pathways for contaminant migration through this geologic system. A generalized east-west cross-section through the site is depicted in Figure 3-5.

3.3.2 Groundwater Monitoring

A program of sampling groundwater both on the Project site as well as from wells at residences around its perimeter was carried out in 1986. The shallow wells in this program fall into five groups:

1. A group of dug shallow wells installed north of, and immediately surrounding the main plant building were monitored for several years before Project start-up and are therefore used for reference to examine long-term trends.

2. The U.S. Geological Survey (USGS) series 80 wells which form an outer ring around the facility dug wells.

3. The USGS series 82 wells that are grouped around the formerly-licensed disposal area. Selected series 75 wells also fall into this category.

4. Additional monitoring wells which were installed by Project scientists to supplement the existing groundwater monitoring network around specifically identified waste management areas to expand the non-radiological water quality data base.

5. Private wells around the perimeter that are used for drinking water by site neighbors (half of these are sampled each year).

Appendix A gives more information on sampling requirements and on the location of these wells (shown in Figures A-3, A-5 and A-6). Appendix C-1 summarizes results of the radiological analyses of samples from the wells (Tables C-1.7, -1.8, and -1.9).

In order to more effectively monitor several specific on-site areas which have the potential for radiological and nonradiological ground water contamination, a more comprehensive ground water monitoring program was approved by DOE and implemented in 1986.
The areas identified for additional groundwater monitoring are:

A. Low-Level Radioactive Waste Lagoon System
B. High-Level Radioactive Waste Tank Complex
C. NRC Licensed Disposal Area (Area utilized by NFS prior to 1982, including areas used by WVNS for disposal of plant solid low-level radioactive wastes).

These areas are shown in Figure 3-6. The low-level waste lagoon system includes four active lagoons (Nos. 2 through 5) and one inactive lagoon (No. 1). During the operation of the Nuclear Fuel Services (NFS) fuel reprocessing plant, wastewater from the reprocessing operations entered the system through Lagoon 1 and passed to Lagoon 2 for temporary storage. Wastewater was withdrawn from these two lagoons for treatment, after which the water was pumped to Lagoons 4 and 5, and thence to Lagoon 3, from which it was discharged to Erdman Brook.

Lagoon 1 was removed from active service in 1984. At that time, bottom sediments that could easily be removed were transferred to Lagoon 2, and contaminated soil and paving material removed from the hardstand area were placed at the bottom of the cleaned out lagoon. The lagoon was then filled and covered with clean local borrow soil. Lagoons 2 and 3 are excavated into the natural clay/silty till soil available at the bottom of the lagoons. Lagoons 4 and 5 were each lined with a synthetic membrane in the late 1970s.

The high-level waste tank complex includes 2.1 million litres of neutralized liquid high-level radioactive waste (HLW) derived from the Purex process and 45,600 litres of acidic liquid HLW derived from the Thorex process. The neutralized liquid waste is stored in a carbon steel tank (8D-2) in a reinforced concrete vault located underground. The tank rests on a 30 cm thick layer of perlite blocks which is in turn supported by a 7.6 cm layer of pea gravel contained in a carbon steel pan. The vault pad is a minimum of 60 cm thick and rests on a 10 cm thick leveling slab. The concrete vault is immediately underlain by a 1.2 m layer of pea gravel that overlies the natural soil. The acidic liquid waste is stored in a stainless steel tank (8D-4) in a reinforced concrete vault, similar to that described for the neutralized waste tank vault.

The portion of the NRC Licensed Disposal Area of concern to this document is shown on Figure 3-6. It comprises the 2.9 hectare rectangular area primarily used by NFS for disposal of highly radioactive fuel hardware, as well as other solid wastes generated during reprocessing operations. The NFS burials were limited to a U-shaped band following the perimeter of the north, east and west boundaries of the rectangular area. The area inside this 'U' comprises an area of 0.4 hectares, some of which has been used for disposal of low-level radioactive wastes that resulted from the WVDP's maintenance of the shut down reprocessing plant (plant waste).

For the three waste management areas considered, a monitoring well system comprised of 14 wells has been designed. In addition, a groundwater seep and an existing monitoring station at the french drain outlet in the lagoon area are included in the monitoring program. Of the 14 wells, five were existing wells installed by the USGS as observation wells, and the remaining nine wells were installed in the Summer of 1986. The locations of these wells and monitoring points are shown on Figure 3-6.

The location of the upgradient and downgradient monitoring wells was selected on the basis of: (1) known groundwater flow patterns in the given area; and, (2) the presence and proximity of other potential contamination sources close to the waste management area. Wells were located so that no other possible contamination source would lie between the well (downgradient or upgradient) and the waste management area which it is to monitor.

As shown on Figure 3-6, six monitoring wells are included in the Low-Level Waste Lagoon System. Wells 80-5, 80-6, 86-3, and 86-4 are all downgradient wells and Well 86-6 is upgradient of the lagoon system. Two locations are existing USGS wells (80-5 and 80-6, respectively). Well 86-5 is designed to monitor the quality of groundwater flowing beneath old Lagoon 1 in the direction of Erdman Brook. The outlet for the french drain (WNSP008) and a groundwater seep along the western bank of Frank's Creek are included in the monitoring system for this area. The outlet for the french drain is currently also a sampling point (008) under the New York State SPDES permit. This drain serves as a sink for a major portion of the surficial groundwater flowing in the immediate vicinity of the lagoon system, and provides an indication of the change in the local groundwater quality over time. The groundwater seep located on the upper western bank of Frank's Creek provides an indication of the groundwater quality in the surficial deposits, along with monitoring wells 80-5 and 80-6. It is not clear just how much groundwater flowing beneath the lagoon system escapes discharge to the french drain. However, it is believed that some of the deeper surficial groundwater, particularly on the northern sides of Lagoons 4 and 5, tends to flow eastward or northeastward toward Frank's Creek.

Four wells were selected to monitor the High-Level Waste Tank Complex. Wells 86-7, 86-8 and 86-9 are new downgradient wells, while existing well 80-2 serves as the upgradient well. Wells 86-7 through 86-9 are located along the major flow paths passing through the tank complex as determined by Yager (1985). At the same time, they were placed clearly upgradient of the hardstand and salvage areas.

Four wells were selected to monitor the disposal unit within the NRC Licensed Disposal Area. All four tap the Lacustrine Unit. Wells 86-11 and 86-12 are new downgradient wells located along the northeastern boundary of the area, and just upgradient of the New York State commercial disposal area. Well 82-1D is located downgradient of the western one-third of the NDA. Well 83-2D is located clearly upgradient of the disposal unit.

The parameters and sampling schedule shown in Table 3-1 will be followed for the groundwater monitoring program. The category III groundwater contamination indicator parameters were selected after considering the type, quantities and concentrations of constituents in the wastes of the three waste management areas, in addition to their mobility, persistence and detectability. These parameters are sensitive indicators and at the same time are representative of the wastes existing at the three areas.

At each sampling, sufficient liquid is obtained (if possible) from each well for four replicate analyses of each groundwater monitoring parameter. At each sampling event, the depth to the static water level from a leveled reference point (generally top of the well casing) is measured and recorded prior to purging the well and taking the necessary water sample.

Sampling and analysis is performed in accordance with accepted practice formalized in approved procedures to ensure the reliability and retrievability of water quality data.

In addition to monitoring the wells described above, a number of existing wells (the WNW80- and 82- series) will continue to be sampled routinely; however, in the future these samples will be analyzed for a variety of water quality parameters (see Appendix A) as well as for radioactivity. The location of these existing wells is shown on Figure A-3. Note that several of the wells are also included in Figure 3-6 because they were incorporated into the revised groundwater monitoring plan.

3.4 Special Monitoring

Two special monitoring activities took place in 1986. The first was special sampling for the effects of the Chernobyl incident in late April. The effects of the fallout can be noted in routine background air and biological samples, and a detailed description of WVDP sampling is in Appendix F. The second major effort involved a stream bed gamma survey and sample collection on Cattaraugus Creek from Springville to Lake Erie. Results of this survey were in agreement with the 1984 aerial survey, and no concentrated radioactive material was found. The details of this survey are also described in Appendix F.

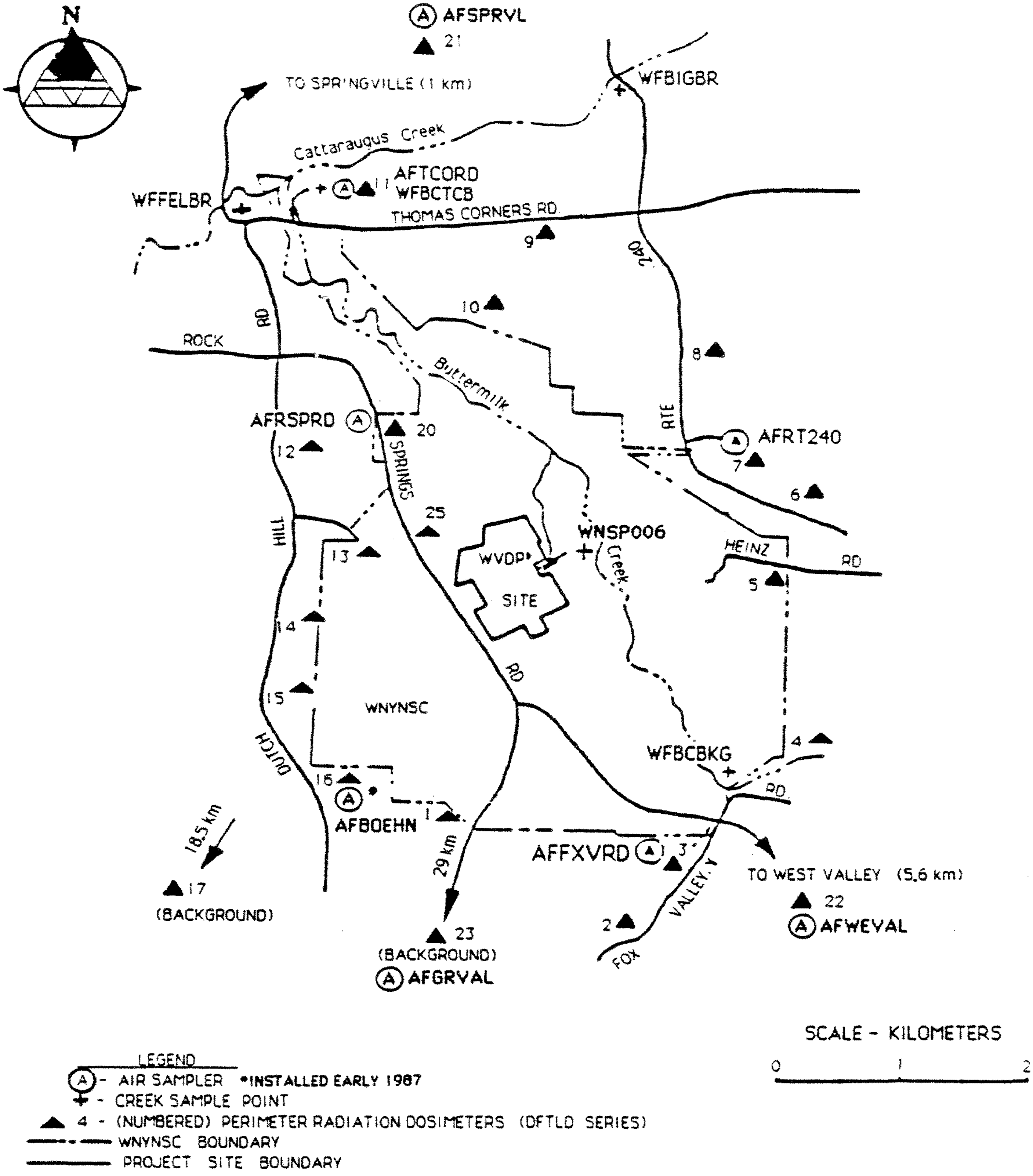


FIGURE 3-1
Locations of Perimeter Environmental Monitoring Stations


ENVIRONMENTAL SAMPLING POINTS
MORE THAN 5 km FROM WVDP SITE
N
BFVCTRL
32Km NNW
BFVNEAR
AFSPRVL
WFWEL10
BFFCATC
BFFCATD
BFFCTRL
10 km
20 km
30 km
AFWEVAL
WFWEL06
DFTLD17
BFDCTRL
65Km SW
AFGRVAL
BFBCTRL
LEGEND
- Thermoluminescent Dosimetry
- Air Sampler
- Drinking Water Well Supply
- Meat Sampling Point
- Vegetation Sampling Point
5 0 5 10 15 20 25 30 Kilometers

FIGURE 3-2

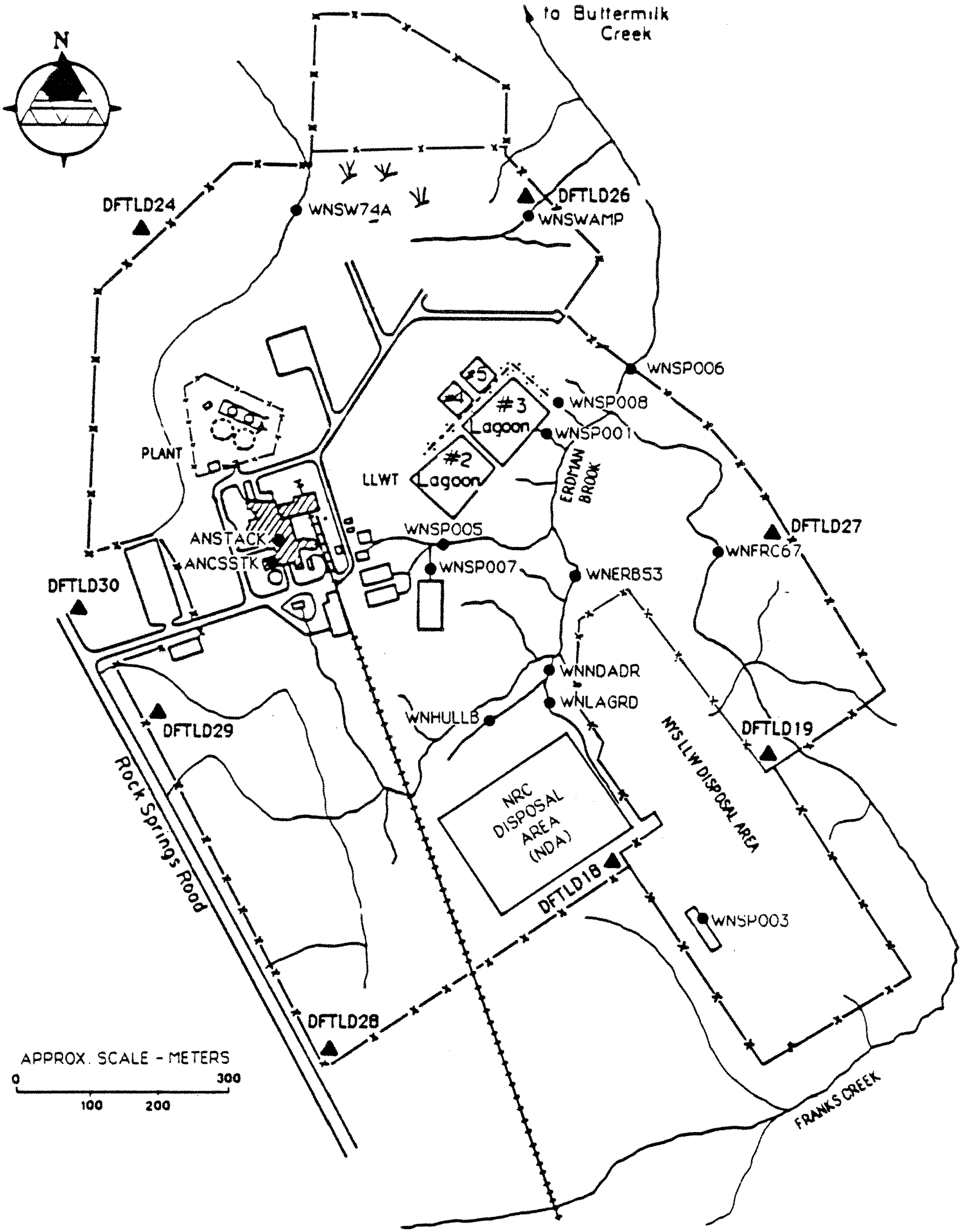


FIGURE 3-3
Location of
Radiological Monitoring Points On-site

KEY

WNSP 001-LAGOON 3 DISCHARGE

WNSP 003-NEW YORK STATE COMMERCIAL LOW LEVEL WASTE DISPOSAL LAGOON

WNSP 007-SPDES 007 MIXING BASIN, CONSTRUCTED IN 1985

WNSP 008-DRAINS SUBSURFACE WATER FROM LLWT AREA (FRENCH DRAIN)

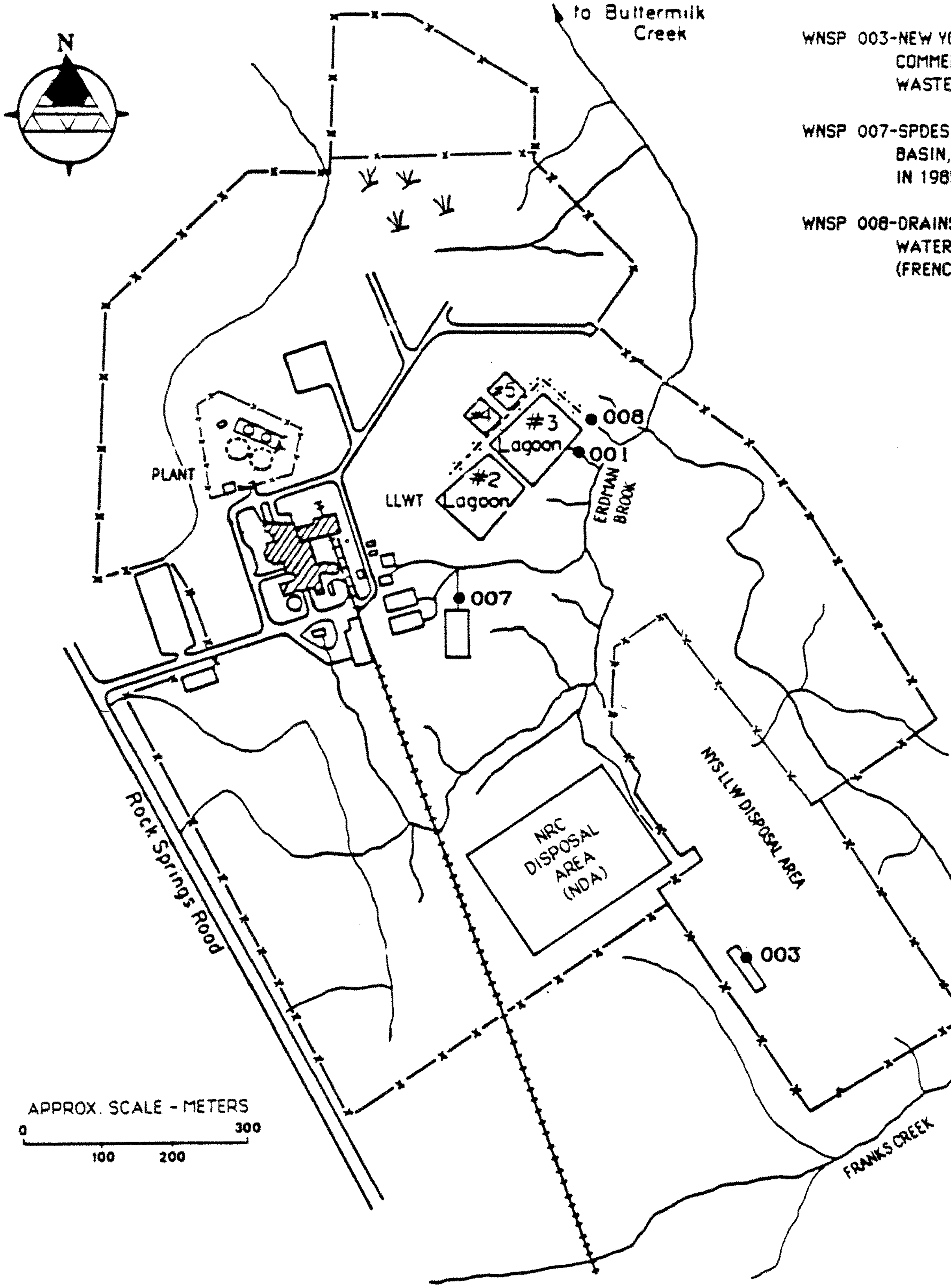
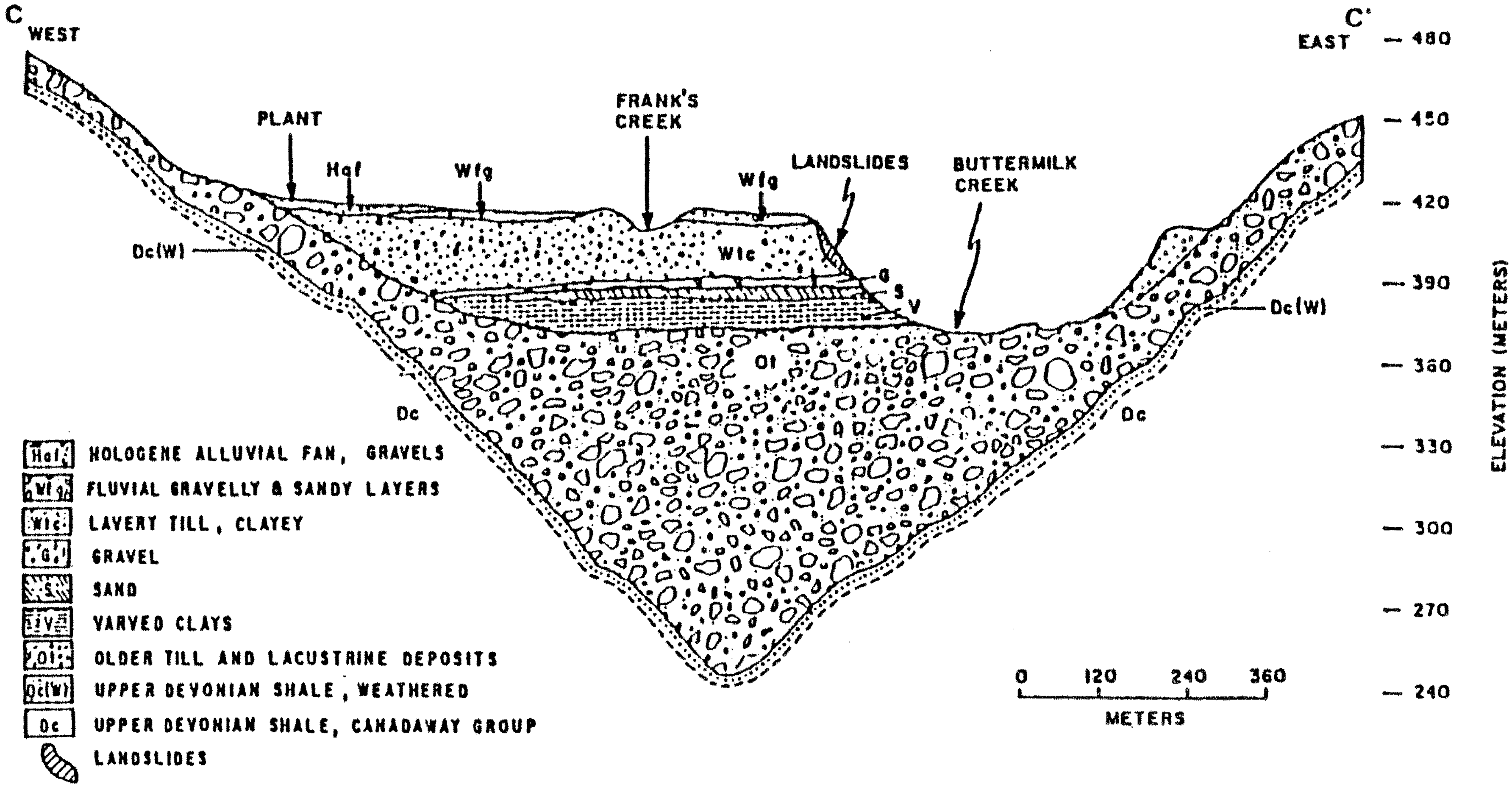


FIGURE 3-4
Locations of SPDES Monitoring Points On-site



NOTE:
Vertical scale = 1/4 horizontal scale.
Adapted from Dana et al. (1979a).

GENERALIZED EAST-WEST GEOLOGIC CROSS SECTION AT THE WEST VALLEY DEMONSTRATION PROJECT

FIGURE 3-5

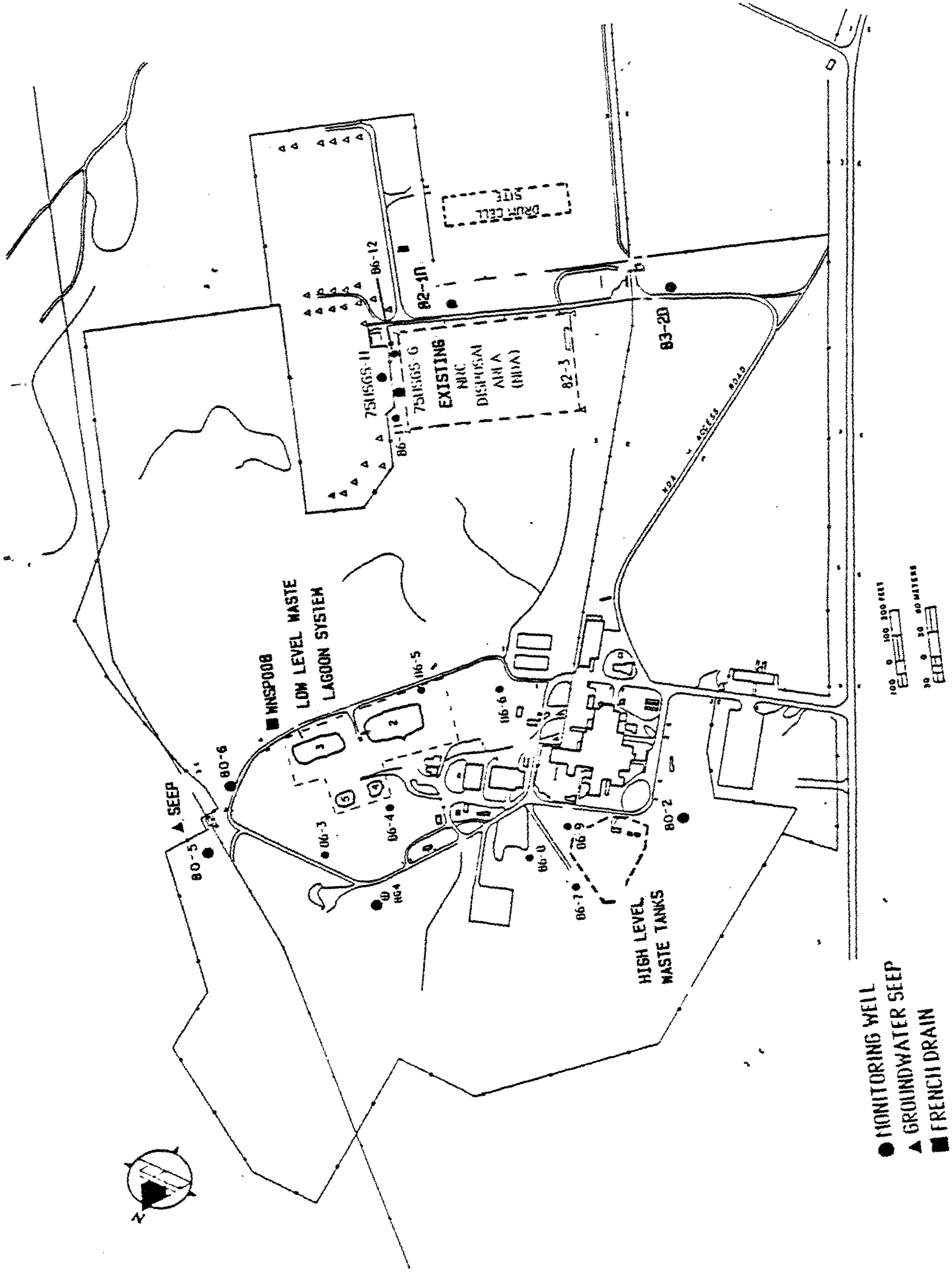


FIGURE 3-6
Location of Groundwater Monitoring
Area Sample Points

TABLE 3-1
SCHEDULE OF GROUNDWATER SAMPLING AND ANALYSIS

Category	Parameter	Frequency	Comment
I. EPA Interim Drinking Water Standards	Arsenic Barium Cadmium Chromium Fluoride Lead Mercury Nitrate (as N) Seleium Silver Radium Gross Alpha Gross Beta	Quarterly for 1^{st} year.	Annually after 1st year except coliform and pesticides.
	Coliform Bacteria Endrin Lindane Methoxychlor Toxaphene 2, 4-D 2, 4, 5-TP Silvex		May be omitted if demonstrated that wastes do not contain these compounds and site history does not indicate past usage.
II. Groundwater Quality Indicators	Chloride Iron Manganese Phenols Sodium Sulfate	Quarterly for 1^{st} year, annually therafter.	
III. Groundwater Contamination Indicators	Nitrate pH Conductivity Total Organic Carbon Total Organic Halogen Tritium Gross Alpha Gross Beta Specific Gamma Emitters	Quarterly for 1^{st} year, semi-annually thereafter.	All indicator parameters must be measured in 4 replicates of each sample. Same as pesticides in Category I selected by WVNS as indicators of waste treatment/disposal at WVDP.
IV. Groundwater Elevations		Once before collecting each well sample.	

4.0 RADIOLOGICAL DOSE ASSESSMENT

4.1 Methodology

The potential radiological impacts resulting from the release of radioactivity during 1986 have been estimated by calculating radiation doses received by the maximally exposed off-site individual and the population within an 80 km radius of the WVDP facility. The potential pathways of exposure to the general public from radioactive effluents released by the WVDP operations are shown in Figure 4-1. The exposure modes considered in the dose calculations are:

- Direct exposure from immersion in air containing radionuclides,
- Direct radiation from ground surfaces contaminated by deposited radionuclides,
- Immersion in contaminated water,
- Inhalation of airborne radionuclides, and
- Ingestion of contaminated water and food produced from the land and surface waters in the area.

Because the ridges and hills in the vicinity of the WVDP frequently channel the winds, strong systematic deviations from straight-line air flow over long distance are expected. To realistically account for the terrain effects on wind flow, a fine grid, two-dimensional wind field was developed using the Dames & Moore WNDSRF3 code and meteorological data measured hourly at seven stations around the WVDP and the three nearest National Weather Service stations. The wind field data were then input into EPM3, a variable-trajectory Gaussian puff dispersion code for calculating the relative concentrations of radioactivity from routine operational releases.

The EPM3 code is formulated according to the guidelines described by NRC in Regulatory Guide 1.111. The assumption underlying the code is that a number of discrete puffs are serially released from the source to simulate a continuous plume. Each puff is assumed to have a Gaussian concentration distribution in three dimensions. Puffs expand in size as they move downwind from the source in response to spatial and temporal wind and stability conditions. Each puff is transported independently by the nonuniform wind field and is tracked until it leaves the grid region. Relative concentration and deposition are computed at each grid receptor location.

The output of the EPM3 code is then input into AIRDOS-EPA (Moore, et al., 1979) which calculates the radiation doses to receptors of interest. A detailed discussion of the computer codes WNDSRF3 and EPM3 and AIRDOS-EPA is given in the WVDP Safety Analysis Report, Supplements Volume, Section A.3.3-C.

Results quoted in this section of the 1986 Environmental Monitoring Report are based on analyses that use relative concentration values calculated for gaseous effluents released from the WVDP plant at a height of 60 metres and at ground level. Meteorological data collected continuously over a twelve-month period (August 1983 through July 1984) are used as a basis for the dispersion calculations.

The calculated annual average relative concentration values for 60 metre and ground level releases are given in Tables 4-1 and 4-2 respectively, for each of the sixteen 22.5 degree wind sectors in an 80 km radius circle centered at the WVDP main plant stack. The maximum mean annual relative concentration values at actual residences in the vicinity of the site are 1.5 E-07 sec/m^3 (at 2.1 km WSW) and 9.5 E-07 sec/m^3 (at 1.4 km NW) for stack and ground level releases, respectively.

To calculate the radiation doses to the maximally exposed individual and the population within 80 km from the plant, relative concentration values are used as input to the AIRDOS-EPA code. The radiation dose commitment to the maximally exposed individual and the collective dose to the population within 80 km of the WVDP from the water pathway were calculated using the computer code LADTAP II (Simpson and McGill, n.d.). Both LADTAP II and AIRDOS-EPA implement the NRC Regulatory Guide 1.109 recommendations for terrestrial food chain dose assessments.

The dose estimates were made by calculating radionuclide concentrations in air, rates of deposition on ground surfaces, ground surface concentrations, intake rates via inhalation, and ingestion of meat, milk, and fresh vegetables. Site specific data on production and consumption of milk, meat, and agricultural products were used in computing the collective population dose.

A map of the area surrounding the WVDP is shown in Figure 1-1. It was overlaid with an 80 km radius grid system with the facility at its center. The grid system was further divided into 10 concentric regions and 16 compass directions. For each sector formed by the grid system, the specific human populations, beef and dairy cattle populations, and agricultural areas were determined by a 1983 survey. The sector specific data are shown in Figures 4-2 through 4-9.

For each radionuclide of concern, the inhalation dose conversion factors (DCFs) used are for an activity median aerodynamic diameter (AMAD) of 0.3 micrometer. For alpha emitters, the dose conversion factors are derived by using a quality factor of 20 as per International Commission of Radiological Protection (ICRP) recommendations (Dunning, n.d.). All of the doses from internal exposure are committed dose equivalents and are calculated for the 50-year period following inhalation or ingestion. The internal dose conversion factors used in this report are from Dunning (n.d.).

For this report, the effective dose equivalent, as well as the dose equivalent to the thyroid, lungs, bone, liver, kidneys, and gastrointestinal tract were calculated in order to determine the critical organs for various potential pathways of exposure. These estimates were based on parameters applicable to an average adult (ICRP, 1975). The collective population dose estimate in person-rem is the effective dose equivalent commitment as calculated in accordance with the recommendations of the ICRP (ICRP, 1977).

In addition to these estimates of dose commitments based on dispersion modeling, the dose to a hypothetical maximally exposed individual who consumed locally produced milk, fish, beef, and venison (deer) was estimated. Measured radionuclide concentrations from local and control samples of milk, fish, beef, and venison were used in these calculations. Although state-of-the-art methods and instrumentation were used to determine concentrations, certain nuclides, if present in these samples, are often below the minimum detectable concentration (MDC). In cases where both the sample and its control were below the MDC for a specific nuclide, it was assumed that the nuclide was not present at a concentration greater than natural background.

4.2 Source Term Estimates

4.2.1 Airborne Radioactive Effluents

There are four points on the plant site from which ventilation systems release low concentrations of airborne radioactivity. These four locations are:

1. Process building main stack,
2. Cement solidification system (CSS) exhaust stack,
3. Laundry exhaust vent, and
4. Low-level waste treatment system (LLWT) ventilation exhaust.

The air released from these vents is sampled routinely and the collected particulates are periodically analyzed. For the main plant and CSS stacks, the sampling is continuous. The results of measurements during 1986 are summarized in Table 4-3. A total of 4.0 E-06 Ci of gross alpha activity and 1.5 E-03 Ci of gross beta/gamma was released from these vents during the year. Greater than ninety-nine percent (99.66%) of the activity released to the atmosphere was discharged through the main plant stack.

The Cement Solidification System (CSS) began operation in December of 1985. Its exhaust is continuously monitored for radioactivity, in a manner similar to that used for the main plant stack. The data for 1986 represent the first full year of system operation.

4.2.2 Liquid Radioactive Effluents

There were three sources of liquid effluents from WVDP operations in 1985:

1. Lagoon 3 discharges (six planned releases),
2. Sewage treatment outfall (WNSP007), and
3. Surface water releases from the northeast swamp drain and french drain.

The volumes of the liquid effluents and the radioactivity they contained (reported in WVDP 1986 Effluent and On-Site Discharge Report, March, 1987) are summarized in Table 4-4. All liquids were discharged via Buttermilk Creek. Relevant release standards and derived concentration guides (DCGs) (DOE Order 5480.1) are presented in Appendix B. Collective population doses from these liquid effluents are based on the number of curies released for each identified nuclide in Table 4-4 (see Section 4.3.2).

4.3 Potential Radiation Doses to the Public

4.3.1 Maximum Hypothetical Individual Doses

The point of maximum potential long-term radiation exposure in the vicinity of the site from radioactivity released from the plant stack is a private residence about 2.1 km WSW of the WVDP plant. A hypothetical maximum effective dose equivalent of 0.0022 mrem was calculated as a result of WVDP airborne releases during 1986 when all possible pathways were considered. The calculated dose commitment to bone surface (the critical organ) at this location was 0.013 mrem. These maximum hypothetical exposures are about 0.01 percent for whole body and 0.02 percent for the critical organ of the applicable standards for airborne releases promulgated by the U. S. Environmental Protection Agency (EPA) in 40 CFR 61.

An important potential contributor to the dose commitment from radioactivity in the terrestrial food-chain is the airborne pathway to the pasture and then to cow and to milk. Measurements of radioactivity in the milk produced at the nearest dairy farm to the WVDP facility (see Table C-3.1) indicated that no I-129, Cs-134, or Cs-137 were present in concentrations above the limits of detection. The maximum dose to an individual from ingestion of about 1 litre of this milk per day was estimated from the strontium-90 concentrations in excess of the control sample. This calculation predicts a dose commitment of 2.1 mrem to bone surfaces, 2.0 mrem to the thyroid and an effective dose equivalent of 0.2 mrem. These calculated maximum potential doses are less than three (2.8) percent and one (0.8) percent respectively of the allowable 40 CFR 61 standards.

Estimates were made of the hypothetical maximum dose commitments to an adult from consumption of 21 kg per year of fish (the maximum value recommended in NRC Regulatory Guide 1.109) caught in Cattaraugus Creek. From the measured concentrations of radionuclides in the edible parts of the fish (see Table C-3.4), the maximum organ dose commitment to an individual was estimated to be 1.3 mrem to bone surfaces. The maximum effective dose equivalent commitment to an individual was calculated to be 0.12 mrem from consumption of 21 kg of fish.

If I-129 were assumed to be present in the milk at a net concentration equal to the MDC (0.6 pCi/l) the predicted, hypothetical maximum thyroid dose would be approximately 2 mrem/year. However, this is not considered to be a realistic assumption. It does however, indicate that an extremely conservative assumption still yields a dose estimate well within regulatory limits.

The hypothetical dose commitment also was estimated for an individual who consumed 45 kg of venison taken from local area (within 1 mile) and for an individual consuming 94 kg of locally raised beef cattle. The measured radionuclide concentrations (Table C-3.2) in the flesh of a deer taken about a kilometre away from the WVDP in the fourth quarter of 1986 was used as the basis for this estimate. The dose commitment to the critical organ was calculated to be 0.59 mrem to the testes and 0.58 mrem for an effective dose equivalent commitment. The maximum individual dose for consumption of locally raised beef cattle was based on two near site samples taken in the second and fourth quarters of 1986. After background subtraction, the maximum individual dose commitment was calculated as 0.24 mrem and the critical organ dose for testes as 0.25 mrem. Table 4-5 summarizes the potential radiation doses to individual adult members of the general public at the points of highest potential exposure from gaseous and liquid effluents from the WVDP facility operations during 1986. Although no direct pathway to drinking water from airborne or liquid effluents was found or evaluated for committed dose, drinking supply well water data are presented in Appendix C (Table C-1.9). Additionally, the results of the radionuclide measurements in stream sediments (Table C-1.10), surface waters (Tables C-1.2 through C-1.6) and in shallow wells (C-1.7 and C-1.8) are presented in Appendix C.

4.3.2 Collective Dose to the Population

The collective effective dose equivalent commitment to the population within an 80 km radius of the WVDP from operations during 1986 was estimated to be 0.02 person-rem from gaseous effluents and 0.06 person-rem from liquid effluents. These estimates are based on the releases summarized in Tables 4-3 and 4-4 and the use of the AIRDOS-EPA (CCC-357), Moore et al, 1979) and LADTAP II codes as described in Section 4.1.

These collective doses may be compared to an estimated annual 170,000 person-rem to the same population resulting from natural background radiation. Based on the collective dose given above and a total population of 1.7 million in the region, the average effective dose equivalent to an individual residing within 80 km of the WVDP was about 0.000047 mrem during 1986--insignificant when compared to the average dose to each individual of approximately 100 mrem per year from natural sources.

Recent recommendations of the National Council on Radiation Protection and Measurements (NCRP, 1985) and the proposed revisions to the Code of Federal Regulations, Chapter 10, Part 20 (USNRC, 1986) define a risk level which is below regulatory concern for purposes of determining collective population doses. These agencies recommend that doses of $\leq$ 1 mrem/yr incurred by individual members of the public be excluded for purposes of assessing the collective dose to a population. Despite the conservatisms used in assessing the dose to the maximum hypothetical individual from environmental releases of radioactivity in 1986 from the WVDP, no individual member of the public was predicted to receive a dose in excess of 1 mrem/yr above background. Accordingly, within the framework of the NCRP and NRC methodology, the collective population dose in excess of natural background within an 80 km radius of the WVDP would, in fact, be reported as zero as a result of radionuclide releases in 1986.

4.3.3 Dose Assessment Model Prediction Versus Actual Release Data

Dose assessment models used at WVDP for liquid and airborne effluents have been used to compare model predictions with actual sample analysis. Based on actual releases of liquid effluents in 1986, LADTAP II predicts the maximum individual dose from consumption of 21 kg of fish taken from Cattaraugus Creek to be 0.4 mrem. This is in good agreement with the predicted maximum individual dose of 0.12 mrem calculated from actual measured radionuclide concentrations in fish flesh, given the statistical error associated with the sample analyses.

The predicted maximum individual dose based on actual air sampling data collected at a nearby residence (Table C-2.2.2) turns out to be zero when the background air sample data from Great Valley (Table C-2.2.7) at 42 km from the site is subtracted. This agrees with the 0.0022 mrem predicted by AIRDOS-EPA from the measured quantity of radioactivity actually discharged from the plant, in that this dose can be considered as essentially zero.

A comparison was also made of the radioactive particulate concentrations (uCi/ml) based upon air sampler data from a nearby residence (Table C-2.2.2) with those calculated from the measured release data (Table C-2.1) and the site specific annual average relative concentrations (Tables 4-1 and -2). The concentrations predicted using the stack discharge data are more than five orders of magnitude below those measured at the perimeter air monitoring stations. This finding reinforces the observation that the air sampler at the nearby residence is essentially measuring background particulate radioactivity with <0.001% of the collected activity being provided by airborne releases from the WVDP.

4.3.4 NESHAPS Compliance

This section has been added to the WVDP annual report to present data and discussion concerning compliance with 40 CFR 61 entitled National Emission Standards for Hazardous Air Pollutants, Subpart H.

Section 40 CFR 61.93 stipulates that:

"To determine compliance with the standard, radionuclide emissions shall be determined and dose equivalents to members of the public shall be calculated using EPA approved sampling procedures, EPA models AIRDOS-EPA and RADRISK, or other procedures, including those based on environmental measurements, that EPA has determined to be suitable. Compliance with this standard will be determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public resides or abides."

The EPA has determined CAAC (CCC-476) to be the suitable version of the AIRDOS-EPA dispersion code which uses ICRP 2 derived (rather than the more current ICRP 26 and 30) dose conversion factors to calculate doses to members of the public. In addition, CAAC uses simplified straight-line Gaussian methodology to describe meteorological dispersion from elevated and ground-level sources.

Whole-body and critical organ dose equivalents were calculated for all significant effluent pathways. Table 4-6 presents the calculated dosimetric data at the location of the maximum individual for both elevated and ground level releases.

The collective population dose (within 80 km of WVDP) calculated for all airborne pathways is 2.4 E-02 person-rem. As previously discussed, the hypothetical collective dose due to WVDP operations should be compared to the collective dose from natural background to the same population of 170,000 person-rem per year.

In summary, the dose calculations show that the WVDP is in compliance with the emission standard for radioactive airborne releases in that calculated doses to the maximally exposed individuals for elevated and ground level releases from the site do not exceed the applicable EPA limits.

4.3.5 Statistical Considerations

A simple one-way analysis of variance (ANOVA) statistical application was used to test if observed differences among the various sample means can be attributed to chance or whether they are indicative of actual differences among the corresponding population means. The null hypothesis being tested by the statistical application is whether or not the various population means are all equal.

In the case of the environmental air sampling data, Tables C-2.2.1 through C-2.2.7, the ANOVA test showed no statistically significant differences (at the 1% level) in gross beta, Sr-90 or Cs-137 measurements for all possible combinations. Table 4-7 shows the statistically significant differences (a total of six out of a possible 42 combinations) for the air sampling station alpha data. The five significant differences in the Fox Valley data are attributable only to background variation since the average alpha concentration predicted at the sampler as a result of WVDP stack releases is 5.7 E-21 μCi/ml, compared to the average alpha concentration of 1.5 E-15 μCi/ml from air sample analysis. The same background variation also explains the Thomas Corners versus Great Valley statistical difference in that WVDP releases would predict average concentrations of 8.6 E-22 μCi/ml compared to the average air sample analysis concentration of 1.1 E-16 μCi/ml.

TABLE 4 - 1

elative Concentration Values (sec/m^3) by Sector From 60 Metre Stack Release

RECEPTOR AZIMUTH (DEGREES)	Distance (metres) 805.0	2414.0	4023.0	5633.0	7242.0
22.50	1.34865E-08	1.71927E-08	1.53659E-08	1.16008E-08	1.00686E-08
45.00	3.03278E-08	6.62833E-08	1.19462E-07	2.28011E-08	1.79983E-08
67.50	3.64481E-08	7.69928E-08	1.02821E-07	9.41803E-08	5.77431E-08
90.00	3.74919E-08	6.31151E-08	5.99791E-08	5.94190E-08	3.82357E-08
112.50	5.65527E-08	6.61298E-08	1.00890E-07	6.25578E-08	5.45213E-08
135.00	6.47129E-08	4.14320E-08	4.15299E-08	5.34836E-08	5.67103E-08
157.50	3.90271E-08	4.06824E-08	6.03020E-08	4.09102E-08	2.77476E-08
180.00	3.81781E-08	1.22124E-07	5.71550E-08	3.20513E-08	1.65135E-08
202.50	3.39626E-08	1.18178E-07	3.81683E-08	2.06887E-08	1.37497E-08
225.00	2.65459E-08	1.33789E-07	1.40559E-08	1.47592E-08	2.14601E-08
247.50	2.28710E-08	1.40234E-07	9.92964E-09	9.23873E-09	1.20779E-08
270.00	1.89206E-08	5.87795E-08	8.15001E-09	4.43197E-09	3.40140E-09
292.50	1.83572E-08	2.03576E-08	7.37967E-09	7.54285E-09	6.41235E-09
315.00	1.61837E-08	1.12181E-08	5.58730E-09	3.40013E-09	4.18897E-09
337.50	1.37407E-08	8.56651E-09	6,98284E-09	6.43618E-09	1.03046E-08
360.00	1.63022E-08	1.86618E-08	1.33696E-08	1.43328E-08	1.57260E-08

RECEPTOR AZIMUTH (DEGREES)	12070.0	24140.0	40234.0	56327.0	72420.0
22.50	3.76277E-08	4.60131E-09	1.47903E-09	4.16372E-10	2.13197E-10
45.00	1.14274E-08	1.28140E-08	3.44087E-09	8.05384E-10	3.94584E-10
67.50	1.83720E-08	9.47802E-09	2.61500E-09	8.27191E-10	4.15068E-10
90.00	1.31074E-08	4.10035E-09	1.79761E-09	9.47011E-10	5.42868E-10
112.50	1.79356E-08	3.37901E-09	1.27235E-09	7.68376E-10	4.83769E-10
135.00	2.17244E-08	4.63600E-09	1.59818E-09	9.12074E-10	6.59780E-10
157.50	1.22420E-08	3.63091E-09	1.23836E-09	7.59553E-10	3.65875E-10
180.00	5.12675E-09	1.39954E-09	7.05623E-10	3.11794E-10	1.83159E-10
202.50	4.33084E-09	1.20774E-09	4.61639E-10	3.76630E-10	2.20628E-10
225.00	4.05277E-09	9.84525E-10	3.82512E-10	2.98694E-10	2.65110E-10
247.50	5.01156E-09	8.45959E-10	3.45917E-10	2.67128E-10	1.89775E-10
270.00	2.40747E-09	1.31323E-09	4.71842E-10	2.33303E-10	1.46546E-10
292.50	3.13835E-09	8.59311E-10	3.11297E-10	1.78562E-10	1.59762E-10
315.00	3.96969E-09	8.39388E-10	3.62375E-10	1.90663E-10	1.45786E-10
337.50	3.50730E-08	1.98774E-09	5.05830E-10	2.95021E-10	2.01301E-10
360.00	1.00030E-08	3.05156E-09	8.97284E-10	4.01802E-10	2.13954E-10

TABLE 4 - 2

Relative Concentration Values (sec/m^3) by Sector From Ground Level Release

RECEPTOR AZIMUTH (DEGREES)	Distance (metres) 805.0	2414.0	4023.0	5633.0	7242.0
22.50	1.49512E-06	3.97532E-07	1.47083E-07	8.42645E-08	5.33960E-08
45.00	1.44903E-06	3.53979E-07	1.37949E-07	4.90462E-08	3.72500E-08
67.50	1.03183E-06	8.08442E-07	9.76874E-08	6.06793E-08	4.874[illegible]E-08
90.00	1.12677E-06	1.93299E-07	7.68176E-08	4.17450E-08	2.62357E-08
112.50	1.85268E-06	2.85787E-07	1.13283E-07	5.70845E-08	3.65770E-08
135.00	2.07273E-06	2.98862E-07	1.13469E-07	6.26892E-08	4.29658E-08
157.50	1.23256E-06	1.83067E-07	7.49610E-08	3.87072E-08	2.45899E-08
180.00	9.11350E-07	1.21526E-07	4.68202E-08	2.12329E-08	1.26233E-08
202.50	5.43176E-07	8.27004E-08	3.14103E-08	1.62575E-08	1.01974E-08
225.00	6.51885E-07	7.38846E-08	2.38500E-08	1.47004E-08	1.10149E-08
247.50	4.49106E-07	8.76961E-08	1.99020E-08	1.24206E-08	1.17705E-08
270.00	8.33984E-07	9.80329E-08	2.08584E-08	9.69459E-09	6.35376E-09
292.50	1.51654E-06	2.19763E-07	3.25829E-08	3.23126E-08	2.15032E-08
315.00	3.09325E-06	6.30377E-07	7.04640E-08	2.02217E-08	2.77029E-08
337.50	6.43818E-06	1.39608E-07	5.78384E-08	6.06062E-08	1.03569E-07
360.00	3.61907E-06	4.15637E-07	9.97603E-08	1.26180E-07	1.51884E-07

RECEPTOR AZIMUTH (DEGREES)	12070.0	24140.0	40234.0	56327.0	72420.0
22.50	3.04523E-08	2.98520E-09	8.55379E-10	3.03205E-10	1.46205E-10
45.00	2.15690E-08	5.14011E-09	1.73757E-09	6.37543E-10	3.64292E-10
67.50	1.54270E-08	5.34287E-09	1.92672E-09	8.74415E-10	5.08823E-10
90.00	9.70640E-09	3.01629E-09	1.45596E-09	8.22257E-10	4.93815E-10
112.50	1.29208E-08	3.20793E-09	1.16046E-09	7.54841E-10	4.73182E-10
135.00	1.64306E-08	3.85002E-09	1.31326E-09	7.71110E-10	5.18604E-10
157.50	1.02799E-08	2.75939E-09	9.61845E-10	5.49548E-10	2.85193E-10
180.00	4.31490E-09	1.06545E-09	4.04546E-10	1.98032E-10	1.31576E-10
202.50	3.84823E-09	9.15400E-10	3.95853E-10	2.51647E-10	1.43985E-10
225.00	3.37117E-09	8.69089E-10	3.30965E-10	2.44201E-10	1.30591E-10
247.50	3.00494E-09	7.52568E-10	3.28716E-10	2.37072E-10	1.50662E-10
270.00	2.83375E-09	1.13770E-09	4.49076E-10	2.20809E-10	1.51995E-10
292.50	7.62140E-09	1.26463E-09	3.63726E-10	1.83658E-10	1.46872E-10
315.00	2.43399E-08	8.55431E-10	4.37296E-10	2.11385E-10	1.16099E-10
337.50	2.36564E-08	1.70745E-09	5.95391E-10	3.21227E-10	2.20000E-10
360.00	2.55674E-08	3.41404E-09	9.24519E-10	3.80997E-10	1.83592E-10

TABLE 4-3

RADIOACTIVITY RELEASED TO THE ATMOSPHERE DURING 1986

Release Point	Total Volume (m^3)	Total Curies Released			
		Gross Alpha	Gross Beta	Specific Nuclides	
Main Plant Stack (ANSTACK)	8.9 E+08	3.75±0.3 E-06	1.51±0.004 E-03	H-3	4.1±0.04 E-01
				Co-60	1.95±0.2 E-06
				Sr-90	4.75±0.4 E-04
				I-129	4.03±0.2 E-05
				Cs-134	1.43±0.3 E-06
				Cs-137	4.74±0.02 E-0
				Eu-154	1.50±0.4 E-06
				U-234	5.27±0.5 E-08
				U-235	4.21±1.8 E-09
				U-238	3.11±0.4 E-08
				Pu-238	5.03±0.3 E-07
				Pu-239	6.68±0.4 E-07
				Am-241	2.15±1.0 E-06
Cement Solidification System Stack (ANCSSTK)	1.5 E+08	4.54±7.0 E-08	6.2±2.9 E-07	Sr-90	2.13±0.3 E-07
				I-129	< 1.5 E-07
				U-234	1.56±0.3 E-08
				U-235	5.89±5.8 E-10
				U-238	1.47±0.3 E-08
				Pu-238	7.69±6.3 E-10
				Pu-239	3.54±1.2 E-09
				Am-241	2.04±1.1 E-09
Laundry Vent (ANLAUNV)	1.4 E+07	6.3 E-08	1.7 E-06	None Identified	
LLWT Vent (ANLLWTV)	1.1 E+08	1.7 E-07	2.5 E-06	None Identified	

TABLE 4-4
RADIOACTIVITY RELEASED IN LIQUID
EFFLUENTS DURING 1986

Release Point	Volume Released (Litres)	Released Radioactivity (Ci)					
		Gross Alpha	Gross Beta	H-3	Sr-90	I-129	Cs-137
Lagoon 3	5.0 E+07	2.7±1.0 E-03	7.2±0.4 E-02	1.2±0.3 E-00	9.0±0.3 E-03	1.7E±0.1 E-03	6.6E±0.5 E-02
Sewage Treatment Outfall (WNSP007)	2.7 E+07	<7.2 E-05	6.0±1.4 E-04	<1.4 E-02	------	------	------
Swamp Drain	1.6 E+07	------	------	8.0±0.6 E-02	------	------	------
French Drain	2.7 E+06	------	------	1.2±0.04 E-01	------	------	------
TOTAL:	9.6 E+07	2.8±1.0 E-03	7.3±0.4 E-02	1.4±0.3 E+00	9.0±0.3 E-03	1.7E±0.1 E-03	6.6E±0.5 E-02

Release Point	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
Lagoon 3	1.7±0.2 E-03	4.8±2.8 E-05	8.0±0.9 E-04	3.6±0.8 E-06	2.9±0.6 E-06	3.8±1.0 E-06
Sewage Treatment Outfall	------	------	------	------	------	------
Swamp Drain	------	------	------	------	------	------
French Drain	-------	------	------	------	-------	------
TOTAL:	1.7±0.2 E-03	4.8±2.8 E-05	8.0±0.9 E-04	3.6±0.8 E-06	2.9±0.6 E-06	3.8±1.0 E-06

TABLE 4-5

SUMMARY OF HYPOTHETICAL DOSE COMMITMENTS
TO AN ADULT INDIVIDUAL AT LOCATIONS OF MAXIMUM EXPOSURE DURING 1986

Pathway	Location	Committed Dose Equivalent (mrem) Effective	Critical Organ
Airborne Effluents			(Bone surface unless otherwise specified)
Elevated Releases All Pathways*			
Main Plant Stack (ANSTACK)	Nearby residence (2.1 km WSW)	0.0022	0.013
Ground Level Releases All Pathways*			
CSS Stack (CSSTK)	Nearby residence (1.4 km, NW)	0.000011	0.000065[1]
Laundry Vent (ANLAUNV)	Nearby residence (1.4 km, NW)	0.000025	0.00037
LLWT Vent (ANLLWTV)	Nearby residence (1.4 km, NW)	0.000054	0.00084
Milk	Collected 3.5 km SSW	0.17	1.8
Venison	Collected within 1 km of WVDP	0.58	0.59[2]
Beef	Collected 4 km N of WVDP	0.24	0.25[2]
Liquid Effluents			
Fish	Collected in Cattaraugus Creek below WVDP	0.12	1.3

*Estimates based on measured radioactivity in airborne effluents (Table 4-3) and dispersion and radiological dose calculations described in Section 4.1. All other values based on measured concentrations in food and consumption rates for maximally exposed individuals recommended in U.S. NRC Regulatory Guide 1.109.

Note: Annual average whole body dose from natural background sources in the U.S. is about 100 mrem.

1 Thyroid
2 Testes

TABLE 4-6

SUMMARY OF HYPOTHETICAL DOSE EQUIVALENTS CALCULATED PER 40 CFR 61 TO AN ADULT INDIVIDUAL AT LOCATIONS OF MAXIMUM EXPOSURE DURING 1986

Pathway	Location	Dose Equivalent (mrem)	
		Whole-body	Critical Organ
Airborne Effluents			(Bone surface unless otherwise specified)
Elevated Releases All Pathways*			
Main Plant Stack (ANSTACK)	Nearby residence (3.4 km SE)	0.00015	0.0023[1]
Ground Level Releases All Pathways*			
CSS Stack (CSSTK)	Nearby residence (1.9 km, NNW)	0.000033	0.0000069[1]
Laundry Vent (ANLAUNV)	Nearby residence (1.9 km, NNW)	0.000073	0.0018
LLWT Vent (ANLLWTV)	Nearby residence (1.9 km, NNW)	0.00019	0.0047

*Estimates based on measured radioactivity in airborne effluents (Table 4-3) and dispersion and radiological dose calculations described in Section 4.3.4. All other values based on measured concentrations in food and consumption rates for maximally exposed individuals recommended in U.S. NRC Regulatory Guide 1.109.

Note: Annual average whole body dose from natural background sources in the U.S. is about 100 mrem.

[1] Thyroid

TABLE 4-7

Air Sampling Station Around WVDP Exhibiting Pair-Wise Statistically Significant Differences in Average Detected Alpha Concentrations(*)

	Rock Springs Road	Great Valley	Fox Valley	Route 240	Thomas Corners	Spring-ville	West Valle
Rock Springs Road	—	†					
Great Valley		—					
Fox Valley	*	*	—	*		*	*
Route 240				—			
Thomas Corners		*			—		
Springville						—	
West Valley							—

† Empty box designates no statistically significant differences.

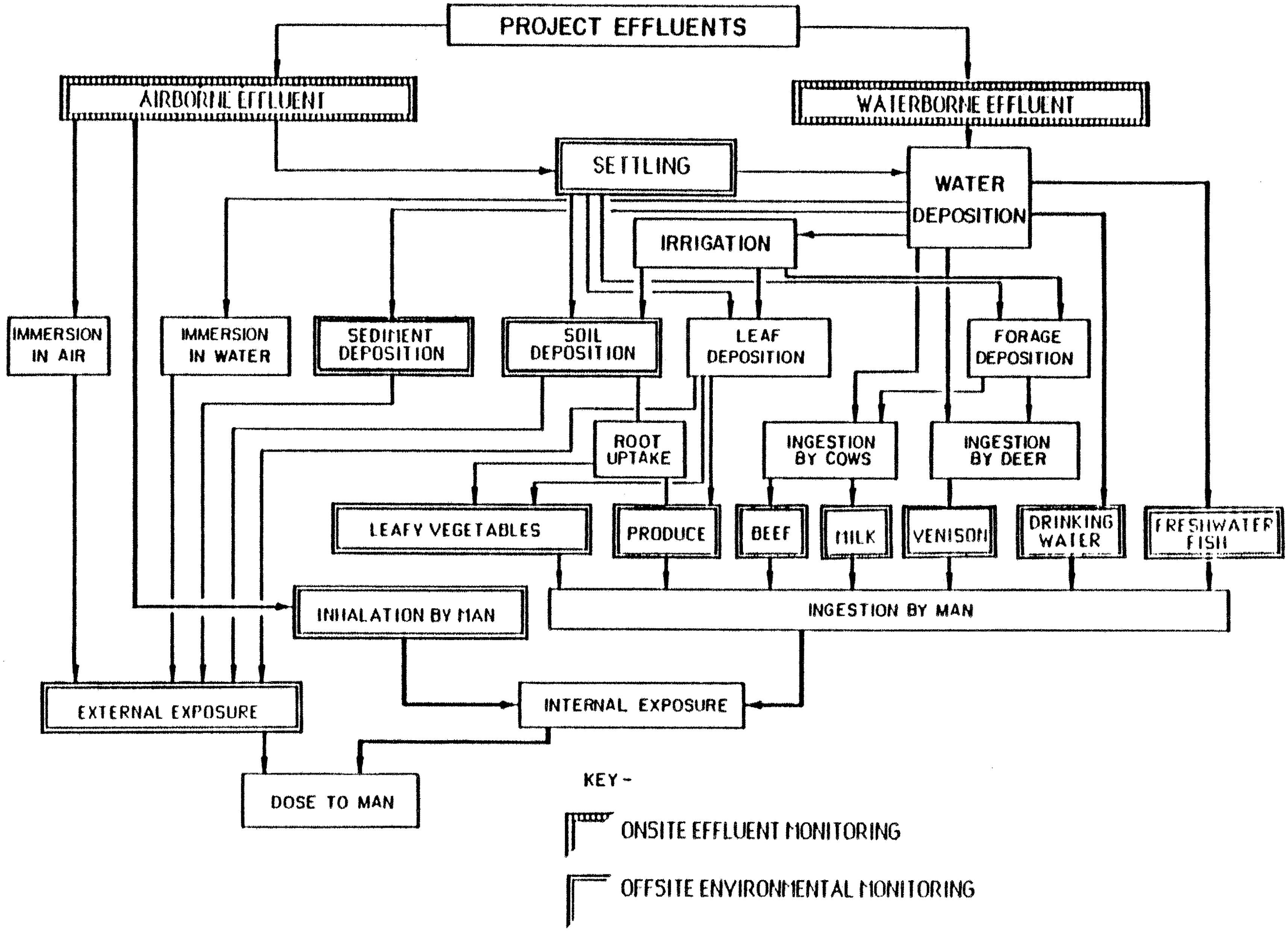
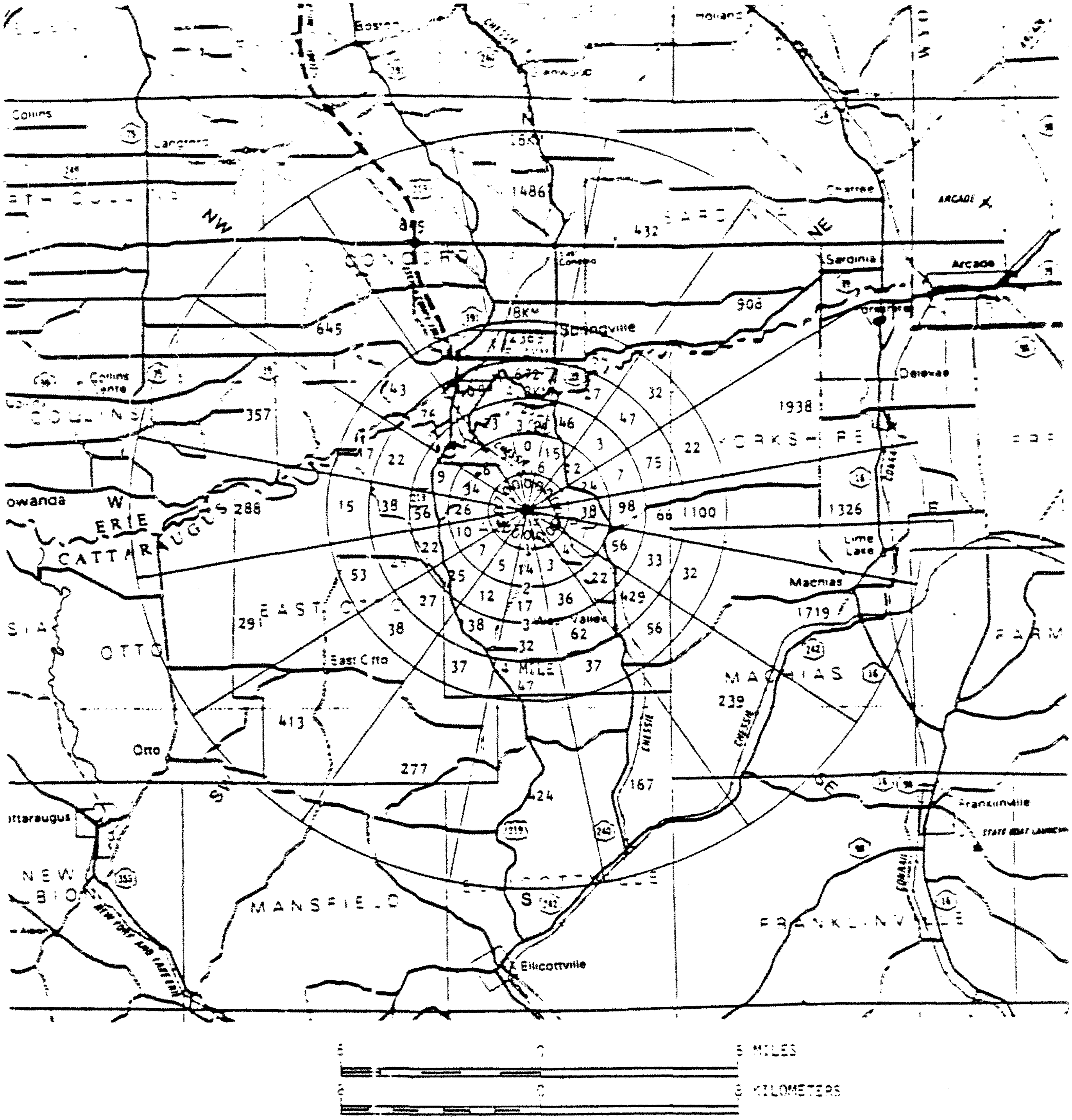


FIGURE 4-1

COMPARTMENT MODEL OF PATHWAYS AND MONITORING INTERCEPT POINTS



1990 POPULATION PROJECTIONS BY SECTOR

WITHIN 16 KILOMETERS (10 MILES) OF SITE

FIGURE 4-2

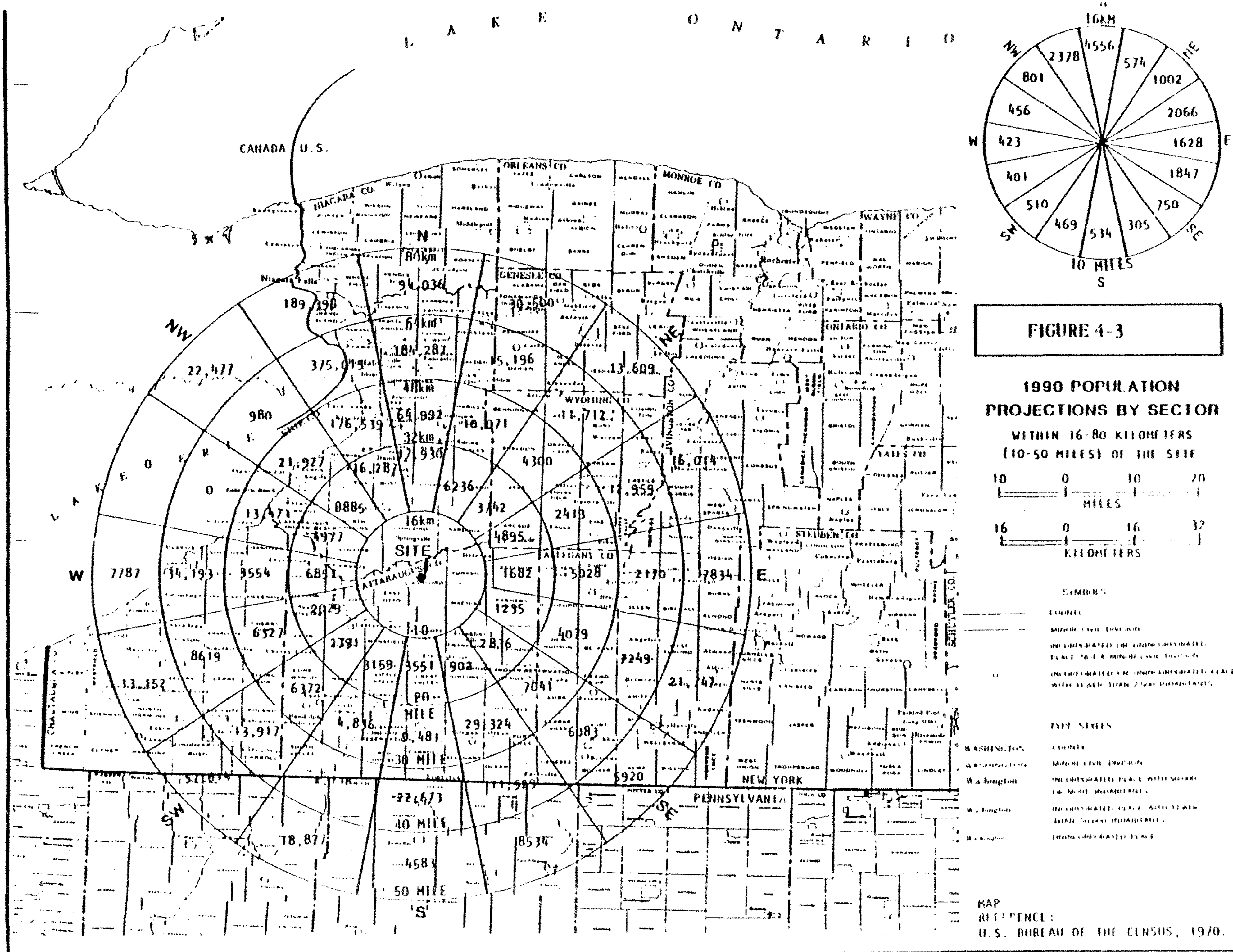
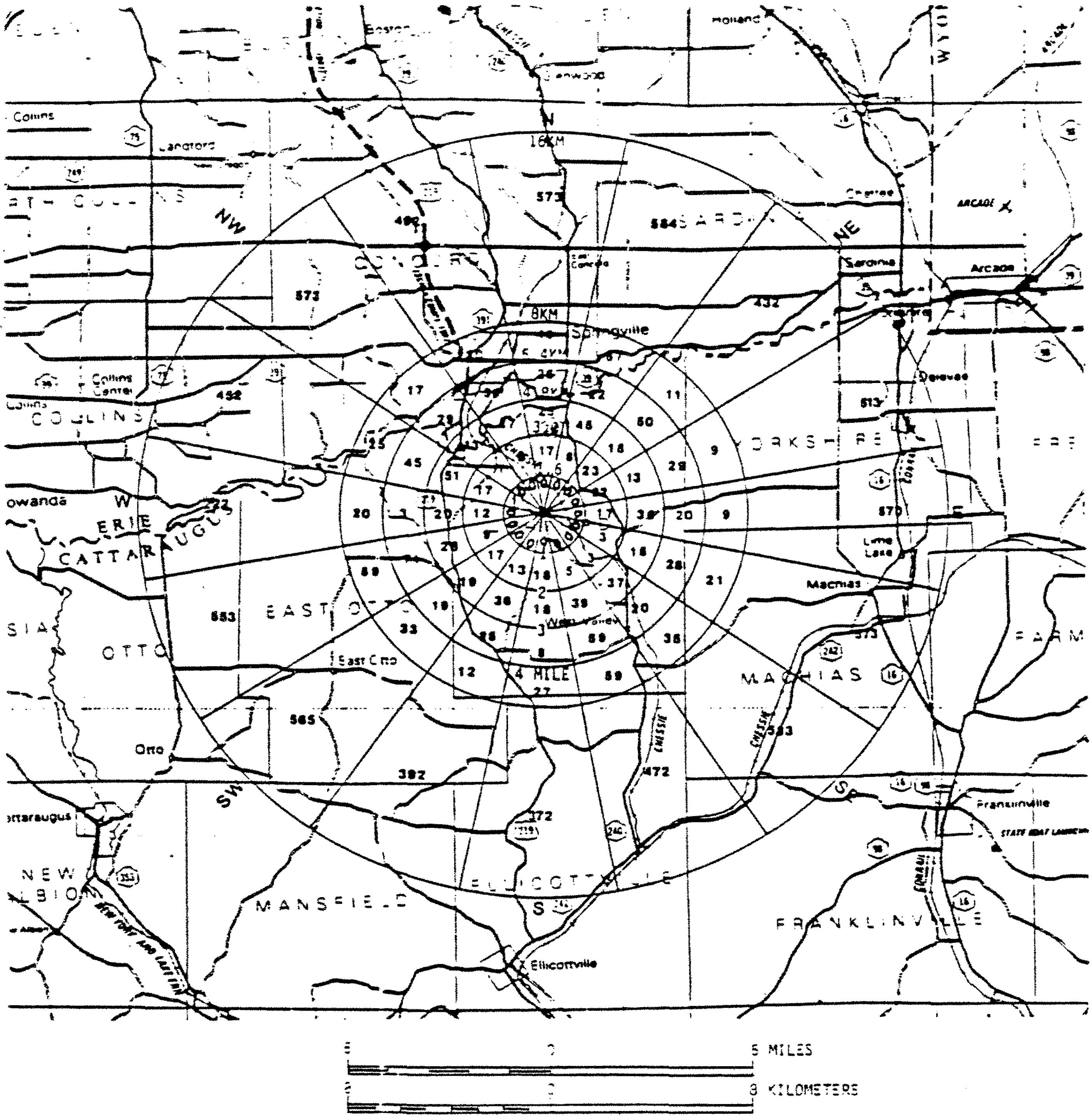


FIGURE 4-3

1990 POPULATION PROJECTIONS BY SECTOR WITHIN 16-80 KILOMETERS (10-50 MILES) OF THE SITE

MAP REFERENCE: U.S. BUREAU OF THE CENSUS, 1970.



NUMBER OF DAIRY COWS BY SECTOR

WITHIN 16 KILOMETERS (10 MILES) OF SITE

FIGURE 4-4

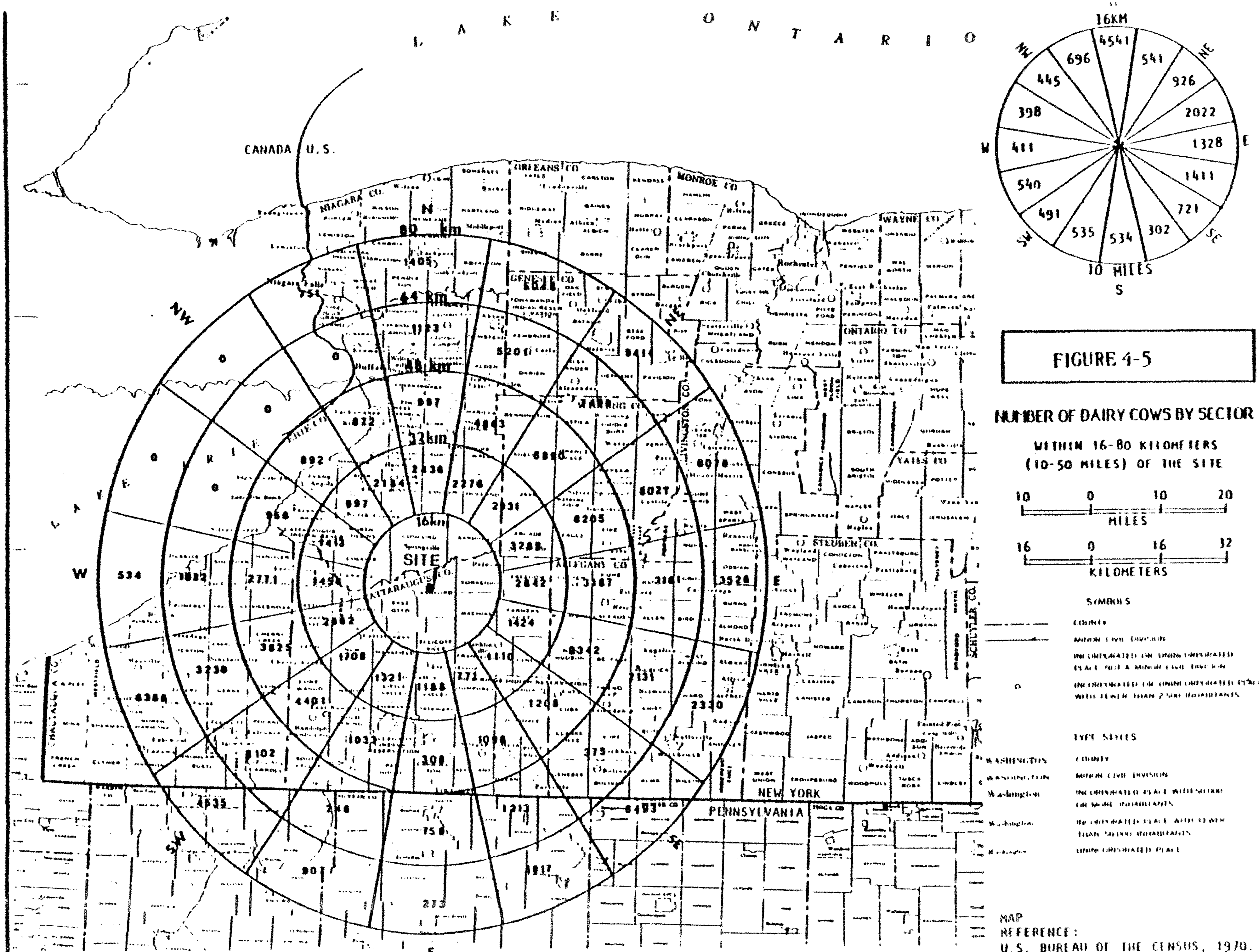
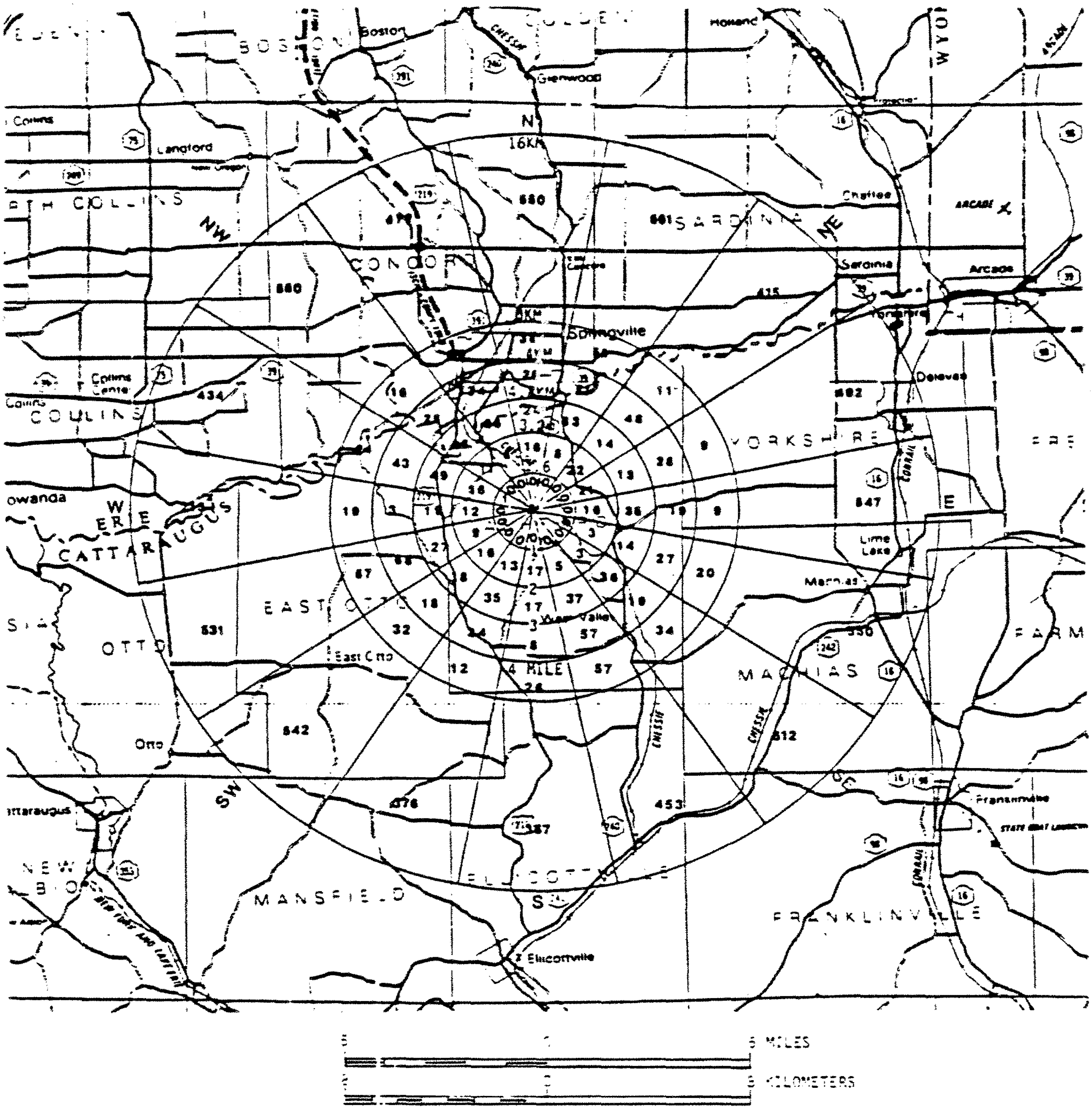


FIGURE 4-5

NUMBER OF DAIRY COWS BY SECTOR

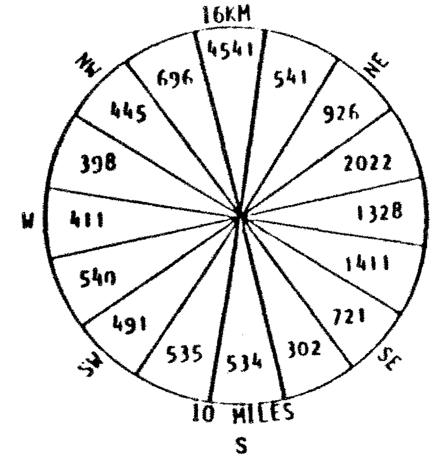
WITHIN 16-80 KILOMETERS (10-50 MILES) OF THE SITE



NUMBER OF MEAT-PRODUCING ANIMALS BY SECTOR

WITHIN 16 KILOMETERS (10 MILES) OF SITE

FIGURE 4-6



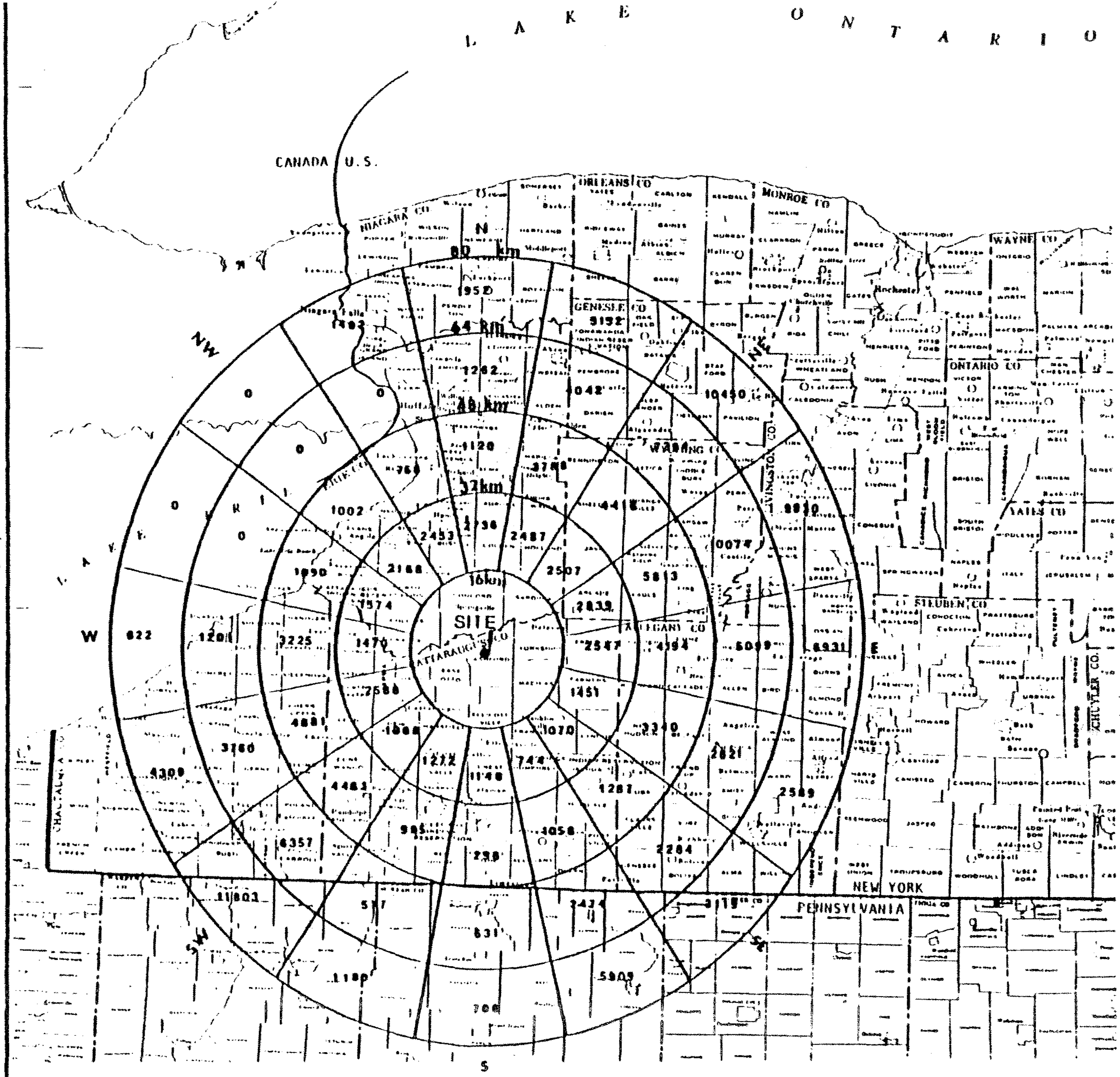


FIGURE 4-7

NUMBER OF MEAT-PRODUCING ANIMALS BY SECTOR

WITHIN 16-80 KILOMETERS (10-50 MILES) OF THE SITE

10 0 10 20
MILES

16 0 16 32
KILOMETERS

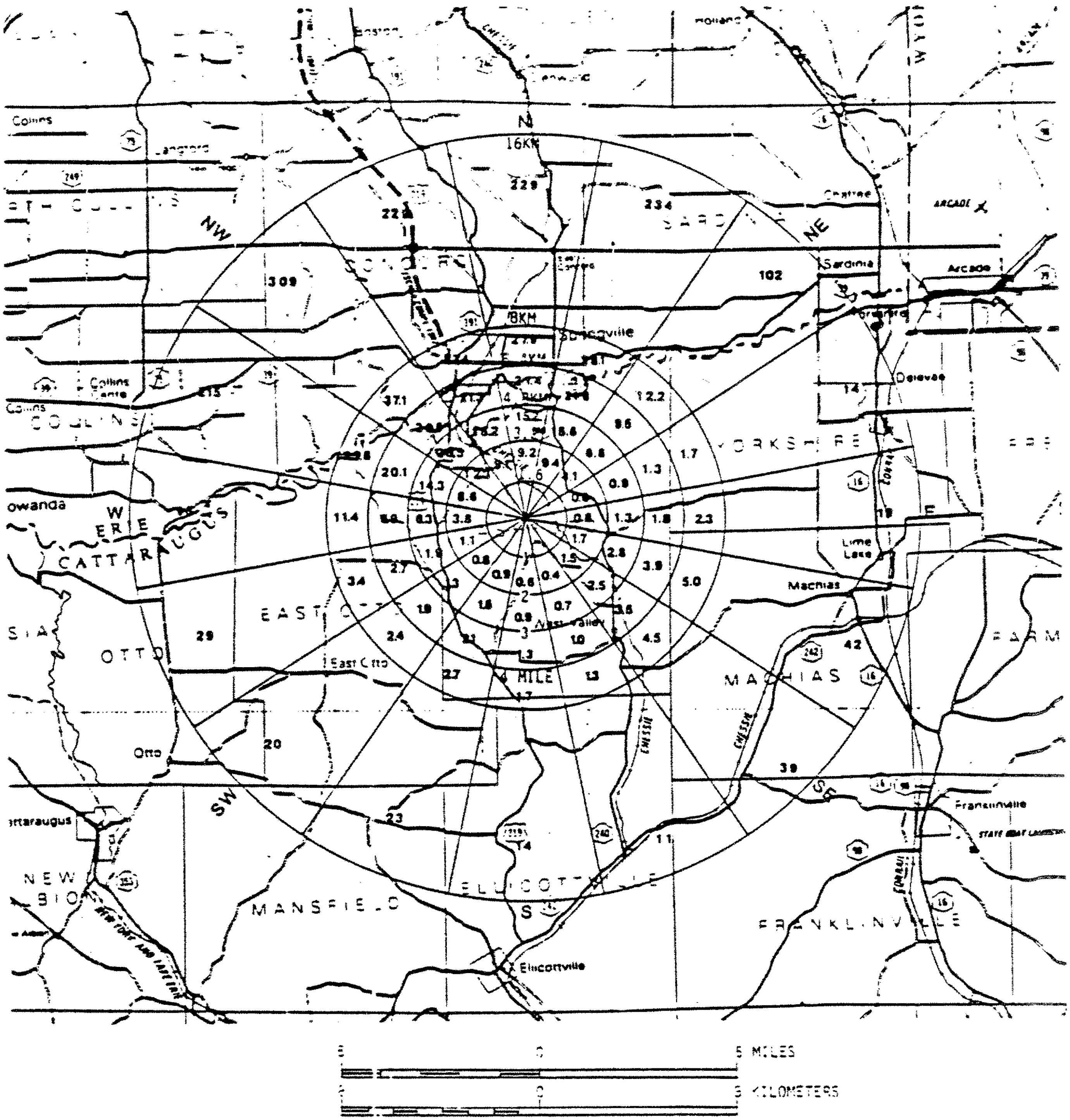
SYMBOLS

COUNTY
MINOR CIVIL DIVISION
INCORPORATED OR UNINCORPORATED PLACE NOT A MINOR CIVIL DIVISION
INCORPORATED OR UNINCORPORATED PLACE WITH FEWER THAN 2,500 INHABITANTS

TYPE STYLES

WASHINGTON — COUNTY
WASHINGTON — MINOR CIVIL DIVISION
Washington — INCORPORATED PLACE WITH 50,000 OR MORE INHABITANTS
Washington — INCORPORATED PLACE WITH FEWER THAN 2,500 INHABITANTS
Washington — UNINCORPORATED PLACE

MAP REFERENCE:
U.S. BUREAU OF THE CENSUS, 1970.



AGRICULTURAL PRODUCE LAND AREA (ha) BY SECTOR

WITHIN 16 KILOMETERS (10 MILES) OF SITE

FIGURE 4-8

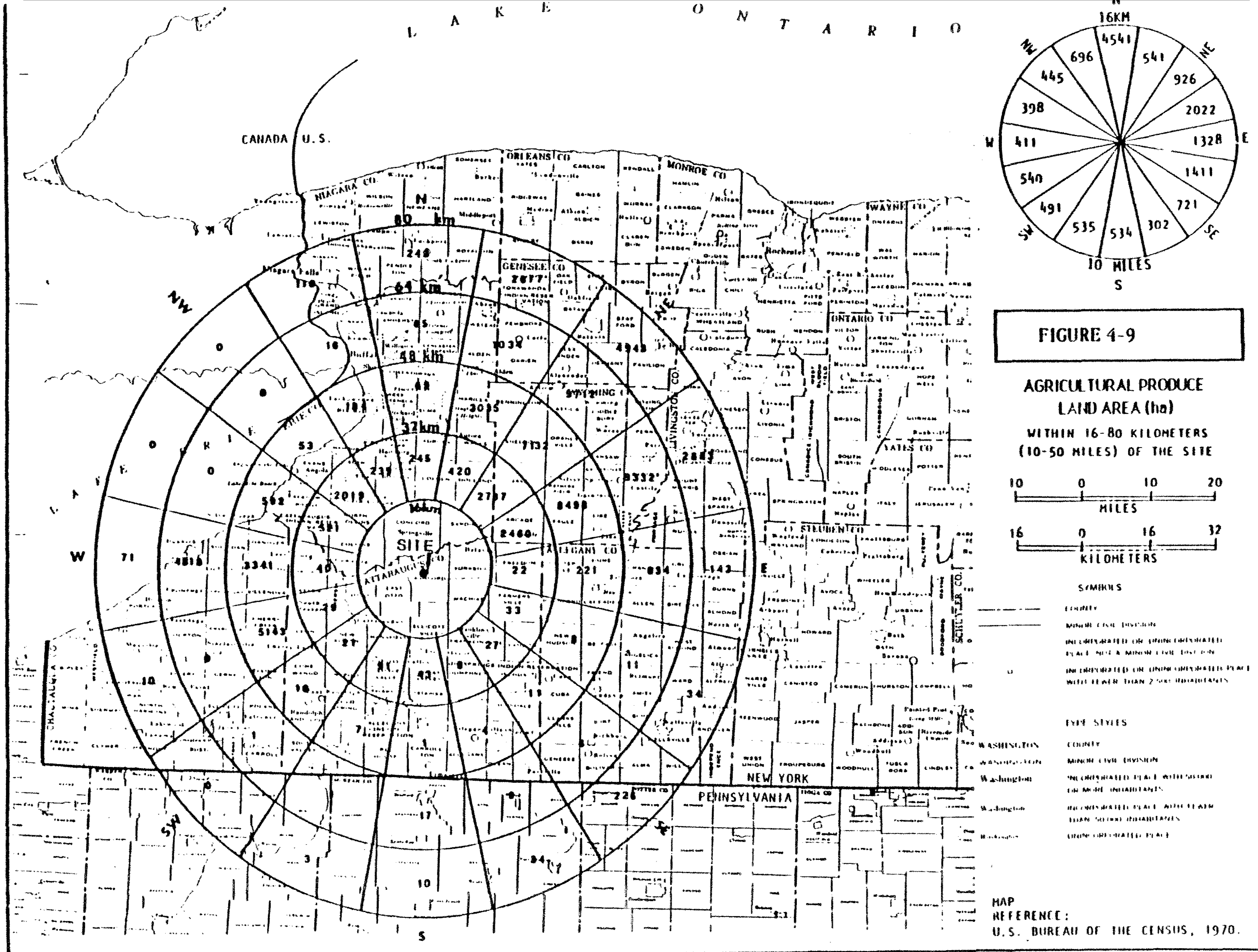


FIGURE 4-9

AGRICULTURAL PRODUCE LAND AREA (ha) WITHIN 16-80 KILOMETERS (10-50 MILES) OF THE SITE

5.0 STANDARDS AND QUALITY ASSURANCE

5.1 Environmental Standards and Regultations

The following environmental standards and laws are applicable to the WVDP:

- DOE Orders including 5480.1, "Requirements for Radiation Protection," August 1981 and 5484.1, "Environmental Protection, Safety,and Health Protection Information Reporting Requirements", February 1981.

- Clean Air Act 42 USC 1857 et. seq., as amended.

- Federal Water Pollution Control Act (Clean Water Act), 33 USC 1251, as amended.

- Resource Conservation and Recovery Act, 42 USC 6905 as amended. (Including Hazardous and Solid Waste Amendments of 1984)

- Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 960. (Including Superfund Amendments and Reauthorization Act of 1986)

- Toxic Substances Control Act, 15 USC 2601, as amended.

- Environmental Conservation Law of New York State.

The standards and guides applicable to releases of radionuclides from the WVDP are those of DOE order 5480.1 Chapter XI, dated August 13, 1981, entitled, "Requirements for Radiation Protection." Radiation protection standards and selected radioactivity limitations from Chapter XI, as amended by the Derived Concentration Guides, are listed in Appendix B.

These listed concentrations are guidelines provided by DOE to assure compliance with the performance standard of 100 mrem effective dose equivalent to the maximally exposed individual. Ambient water quality standards contained in the SPDES permit issued for the facility are listed in Table C-5.2. Airborne discharges are also regulated by the U.S. Environmental Protectio Agency, National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, 1984.

5.2 Quality Assurance

Off-site laboratories performed the majority of the analyses requiring radiochemical separation for the environmental samples collected during 1985. The documented quality assurance plan use by these laboratories includes periodic interlaboratory cross-checks, prepared standard and blank analyses, routine instrument calibration, and use of standardized procedures. Off-site laboratories analyze blind duplicates of approximately 10% of the samples analyzed on-site for the same parameters in addition to unknown cross-check samples. Additionally, physical surveys were made of the contract laboratory facilities in conjunction with a quality assurance review by Project personnel.

Sample collection, preparation, and most direct radiometric analyses were performed at the WVDP Environmental Laboratory for all media collected. Additionally, determination of Sr-90 in water is a routine radiochemical measurement performed in the Environmental Laboratory. For all continuous sampling equipment, measurement devices, and counting instruments, periodic calibration was maintained using standards traceable to the National Bureau of Standards.

Formal cross-check programs between the WVDP Environmental Laboratory and the DOE Radiological and Environmental Science Laboratory (RESL), Idaho National Engineering Laboratory (INEL) and Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental samples monitored in 1986. A comparison of water analyses at WVDP and INEL is presented in Table D-1.1. Comparative data from a variety of environmental materials analyzed at WVDP and EML are summarized in Tables D-1.2 and D-1.4. The U.S. Environmental Protection Agency (EPA) cross-check programs for nonradiological water quality parameters also provided audit samples in 1986. In addition, the routine program of splitting samples between WVDP and the New York Department of Health, and TLD monitoring point calculations with the U.S. NRC provided additional quality assurance data.

As a result of the RESL cross-checks, the current gamma isotopic analysis procedure for water was found to be satisfactory. Air filter media of the geometry provided by RESL in the cross-check sample, however, is not normally used at WVDP, the use of a nearly equivalent calibration produced results for air filter media biased about ten percent high, but with acceptable precision. The bias is accounted for in analysis of routine samples in the calibration geometry. A set of cross-check samples in 1986 between WVDP and EML included soil, tissue, vegetation, air samples, and water samples. Results were satisfactory for all media routinely analyzed at the WVDP environmental laboratory. The one unsatisfactory result was for a sample which required radiochemical separations and a significantly different (compared to WVDP analyses) counting geometry performed at the contract laboratory facilities. The isotope was reported as less than detectable activity for the aliquot analyzed. This specific analysis is also being reviewed by EML because 75% of the laboratories participating in the cross-check program reported results that were outside the expected value. Of 48 analyses performed by WVDP and our contract laboratory, four were in the warning area, and one was not acceptable.

The TLDs colocated at the NRC TLD locations from June to October 1986 yielded one set of results which were not in agreement (Table D-1.3). The maximum discrepancy was a factor of 0.74, but the remainder of the results were statistically equivalent. The location which was not in close agreement is being monitored closely in order to resolve the discrepancies. It is noted that several factors may cause variations, including the proximity of the dosimeters to poles and buildings, or the ground. The one location where these variables are removed by virtue of side-by-side colocation (DFTLD24) and an exposure rate considerably above background, gives very good agreement. The results for environmental media split with the NYSDOH through 1986 were not available for comparisons.

Results of the 1985/1986 international dosimeter intercomparison are given in Table D-1.4, and show acceptable results. Since the TLDs used at WVDP are calibrated to Cs-137, it was noted with interest that the central value was very close to the calculated laboratory Cs-137 exposure provided by EML.

Based on the various audit and cross-check results, the WVDP Environmental Monitoring Program is functioning well, and the areas needing improvement have been identified and are receiving appropriate attention.

5.3 Statistical Reporting Of Data

Except where noted, individual analytical results are reported with plus or minus (±) two standard deviations (2 σ) giving a value at the 95% confidence level. The arithmetic averages were calculated using actual results, including zero and negative values. In the final results, if the uncertainty (2 σ) was equal to or greater than the value, the measurement was considered to be below the Minimum Detectable Concentration (MDC) (see Section 5.4), and is reported as a less-than (<) value. These MDC values will vary among samples, especially in biological media where sample size cannot be easily standardized.

The total statistical uncertainty for radiological measurements, including systematic (processing and physical measurement) uncertainty plus the random radioactivity counting uncertainty, is reported as one value for the 1986 data. In most cases, systematic uncertainties (e.g., due to laboratory glassware or analytical balance variation) are a small percentage of the larger counting uncertainties at typical environmental levels of radioactivity. The notation normally used in reporting of raw laboratory data to convey the total uncertainty is in the form: (V.00 ± R.0; T.0) E-00 where "V.00" is the analytical value to three significant figures, "± R.0" is the random uncertainty to two significant figures, "T.0" is the total of random plus systematic uncertainties, and "E-00" is the exponent of 10 used to signify the magnitude of the parenthetical expression.

5.4 Analytical Detection Limits

For unique or individual samples analyzed on an infrequent basis, generic minimum detection limits for the entire analytical measurement protocol have not been developed, although a Lower Limit of Detection (LLD) based solely on the counting uncertainty is calculated for each sample. For routine measurements using standardized sample sizes, equipment, and preparation techniques, an average Minimum Detectable Concentration (MDC) has been calculated for WVDP environmental samples. These are listed in Table 5-1.

Specific sample media were analyzed for radionuclides from multiple split samples, using routine procedures, normal laboratory techniques, and standard counting parameters. The counting statistics determined the estimated LLD above which there was 95% probability that radioactivity was present. This LLD is derived from the detection efficiency of the measuring instrument for the type of activity being measured, the level of normal background signal with no sample present (determined by counting a "background" of the same material as the sample) and the length of time the background and sample were counted. For radioactive decay, these factors can be used to accurately predict what value is the lowest which can be measured at a given confidence level. A separate calculation for systematic uncertainty, including the variation between duplicate samples, labware differences, and physical measurements was made and added to the statistical counting LLD to obtain the minimum analytical detection limit or MDC for the entire process. Volumetric measurement of sample flow rates, calibration standard uncertainties, and pipetting device accuracy were some of the factors included in this calculation. The overall result is the average Minimum Detectable Concentration (at the 95% confidence level) for each type of sample treated in a uniform manner. For most sample analyses, there is little or no significant difference between the LLD and the MDC.

TABLE 5-1

MINIMUM DETECTABLE CONCENTRATIONS FOR ROUTINE SAMPLES

Measurement	Medium	Sample Size	MDC
gross alpha	water	1 litre	8.1 E-10 uCi/ml
gross beta	water	1 litre	7.7 E-10 uCi/ml
Cs-137	water	250 ml	2.1 E-08 uCi/ml
H-3	water	5 ml	1.0 E-07 uCi/ml
Sr-90	water	1 litre	1.6 E-09 uCi/ml
gross alpha	air	400 m^3	1.1 E-15 uCi/ml
gross beta	air	400 m^3	1.9 E-15 uCi/ml
Cs-137	air	400 m^3	1.4 E-14 uCi/ml
gross alpha	soil	150 mg	5.5 E-06 uCi/g
gross beta	soil	150 mg	5.3 E-06 uCi/g
Cs-137	soil	350 g	6.3 E-08 uCi/g

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APPENDIX A

EFFLUENT, ON-SITE AND OFF-SITE MONITORING PROGRAM FOR IMPLEMENTATION DURING 1986

EFFLUENT AND ON-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I. D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Main plant ventilation exhaust stack **ANSTACK**	Release point for airborne radioactive exhaust Required by: DOE 5484.1, Tech Spec 4.1.1 Reported: Internal Monthly Summary Annual Effluent Report Annual Environmental Report	Continuous off-line air particulate monitor[a]	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and be monitoring
		Continuous off-line air particulate and iodine sampler[a] **Continuous off-line tritium (as water vapor) sampler**	Weekly collection of filter paper, charcoal absorber, and dessicant	156	Filters for gross alph beta, gamma isotopic upon collection, H-3 weekly. Quarterly composites: filters for Sr-90, Pu isotopic, Am-241 gamma isotopic; charcoal for I-129
Cement Solidification (CSS) system ventilation exhaust. **ANCSSTK**	Release point for airborne radioactive exhaust Required by: DOE 5484.1, Tech Spec 4.1.1 Reported: Internal Monthly Summary Annual Effluent Report Annual Environmental Report	Continuous off-line air particulate monitor[a]	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and be monitoring
			Weekly collection of filter paper, charcoal absorber	104	Filters for gross alph beta, gamma isotopic upon collection Quarterly composites: filters for Sr-90, Pu/ isotopic, Am-241 gamma isotopic; charcoal for I-129
Lagoon 3 discharge weir **WNSP001**	Primary point of liquid effluent batch release Required by: DOE 5484.1 Tech Spec 4.2 SPDES Reported: NYSDEC Monthly DMR Annual Effluent Report Annual Environmental Report	Grab Liquid	Daily, during Lagoon 3 discharge	40-80	Daily: Gross beta, conductivity, pH. Eve sixth daily sample: gross alpha/ beta, H-3 Sr-90, gamma isotopic. Weighted monthly composite of daily samples: gross alpha/ beta, H-3, Sr-90, I-12 gamma isotopic. Quarterly weighted composite of daily samples: U isotopic, Pu isotopic, Am-241
		Composite Liquid	Twice during discharge, near start, and near end.	8-10	Two 24 hour composites for Al, NH_3, As, BOD-5 Fe, Zn, pH, suspended solids;
		Grab Liquid	Twice during discharge, same as composite.	8-10	Settleable solids, pH, cyanide, oil and greas
		Composite Liquid	Annually	1	Annually, a 24 hour composite for: Cd, Cr Cu, Pb, Ni, Se

[a] Isokinetic sampling probes placed at 231' (plant elevation) within the main stack, at the 168' level within the CSS vent stack.

EFFLUENT AND ON-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Erdman Brook at security fence **WNSP006**	Combined facility liquid discharge Required by: DOE 5484.1 Reported: Internal Monthly Summary Annual Environmental Report **NH_3 & Fe deleted from schedule**	Continuous proportional sample liquid	Monthly* (Composite of biweekly collections)	12	Gross alpha/beta, H-3, **pH, conductivity** Quarterly composite: gamma isotopic, Sr-90, **I-129**
On-site ground water (wells) **WNW80-series** **WNW82-series** **WNW83-series**	Ground water monitoring wells around site facilities Required by: DOE 5484.1 Reported: Annual Environmental Report	Grab liquid	**Quarterly* during 1st year, semiannual/ annual thereafter (see Table 9)**	132	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity, chloride Fe, Mn, Na, sulfate, phenols, nitrate, TOC, TOH

*Samples to be split (shared with NYSDOH)

EFFLUENT AND ON-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I. D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Sanitary Waste Discharge **WNSP007**	Liquid effluent point for sanitary and utility plant combined discharge Required by: DOE 5484.1 SPDES	24 hr composite liquid	3/month	36	Gross alpha/beta, pH, H-3, settleable solids suspended solids, NH_3 BOD-5, Fe
	Reported: NYSDEC Monthly DMR Internal Monthly Summary Annual Effluent Report Annual Environmental Report	Grab	Annually	1	Chloroform
N.E. Swamp drainage **WNSWAMP** North Swamp drainage **WNSW74A**	Site surface drainage Required by: DOE 5484.1 Reported: Annual Effluent Report	Grab liquid	Monthly*	24	Gross alpha/beta, H-3 pH

*Samples to be split (WNSWAMP only) with NYSDOH

EFFLUENT AND ON-SITE MONITORING PROGRAM FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
French Drain **WNSP008**	Drains subsurface water from LLWT lagoon area	Grab liquid	**3/month**	**36**	**pH, conductivity, BOD-5 Fe**
	Required by: DOE 5484.1				
	Reported: NYSDEC Monthly DMR		Monthly	12	Gross alpha/beta, H-3
	Annual Effluent Report		**Annually**	1	**Ag, Zn**
Franks Creek E of NYSLLWB **WNFRC67**	Drains NYS Low Level Waste Burial area	Grab liquid	Monthly	12	Gross alpha/beta, H-3, **pH**
	Required by: DOE 5484.1		Weekly*		
	Reported: Internal review NYSERDA				
Erdman Brook N of burial areas **WNERB53**	Drains NYS and WVDP disposal areas	Grab liquid	Weekly*	52	Gross alpha/beta, H-3 **pH**
	Required by: DOE 5484.1				
	Reported: Internal Review NYSERDA				

*Samples to be split (shared with NYSDOH).

EFFLUENT AND ON-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Ditch N of WVDP NDA & LLWB **WNNDADR**	Drains WVDP disposal area Required by: DOE 5484.1 Reported: Internal Review	**Composite continuous liquid**	Weekly	52	**Weekly gamma** isotopic, **pH, conductivity, monthly:** gross alpha/beta, **quarterly composite:** Sr-90, I-129
Condensate and Cooling Water Ditch **WNSP005**	Combined drainage from facility yard area Required by: DOE 5484.1 SPDES Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3 pH
Cooling Tower Basin **WNCOOLW**	Cools plant utility steam system water Required by: DOE 5484.1 Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3 pH

*Samples to be split (shared with NYSDOH)

MCW0614b:S/EA02

EFFLUENT AND ON-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
(7) On-site standing water (ponds not receiving effluent) **WNSTAW-series**	Water within vicinity of plant airborne or ground water effluents Required by: DOE 5484.1 Reported: Internal Review	Grab liquid	Annually	7	Gross alpha/beta, H-3, pH, conductivity, chloride, Fe, Mn, Na, phenols, sulfate
Site potable water **WNDRNKW**	Source of water within site perimeter Required by: DOE 5484.1 Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH, conductivity
			Annually	2	Toxic metals, pesticide chemical pollutants

MCW0614b:S/EA02

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek at Felton Bridge location **WFFELBR**	Unrestricted surface waters receiving plant effluents Required by: DOE 5484.1 Reported: Internal Monthly Summary Annual Environmental Report	Flow weighted continuous liquid	Weekly*	52	Weekly for gross alpha/beta, H-3, pH; Monthly composite for gamma isotopic and Sr-

*Samples to be split (shared with NYSDOH)

MCW0614b:S/EA02

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Buttermilk Creek, just upstream of Cattaraugus Creek confluence at Thomas Corners Road **WFBCTCB**	Restricted surface waters receiving plant effluents Required by: DOE 5484.1 Reported: Annual Environmental Report	Composite continuous liquid	Biweekly	26	Monthly for gross alpha/beta, H-3, pH; Quarterly composite for gamma isotopic and Sr-90
Buttermilk Creek control location near Fox Valley **WFBCBKG**	Restricted surface water background Required by: DOE 5484.1 Reported: Internal Monthly Summary Annual Environmental Report	Composite continuous liquid	Biweekly	26	Monthly for gross alpha/beta, H-3; Quarterly composite for gamma isotopic and SR-90

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Wells near WVDP outside WNYNSC Perimeter 3.0 Km WNW **WFWEL01** 1.5 Km NW **WFWEL02** 4.0 Km NW **WFWEL03** 3.0 Km NW **WFWEL04** 2.5 Km SW **WFWEL05** 11.0 Km SSW **WFWEL06** 4.0 Km NNE **WFWEL07** 2.5 Km ENE **WFWEL08** 3.0 Km SE **WFWEL09** 7.0 Km N **WFWEL10**	Drinking supply ground water near facility. Required by: DOE 5484.1 Reported: Annual Environmental Report	Grab liquid	Biennially	10 (year of collection)	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

MCW0614b:S/EA02

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
3.0 Km SSE at Fox Valley **AFFXVRD** 3.7 Km NNW at Thomas Corners Road **AFTCORD** 2.0 Km NE of Route 240 **AFRT240*** 1.5 Km NW on Rock Springs Road (added in 1984) **AFRSPRD*†** 29 Km S at Great Valley (background added in 1984) **AFGRVAL*†** 7 Km at Springville (added in 1984) **AFSPRVL** 6 Km SSE at West Valley (added in 1984) **AFWEVAL** **50 Km W at Dunkirk AFDNKRK** **2.3 Km SW on Dutch Hill Road AFBOEHN**	Particulate air samples around WNYNSC perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report ***Monthly Internal Summary**	Continuous air particulate **Continuous H-3, charcoal†**	Weekly	**780**	Weekly (each filter) gross alpha/beta, H-3 **(on 3 stations)** Quarterly: (Each station) composite filters for Sr-90, gamma isotopic; I-129 (on 3 **stations)**

† see sample location

MCW0614b:S/EA02

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
2.5 Km SW **AFDHFOP** 3.0 Km SSE **AFFXFOP** 3.7 Km NNW **AFTCFOP** 2.0 Km NE **AF24FOP**	Fallout particulate and fluid collection around WNYNSC perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report	Integrating liquid	Monthly	48	Gross alpha/beta, H-3, pH
(9) Surface soil (at each air particulate sampler) 26 Km SSW at Little Valley **SF-series**	Long-term fallout accumulation Required by: DOE 5484.1 Reported: Annual Environmental Report	Surface plug composite soil	Triennially*	10 (year of collection)	Gamma isotopic, Sr-90, Pu, Am-241

*Samples to be split (shared with NYSDOH)

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Buttermilk Creek at Thomas Corners Road **SFTCSED†**	Deposition in sediment downstream of facility effluents	Grab stream sediment	Semiannually * (split two only)	10	Gross alpha/beta, isotopic gamma and Sr-90
			Annually†	2	U/Pu isotopic, Am-241
Buttermilk Creek at Fox Valley Road (background)*† **SFBCSED**	Required by: DOE 5484.1				
Cattaraugus Creek at Felton Bridge **SFCCSED**	Reported: Annual Environmental Report				
Cattaraugus Creek at Springville Dam* **SFSDSED**					
Cattaraugus Creek at Bigelow Bridge (background) **SFBISED**					

† see specific sample location

*Samples to be split (shared with NYSDOH)

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek downstream of the Buttermilk Creek confluence **BFFCATC**	Fish in waters downstream of facility effluents Required by: DOE 5484.1	Individual collection, biological	Semiannually*	60 (each sample point is 10 fish)	Isotopic gamma and Sr-90 in edible portions
Cattaraugus Creek downstream of Springville Dam **BFFCATD**	Reported: Annual Environmental Report				
Control sample from nearby stream not affected by WVDP (7 Km or more upstream of site effluent point) **BFFCTRL**					

*Samples to be split (shared with NYSDOH)

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Dairy farm, 3.8* Km NNW **BFMREED** Dairy farm, 2.5* Km ENE **BFMZIMM** Dairy farm, 1.9 Km WNW **BFMCOBO** Control location, 30 Km N and 25 Km S **BFMCTLN, BFMCTLS**	Milk from animals foraging around facility perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report	Grab biological	Monthly (BFMREED, BFMCOBO, BFMCTLS, BFMCTLN)	48	Gamma isotopic, Sr-90 H-3 and I-129 on annua samples and quarterly composites of monthly samples
Dairy farm 3 Km SE of site BFMWIDR Dairy farm 3.5 Km SSW BFMHAUR			Annual	3	

*Samples to be split (shared with NYSDOH)

MCW0614b:S/EA02

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENT	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
(3) Nearby downwind location **BFVNEAR** (3) Remote location (16 Km or more from facility) **BFVCTRL**	Fruit and vegetables grown near facility perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report	Grab Biological	Annually,* at harvest	6	Gamma isotopic and Sr-9 analyses of edible portions, H-3 in free moisture
Beef animal from nearby farm in downwind direction **BFBNEAR** Beef animal from control location (16 Km or more from facility) **BFBCTRL**	Meat-Beef foraging near facility perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report	Grab biological	Semiannually*	4	Gamma isotopic analysis of meat.

*Samples to be split (shared with NYSDOH)

OFF-SITE MONITORING PROGRAM FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
In vicinity of the site **BFDNEAR** Control animal (16 Km or more from facility) **BFDCTRL**	Meat-Deer foraging near facility perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report	Individual collection biological	Annually, during hunting season* During year as available*	2	Gamma isotopic analyses of meat, Sr-90 in meat

*Samples to be split (shared with NYSDOH)

OFF-SITE MONITORING PROGRAM
FOR IMPLEMENTATION DURING 1986

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Thermoluminescent Dosimetry (TLD) (16) at each of 16 compass sectors, at nearest accessible perimeter point (2) at corners of NYS LLW burial area **(5) at security fence around site.** Rock Springs Road 500 m NNW of plant. 1500 m NW (nearest downwind receptor) "5 Points" landfill, 19 Km SW (background) Great Valley, 29 Km S (background) Springville 7 Km N West Valley 6 Km SSE **Dunkirk, 50 Km W (background)** **DFTLD-series**	Direct Radiation around facility Required by: DOE 5484.1 Reported: Annual Environmental Report	Integrating LiF TLD	Quarterly* (data shared from overlap locations)	116	Quarterly gamma dose

*Samples to be split (shared with NYSDOH)
†DFTLD Series

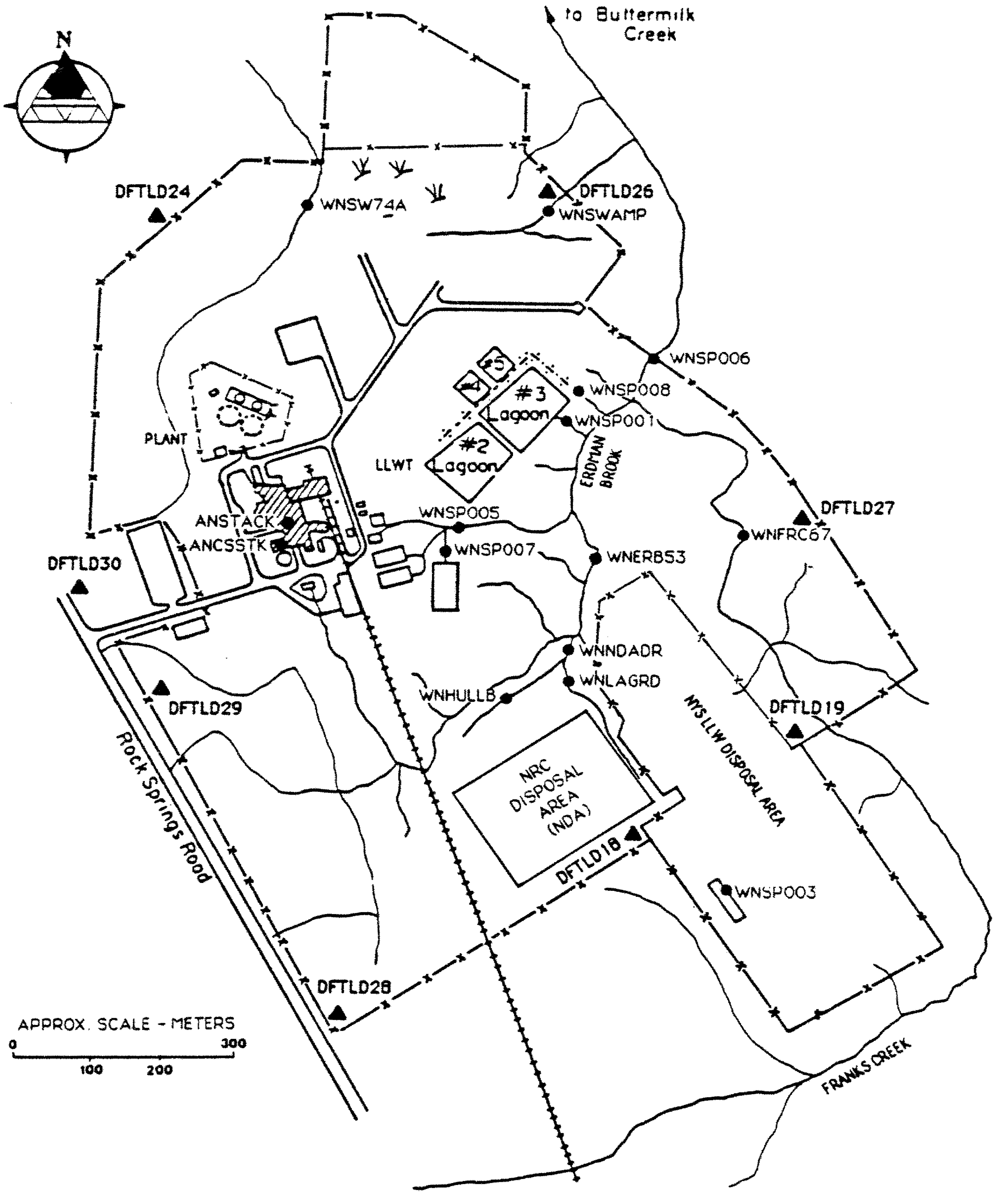


FIGURE A-1
Location of
Radiological Monitoring Points On-site

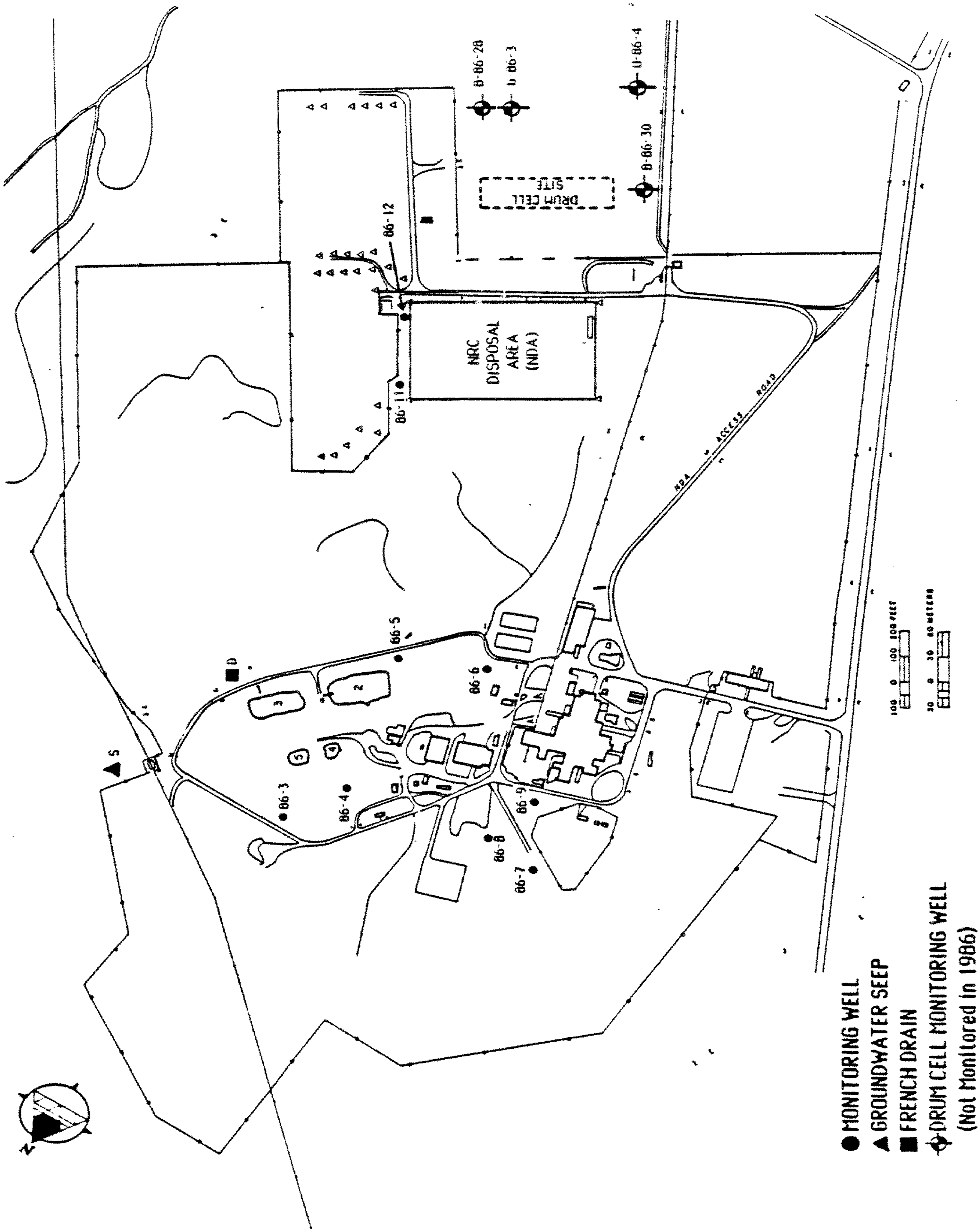


FIGURE A-2
Location of Groundwater Monitoring Stations Added in 1986

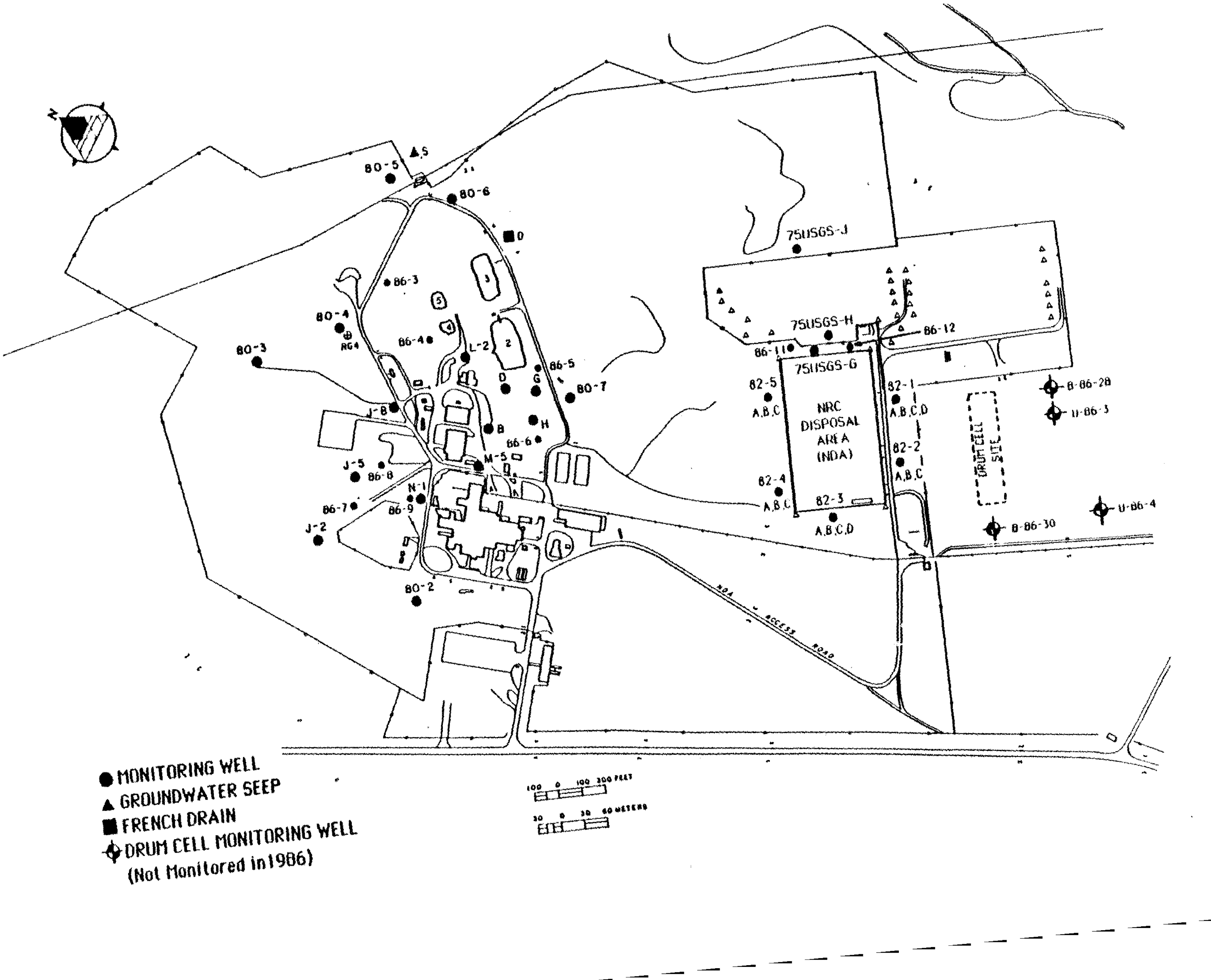


FIGURE A-3
Location of Groundwater Stations
Monitored in 1986

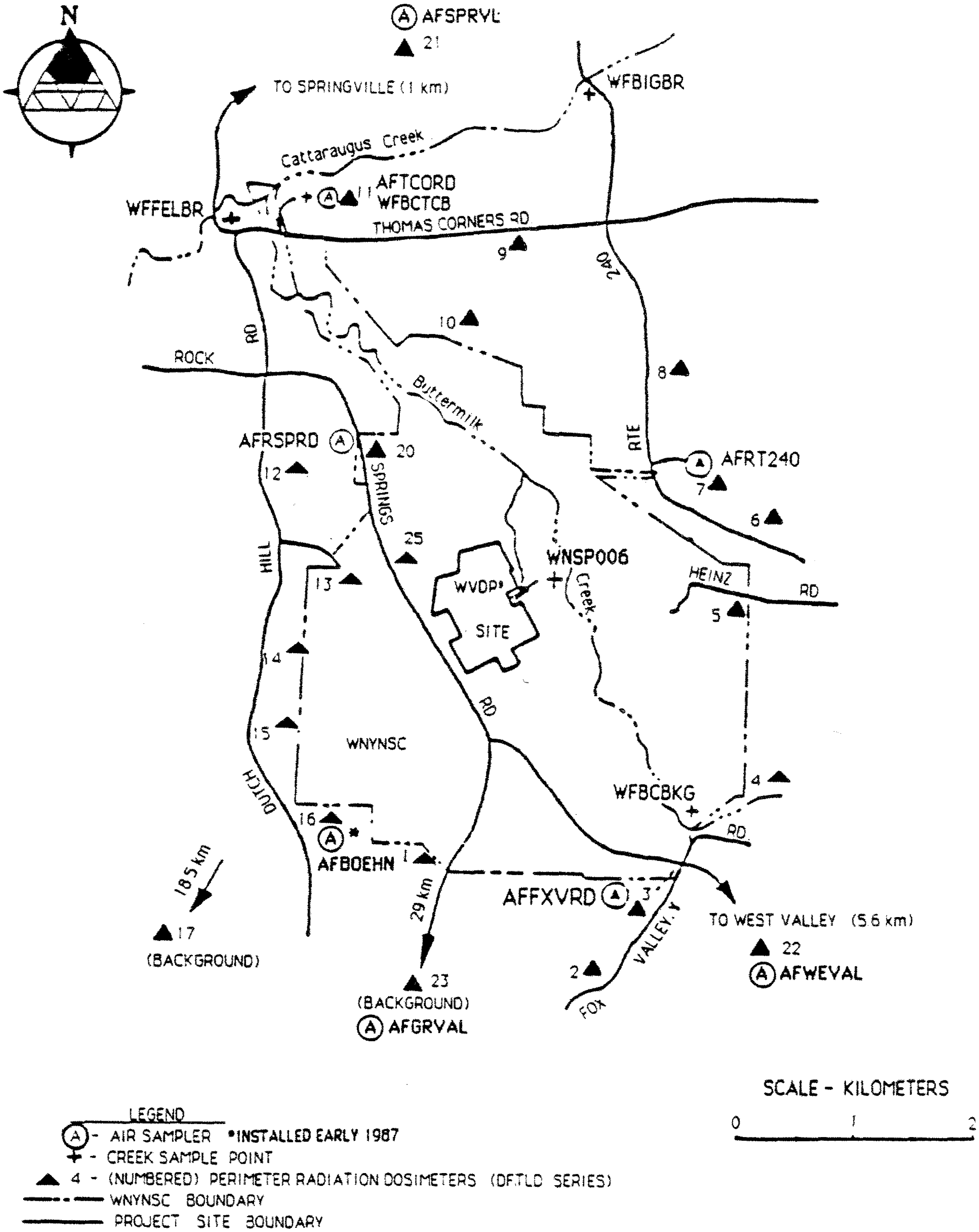


FIGURE A-4
Locations of Perimeter Environmental Monitoring Stations

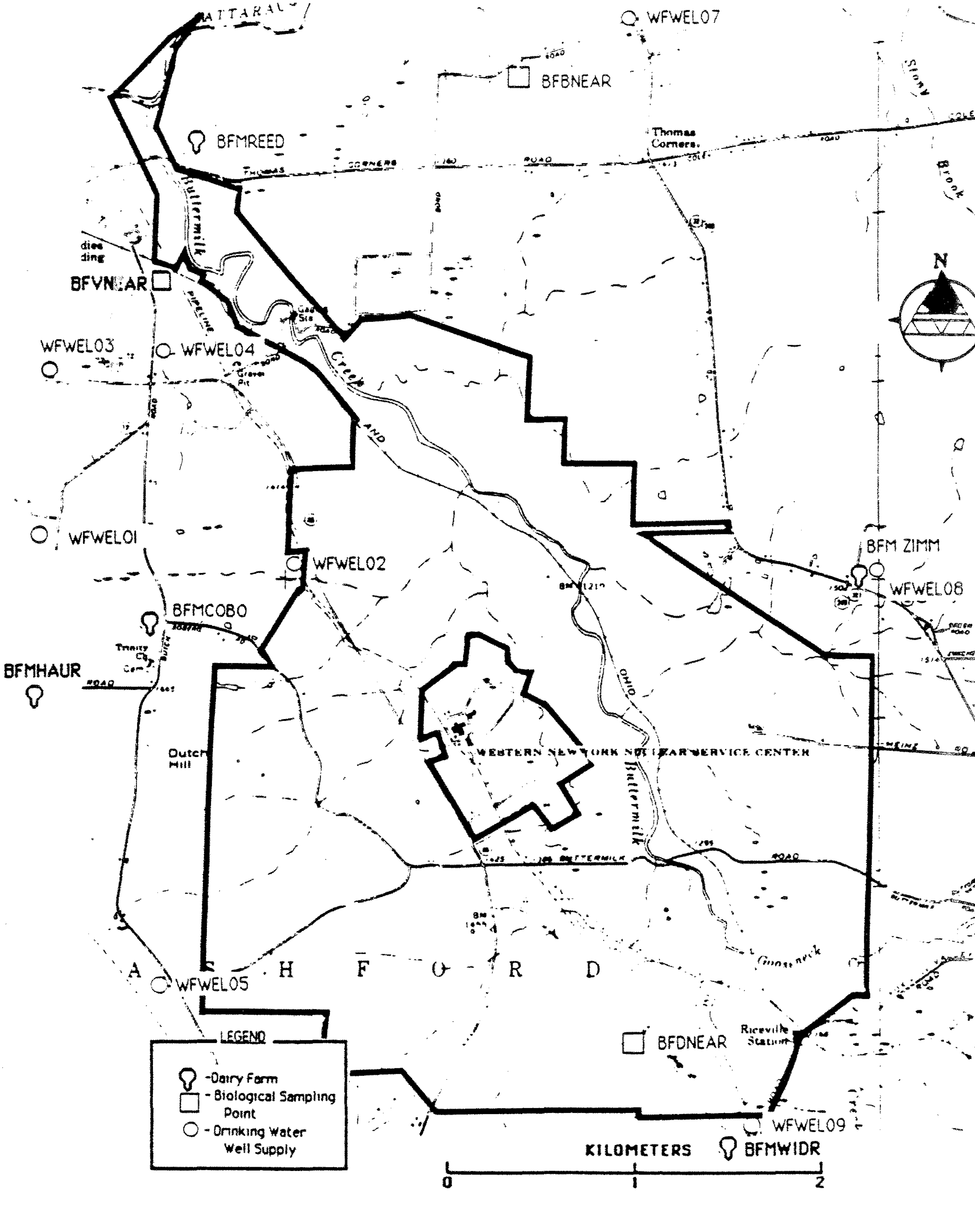


FIGURE A-5
Nearsite Drinking Water
and Biological Sample Points - 1986

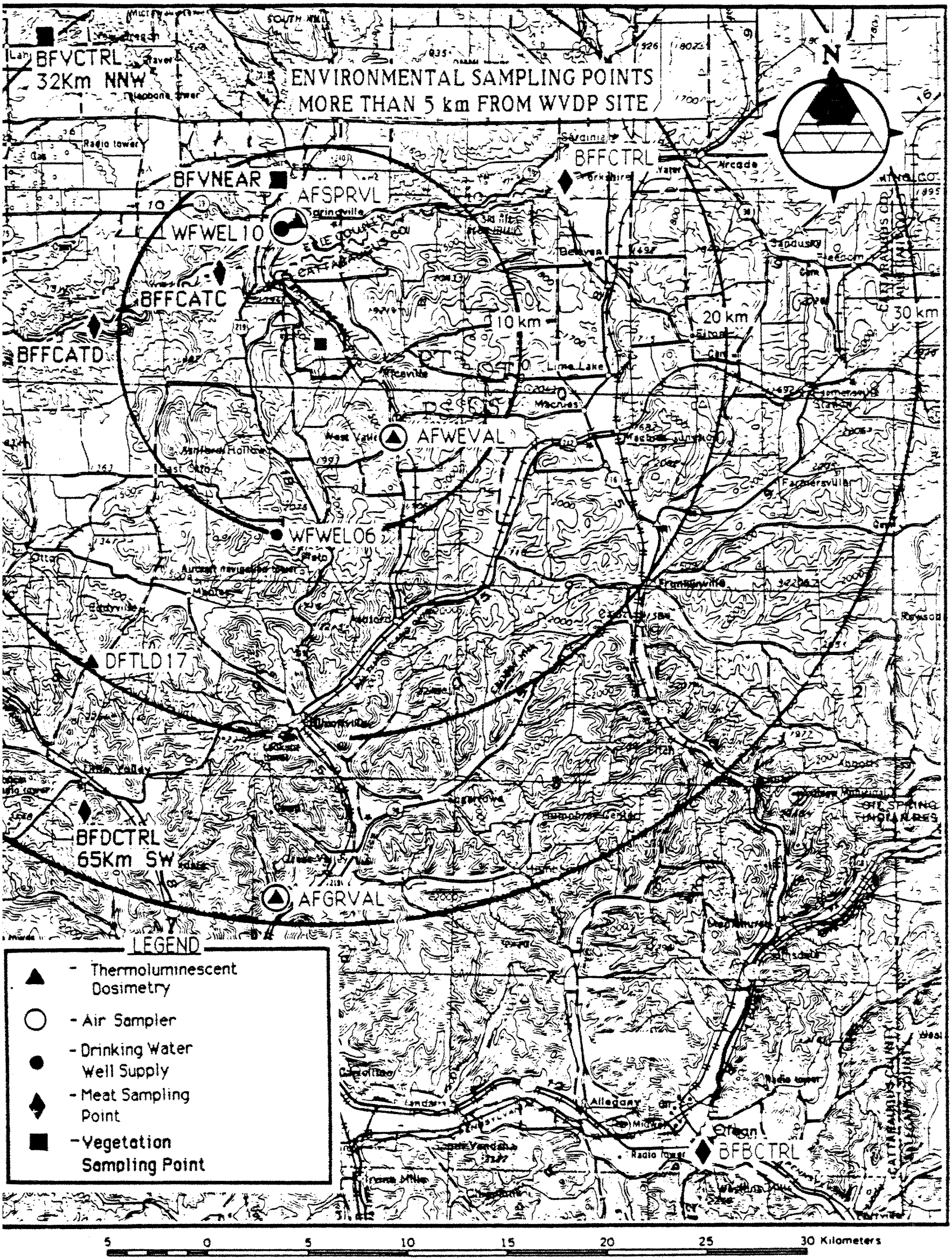

ENVIRONMENTAL SAMPLING POINTS
MORE THAN 5 km FROM WVDP SITE
N
BFVCTRL
32Km NNW
BFVNEAR
AFSPRVL
WFWEL10
BFFCATC
BFFCATD
BFFCTRL
AFWEVAL
WFWEL06
DFTLD17
BFDCTRL
65Km SW
AFGRVAL
BFBCTRL
10 km
20 km
30 km
LEGEND
- Thermoluminescent Dosimetry
- Air Sampler
- Drinking Water Well Supply
- Meat Sampling Point
- Vegetation Sampling Point
5
0
5
10
15
20
25
30 Kilometers

FIGURE A-6

SUMMARY OF MONITORING PROGRAM CHANGES IMPLEMENTED IN 1986

The following is a summary of the significant environmental monitoring program modifications which were implemented in 1986. Some of the changes reflect readjustments due to plant process improvements, and others are a result of program evaluation and long-term planning adjustments. The description and results of most of the near plant monitoring is not included in the scope of this report, but a summary schedule (Appendix A) is provided for information.

Location I.D.	Description of Changes Implemented
ANSTACK	added tritium, quarterly U/Pu and Am-241
WNSP001	added cyanide, oil and grease to SPDES parameters
WNSP006	removed SPDES parameters (new permit)
WNINTER	removed from Environmental to Operations as a process control point
WNWNF Series	removed because more recently drilled wells are now available nearby
WNW80,82,83 Series	added a list of parameters to reflect expanded program requirements
WNSP007	changed to reflect new SPDES permit
WNSW74A	added to monitor additional on-site North Plateau drainage
WNSP008	changed (from WNFRDRN) to reflect new SPDES permit
WNNDADR	changed (from WNHULLB) location 10 metres downstream, and upgraded to automatic composite sampler
WNSFILT	removed to reflect new combined drainage at WNS0007
WNCONDP	removed to reflect new combined drainage at WNSP007
WNSTAW	added chemical parameters
WNDRNKW	added chemical parameters to routine schedule
WFBIGBR	removed water grab sample

Location I.D.	Description of Changes Implemented
WFWEL01 through 10	added chemical indicator parameters
AFRSPRD	added tritium in air and charcoal media nearsite
AFGRVAL	added tritium in air and charcoal media background
AFDNKRK	added location: sited but not placed in operation
AFBOEHN	added location: sited but not placed in operation
SF Series Soil	added Am-241
SFTCSED	added annual U/Pu isotopic and Am-241
SFBCSED	added annual U/Pu isotopic and Am-241
BFFCATD	added sample point for fish downstream of Springville dam; all fish now 10 specimens per sample point from 9 previously
BFMCTRL	added a North and South location quarterly, removed annual Albany location
BFMWIDR	added a Southeast nearsite annual sample
BFMHAUR	added a Southwest nearsite annual sample
BFMCOBO	changed West annual nearsite sample point to quarterly composite

SUMMARY OF MONITORING PROGRAM CHANGES IMPLEMENTED IN 1986 (continued)

Location I.D.	Description of Changes Implemented
BFVNEAR	added tritium
BFVCTRL	added tritium
BFDNEAR	changed requirement for bone analysis: will not be required under modification of technical specifications
DFTLD Series	added inner security fence monitoring points, and at AFDNKRK location when operable

APPENDIX B

STANDARDS AND CONCENTRATION GUIDES

TABLE B-1

STANDARDS AND CONCENTRATION GUIDES

Radiation Standards for Protection of the Public*

Annual Effective Dose Equivalent

	(mrem/yr)	(mSv/year)
Continuous Exposure of Any Member of the Public	100	(1)
Occasional Annual (less than 5 years duration) Exposure	500	(5)

DOE-Derived Concentration Guides (DCG) for Drinking Water and Breathing Air Contaminated with Radionuclides by Members of the Public

Radionuclide	Concentration μCi/ml In Air	In Water
H-3	2 E-07	2 E-03
C-14	6 E-09	7 E-05
Fe-55	5 E-09	2 E-04
Co-60	8 E-11	5 E-06
Ni-63	2 E-09	3 E-04
Sr-90	9 E-12	1 E-06
Zr-93	4 E-11	9 E-05
Nb-93m	4 E-10	3 E-04
Tc-99	2 E-09	1 E-04
Ru-106	3 E-11	6 E-06
Rh-106	6 E-08	2 E-04
Sb-125	1 E-09	6 E-05
Te-125m	2 E-09	4 E-05
I-129	7 E-11	5 E-07
Cs-134	2 E-10	2 E-06
Cs-135	3 E-09	2 E-05
Cs-137	4 E-10	3 E-06
Pm-147	3 E-10	1 E-04
Sm-151	4 E-10	4 E-04
Eu-152	5 E-11	2 E-05
Eu-154	5 E-11	2 E-05
Eu-155	3 E-10	1 E-04
Th-232	7 E-15	5 E-08
U-233	9 E-14	5 E-07
U-234	9 E-14	5 E-07
U-235	1 E-13	6 E-07
U-236	1 E-13	5 E-07
U-238	1 E-13	6 E-07
Np-239	5 E-09	5 E-05
Pu-238	3 E-14	4 E-07
Pu-239	2 E-14	3 E-07
Pu-240	2 E-14	3 E-07
Pu-241	1 E-12	2 E-05
Am-241	2 E-14	6 E-08
Am-243	2 E-14	6 E-08
Cm-243	3 E-14	9 E-08
Cm-244	4 E-14	1 E-07
Gross alpha (as Am-241)	2 E-14	6 E-08
Gross beta (as Ra-228)	3 E-12	1 E-07

* As transmitted by memorandum from Robert J. Stern, Director, Office of Environmental Guidance, U.S. Department of Energy, dated February 28, 1986.

APPENDIX D

SUMMARY OF QUALITY ASSURANCE ANALYSES

TABLE D - 1.1

COMPARISON OF RADIOLOGICAL CONCENTRATIONS IN QUALITY
ASSURANCE SAMPLES BETWEEN WVDP LAB (WV)
AND IDAHO NATIONAL ENGINEERING LABORATORY (INEL) - 1986

DATE YR/MO	TYPE	LAB	ISOTOPE	(uCi) REPORTED VALUE	(uCi) INEL VALUE	RATIO WVNS/INEL	+/-
86 05	WATER	WV	CE - 144	4.25 +/- 0.40 E-02	4.16 +/- 0.23 E-02	1.02	0.11
86 05	WATER	WV	CE - 141	1.14 +/- 0.13 E-02	1.01 +/- 0.05 E-02	1.13	0.14
86 05	WATER	WV	CR - 51	1.70 +/- 0.12 E-01	1.98 +/- 0.08 E-01	0.86	0.07
86 05	WATER	WV	CS - 134	1.57 +/- 0.12 E-02	1.71 +/- 0.08 E-02	0.92	0.08
86 05	WATER	WV	CS - 137	1.44 +/- 0.12 E-02	1.44 +/- 0.06 E-02	1.00	0.09
86 05	WATER	WV	CO - 58	3.16 +/- 0.22 E-02	3.51 +/- 0.15 E-02	0.90	0.07
86 05	WATER	WV	MN - 54	9.12 +/- 0.93 E-03	1.01 +/- 0.04 E-02	0.90	0.10
86 05	WATER	WV	FE - 59	6.48 +/- 0.43 E-02	6.39 +/- 0.29 E-02	1.01	0.08
86 05	WATER	WV	ZN - 65	2.99 +/- 0.24 E-02	3.05 +/- 0.14 E-02	0.98	0.09
86 05	WATER	WV	CO - 60	1.70 +/- 0.13 E-02	1.70 +/- 0.08 E-02	1.00	0.09
86 12	AIR FILTER	WV	CE - 144	1.17 +/- 0.04 E-01	1.06 +/- 0.03 E-01	1.10	0.05
86 12	AIR FILTER	WV	CS - 137	1.64 +/- 0.08 E-02	1.46 +/- 0.03 E-02	1.12	0.06
86 12	AIR FILTER	WV	MN - 54	1.65 +/- 0.08 E-02	1.48 +/- 0.05 E-02	1.11	0.07
86 12	AIR FILTER	WV	CO - 60	3.40 +/- 0.14 E-02	3.08 +/- 0.09 E-02	1.10	0.06
86 12	AIR FILTER	WV	Y - 88	5.89 +/- 0.23 E-02	5.38 +/- 0.13 E-02	1.09	0.05

TABLE D-1.2

COMPARISON OF RADIOLOGICAL CONCENTRATIONS IN QUALITY ASSURANCE SAMPLES BETWEEN WVNS LAB (WV) AND ENVIRONMENTAL MEASUREMENTS LABORATORY (EML) JUNE-1986

Date	Type	Lab	Isotope	Ser	Reported Value	Reported % Error	EML Value	Ratio Rp/EML	Ratio +/-
86 06	AIR	WV	BE 7	1	0.213E+04	5	0.198E+04	1.08	0.07
86 06	AIR	WV	BE 7	2	0.159E+04	6	0.198E+04	0.80	0.06
86 06	AIR	WV	MN 54	1	0.279E+03	3	0.238E+03	1.17	0.07
86 06	AIR	WV	MN 54	2	0.199E+03	4	0.238E+03	0.84	0.05
86 06	AIR	WV	CO 60	1	0.244E+03	4	0.210E+03	1.16	0.07
86 06	AIR	WV	CO 60	2	0.190E+03	5	0.210E+03	0.90	0.06
86 06	AIR	WV	SR 90	1	0.400E+01	23	0.452E+01	0.88	0.21
86 06	AIR	WV	SR 90	2	0.452E+01	11	0.452E+01	1.00	0.12
86 06	AIR	WV	CS 137	1	0.245E+03	4	0.221E+03	1.11	0.06
86 06	AIR	WV	CS 137	2	0.175E+03	4	0.221E+03	0.79	0.05
86 06	AIR	WV	PU 239	1	0.254E+01	11	0.239E+01	1.06	0.13
86 06	AIR	WV	PU 239	2	0.189E+01	13	0.239E+01	0.79	0.11
86 06	AIR	WV	AM 241	1	0.245E+01	11	0.260E+01	0.94	0.12
86 06	AIR	WV	AM 241	2	0.284E+01	11	0.260E+01	1.09	0.14
86 06	AIR	WV	U 234	1	0.134E+01	13	0.115E+01	1.17	0.18
86 06	AIR	WV	U 234	2	0.134E+01	13	0.115E+01	1.17	0.18
86 06	AIR	WV	U 238	1	0.125E+01	13	0.115E+01	1.09	0.17
86 06	AIR	WV	U 238	2	0.121E+01	14	0.115E+01	1.05	0.17
86 06	AIR	WV	U UG	1	0.377E+01	13	0.333E+01	1.13	0.17
86 06	AIR	WV	U UG	2	0.365E+01	13	0.333E+01	1.10	0.16
86 06	SOIL	WV	K 40	1	0.202E+02	10	0.204E+02	0.99	0.11
86 06	SOIL	WV	SR 90	1	0.179E+01	19	0.199E+01	0.90	0.16
86 06	SOIL	WV	CS 137	1	0.747E+00	16	0.810E+00	0.92	0.17
86 06	SOIL	WV	RA 226	1	0.370E+00	29	0.600E+00	0.95	0.29
86 06	SOIL	WV	PU 239	1	0.104E-01	35	0.100E-01	1.04	0.38
86 06	SOIL	WV	AM 241	1	0.695E-02	47			
86 06	SOIL	WV	U 234	1	0.497E+00	7	0.559E+00	0.89	0.07
86 06	SOIL	WV	U 238	1	0.518E+00	7	0.527E+00	0.98	0.10
86 06	SOIL	WV	U UG	1	0.155E+01	7	0.158E+01	0.98	0.08
86 06	TISSUE	WV	K 40	1	0.206E+01	33	0.210E+01	0.98	0.41
86 06	TISSUE	WV	SR 90	1	0.139E+01	19	0.203E+01	0.68	0.13
86 06	TISSUE	WV	RA 226	1	0.267E+00	38	0.351E+00	0.76	0.30
86 06	TISSUE	WV	PU 239	1	<0.388E-03		0.500E-03		
86 06	TISSUE	WV	AM 241	1	<0.617E-03				
86 06	VEGETN	WV	K 40	1	0.106E+02	16	0.980E+01	1.08	0.19
86 06	VEGETN	WV	SR 90	1	0.275E+01	11	0.333E+01	0.83	0.13
86 06	VEGETN	WV	CS 137	1	0.148E+01	13	0.139E+01	1.06	0.15
86 06	VEGETN	WV	PU 239	1	0.193E-01	13	0.170E-01	1.14	0.20
86 06	VEGETN	WV	AM 241	1	0.123E-01	13	0.100E-01	1.23	0.21
86 06	WATER	WV	H 3	1	0.184E+02	3	0.219E+02	0.84	0.03
86 06	WATER	WV	MN 54	1	0.237E+01	3	0.230E+01	1.03	0.07
86 06	WATER	WV	FE 55	1	0.755E+00	11	0.680E+00	1.11	0.16
86 06	WATER	WV	CO 60	1	0.229E+01	3	0.230E+01	1.00	0.07
86 06	WATER	WV	SR 90	1	0.494E+00	3	0.430E+00	1.15	0.05
86 06	WATER	WV	CS 137	1	0.256E+01	3	0.243E+01	1.05	0.06
86 06	WATER	WV	PU 239	1	0.565E-01	7	0.560E-01	1.01	0.09
86 06	WATER	WV	AM 241	1	0.676E-01	7	0.720E-01	0.94	0.14
86 06	WATER	WV	U 234	1	0.381E-01	7	0.320E-01	1.19	0.16
86 06	WATER	WV	U 238	1	0.351E-01	7	0.330E-01	1.06	0.11
86 06	WATER	WV	U UG	1	0.105E+00	7	0.940E-01	1.12	0.11

TABLE D - 1.3

COMPARISON OF WVDP TO USNRC CO-LOCATED
ENVIRONMENTAL TLD DOSIMETERS - 3RD QTR 1986

PERIOD: 7/10/86 TO 10/6/86		PERIOD: 6/19/86 TO 9/23/86		
USNRC TLD NO.	DOSE RATE (ur/hr)	WVNS TLD I.D.*	DOSE RATE (ur/hr)	RATIO WVNS/USNRC
2	10.6	DFTLD 22	9.5	0.90
3	11.0	DFTLD 05	9.5	0.86
4	10.2	DFTLD 07	8.8	0.86
5	11.4	DFTLD 09	8.4	0.74
7	10.9	DFTLD 14	10.6	0.97
8	11.0	DFTLD 15	9.6	0.87
9	19.6	DFTLD 25	16.2	0.83
11	698.1	DFTLD 24	696.5	1.00

* SEE FIGURES A-1 AND A-4

TABLE D - 1.4
INTERCOMPARISON PROJECT RESULTS

EIGHTH INTERNATIONAL ENVIRONMENTAL DOSIMETER
INTERCOMPARISON PROJECT
DECEMBER 1985 TO MARCH 1986

EXPOSURE CATEGORY	WEST VALLEY DEMONSTRATION PROJECT (WVDP) RESULTS		ENVIRONMENTAL MEASUREMEMTS LABORATORY (EML) ESTIMATED VALUES		RATIO
	EXPOSURE (MR)	UNCERTAINTY (MR)	EXPOSURE (MR)	UNCERTAINTY (MR)	WVDP/EML
FIELD SITE #1 (CHESTER, N.J.)	31.6	3.8	29.7	1.5	1.06
FIELD SITE #2 (SANDY HOOK, N.J.)	9.1	1.2	10.4	0.5	0.88
LABORATORY (CESIUM - 137)	17.0	2.3	17.2	0.9	0.99

APPENDIX E

HYDROGEOLOGY OF THE WVDP SITE

The WVDP site lies within the Glaciated Alleghany Plateau section of the Appalachian Plateau Physiographic Province. The section is a maturely dissected plateau with surficial bedrock units of Devonian shales and sandstones. Bedding dips gently (4 to 7.5 metres per km) and uniformly to the south. The plateau has been subjected to the erosional and depositional actions of repeated glaciations, resulting in accumulation of till, outwash, and lacustrine deposits over the area.

The site is underlain by a thick sequence of silty clay tills and more granular deposits overlying a bedrock valley that has been carved through Devonian shales by Cattaraugus Creek and its tributaries. Figure 3-5 shows a generalized east-west cross section through the site. The uppermost till unit is the Lavery, a very compact gray silty clay. The Lavery is approximately 6 m thick at the western boundary of the WVDP and thickens to the east. At the western edge of the developed portion of the WVDP, the Lavery is approximately 30 m thick. In situ measurements of the hydraulic conductivity in the Lavery have generally ranged between 10^{-9} and 10^{-7} cm/sec.

The upper 3 m (approximately) of the Lavery have been chemically weathered by leaching and oxidation and mechanically weathered by bioturbation. The hydraulic conductivity of the weathered till is much higher than that of the underlying unweathered parent material, probably as a result of increased fracture flow.

The northern portion of the WVDP site is blanketed by a layer of alluvial gravels up to 6 m thick. These gravels extend from the plant area northward; they are not encountered in the disposal areas in the southern part of the WVDP site.

Below the Lavery till is a more granular unit referred to locally as the Lacustrine Unit. It comprises silts, sands and, in some areas, gravels which overlie a varved clay. The Lacustrine is believed to be more permeable than the Lavery, but little permeability testing has been performed in this unit. Prior modelers of site hydrogeology have generally assumed hydraulic conductivities on the order of 10^{-5} to 10^{-4} cm/sec-- conservative in consideration of the gradation of the Lacustrine Unit materials.

Free field groundwater flow through the described geosystem occurs in two aquifers and to a considerably lesser extent in the aquaclude between them. The upper aquifer is a transient water table aquifer in the weathered till and, where it is encountered, the alluvial gravels. To a lesser extent, the highly fractured upper metre of the unweathered till is also part of this aquifer. This unit is generally unsaturated, but immediately after periods of intensive runoff, such as a spring thaw, significant quantities of groundwater are believed to flow through this unit. The primary flow occurs through the extensive system of fractures which dissects this unit.

The lower aquifer is an unconfined aquifer in the Lacustrine Unit. The piezometers embedded in this unit all exhibit phreatic heads below the top of this unit. The total recharge mechanism for the unit is not well defined because of a paucity of data, but it is reasonable to conclude from available data that the unit is recharged from the fractured bedrock and downward seepage through the overlying Lavery till. The bedrock recharge zone to the west is recharged at outcrops in the uplands to the west of the site. Flow through this unit appears to be to the east toward Buttermilk Creek.

The aquaclude that separates these two aquifers is the Lavery. Its mass permeability is extremely low but it does permit seepage. When the weathered till is acting as a transient aquifer, a vertical gradient of unity exists in the till and causes water to move downward, but at a very low rate.

The USGS and NYSGS have performed extensive hydrogeologic investigations in and around the area once used by NFS for solid waste disposals and now contemplated as a potential site for disposal of Project wastes. All of these studies assumed that the groundwater pathway from the disposal trenches was one-dimensional downward seepage through the unweathered till. This was based on observations of water levels in well screen piezometers and some simplifying assumptions. No measurements were made to characterize unsaturated flow in the weathered till.

The observation of solvent in the shallow weathered till some 60 ft (18 m) away from its point of disposal casts considerable doubt on some of the assumptions which neglected flow in the unsaturated zone. Therefore, as part of the preparation of the Environmental Assessment for low-level waste disposal, WVNS has implemented extensive explorations and an instrumentation network to characterize and monitor flow in the unsaturated weathered till. Because data from the solvent seepage explorations indicated rapid fluctuations in the level of the transient perched water table, the instrumentation network uses real-time data loggers that record water levels at hourly intervals.

The hypothesis of one-dimensional downward flow is also being tested as part of this exploration program. The well screen piezometers all have significant time lags. (For example if the piezometric level rose one foot, it might take more than a year before the rise was evident in a well screen piezometer. This could mask a lateral flow component, particularly a transient one.) WVNS has therefore installed pneumatic pore pressure transducers which have a time lag of less than one minute.

The results of this investigation were reported in the Environmental Assessment published in February 1986.

APPENDIX C-1

SUMMARY OF WATER AND SEDIMENT MONITORING DATA

TABLE C 1.1.1

TOTAL RADIOACTIVITY OF LIQUID EFFLUENTS RELEASED
FROM WVDP LAGOON 3 IN 1986
(CURIES)

	ALPHA	BETA	H-3	CS-137	SR-90	I-129
1ST QTR	1.03 ± 0.7 E-03	2.96 ± 0.3 E-02	4.34 ± 0.2 E-01	2.96 ± 0.3 E-02	3.09 ± 0.2 E-03	2.79 ± 0.4 E-04
2ND QTR	5.13 ± 2.3 E-04	4.91 ± 0.3 E-03	2.03 ± 0.1 E-01	5.94 ± 1.0 E-03	9.22 ± 0.7 E-04	5.84 ± 0.8 E-04
3RD QTR	8.62 ± 5.6 E-04	2.30 ± 0.2 E-02	2.97 ± 0.1 E-01	1.75 ± 0.3 E-02	1.88 ± 0.1 E-03	4.14 ± 0.8 E-04
4TH QTR	3.14 ± 2.9 E-04	1.43 ± 0.2 E-02	2.14 ± 0.1 E-01	1.33 ± 0.2 E-02	1.13 ± 0.1 E-03	3.75 ± 0.6 E-04
1986 TOTALS	2.72 ± 1.0 E-03	7.18 ± 0.4 E-02	1.15 ± 0.3 E+00	6.63 ± 0.5 E-02	7.02 ± 0.3 E-03	1.65 ± 0.1 E-03
AVERAGE CONCENTRATION (uCi/ml)	5.44 E-08	1.44 E-06	2.30 E-05	1.33 E-05	1.40 E-07	3.30 E-08

	U-238	U-234	U-235	PU-238	PU-239	AM-241
1ST QTR	1.71 ± 0.6 E-04	5.95 ± 2.1 E-04	1.51 ± 0.6 E-05	1.30 ± 0.5 E-06	1.46 ± 0.5 E-06	N/A
2ND QTR	1.80 ± 0.4 E-04	3.74 ± 0.9 E-04	1.22 ± 2.0 E-05	1.60 ± 0.9 E-07	2.14 ± 1.0 E-07	4.68 ± 2.1 E-07
3RD QTR	3.44 ± 0.5 E-04	4.70 ± 0.6 E-04	1.01 ± 1.5 E-05	1.68 ± 0.6 E-06	6.40 ± 3.9 E-07	2.10 ± 0.9 E-06
4TH QTR	1.08 ± 0.3 E-04	2.20 ± 0.4 E-04	1.08 ± 1.1 E-05	4.69 ± 2.7 E-07	5.68 ± 2.7 E-07	1.19 ± 0.5 E-06
1986 TOTALS	8.03 ± 0.9 E-04	1.66 ± 0.2 E-03	4.82 ± 2.8 E-05	3.61 ± 0.8 E-06	2.88 ± 0.7 E-06	3.76 ± 1.1 E-06
AVERAGE CONCENTRATION (uCi/ml)	1.61 E-08	3.32 E-08	< 1.0 E-09	7.22 E-11	5.76 E-11	1.16 E-10

TABLE C-1.1.2

1986 WVDP LAGOON 3
COMPARISON OF LIQUID EFFLUENT
RADIOACTIVITY LEVELS WITH DOE GUIDELINES

ISOTOPE	TOTAL uCi RELEASED	AVG CONC (uCi/ml)	DCG (uCi/ml)	PERCENT OF DCG
Alpha	2.72 E+03	5.44 E-08	6.0 E-08[1]	91
Beta	7.18 E+04	1.44 E-06	1.0 E-06[2]	144
H-3	1.15 E+06	2.30 E-05	2.0 E-03	1.2
Cs-137	6.63 E+04	1.33 E-06	3.0 E-06	44.3
Sr-90	7.02 E+03	1.40 E-07	1.0 E-06	14.0
I-129	1.65 E+03	3.30 E-08	5.0 E-07	6.6
U-234[3]	1.66 E+03	3.32 E-08	5.0 E-07	6.6
U-235[3]	4.82 E+01	<1.00 E-09	6.0 E-07	0.2
U-238[3]	8.03 E+02	1.61 E-08	6.0 E-07	2.7
Pu-238	3.61 E+00	7.22 E-11	4.0 E-07	<0.1
Pu-239	2.88 E+00	5.76 E-11	3.0 E-07	<0.1
Am-241	3.76 E+00	1.16 E-10	6.0 E-08	0.2
				76.0[4]

Notes:

* Total Volume Released = 5.00 E+10 ml, measured at actual on-site release point.

1 as Am-241

2 as Sr-90

3 Total U(ugm) = 2.41 E+09 Avg U(ug/ml) = 4.82 E-02

4 Total Percent DCG for all releases

TABLE C-1.2

RADIOACTIVITY CONCENTRATIONS
IN SURFACE WATER UPSTREAM OF WVDP
AT FOX VALLEY (WFBCBKG) uCi/ml

1986	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 5.1 E-10	1.58 ± 1.0 E-09	2.42 ± 1.0 E-07		
FEB	< 8.6 E-10	3.17 ± 1.1 E-09	< 1.0 E-07		
MAR	3.51 ± 2.1 E-09	1.03 ± 0.2 E-08	< 1.0 E-07		
1ST QTR				4.73 ± 2.1 E-09	< 2.1 E-08
APR	< 7.6 E-10	2.58 ± 1.0 E-09	< 1.0 E-07		
MAY	< 5.0 E-10	1.51 ± 1.0 E-09	< 1.0 E-07		
JUN	1.43 ± 1.3 E-09	4.25 ± 1.3 E-09	< 1.0 E-07		
2ND QTR				4.90 ± 2.3 E-09	< 2.1 E-08
JUL	< 5.1 E-10	3.04 ± 1.1 E-09	< 1.0 E-07		
AUG	< 1.0 E-09	3.55 ± 1.2 E-09	< 1.0 E-07		
SEP	< 7.8 E-10	6.14 ± 1.4 E-09	< 1.0 E-07		
3RD QTR				8.34 ± 2.9 E-09	< 2.1 E-08
OCT	< 8.9 E-10	4.76 ± 1.3 E-09	< 1.0 E-07		
NOV	< 5.7 E-10	3.78 ± 1.2 E-09	< 1.0 E-07		
DEC	< 9.0 E-10	5.83 ± 1.3 E-09	< 1.0 E-07		
4TH QTR				< 2.3 E-09	< 2.1 E-08

TABLE C-1.3

RADIOACTIVITY CONCENTRATIONS
IN SURFACE WATER DOWNSTREAM OF WVDP
AT THOMAS CORNERS (WFBCTCB) uCi/ml

1986	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 1.0 E-09	4.27 ± 1.2 E-09	1.70 ± 0.9 E-07		
FEB	4.05 ± 2.6 E-09	1.27 ± 0.2 E-08	< 1.0 E-07		
MAR	3.22 ± 1.6 E-09	7.56 ± 1.4 E-09	< 1.0 E-07		
1ST QTR				2.88 ± 1.6 E-09	< 2.1 E-08
APR	2.96 ± 1.9 E-09	8.17 ± 1.5 E-09	< 1.0 E-07		
MAY	< 7.4 E-10	3.21 ± 1.1 E-09	< 1.0 E-07		
JUN	< 1.0 E-09	5.65 ± 1.4 E-09	< 1.3 E-07		
2ND QTR				3.30 ± 2.2 E-09	< 2.1 E-08
JUL	1.46 ± 1.2 E-09	6.37 ± 1.4 E-09	< 1.0 E-07		
AUG	2.51 ± 1.9 E-09	9.94 ± 1.7 E-09	< 1.0 E-07		
SEP	< 8.4 E-10	1.09 ± 0.2 E-08	2.01 ± 1.1 E-07		
3RD QTR				6.57 ± 2.4 E-09	< 2.1 E-08
OCT	1.80 ± 1.4 E-09	1.21 ± 0.2 E-08	< 1.0 E-07		
NOV	< 5.9 E-10	5.71 ± 1.3 E-09	< 1.0 E-07		
DEC	< 8.2 E-10	7.25 ± 1.4 E-09	< 1.0 E-07		
4TH QTR				3.22 ± 2.5 E-09	3.5 ± 3.1 E-08

TABLE C-1.4

RADIOACTIVITY CONCENTRATIONS
IN SURFACE WATER DOWNSTREAM OF WVDP
AT FRANKS CREEK (WNSP006) uCi/ml

1986	ALPHA	BETA	H-3	SR-90	CS-137
JAN	4.32 ± 2.8 E-09	4.37 ± 0.3 E-08	1.60 ± 0.1 E-06		
FEB	2.26 ± 1.6 E-09	4.51 ± 0.3 E-08	3.35 ± 1.0 E-07		
MAR	1.67 ± 1.3 E-09	2.26 ± 0.2 E-08	2.12 ± 1.1 E-07		
1ST QTR				1.19 ± 0.2 E-08	1.71 ± 0.4 E-07
APR	2.54 ± 1.9 E-09	4.84 ± 0.3 E-08	< 1.0 E-07		
MAY	< 1.1 E-09	3.36 ± 0.3 E-08	4.86 ± 1.1 E-07		
JUN	7.62 ± 4.4 E-09	9.77 ± 0.5 E-08	3.83 ± 0.2 E-06		
2ND QTR				2.92 ± 0.4 E-08	8.57 ± 4.2 E-08
JUL	4.07 ± 3.1 E-09	7.00 ± 0.4 E-08	2.05 ± 0.2 E-06		
AUG	< 1.7 E-09	3.21 ± 0.3 E-08	2.68 ± 1.3 E-07		
SEP	4.06 ± 2.7 E-09	4.81 ± 0.3 E-08	5.69 ± 1.2 E-07		
3RD QTR				1.96 ± 0.3 E-08	1.72 ± 0.5 E-07
OCT	4.36 ± 3.8 E-09	6.56 ± 0.4 E-08	1.69 ± 0.2 E-06		
NOV	< 9.2 E-10	1.67 ± 0.2 E-08	1.94 ± 1.0 E-07		
DEC	3.88 ± 3.4 E-09	7.47 ± 0.4 E-08	1.60 ± 0.1 E-06		
4TH QTR				1.81 ± 0.4 E-08	2.70 ± 0.4 E-07

TABLE C-1.5

RADIOACTIVITY CONCENTRATIONS
IN SURFACE WATER DOWNSTREAM OF BUTTERMILK CREEK
AT FELTON BRIDGE (WFFELBR) uCi/ml

1986	ALPHA	BETA	H-3	SR-90	CS-137
JAN	1.76 ± 1.6 E-09	1.03 ± 0.2 E-08	< 1.0 E-07	2.46 ± 1.4 E-09	< 2.1 E-08
FEB	< 9.7 E-10	4.95 ± 1.3 E-09	< 1.0 E-07	2.99 ± 1.8 E-09	< 2.1 E-08
MAR	< 7.5 E-10	5.46 ± 1.3 E-09	< 1.0 E-07	< 1.1 E-09	< 2.1 E-08
APR	< 8.0 E-10	2.01 ± 1.0 E-09	1.43 ± 1.1 E-07	8.45 ± 2.5 E-09	< 2.1 E-08
MAY	< 8.3 E-10	4.55 ± 1.3 E-09	< 1.0 E-07	5.11 ± 2.6 E-09	4.47 ± 3.5 E-08
JUN	< 1.3 E-09	4.83 ± 1.3 E-09	< 1.0 E-07	7.09 ± 2.6 E-09	< 2.1 E-08
JUL	< 1.1 E-09	4.51 ± 1.3 E-09	< 1.0 E-07	4.80 ± 2.0 E-09	< 2.1 E-08
AUG	1.34 ± 1.3 E-09	7.76 ± 1.5 E-09	< 1.0 E-07	2.92 ± 1.8 E-09	< 2.1 E-08
SEP	2.52 ± 1.9 E-09	6.52 ± 1.5 E-09	1.31 ± 1.1 E-07	8.14 ± 2.4 E-09	< 2.1 E-08
OCT	3.00 ± 2.0 E-09	1.21 ± 0.2 E-08	< 1.0 E-07	1.30 ± 0.3 E-08	< 2.1 E-08
NOV	< 1.2 E-09	1.26 ± 0.2 E-08	< 1.0 E-07	8.57 ± 3.1 E-09	< 2.1 E-08
DEC	1.40 ± 1.4 E-09	1.27 ± 0.2 E-08	< 1.0 E-07	4.64 ± 2.4 E-09	3.37 ± 3.1 E-08

TABLE C-1.6

RADIOACTIVITY CONCENTRATIONS IN GROUND WATER
NEAR SITE FACILITIES

LOCATION CODE	FIRST QUARTER 1986 (uCi/ml) ALPHA	BETA	TRITIUM	SECOND QUARTER 1986 (uCi/ml) ALPHA	BETA	TRITIUM
WNW80 2	< 6.6 E-10	1.28 ± 1.1 E-09	< 1.0 E-07	< 6.1 E-10	1.37 ± 1.0 E-09	< 1.0 E-07
WNW80 3	< 6.0 E-10	2.44 ± 0.1 E-07	2.46 ± 1.1 E-07	< 1.4 E-09	3.38 ± 0.1 E-07	< 1.0 E-07
WNW80 4	< 7.5 E-10	1.52 ± 0.2 E-08	2.75 ± 1.1 E-07	< 1.0 E-09	1.73 ± 0.2 E-08	3.92 ± 1.2 E-07
WNW80 5	< 4.5 E-10	1.05 ± 0.9 E-09	1.34 ± 0.9 E-07	< 5.2 E-10	1.83 ± 1.0 E-09	< 1.0 E-07
WNW80 6	< 2.6 E-09	3.74 ± 1.4 E-09	3.15 ± 0.2 E-06	< 2.1 E-09	3.38 ± 1.4 E-09	1.44 ± 0.2 E-06
WNW80 7	< 1.8 E-09	2.91 ± 0.4 E-08	< 1.0 E-07	****************	NOT ACCESSIBLE	****************

LOCATION CODE	THIRD QUARTER 1986 (uCi/ml) ALPHA	BETA	TRITIUM	FOURTH QUARTER 1986 (uCi/ml) ALPHA	BETA	TRITIUM
WNW80 2	< 6.6 E-10	2.59 ± 1.1 E-09	1.63 ± 1.0 E-07	< 6.0 E-10	6.17 ± 1.4 E-09	3.81 ± 1.1 E-07
WNW80 3	1.60 ± 1.6 E-09	2.65 ± 0.1 E-07	1.82 ± 1.0 E-07	< 1.0 E-09	3.50 ± 0.1 E-07	2.74 ± 1.1 E-07
WNW80 4	< 6.3 E-10	4.15 ± 1.3 E-09	1.15 ± 0.1 E-06	< 8.0 E-10	8.49 ± 1.6 E-09	5.32 ± 1.1 E-07
WNW80 5	< 1.1 E-09	1.78 ± 1.1 E-09	6.78 ± 1.2 E-07	< 8.2 E-10	1.54 ± 0.2 E-08	3.21 ± 1.1 E-07
WNW80 6	< 5.5 E-09	1.35 ± 0.3 E-08	7.45 ± 1.2 E-07	< 1.3 E-09	1.04 ± 0.2 E-08	1.77 ± 0.2 E-06
WNW86 3				< 9.7 E-10	8.69 ± 1.7 E-09	1.98 ± 0.2 E-06
WNW86 4				< 1.7 E-09	9.03 ± 1.7 E-09	2.06 ± 0.2 E-06
WNW86 5				6.93 ± 3.1 E-09	1.65 ± .01 E-05	2.64 ± 0.1 E-05
WNW86 6				< 4.5 E-09	1.82 ± 0.3 E-08	7.87 ± 1.2 E-07
WNW86 7				< 2.1 E-09	8.49 ± 1.7 E-09	4.56 ± 1.1 E-07
WNW86 8				< 1.1 E-09	5.76 ± 1.5 E-09	2.92 ± 0.2 E-06
WNW86 9				< 1.1 E-09	8.06 ± 0.4 E-08	4.08 ± 0.2 E-06

TABLE C - 1.7
(Sheet 1 of 2)
CHEMICAL WATER QUALITY PARAMETERS OF GROUNDWATER
NEAR SITE FACILITIES - 1986

LOCATION CODE	1ST QTR pH	1ST QTR CONDUCTIVITY (umhos/cm @ 25C)	2ND QTR pH	2ND QTR CONDUCTIVITY (umhos/cm @ 25C)	3RD QTR pH	3RD QTR CONDUCTIVITY (umhos/cm @ 25C)	4TH QTR pH	4TH QTR CONDUCTIVITY (umhos/cm @ 25C)
WNW80 - 2	7.88	366	7.72	260	7.66	290	7.74	305
WNW80 - 3	7.02	401	6.78	520	6.83	515	6.82	515
WNW80 - 4	7.48	687	7.16	645	6.66	536	7.07	637
WNW80 - 5	8.00	182	7.50	257	7.00	482	7.22	413
WNW80 - 6	6.84	1015	7.14	1185	6.47	2411	6.48	1356
WNW80 - 7	5.97	253	WELL OUT OF SERVICE		WELL OUT OF SERVICE		WELL OUT OF SERVICE	

NON-RADIOLOGICAL
MEASUREMENTS MADE DURING 4TH QTR

LOCATION CODE	pH	CONDUCTIVITY (umhos/cm @ 25C)	NO3	SO4	CL	F	TOC	PHENOLS
			<----------	----------	mg/l	----------	----------	---------->
WNW80 - 2	7.74	305	2.0	9.5	16.7	<0.1	2.4	<0.1
WNW80 - 3	6.82	515						
WNW80 - 4	7.07	637						
WNW80 - 5	7.22	413	2.0	31.0	19.1	<0.1	2.4	<0.1
WNW80 - 6	6.48	1356	2.1	288	93.3	<0.1	4.4	<0.1
WNW80 - 7	WELL	OUT	OF	SERVICE				
WNW86- 3	7.37	726	4.6	36.6	67.7	<0.1	0.1	<0.1
WNW86- 4	7.23	702	2.7	35.9	62.4	<0.1	<0.1	<0.1
WNW86- 5	6.72	693	3.0	54.6	12.0	<0.1	8.9	<0.1
WNW86- 6	6.66	2584	1.0	50.3	714	0.11	1.7	<0.1
WNW86- 7	6.40	1015	6.3	227	6.4	<0.1	2.6	<0.1
WNW86- 8	6.26	761	4.9	168	23.4	<0.1	10.0	<0.1
WNW86- 9	6.97	641	7.3	38.4	10.9	<0.1	3.2	<0.1
WNSP008	6.91	846	3.4	70.5	35.5	<0.1	2.9	0.1
WNGSEEP	6.24	430	2.8	50.3	30.9	<0.1	<2.0	0.1

TABLE C - 1.7
(Sheet 2 of 2)
CHEMICAL WATER QUALITY PARAMETERS OF GROUNDWATER
NEAR SITE FACILITIES - 1986

LOCATION CODE	FE	MN	NA	CR	PB	BA	CD	HG	AS	SE	AG
	<------				mg/l						------>
WNW80 - 2	0.55	0.06	3.98	0.01	<0.01	0.05	<0.01	<0.01	<0.01	0.01	<0.01
WNW80 - 3			NOT	ANALYZED	FOR	METALS					
WNW80 - 4			NOT	ANALYZED	FOR	METALS					
WNW80 - 5	0.09	0.03	3.30	<0.01	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01
WNW80 - 6	0.31	1.26	51.00	<0.02	0.02	0.04	<0.01	<0.01	<0.01	0.01	<0.01
WNW80 - 7			WELL	NOT	AVAILABLE						
WNW886- 3	0.03	<0.01	17.90	<0.02	<0.01	0.15	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886- 4	0.12	0.05	17.10	<0.02	0.01	0.21	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886- 5	1.20	4.45	25.28	0.02	0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886- 6	0.11	3.00	257.00	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	<0.01
WNW886- 7	0.05	0.43	11.70	0.01	0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886- 8	4.70	31.00	7.60	0.02	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886- 9	0.06	0.04	7.93	0.01	<0.01	0.15	<0.01	<0.01	<0.01	<0.01	<0.01
WNSP008	0.09	1.83	39.90	<0.02	0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.01
WNGSEEP	0.02	<0.01	8.10	0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.02	<0.01

TABLE C-1.8

RADIOACTIVITY CONCENTRATIONS IN GROUND WATER
NEAR THE NRC DISPOSAL AREA

LOCATION CODE	FIRST QUARTER 1986 (uCi/ml) ALPHA	FIRST QUARTER 1986 (uCi/ml) BETA	FIRST QUARTER 1986 (uCi/ml) TRITIUM	SECOND QUARTER 1986 (uCi/ml) ALPHA	SECOND QUARTER 1986 (uCi/ml) BETA	SECOND QUARTER 1986 (uCi/ml) TRITIUM
WNW821A	< 3.2 E-09	3.58 ± 1.4 E-09	7.07 ± 1.2 E-07	< 2.9 E-09	2.09 ± 1.2 E-09	4.67 ± 1.3 E-07
WNW821B	< 2.1 E-09	5.14 ± 1.4 E-09	1.99 ± 0.1 E-06	< 1.9 E-09	5.73 ± 1.7 E-09	3.61 ± 1.3 E-07
WNW821C	3.86 ± 3.2 E-09	9.36 ± 2.8 E-09	7.17 ± 1.2 E-07	< 1.8 E-09	< 3.3 E-09	< 1.0 E-07
WNW822B	3.19 ± 2.4 E-08	5.93 ± 1.1 E-08	< 1.0 E-07	1.02 ± 0.6 E-08	1.41 ± 0.4 E-08	< 1.0 E-07
WNW824A1	< 3.2 E-09	5.33 ± 1.6 E-09	5.88 ± 0.2 E-05	< 2.1 E-09	3.65 ± 1.3 E-09	4.07 ± 0.1 E-05
WNW824A2	3.87 ± 3.6 E-09	6.90 ± 2.6 E-09	4.59 ± 1.1 E-07	4.05 ± 3.5 E-09	2.29 ± 1.4 E-09	2.74 ± 1.2 E-07
WNW824A3	< 2.0 E-09	3.89 ± 1.3 E-09	4.69 ± 1.1 E-07	< 1.5 E-09	1.64 ± 1.4 E-09	2.64 ± 1.2 E-07
WNW832D	6.17 ± 4.7 E-09	1.07 ± 0.4 E-08	2.50 ± 1.1 E-07	< 2.3 E-09	8.94 ± 1.8 E-09	1.15 ± 1.1 E-07

LOCATION CODE	THIRD QUARTER 1986 (uCi/ml) ALPHA	THIRD QUARTER 1986 (uCi/ml) BETA	THIRD QUARTER 1986 (uCi/ml) TRITIUM	FOURTH QUARTER 1986 (uCi/ml) ALPHA	FOURTH QUARTER 1986 (uCi/ml) BETA	FOURTH QUARTER 1986 (uCi/ml) TRITIUM
WNW821A	< 2.5 E-09	4.44 ± 1.6 E-09	4.54 ± 1.1 E-07	< 1.5 E-09	3.90 ± 1.4 E-09	3.45 ± 1.1 E-07
WNW821B	< 2.3 E-09	3.25 ± 1.4 E-09	5.06 ± 1.1 E-07	< 2.2 E-09	5.55 ± 1.5 E-09	1.41 ± 1.1 E-07
WNW821C	< 1.9 E-09	2.93 ± 2.2 E-09	< 1.0 E-07	< 1.1 E-09	6.47 ± 3.1 E-09	< 1.0 E-07
WNW822B	< 1.6 E-09	4.43 ± 1.5 E-09	< 1.0 E-07	7.71 ± 4.7 E-09	1.77 ± 0.2 E-08	5.49 ± 1.1 E-07
WNW824A1	< 1.5 E-09	4.84 ± 1.5 E-09	3.68 ± 0.1 E-05	5.25 ± 4.7 E-09	7.61 ± 1.8 E-09	3.10 ± 0.1 E-05
WNW824A2	< 3.2 E-09	5.61 ± 1.9 E-09	4.65 ± 1.1 E-07	< 1.6 E-09	7.47 ± 1.7 E-09	2.09 ± 1.1 E-07
WNW824A3	< 2.9 E-09	2.84 ± 1.4 E-09	6.12 ± 1.1 E-07	2.43 ± 2.2 E-09	3.21 ± 1.6 E-09	1.39 ± 1.1 E-07
WNW832D	2.14 ± 2.1 E-09	9.70 ± 1.8 E-09	1.62 ± 1.0 E-07	5.48 ± 3.8 E-09	1.95 ± 0.4 E-08	< 1.0 E-07
WNW8610				< 7.3 E-10	1.07 ± 0.2 E-08	< 1.0 E-07
WNW8611				< 2.2 E-09	1.50 ± 0.2 E-08	< 1.0 E-07

TABLE C - 1.9
(Sheet 1 of 2)
CHEMICAL WATER QUALITY PARAMETERS OF GROUNDWATER
NEAR THE NRC DISPOSAL AREA - 1986

LOCATION CODE	1ST QTR pH	1ST QTR CONDUCTIVITY (umhos/cm @ 25C)	2ND QTR pH	2ND QTR CONDUCTIVITY (umhos/cm @ 25C)	3RD QTR pH	3RD QTR CONDUCTIVITY (umhos/cm @ 25C)	4TH QTR pH	4TH QTR CONDUCTIVITY (umhos/cm @ 25C)
WNW82-1A	7.12	1341	7.20	1279	7.00	1228	7.25	1194
WNW82-1B	7.25	1400	7.14	1447	6.92	1366	7.42	1333
WNW82-1C	7.59	548	7.83	537	7.82	515	7.77	484
WNW82-2A			WELL NOT AVAILABLE					
WNW82-2B	7.35	812	7.53	808	7.48	802	7.62	808
WNW82-4A1	7.02	1403	7.02	1294	6.80	1396	7.01	1402
WNW82-4A2	6.98	1490	6.83	1489	6.79	1495	6.84	1500
WNW82-4A3	6.83	1484	6.94	1452	6.73	1503	6.91	1425
WNW75-G1	11.67	663	11.33	492	11.39	510	11.80	669
WNW75-G2	10.44	253	10.02	246	10.26	233	WELL DRY	
WNW75-G3	8.51	305	8.18	304	8.15	316	WELL DRY	
WNW83-2D	12.12	2082	11.55	1908	11.86	1137	12.10	1095
WNW86-10	NEW WELL NOT READY FOR SAMPLING UNTIL 4TH QTR						8.75	467
WNW86-11	NEW WELL NOT READY FOR SAMPLING UNTIL 4TH QTR						9.46	592

DRY WELLS NOT ANALYZED: WNW82-1D, WNW82-2C, WNW82-3A, WNW82-3B, WNW82-3C, WNW83-3D, WNW82-4B, WNW82-4C

NON-RADIOLOGICAL
MEASUREMENTS MADE DURING 4TH QTR

LOCATION CODE	pH	CONDUCTIVITY (umhos/cm @ 25C)	NO3 (mg/l)	SO4 (mg/l)	CL (mg/l)	F (mg/l)	TOC (mg/l)	PHENOLS (mg/l)
WNW82-1D		DRY WELL NOT SAMPLED						
WNW83-2D	12.10	1095	<0.5	18.1	09.6	0.2	180.0	0.1
WNWB86-10	8.75	467	2.2	67.9	1.7	<0.1	9.2	<0.1
WNWB86-11	9.46	592	<0.5	22.7	0.4	<0.1	11.0	0.1

TABLE C - 1.9
(Sheet 2 of 2)
CHEMICAL WATER QUALITY PARAMETERS OF GROUNDWATER
NEAR THE NRC DISPOSAL AREA - 4TH QTR 1986

LOCATION CODE	FE	MN	NA	CR	PB	BA	CD	HG	AS	SE	AG
	<----------				MG/L						---------->
WNW82 -1D	DRY	NO SAMPLES		ANALYZED							
WNW83 -2D	0.02	<0.01	20.5	<0.02	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886-10	0.03	0.05	44.3	<0.02	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
WNW886-11	0.28	<0.01	83.3	0.006	<0.01	0.06	<0.01	<0.01	<0.01	<0.02	<0.01

TABLE C-1.10

RADIOACTIVITY CONCENTRATIONS IN POTABLE WELL WATER
AROUND THE WVDP SITE - 1986
(uCi/ml)

SAMPLE I.D.	ALPHA	BETA	TRITIUM	Cs - 137
WFWEL 01	< 4.5 E-10	3.53 ± 1.2 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 03	< 8.5 E-10	3.71 ± 1.3 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 04	< 1.8 E-09	3.07 ± 1.4 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 06	< 5.9 E-10	3.40 ± 1.2 E-09	2.59 ± 1.1 E-07	< 2.1 E-08
WFWEL 07	< 1.0 E-09	2.86 ± 1.2 E-09	< 1.0 E-07	< 2.1 E-08

WFWEL.RPT

TABLE C - 1.11

Radioactivity of Stream Sediment Around WVDP Site in 1986

Concentration (uCi/g) (dry weight from upper 15 cm)

ID	Date	Gross Alpha	Gross Beta	K-40	Sr-90	Cs-137	Pu-239	Am-241
SFBCSED	May 1986	6.4 ± 6.8 E-06	2.62 ± 0.8 E-05	1.24 ± 0.5 E-05	1.00 ± 1.7 E-08	6.32 ± 2.9 E-08	6.01 ± 4.9 E-09	<4 E-09
SFSDSED	June 1986	3.1 ± 4.4 E-06	2.14 ± 0.7 E-05	1.18 ± 0.2 E-05	2.54 ± 1.7 E-08	1.06 ± 0.2 E-06	2.73 ± 2.3 E-09	7.75 ± 7.8 E-09
SFTCSED	May 1986	6.3 ± 5.8 E-06	2.79 ± 0.9 E-05	1.35 ± 0.2 E-05	6.49 ± 1.4 E-08	2.70 ± 0.2 E-06		
SFCCSED	May 1986	4.2 ± 5.0 E-06	3.37 ± 0.9 E-05	1.03 ± 0.2 E-05	1.76 ± 0.3 E-07	7.56 ± 0.3 E-06		
SFBISED	May 1986	<1.2 E-05	2.34 ± 1.0 E-05	1.14 ± 0.1 E-05	<3 E-08	6.10 ± 3.1 E-08		
SFBCSED	Dec. 1986	<1.1 E-05	2.63 ± 1.3 E-05	9.85 ± 0.5 E-06	<6 E-08	3.33 ± 2.9 E-08	2.67 ± 3.2 E-09	2.68 ± 5.4 E-09
SFSDSED	Dec. 1986	5.4 ± 5.4 E-05	3.33 ± 1.2 E-05	9.88 ± 0.4 E-06	3.71 ± 2.0 E-08	4.86 ± 0.4 E-07	2.60 ± 2.6 E-09	1.80 ± 1.5 E-08
SFTCSED	Dec. 1986	3.3 ± 4.9 E-06	3.68 ± 1.0 E-05	9.62 ± 0.5 E-06	6.59 ± 3.3 E-08	2.82 ± 0.1 E-06		
SFCCSED	Dec. 1986	2.2 ± 5.8 E-06	1.52 ± 0.8 E-05	8.70 ± 0.5 E-06	1.66 ± 1.0 E-08	1.97 ± 0.1 E-06		
SFBISED	Dec. 1986	7.6 ± 16.0 E-06	2.44 ± 0.9 E-05	9.57 ± 0.5 E-06	8.49 ± 11.9 E-09	<3.21 ± E-08		

CIN0034:SEA-61

TABLE C-1.12

1986 CONTRIBUTION BY NEW YORK STATE LOW LEVEL WASTE DISPOSAL AREA TO RADIOACTIVITY IN WVDP LIQUID EFFLUENTS (Ci)

	GROSS ALPHA	GROSS BETA	TRITIUM	Sr-90	I-129	Cs-137
1986 TOTALS	3.28 ± 3.1 E-06	1.50 ± 0.1 E-03	8.86 ± 0.3 E-02	9.08 ± 0.2 E-04	< 1.0 E-06	< 2.6 E-05

FIGURE C-1.1
GROSS BETA CONCENTRATIONS IN
SURFACE WATER DOWNSTREAM OF WVDP - 1986

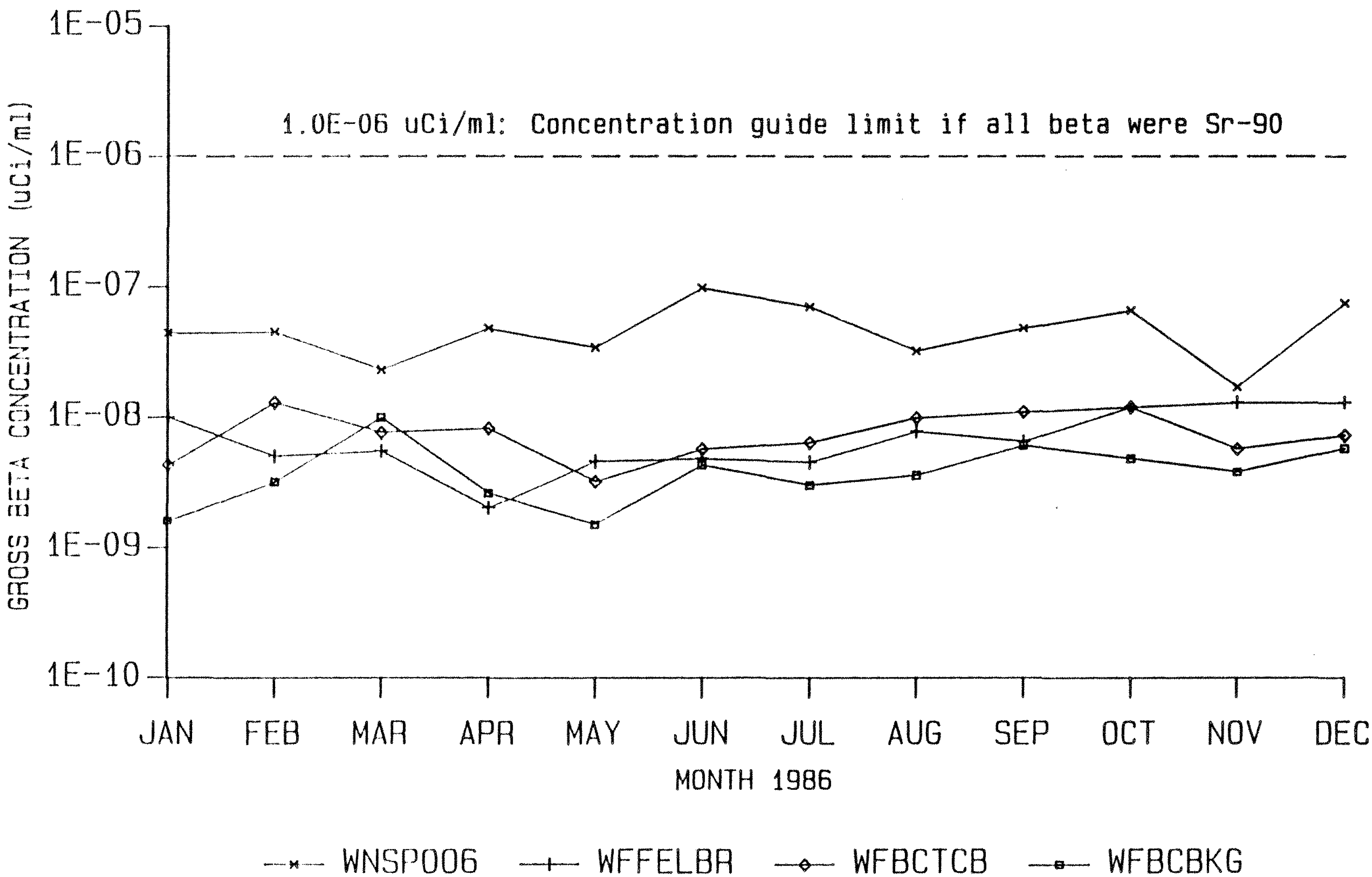


FIGURE C-1.2
TRENDS OF GROSS BETA ACTIVITY IN SURFACE WATER FROM CATTARAUGUS CREEK (WFFELBR) 1983-1986

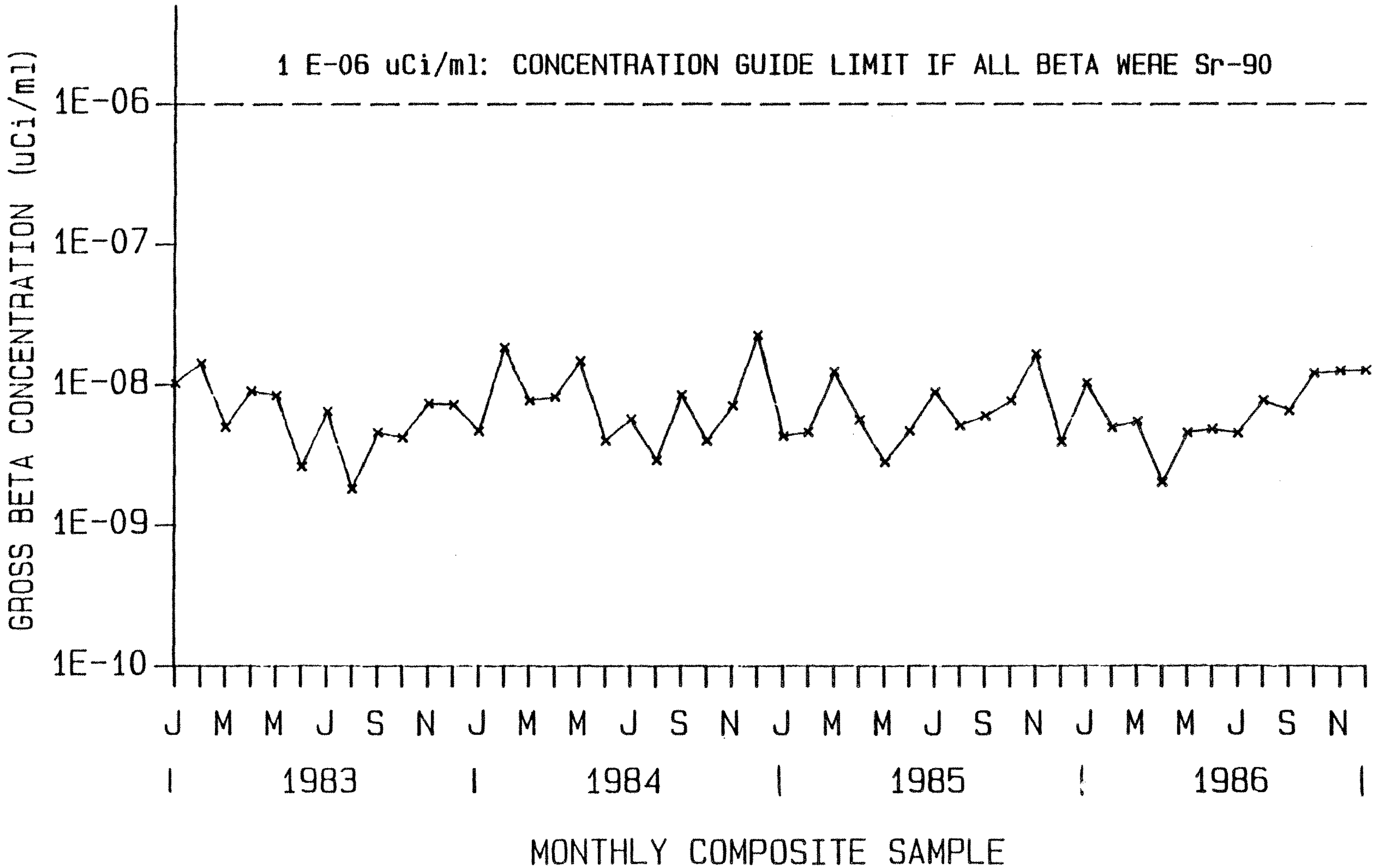
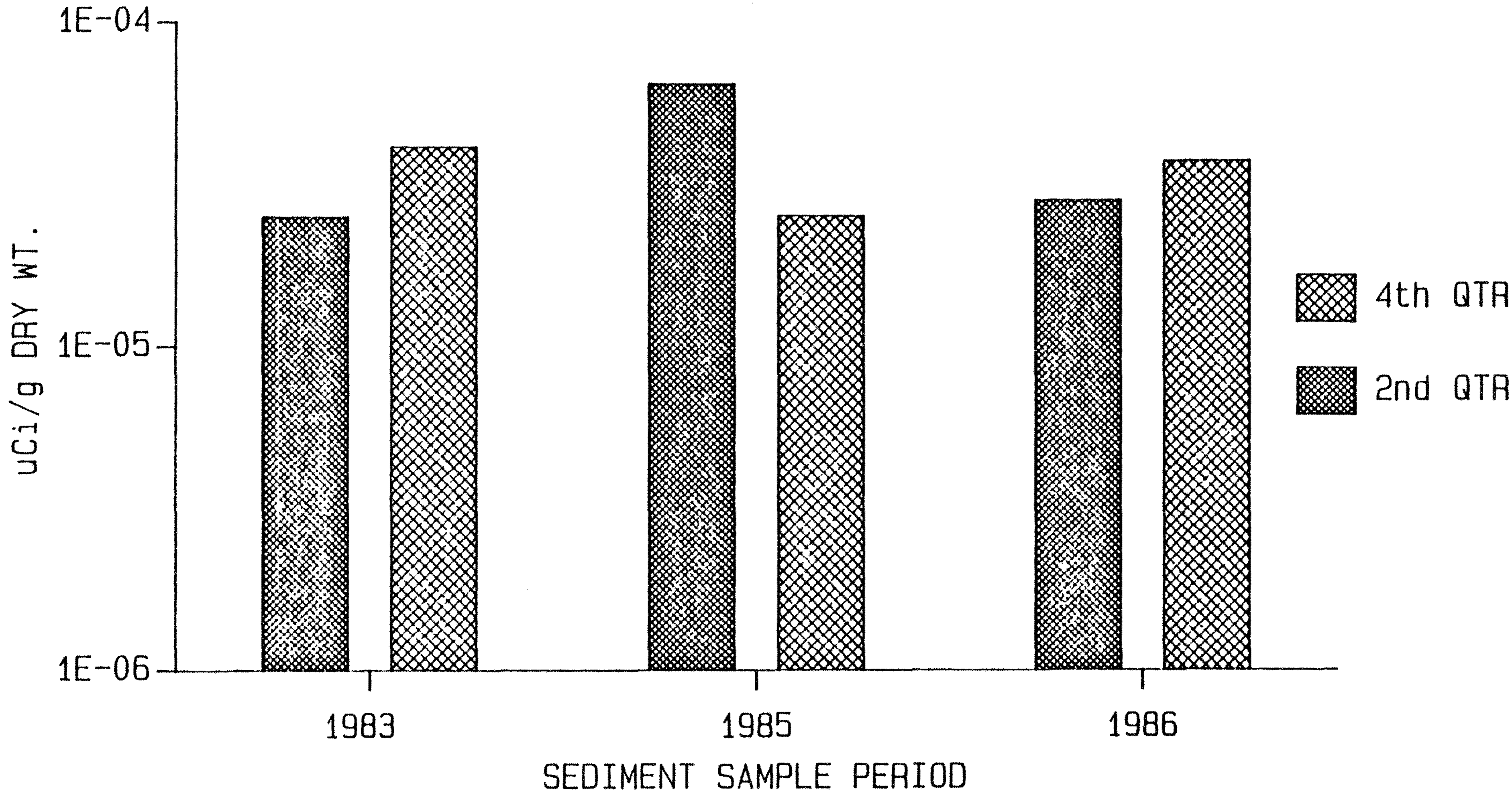


FIGURE C-1.3
TRENDS OF GROSS BETA ACTIVITY IN SEDIMENT FROM BUTTERMILK CREEK (SFTCSED) 1983, 1985, & 1986



APPENDIX C-2

SUMMARY OF AIR MONITORING DATA

TABLE C-2.1.1

AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY
TOTALS FROM MAIN VENTILATION STACK (ANSTACK) CURIES
1986

MONTH	ALPHA	BETA	TRITIUM
JAN	3.07 ± 0.9 E-07	1.55 ± 0.05 E-05	NA
FEB	2.10 ± 0.7 E-07	1.35 ± 0.05 E-05	NA
MAR	1.34 ± 0.7 E-07	5.07 ± 0.34 E-06	NA
APR	1.93 ± 0.7 E-07	1.32 ± 0.05 E-05	2.38 ± 0.1 E-02
MAY	2.30 ± 0.9 E-07	4.17 ± 0.09 E-05	3.03 ± 0.1 E-02
JUN	1.02 ± 0.1 E-06	6.95 ± 0.02 E-04	3.98 ± 0.1 E-02
JUL	3.29 ± 0.8 E-07	4.54 ± 0.02 E-04	3.47 ± 0.1 E-02
AUG	2.90 ± 0.9 E-07	1.52 ± 0.06 E-05	4.80 ± 0.1 E-02
SEP	1.35 ± 0.6 E-07	1.83 ± 0.05 E-05	3.88 ± 0.1 E-02
OCT	1.43 ± 0.6 E-07	6.59 ± 0.09 E-05	2.58 ± 0.1 E-02
NOV	3.06 ± 0.9 E-07	4.06 ± 0.09 E-05	3.57 ± 0.1 E-02
DEC	4.55 ± 1.0 E-07	1.32 ± 0.01 E-04	3.06 ± 0.1 E-02
TOTAL FOR 1986	3.75 ± 0.3 E-06	1.51 ± .004 E-03	3.08 ± 0.03 E-01*

* Prorated to 4.1 ± 0.04 E-01 due to lack of 1st Quarter data.

TABLE C-2.1.2

1986 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM MAIN VENTILATION STACK (ANSTACK)
(CURIES)

	CO-60	SR-90	CS-134	CS-137	EU-154	I-129
1ST QTR	2.86 ± 0.8 E-07	7.88 ± 0.9 E-06	8.05 ± 1.1 E-06	4.19 ± 6.0 E-08	1.17 ± .03 E-05	1.38 ± 0.4 E-07
2ND QTR	8.29 ± 1.4 E-07	2.40 ± 0.3 E-04	1.40 ± 0.2 E-05	7.15 ± 2.0 E-07	2.16 ± .01 E-04	6.79 ± 2.5 E-07
3RD QTR	5.37 ± 1.3 E-07	1.67 ± 0.2 E-04	8.54 ± 1.2 E-06	4.00 ± 1.7 E-07	1.43 ± .01 E-04	< 2.2 E-07
4TH QTR	2.99 ± 0.9 E-07	6.02 ± 0.7 E-05	9.73 ± 1.3 E-06	2.75 ± 1.0 E-07	1.03 ± .01 E-04	4.67 ± 2.5 E-07
1986 TOTALS	1.95 ± 0.2 E-06	4.75 ± 0.4 E-04	3.26 ± 0.2 E-05	1.43 ± 0.3 E-06	4.74 ± .02 E-04	1.50 ± 0.4 E-06

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	1.95 ± 0.3 E-08	5.53 ± 7.3 E-10	7.16 ± 1.5 E-09	8.16 ± 0.6 E-08	9.51 ± 0.7 E-08	2.70 ± 0.2 E-07
2ND QTR	1.29 ± 0.2 E-08	1.64 ± 0.8 E-09	8.28 ± 1.6 E-09	1.59 ± 0.1 E-07	1.92 ± 0.1 E-07	8.19 ± 0.5 E-07
3RD QTR	1.07 ± 0.3 E-08	1.67 ± 1.2 E-09	6.77 ± 2.0 E-09	1.17 ± 0.2 E-07	1.68 ± 0.3 E-07	2.70 ± 0.3 E-07
4TH QTR	9.60 ± 2.4 E-09	3.49 ± 6.8 E-10	8.86 ± 2.4 E-09	1.45 ± 0.1 E-07	2.13 ± 0.2 E-07	7.93 ± 0.8 E-07
1986 TOTALS	5.27 ± 0.5 E-08	4.21 ± 1.8 E-09	3.11 ± 0.4 E-08	5.03 ± 0.3 E-07	6.68 ± 0.4 E-07	2.15 ± 0.1 E-06

TABLE C-2.1.3

AIRBORNE EFFLUENT ACTIVITY COMPARISON
WITH DOE GUIDELINES

1986 MAIN STACK EXHAUST*

ISOTOPE	TOTAL uCi RELEASED	AVG CONC (uCi/m^3)	DCG (uCi/m^3)	PERCENT OF DCG
Gross Alpha	3.75 E+00	4.2 E-09	2 E-08[1]	21
Gross Beta	1.51 E+03	1.7 E-06	9 E-06[2]	19
H-3	4.10 E+05	4.6 E-04	2 E-01	0.2
Co-60	1.95 E+00	2.2 E-09	8 E-05	<0.1
Sr-90	4.75 E+02	5.3 E-07	9 E-06	5.9
I-129	4.03 E+01	4.5 E-08	7 E-05	<0.1
Cs-134	1.43 E+00	1.6 E-09	2 E-04	<0.1
Cs-137	4.74 E+02	5.3 E-07	4 E-04	0.1
Eu-154	1.50 E+00	1.7 E-09	5 E-05	<0.1
U-234[3]	5.27 E-02	5.9 E-11	9 E-08	<0.1
U-235[3]	4.21 E-03	4.7 E-12	1 E-07	<0.1
U-238[3]	3.11 E-02	3.5 E-11	1 E-07	<0.1
Pu-238	5.03 E-01	5.6 E-10	3 E-08	1.9
Pu-239	6.68 E-01	7.5 E-10	2 E-08	3.8
Am-241	2.15 E+00	2.4 E-09	2 E-08	12.0
				23.9[4]

Notes:

* @ 60,000 cfm = 8.93 E+8 m^3/yr
(Total uCi/yr) / (8.93 E+8 m^3/yr) = uCi/m^3 avg

1: as Am-241   2: as Sr-90

3 U total (ug) = 9.451 E+4   Avg U ug/m^3 = 1.058 E-04

4 Total Percent DCG for all releases

TABLE C - 2.2.1

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT FOX VALLEY (AFFXVRD)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	1.44 ± 1.0 E-15	2.36 ± 0.5 E-14		
FEB	1.84 ± 1.5 E-15	2.29 ± 0.5 E-14		
MAR	1.33 ± 1.4 E-15	2.40 ± 0.6 E-14		
1ST QTR			6.62 ± 4.5 E-17	< 9.8 E-16
APR	1.23 ± 1.4 E-15	1.71 ± 0.5 E-14		
MAY	1.17 ± 1.2 E-15	1.79 ± 0.1 E-13		
JUNE	1.38 ± 1.4 E-15	2.76 ± 0.6 E-14		
2ND QTR			1.44 ± 0.2 E-15	1.86 ± 0.2 E-14
JUL	1.03 ± 1.2 E-15	3.17 ± 0.6 E-14		
AUG	1.96 ± 1.5 E-15	3.06 ± 0.7 E-14		
SEP	1.22 ± 1.2 E-15	3.57 ± 0.6 E-14		
3RD QTR			1.07 ± 0.5 E-16	< 9.3 E-16
OCT	1.65 ± 1.5 E-15	4.27 ± 0.7 E-14		
NOV	1.04 ± 1.1 E-15	3.79 ± 0.6 E-14		
DEC	2.42 ± 1.5 E-15	5.25 ± 0.7 E-14		
4TH QTR			5.02 ± 5.0 E-17	< 6.5 E-16

TABLE C - 2.2.2

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT ROCK SPRINGS ROAD (AFRSPRD)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	0.85 ± 1.0 E-15	1.93 ± 0.4 E-14		
FEB	1.04 ± 1.0 E-15	2.01 ± 0.4 E-14		
MAR	1.14 ± 1.0 E-15	1.99 ± 0.4 E-14		
1ST QTR			< 1.1 E-16	< 8.9 E-16
APR	7.26 ± 8.2 E-16	1.31 ± 0.4 E-14		
MAY	4.98 ± 6.3 E-16	1.27 ± 0.1 E-13		
JUNE	4.53 ± 6.1 E-16	2.78 ± 0.4 E-14		
2ND QTR			2.22 ± 0.4 E-16	1.22 ± 0.1 E-14
JUL	6.08 ± 8.6 E-16	1.72 ± 0.4 E-14		
AUG	8.07 ± 8.2 E-16	1.82 ± 0.4 E-14		
SEP	5.92 ± 7.6 E-16	2.56 ± 0.5 E-14		
3RD QTR			3.22 ± 3.2 E-17	< 7.3 E-16
OCT	8.89 ± 9.1 E-16	2.80 ± 0.5 E-14		
NOV	1.12 ± 0.9 E-15	2.72 ± 0.5 E-14		
DEC	1.70 ± 1.1 E-15	3.74 ± 0.5 E-14		
4TH QTR			6.17 ± 3.3 E-17	< 7.8 E-16

TABLE C - 2.2.3

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT ROUTE 240 (AFRT240)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	0.79 ± 1.2 E-15	1.70 ± 0.5 E-14		
FEB	1.41 ± 1.5 E-15	2.11 ± 0.6 E-14		
MAR	1.28 ± 1.7 E-15	2.19 ± 0.7 E-14		
1ST QTR			< 8.2 E-17	< 9.6 E-16
APR	1.04 ± 1.0 E-15	1.14 ± 0.4 E-14		
MAY	1.05 ± 0.8 E-15	1.39 ± 0.1 E-13		
JUNE	5.67 ± 6.3 E-16	2.56 ± 0.4 E-14		
2ND QTR			2.38 ± 0.4 E-16	1.48 ± 0.1 E-14
JUL	5.22 ± 6.6 E-16	1.41 ± 0.3 E-14		
AUG	5.73 ± 6.6 E-16	1.68 ± 0.4 E-14		
SEP	4.89 ± 6.3 E-16	1.45 ± 0.3 E-14		
3RD QTR			4.31 ± 2.6 E-17	< 5.1 E-16
OCT	8.03 ± 7.9 E-16	1.80 ± 0.4 E-14		
NOV	4.56 ± 5.8 E-16	1.59 ± 0.3 E-14		
DEC	9.43 ± 8.2 E-16	2.81 ± 0.4 E-14		
4TH QTR			< 6.3 E-17	< 4.4 E-16

TABLE C - 2.2.4

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT SPRINGVILLE (AFSPRVL)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	1.29 ± 1.0 E-15	2.19 ± 0.4 E-14		
FEB	1.02 ± 0.9 E-15	1.81 ± 0.4 E-14		
MAR	1.13 ± 0.9 E-15	1.71 ± 0.3 E-14		
1ST QTR			5.73 ± 5.3 E-17	< 6.7 E-16
APR	9.47 ± 7.4 E-16	2.73 ± 0.3 E-14		
MAY	6.12 ± 6.5 E-16	1.36 ± 0.1 E-13		
JUNE	7.02 ± 6.7 E-16	2.36 ± 0.4 E-14		
2ND QTR			3.18 ± 0.6 E-16	1.31 ± 0.1 E-14
JUL	6.02 ± 6.4 E-16	1.60 ± 0.3 E-14		
AUG	9.40 ± 7.2 E-16	1.74 ± 0.3 E-14		
SEP	8.05 ± 6.7 E-16	1.77 ± 0.3 E-14		
3RD QTR			< 3.3 E-17	< 3.8 E-16
OCT	8.86 ± 6.9 E-16	2.21 ± 0.3 E-14		
NOV	8.08 ± 6.5 E-16	1.65 ± 0.3 E-14		
DEC	1.59 ± 0.9 E-15	2.87 ± 0.4 E-14		
4TH QTR			6.09 ± 2.4 E-17	< 4.6 E-16

TABLE C - 2.2.5

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT THOMAS CORNERS (AFTCORD)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	1.18 ± 1.1 E-15	3.74 ± 0.6 E-14		
FEB	0.95 ± 1.2 E-15	2.02 ± 0.5 E-14		
MAR	1.75 ± 1.4 E-15	2.07 ± 0.5 E-14		
1ST QTR			< 6.7 E-17	< 8.5 E-16
APR	1.26 ± 1.2 E-15	1.38 ± 0.4 E-14		
MAY	1.16 ± 1.2 E-15	1.35 ± 0.1 E-13		
JUNE	1.38 ± 1.2 E-15	2.62 ± 0.5 E-14		
2ND QTR			4.13 ± 1.0 E-16	1.10 ± 0.1 E-14
JUL	4.46 ± 8.4 E-16	1.45 ± 0.4 E-14		
AUG	5.17 ± 7.7 E-16	1.48 ± 0.4 E-14		
SEP	1.19 ± 1.0 E-15	1.60 ± 0.5 E-14		
3RD QTR			2.28 ± 0.5 E-16	< 7.4 E-16
OCT	1.00 ± 0.9 E-15	2.36 ± 0.5 E-14		
NOV	1.17 ± 0.9 E-15	2.07 ± 0.4 E-14		
DEC	1.47 ± 1.1 E-15	2.72 ± 0.5 E-14		
4TH QTR			< 5.0 E-17	7.22 ± 4.8 E-16

TABLE C - 2.2.6

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT WEST VALLEY (AFWEVAL)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	1.02 ± 0.9 E-15	2.02 ± 0.4 E-14		
FEB	1.07 ± 0.8 E-15	1.82 ± 0.3 E-14		
MAR	8.80 ± 8.0 E-16	1.94 ± 0.3 E-14		
1ST QTR			< 3.9 E-17	< 5.1 E-16
APR	1.06 ± 0.8 E-15	1.18 ± 0.3 E-14		
MAY	7.00 ± 5.6 E-16	1.09 ± 0.1 E-13		
JUNE	4.70 ± 4.8 E-16	2.19 ± 0.3 E-14		
2ND QTR			1.66 ± 0.3 E-16	1.12 ± 0.1 E-14
JUL	5.36 ± 6.0 E-16	1.44 ± 0.3 E-14		
AUG	7.50 ± 5.8 E-16	1.51 ± 0.3 E-14		
SEP	7.76 ± 6.1 E-16	1.73 ± 0.3 E-14		
3RD QTR			1.31 ± 0.3 E-16	3.54 ± 1.9 E-16
OCT	7.97 ± 6.0 E-16	1.92 ± 0.3 E-14		
NOV	7.39 ± 5.5 E-16	1.76 ± 0.3 E-14		
DEC	9.95 ± 6.9 E-16	2.31 ± 0.3 E-14		
4TH QTR			2.59 ± 2.4 E-17	< 3.7 E-16

TABLE C - 2.2.7

RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AROUND WVDP ENVIRONS - 1986

AIR SAMPLER AT GREAT VALLEY (AFGRVAL)
uCI/ml

	ALPHA	BETA	SR-90	CS-137
JAN	4.39 ± 5.0 E-16	1.30 ± 0.2 E-14		
FEB	5.42 ± 5.3 E-16	1.26 ± 0.2 E-14		
MAR	6.60 ± 5.6 E-16	1.36 ± 0.2 E-14		
1ST QTR			7.42 ± 3.9 E-17	< 2.9 E-16
APR	5.97 ± 5.5 E-16	1.03 ± 0.2 E-14		
MAY	7.36 ± 6.1 E-16	1.25 ± 0.1 E-13		
JUNE	5.93 ± 5.9 E-16	2.54 ± 0.4 E-14		
2ND QTR			3.59 ± 0.8 E-16	1.43 ± 0.1 E-14
JUL	5.98 ± 6.6 E-16	1.74 ± 0.3 E-14		
AUG	7.10 ± 5.6 E-16	1.78 ± 0.3 E-14		
SEP	9.25 ± 7.2 E-16	2.89 ± 0.4 E-14		
3RD QTR			1.62 ± 0.4 E-16	2.99 ± 2.9 E-16
OCT	8.26 ± 7.1 E-16	2.73 ± 0.4 E-14		
NOV	9.40 ± 6.6 E-16	2.05 ± 0.3 E-14		
DEC	1.40 ± 0.9 E-15	2.77 ± 0.4 E-14		
4TH QTR			< 5.5 E-17	< 6.2 E-16

1r1 AFGRVAL.RPT

TABLE C-2.3.1

RADIOACTIVITY IN FALLOUT (nCi/square metre/mo)

DUTCH HILL (AFDHFOP)				FOX VALLEY ROAD (AFFXFOP)			
MONTH - 1986	GROSS ALPHA	GROSS BETA	H-3 (uCi/ml)	MONTH - 1986	GROSS ALPHA	GROSS BETA	H-3 (uCi/ml)
JANUARY	1.11 E-02	0.10 ± 0.02	<1.0 E-07	JANUARY	3.86 E-02	0.19 ± 0.02	<1.0 E-07
FEBRUARY	1.45 E-02	0.12 ± 0.02	<1.0 E-07	FEBRUARY	3.11 E-02	0.31 ± 0.03	<1.0 E-07
MARCH	1.48 E-02	0.21 ± 0.03	SAMPLE DRY	MARCH	1.34 E-02	0.33 ± 0.03	SAMPLE DRY
APRIL	2.25 E-02	0.17 ± 0.02	<1.0 E-07	APRIL	1.14 E-02	0.16 ± 0.02	<1.0 E-07
MAY	5.45 E-02	0.67 ± 0.06	<1.0 E-07	MAY	3.86 E-02	0.73 ± 0.06	<1.0 E-07
JUNE	4.53 E-02	0.73 ± 0.05	<1.0 E-07	JUNE	6.40 E-02	0.71 ± 0.05	<1.0 E-07
JULY	6.66 E-02	0.55 ± 0.04	<1.0 E-07	JULY	9.10 E-02	0.62 ± 0.04	<1.0 E-07
AUGUST	3.86 E-02	0.30 ± 0.03	<1.0 E-07	AUGUST	2.84 E-02	0.38 ± 0.03	<1.0 E-07
SEPTEMBER	3.11 E-02	0.35 ± 0.03	<1.0 E-07	SEPTEMBER	1.04 E-01	0.33 ± 0.03	<1.0 E-07
OCTOBER	2.16 E-01	0.55 ± 0.04	<1.0 E-07	OCTOBER	2.88 E-02	0.53 ± 0.04	1.94 ± 1.2 E-07
NOVEMBER	2.22 E-02	0.19 ± 0.03	<1.0 E-07	NOVEMBER	6.96 E-02	0.30 ± 0.03	<1.0 E-07
DECEMBER	1.63 E-02	0.28 ± 0.03	1.79 ±1.1 E-07	DECEMBER	1.97 E-02	0.39 ± 0.03	3.29 ± 1.1 E-07

ROUTE 240 (AF24FOP)				THOMAS CORNERS ROAD (AFTCFOP)			
MONTH - 1986	GROSS ALPHA	GROSS BETA	H-3 (uCi/ml)	MONTH - 1986	GROSS ALPHA	GROSS BETA	H-3 (uCi/ml)
JANUARY	1.49 E-02	0.11 ± 0.02	<1.0 E-07	JANUARY	2.75 E-02	0.17 ± 0.02	<1.0 E-07
FEBRUARY	2.29 E-02	0.21 ± 0.02	<1.0 E-07	FEBRUARY	4.32 E-02	0.28 ± 0.03	1.21 ± 1.0 E-07
MARCH	6.58 E-03	0.26 ± 0.03	SAMPLE DRY	MARCH	2.59 E-02	0.36 ± 0.03	7.71 ± 1.2 E-07
APRIL	9.84 E-03	0.17 ± 0.02	<1.0 E-07	APRIL	2.56 E-02	0.20 ± 0.03	<1.0 E-07
MAY	2.14 E-02	0.85 ± 0.06	<1.0 E-07	MAY	5.22 E-02	0.93 ± 0.07	<1.0 E-07
JUNE	2.74 E-02	0.45 ± 0.04	<1.0 E-07	JUNE	6.86 E-02	0.69 ± 0.05	<1.0 E-07
JULY	5.62 E-02	0.62 ± 0.04	<1.0 E-07	JULY	9.91 E-02	0.61 ± 0.04	<1.0 E-07
AUGUST	3.33 E-02	0.51 ± 0.04	<1.0 E-07	AUGUST	3.82 E-02	0.37 ± 0.03	<1.0 E-07
SEPTEMBER	2.51 E-02	0.40 ± 0.03	<1.0 E-07	SEPTEMBER	1.05 E-01	0.49 ± 0.04	<1.0 E-07
OCTOBER	7.92 E-02	0.48 ± 0.04	1.16 ± 1.1 E-07	OCTOBER	5.53 E-02	0.44 ± 0.04	<1.0 E-07
NOVEMBER	3.37 E-02	0.24 ± 0.03	2.96 ± 1.1 E-07	NOVEMBER	8.59 E-02	0.30 ± 0.03	2.50 ± 1.1 E-07
DECEMBER	4.15 E-02	0.34 ± 0.03	1.47 ± 1.1 E-07	DECEMBER	7.86 E-02	0.44 ± 0.04	1.57 ± 1.1 E-07

TABLE C - 2.3.2

pH OF PRECIPITATION FALLOUT COLLECTIONS

MONTH - 1986	DUTCH HILL (AFDHFOP)	FOX VALLEY ROAD (AFFxFOP)	ROUTE 240 (AF24FOP)	THOMAS CORNERS ROAD (AFTCFOP)
JANUARY	NOT		MEASURED	
FEBRUARY	3.96	4.15	3.97	4.00
MARCH	DRY	DRY	DRY	6.22
APRIL	3.62	4.65	3.75	6.09
MAY	4.27	4.61	5.47	3.76
JUNE	3.79	6.23	3.97	3.88
JULY	4.04	4.14	4.01	4.01
AUGUST	6.16	3.81	5.84	3.53
SEPTEMBER	4.49	4.03	5.07	3.94
OCTOBER	4.21	5.16	5.88	4.06
NOVEMBER	4.22	4.33	4.05	4.76
DECEMBER	4.16	4.52	4.12	4.15

TABLE C - 2.4

Radioactivity of Triennial Soil Samples for 1982 and 1985

Concentration (uCi/g) (dry weight from upper 5 cm)

ID	Date	K-40	Cs-137	Sr-90	Pu-239	Am-241
SFSOLWV	Aug. 1982	1.05 ± 0.1 E-05	5.08 ± 0.9 E-07	5.74 ± 4.6 E-08	1.61 ± 0.4 E-08	3.98 ± 3.4 E-09
SFSOLFV	Aug. 1982	9.93 ± 1.1 E-06	1.45 ± 0.1 E-06	6.40 ± 1.2 E-07	3.23 ± 0.6 E-08	1.36 ± 0.4 E-09
SFSOLSP	Aug. 1982	1.34 ± 0.1 E-05	1.22 ± 0.1 E-06	5.11 ± 0.8 E-07	1.67 ± 0.5 E-08	6.35 ± 3.9 E-09
SFSOLTC	Aug. 1982	1.73 ± 0.2 E-05	7.79 ± 1.1 E-07	5.27 ± 0.7 E-07	2.03 ± 0.5 E-08	1.10 ± 0.6 E-09
SFSOL24	Aug. 1982	1.27 ± 0.2 E-05	1.02 ± 0.1 E-06	5.02 ± 0.7 E-07	1.43 ± 0.5 E-08	5.11 ± 2.9 E-09
SFSOLLV	Aug. 1982	1.24 ± 0.1 E-05	4.35 ± 0.8 E-07	1.75 ± 0.4 E-07	6.10 ± 2.9 E-09	4.70 ± 3.8 E-09
SFSOLDK	Aug. 1982	1.67 ± 0.2 E-05	8.03 ± 1.1 E-07	1.54 ± 0.3 E-07	1.41 ± 0.4 E-08	5.43 ± 4.0 E-09
SFSOLSB	Aug. 1982	1.20 ± 0.1 E-05	<5.4 E-08	<4 E-08	1.49 ± 1.1 E-09	2.44 ± 1.6 E-09
SFSOLWV	Dec. 1985	1.40 ± 0.1 E-05	1.78 ± 0.8 E-07	7.80 ± 3.0 E-08	2.81 ± 2.8 E-09	5.55 ± 3.8 E-09
SFSOLFV	Dec. 1985	1.15 ± 0.2 E-05	9.84 ± 1.3 E-07	3.39 ± 0.5 E-07	2.32 ± 0.6 E-08	7.75 ± 2.9 E-09
SFSOLSP	Dec. 1985	1.42 ± 0.2 E-05	4.49 ± 0.8 E-07	1.47 ± 0.3 E-07	4.75 ± 1.8 E-09	2.83 ± 2.3 E-09
SFSOLTC	Dec. 1985	1.92 ± 0.2 E-05	7.02 ± 1.2 E-07	3.57 ± 0.6 E-07	1.39 ± 0.4 E-08	5.28 ± 2.3 E-09
SFSOL24	Dec. 1985	1.34 ± 0.2 E-05	9.07 ± 1.2 E-07	3.41 ± 0.5 E-07	1.76 ± 0.4 E-08	1.11 ± 0.5 E-08
SFSOLLV	Dec. 1985	1.47 ± 0.1 E-05	3.05 ± 0.7 E-07	6.88 ± 3.6 E-08	1.22 ± 0.4 E-08	3.67 ± 2.2 E-09
SFSOLDK	Dec. 1985	1.73 ± 0.2 E-05	6.46 ± 1.2 E-07	2.77 ± 0.4 E-07	1.49 ± 0.4 E-08	9.46 ± 5.3 E-09
SFSOLRS	Dec. 1985	1.54 ± 0.2 E-05	1.87 ± 0.2 E-06	4.59 ± 0.6 E-07	1.93 ± 0.5 E-08	1.52 ± 0.4 E-08
SFSOLGV	Dec. 1985	1.16 ± 0.1 E-05	2.13 ± 0.1 E-06	3.66 ± 0.5 E-07	4.52 ± 0.7 E-08	1.32 ± 0.4 E-08

FIGURE C-2.1
1986 SAMPLING DATA FOR STATION ANSTACK
CURIES RELEASED PER MONTH

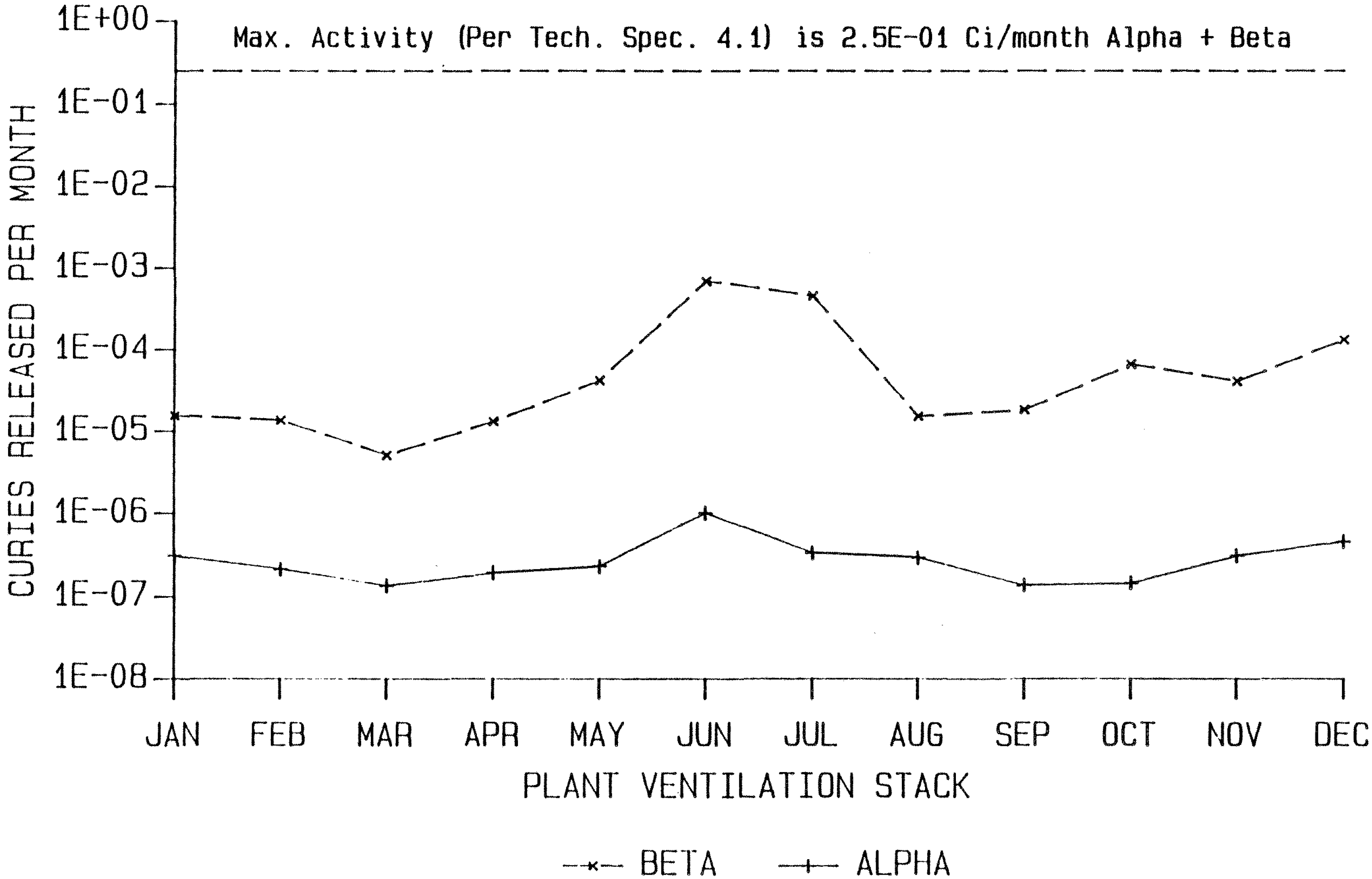
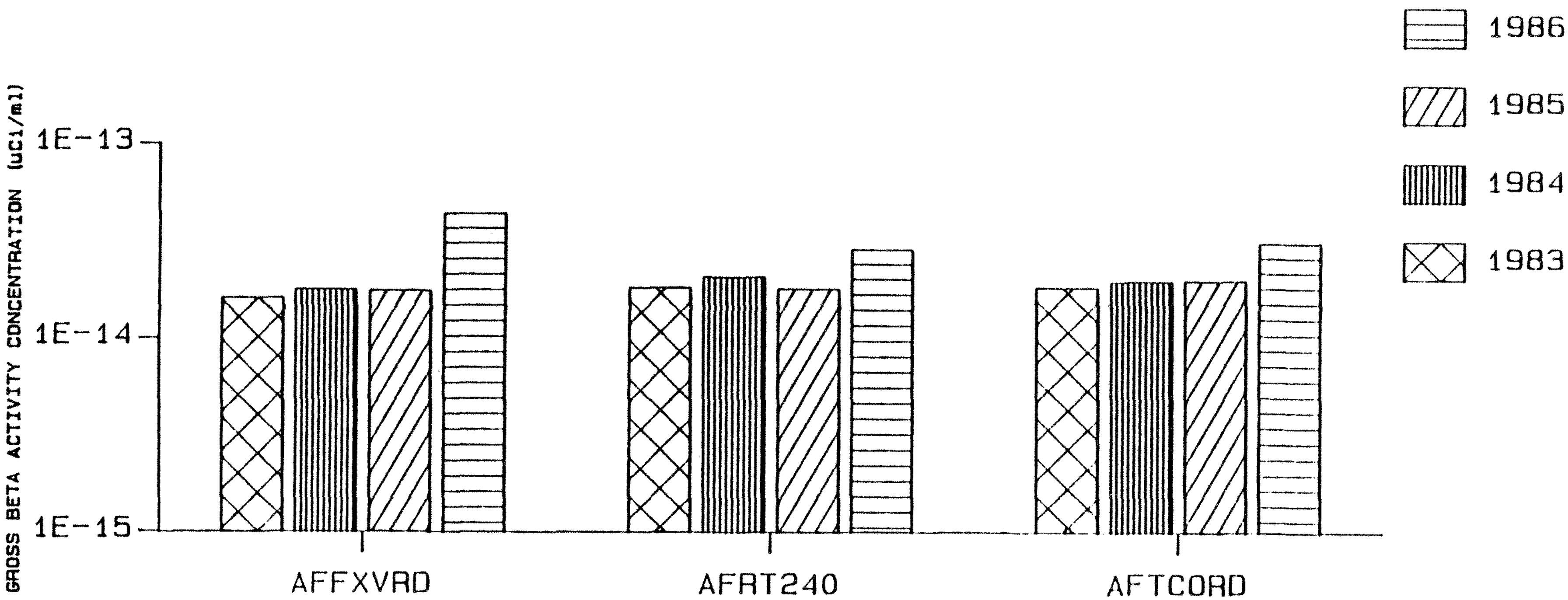


FIGURE C-2.2
TRENDS OF GROSS BETA ACTIVITY IN PERIMETER AIR SAMPLERS
(AFFXVRD, AFRT240, AFTCORD) 1983 1986

uCi/ml

	1983	1984	1985	1986
AFFXVRD	1.61 E-14	1.78 E-14	1.75 E-14	4.38 E-14
AFRT240	1.82 E-14	2.07 E-14	1.80 E-14	2.86 E-14
AFTCORD	1.82 E-14	1.96 E-14	1.97 E-14	3.08 E-14



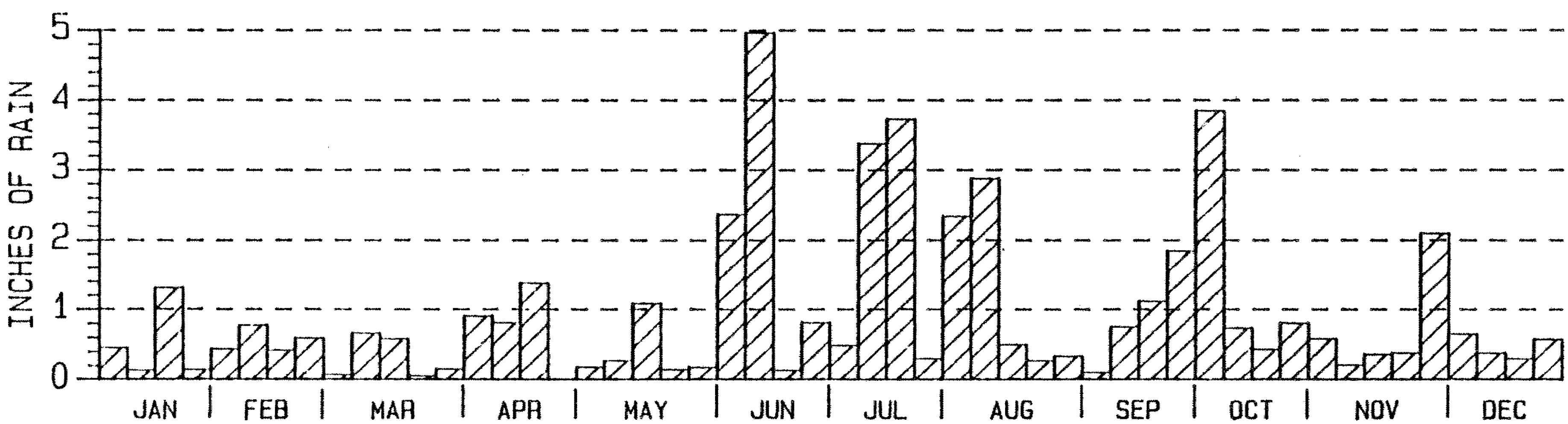
PARTICULATE AIR SAMPLE ANNUAL AVERAGES

Figure C-2.3

1986 COLLECTION DATA FOR SITE RAINFALL

CUMULATIVE TOTAL = 48.48 INCHES

END DATE	IN.	DATE	IN.	DATE	IN.	DATE	IN.	DATE	IN.
JAN 07	0.46	14	0.13	21	1.31	28	0.14		
FEB 04	0.44	11	0.78	18	0.42	25	0.60		
MAR 04	0.07	11	0.67	18	0.58	25	0.05	01	0.16
APR 08	0.91	15	0.81	22	1.38	29	0.00		
MAY 06	0.19	13	0.28	20	1.09	27	0.14	03	0.18
JUN 10	2.37	17	4.97	24	0.13	01	0.82		
JUL 08	0.49	15	3.38	22	3.73	29	0.30		
AUG 05	2.34	12	2.88	19	0.50	26	0.27	02	0.34
SEP 09	0.10	16	0.76	23	1.12	30	1.85		
OCT 07	3.85	14	0.73	21	0.43	28	0.81		
NOV 04	0.58	11	0.21	18	0.33	25	0.39	02	2.10
DEC 09	0.65	16	0.38	23	0.30	31	0.58 (8 days)		



REPORTING BEGINS ON 01/01/86, ENDS ON 12/31/86 MEASUREMENTS TAKEN TUESDAY THRU TUESDAY

APPENDIX C-3

SUMMARY OF BIOLOGICAL SAMPLE DATA

TABLE C-3.1

RADIOACTIVITY CONCENTRATIONS IN MILK - 1986
(uCi/ml)

LOCATION	H-3	Sr-90	I-129	Cs-134	Cs-137
NNW Farm (BFMREED) 1st Qtr 1986		1.74 ± 0.2 E-09	< 7.0 E-10	< 8.0 E-09	< 1.0 E-08
NNW Farm (BFMREED) 2nd Qtr 1986	< 2.0 E-07	2.58 ± 0.4 E-09	< 1.1 E-09	< 9.5 E-09	<1.2 E-08
WNW Farm (BFMCOBO) 2nd Qtr 1986	< 2.0 E-07	2.01 ± 0.3 E-09	< 1.1 E-09	< 1.4 E-08	< 1.4 E-08
NNW Farm (BFMREED) 3rd Qtr 1986	< 3.0 E-07	1.99 ± 0.3 E-09	< 6.0 E-10	< 1.2 E-08	< 1.0 E-08
ENE Farm (BFMZIMM) August, 1986	< 4.C E-07	4.36 ± 0.5 E-09	< 5.0 E-10	< 9.1 E-09	< 9.9 E-09
WNW Farm (BFMCOBO) 3rd Qtr 1986	< 4.0 E-07	3.33 ± 0.5 E-09	< 6.0 E-10	< 1.3 E-08	< 1.5 E-08
NNW Farm (BFMREED) 4th Qtr 1986		2.46 ± 0.3 E-09	< 5.0 E-10	< 1.1 E-08	< 9.8 E-09
SE Farm (BFMWIDR) December, 1986	< 4.0 E-07	3.20 ± 0.5 E-09	< 6.0 E-10	< 1.1 E-08	< 1.3 E-08
SSW Farm (BFMHAUR) December, 1986	< 4.0 E-07	6.90 ± 0.8 E-09	< 6.0 E-10	< 1.1 E-08	< 1.4 E-08
WNW Farm (BFMCOBO) 4th Qtr 1986		5.46 ± 0.7 E-09	< 4.0 E-10	< 9.3 E-09	< 9.8 E-09
Control (BFMCTRL-S) 4th QTR 1986	< 4.0 E-07	2.17 ± 0.4 E-09	< 5.0 E-10	< 1.0 E-09	< 1.3 E-08
Control (BFMCTRL-N) 4th Qtr 1986		3.22 ± 0.6 E-09	< 5.0 E-10	< 1.2 E-08	< 1.5 E-08

TABLE C-3.2

RADIOACTIVITY CONCENTRATIONS IN MEAT - 1986
(uCi/g)

LOCATION	Sr-89	SR-90	Cs-134	Cs-137
Deer Flesh- Near Site (BFDNEAR) 12/86		4.71 ± 0.8 E-09	< 2.4 E-08	3.25 ± 0.3 E-07
Deer Skeleton- Near Site (BFDNEAR) 12/86	< 6.0 E-06	4.48 ± 0.5 E-06		
Deer Flesh- Background (BFDCTRL) 12/86		3.42 ± 0.5 E-09	1.61 ± 1.1 E-08	8.46 ± 1.8 E-08
Beef Flesh- Near Site (BFBNEAR) 6/86			2.47 ± 1.6 E-08	7.08 ± 1.4 E-08
Beef Flesh- Background (BFBCTRL) 6/86			0.91 ± 1.3 E-08	3.69 ± 1.6 E-08
Beef Flesh- Near Site (BFBNEAR) 11/86			< 1.4 E-08	< 1.4 E-08
Beef Flesh- Background (BFBCTRL) 12/86			< 1.2 E-08	1.96 ± 1.1 E-08

RADIOACTIVITY CONCENTRATIONS IN FOOD CROPS - 1986
(uCi/g) DRY

LOCATION	TRITIUM (uCi/ml)	Sr-90	K-40	Co-60	Cs-137
Beans- Near Site (BFVNEAR) 8/86	< 4.0 E-07	5.67 ± 0.7 E-07	1.06 ± 0.2 E-05	< 1.7 E-07	< 1.6 E-07
Beans- Background (BFVCTRL) 8/86	6.4 ± 2.4 E-07	2.27 ± 0.3 E-07	3.35 ± 0.3 E-05	< 1.9 E-07	< 1.3 E-07
Corn- Near Site (BFVNEAR) 8/86	< 4.0 E-07	4.67 ± 0.7 E-08	1.22 ± 0.3 E-05	< 2.0 E-07	<1.6 E-07
Corn- Background (BFVCTRL) 8/86	5.4 ± 2.3 E-07	2.22 ± 1.7 E-09	1.01 ± 0.1 E-05	< 6.4 E-08	3.22 ± 3.0 E-08
Potatoes- Near Site (BFVNEAR) 8/86	< 3.0 E-07	1.52 ± 0.3 E-08	1.34 ± 0.1 E-05	< 3.0 E-08	2.71 ± 1.8 E-08
Potatoes- Background (BFVCTRL) 8/86	< 3.0 E-07	7.33 ± 1.6 E-09	1.68 ± 0.1 E-05	< 4.4 E-08	< 3.4 E-08

TABLE-C-3.4

RADIOACTIVITY CONCENTRATIONS IN FISH FROM CATTARAUGUS CREEK - 1986
(uCi/g - DRY)

CATTARAUGUS CREEK (BFFCATC) - SECOND QUARTER 1986

	FLESH			SKELETON
	Sr-90	Cs-134	Cs-137	Sr-90
MEDIAN	8.20 E-08	<2.4 E-07	<2.5 E-07	3.65 E-07
AVERAGE GEOMETRIC DEVIATION	1.52	1.49	1.51	1.65
MAXIMUM	1.79 ± 0.2 E-07	<4.9 E-07	<3.8 E-07	5.31 ± 0.7 E-07
MINIMUMN	4.28 ± 0.8 E-08	<1.1 E-07	<1.2 E-07	1.24 ± 0.7 E-07

CATTARAUGUS CREEK (BFFCATC) - THIRD QUARTER 1986

	FLESH			SKELETON
	Sr-90	Cs-134	Cs-137	Sr-90
MEDIAN	6.79 E-08	<1.8 E-07	<1.6 E-07	3.17 E-07
AVERAGE GEOMETRIC DEVIATION	1.49	1.61	1.79	1.55
MAXIMUM	9.78 ± 1.9 E-08	<2.8 E-07	5.74 ± 3.0 E-07	5.10 ± 1.2 E-07
MINIMUMN	2.87 ± 1.1 E-08	<7.6 E-08	7.39 ± 7.1 E-08	2.13 ± 0.3 E-07

CATTARAUGUS CREEK (BFFCTRL) - BACKGROUND FISH
SECOND QUARTER 1986
FLESH

	Sr-90	Cs-134	Cs-137
MEDIAN	3.75 E-08	<1.4 E-07	<1.6 E-07
AVERAGE GEOMETRIC DEVIATION	1.79	1.72	1.86
MAXIMUM	8.20 ± 1.4 E-08	<4.7 E-07	<3.9 E-07
MINIMUM	9.93 ± 1.8 E-09	<4.3 E-08	<4.8 E-08

CATTARAUGUS CREEK (BFFCTRL) - BACKGROUND FISH
THIRD QUARTER 1986
FLESH

	Sr-90	Cs-134	Cs-137
MEDIAN	3.62 E-08	<9.5 E-08	<9.9 E-08
AVERAGE GEOMETRIC DEVIATION	1.56	1.35	1.45
MAXIMUM	5.05 ± 1.0 E-08	<1.4 E-07	2.42 ± 1.0 E-07
MINIMUM	<1.4 E-08	<4.9 E-08	<5.3 E-08

CATTARAUGUS CREEK (BFFCATD) - BELOW SPRINGVILLE DAM
SECOND QUARTER 1986
FLESH

	Sr-90	Cs-134	Cs-137
MEDIAN	5.85 E-08	<2.3 E-07	<2.7 E-07
AVERAGE GEOMETRIC DEVIATION	1.31	1.31	1.26
MAXIMUM	8.69 ± 1.5 E-08	<4.3 E-07	<4.0 E-07
MINIMUM	4.13 ± 2.8 E-08	<1.5 E-07	<1.8 E-07

CATTARAUGUS CREEK (BFFCATD) - BELOW SPRINGVILLE DAM
THIRD QUARTER 1986
FLESH

	Sr-90	Cs-134	Cs-137
MEDIAN	9.20 E-09	<3.3 E-08	8.0 E-08
AVERAGE GEOMETRIC DEVIATION	1.70	1.78	1.68
MAXIMUM	4.36 ± 0.7 E-08	<1.0 E-07	1.53 ± 0.3 E-07
MINIMUM	<7.0 E-10	<1.5 E-08	5.41 ± 2.7 E-08

FIGURE C-3.1

COMPARISON OF RADIOACTIVITY IN FISH SAMPLES FROM AROUND WVDP-1986

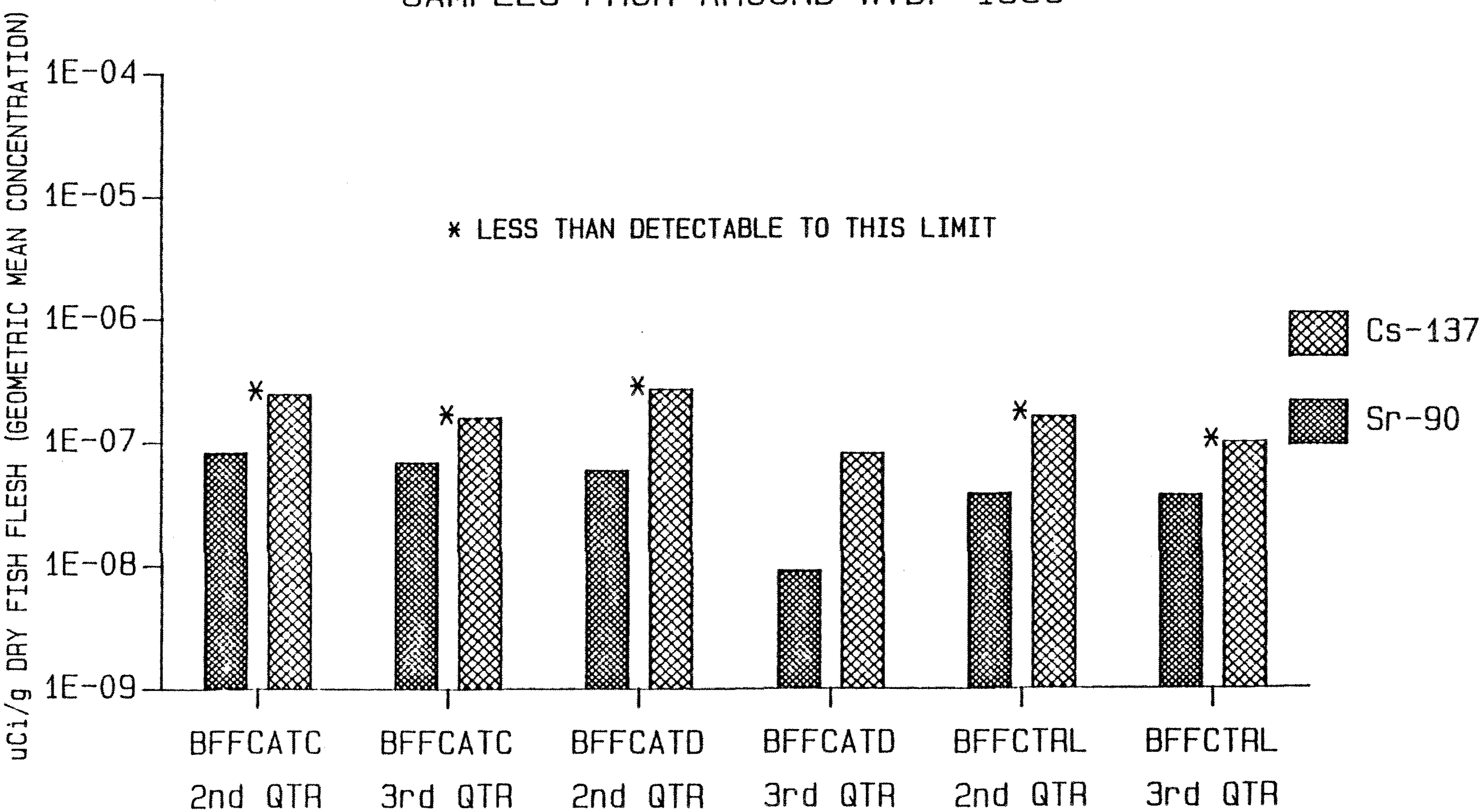


FIGURE C-3.2
TRENDS OF Sr-90 CONCENTRATIONS IN FISH FROM
CATTARAUGUS CREEK (BFFCATC) 1982-1986

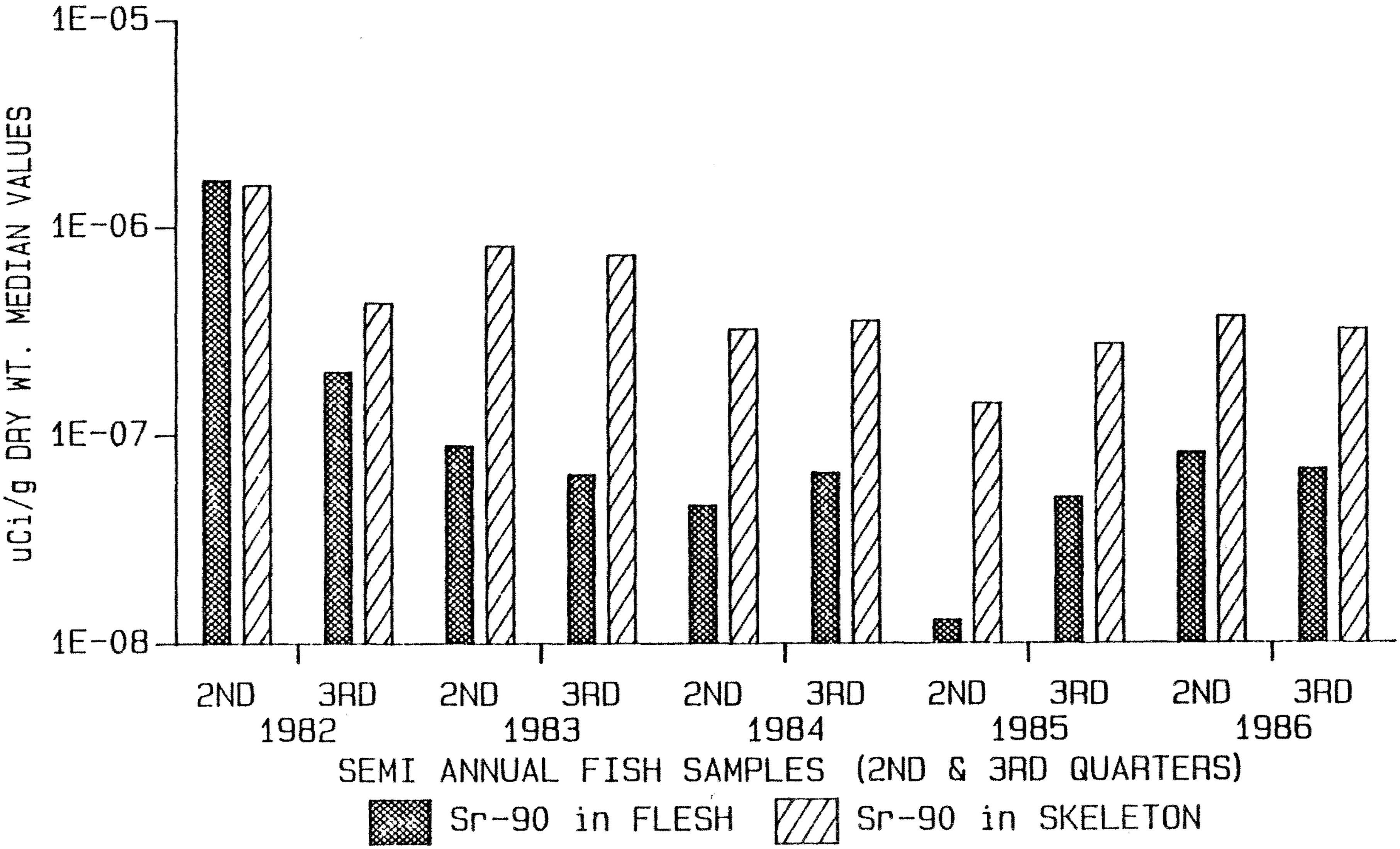
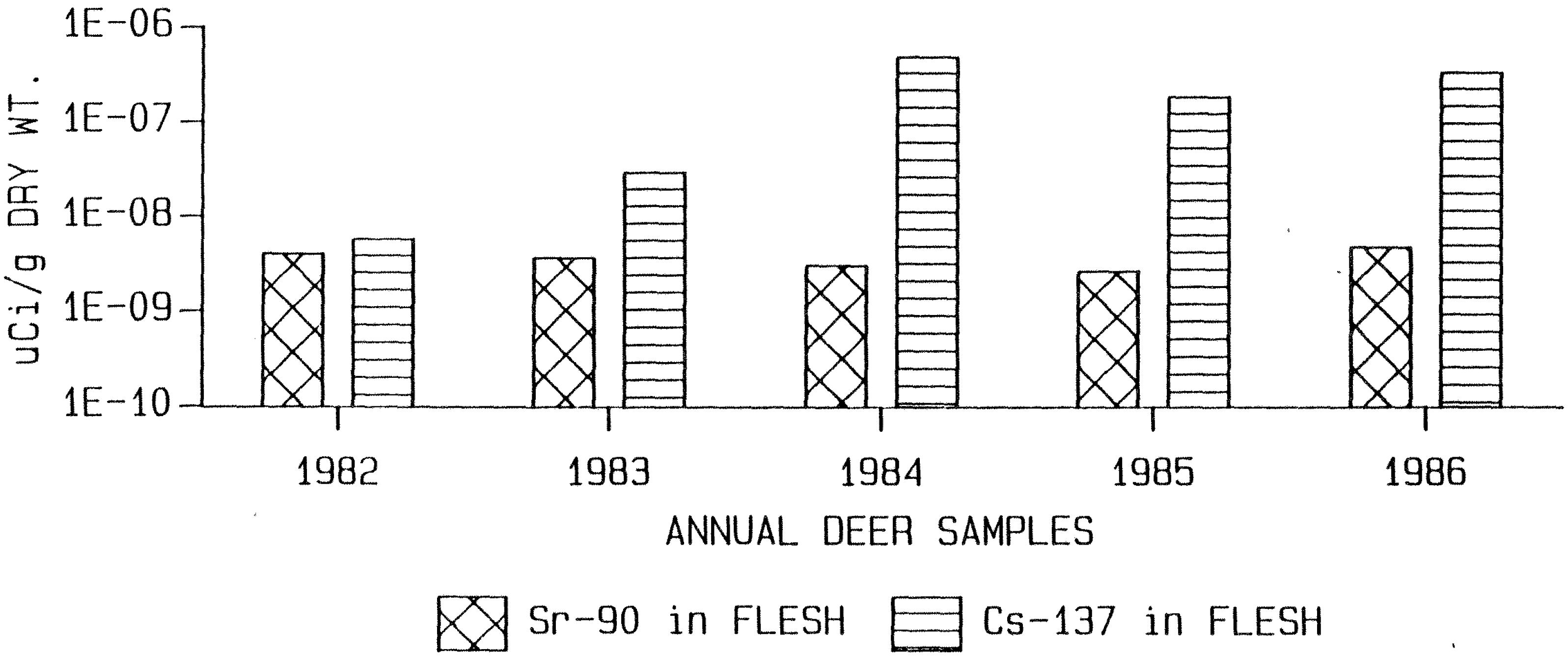


FIGURE C-3.3

TRENDS OF RADIONUCLIDES IN VENISON FROM NEAR WVDP SITE (BFDNEAR) 1982-1986

	Sr-90 in FLESH	Cs-137 in FLESH
1982	4.00+/-3.0 E-09	<5.7 E-09
1983	3.60+/-0.7 E-09	2.90+/-2.1 E-08
1984	3.00+/-0.9 E-09	4.80+/-0.4 E-07
1985	2.60+/-0.4 E-09	1.80+/-0.3 E-07
1986	4.71+/-0.8 E-09	3.25+/-0.3 E-07



APPENDIX C-5

SUMMARY OF NONRADIOLOGICAL MONITORING

Nonradiological emissions and plant effluents are controlled and permitted under New York State and U.S. EPA regulations. Airborne emissions arise from seven sources, all of which are permitted by New York State Department of Environmental Conservation (NYSDEC). These release points include two natural gas-fired boilers, two nitric acid tank vents, an office paper waste incinerator, a glass-melter off-gas system and a cement storage silo vent. The melter off-gas system is currently being tested and operated under a permit to construct. These permits are identified and described in Table C-5.1. Although there are periodic New York State inspections of the air emission points, routine sampling and analysis of nonradiological emissions from these points are not required. Discharges from these points are well below the levels requiring monitoring under the state permit system.

Liquid discharges are regulated under the State Pollution Discharge Elimination System (SPDES). The outfalls and monitoring requirements for the permit are presented in Table C-5.2. The locations of the monitoring points are shown in Figure C-5.1.

The results of the SPDES nonradiological monitoring are presented in Figures C-5.2 through C-5.23. These data indicate Project effluents were generally within the permit limits during 1986. However, the WVDP reported a total of 33 noncompliance episodes. These noncompliances are summarized in Table C-5.3 and are described in the following paragraphs.

The majority of the noncompliance episodes are for pH and solids (either total suspended or settleable) at outfall 007 (the mixing basin for utility room and sewage plant effluents). Of the 33 excursions reported during 1986, 25 were at outfall 007; 19 of which were pH and three each for settleable solids and total suspended solids. The pH excursions occurred between June and October. Solids excursions only occurred during pH excursions.

The pH excursions were, without exception, values that exceeded the maximum limit of 9.0 standard units. The cause of these excursions is believed to be photosynthetically mediated carbon dioxide assimilation by a dense algal bloom which appeared in the basin in the warm summer months. This phenomenon is well documented in eutrophic and hypereutrophic lentic systems.

Aeration increases the carbon dioxide transfer to the water and lowers the pH. However, aeration resuspends material that had settled to the bottom of the basin causing an increase of solids in the effluent. Different means of aerating the basin are being investigated to control pH without increasing the solids in the effluent.

The remaining excursions are for various parameters at other outfalls. Outfall 001, the discharge lagoon for the low level radioactive liquid waste treatment facility (LLWT), experienced pH and solids excursions in June and a solids excursion again in September. In both cases, the lagoon discharge was nearly completed when rainfall washed sediments from the sides and bottom of the lagoon into the effluent. Discharges were terminated as soon as the excursions were discovered.

On two occasions the flow weighted average ammonia concentration for outfalls 001 and 007 exceeded the permit limits. These episodes were caused by operational upsets at the sewage treatment facility. Operator training and modification of operating procedures are being pursued to prevent recurrance of these non-compliances.

The remaining two non-compliance episodes were for flow weighted average iron concentrations from outfalls 001, 007 and 008. The iron discharge limit is a net discharge limit which provides for subtraction of the mass of iron in the raw water supply from the effluent mass discharge. On both occasions, lagoon 3 was being discharged through outfall 001, an operation which takes up to 10 days. At the start of the discharge, the raw water iron concentration (and mass) provided adequate offset to discharge effluent of a given iron concentration at a high rate. As the discharge continued, the iron concentration in the effluent did not change significantly, but the concentration in the raw water dropped. (Wide fluctuations in the raw water iron concentration have been observed in the past.) This resulted in a lower mass offset and a higher net effluent concentration than the permit limits allow.

These noncompliance episodes are summarized in Table C-5.3. The environmental impacts associated with these noncompliance episodes are negligible because of their generally small magnitude and short duration, the innocuous nature of the noncomplying parameters, and natural dilution by a factor of approximately 1000 between the point where Erdman Brook leaves the controlled area of the site (formerly outfall 006) and Cattaraugus Creek (the nearest point of public access).

Table C-5.1

West Valley Demonstration Project

Environmental Permits

Permit #	Issued by	Expiration Date	Type of Permit
042200-0114-00002 WC	NYSDEC	6/89	Certificate to operate air contamination source - boiler
042200-0114-00003 WC	NYSDEC	6/89	Certificate to operate air contamination source - boiler
042200-0114-00004 WR	NYSDEC	6/89	Certificate to operate air contamination source - incinerator†
042200-0114-00010 WI	NYSDEC	6/89	Certificate to operate air contamination source - Low Level Waste Treatment Facility Nitric Acid Storage Tank
042200-0114-014D1 WI	NYSDEC	6/89	Certificate to operate air contamination source - Nitric Acid Bulk Storage Tank
042200-0114 CSS01	NYSDEC	6/89	Certificate to Operate Cement Storage Silo Ventilation System.
042200-0114 015F-1	NYSDEC	6/86*	Permit to Construct Vitrification Off-Gas System
NY-0000973	NYSDEC	9/90	State Pollution Discharge Elimination System (SPDES permit)

*Permit to construct is extended annually with submittal of status report.

†Currently nonradioactive waste is removed to a commercial landfill and not incinerated.

TABLE C-5.2
West Valley Demonstration Project
SPDES Sampling Program
Effective September 1, 1985

Outfall #	Parameter	Limit	Sample Frequency
001 (Process and Storm waste waters)	Flow		2 per discharge event
	Aluminum	14.0 mg/L	2 per discharge event
	Ammonia	*	2 per discharge event
	Arsenic	0.01 mg/L	2 per discharge event
	BOD-5	**	2 per discharge event
	Iron	**	2 per discharge event
	Zinc	0.31 mg/L	2 per discharge event
	Suspended Solids	45.0 mg/L	2 per discharge event
	Cyanide	0.1 mg/L	2 per discharge event
	Settleable Solids	0.30 ml/L	2 per discharge event
	pH	6.0 - 9.0	2 per discharge event
	Cadmium	0.013 mg/L	annual
	Chromium	0.050 mg/L	annual
	Copper	0.050 mg/L	annual
	Lead	0.080 mg/L	annual
	Nickel	0.080 mg/L	annual
	Selenium	0.040 mg/L	annual
007 (Sanitary and Utility waste water)	Flow		3 per month
	Ammonia	*	3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
	Suspended Solids	45.0 mg/L	2 per month
	Settleable Solids	0.3 ml/L	Weekly
	pH 6.0 - 9.0	Weekly	
	Chloroform	0.020 mg/L	annual
008 (French Drain waste water)	Flow		3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
pH	6.0 - 9.0	3 per month	
Silver	0.008 mg/l	annual	
Zinc	0.100 mg/l	annual	

* Reported as flow weighted average of Outfalls 001 and 007.

** Reported as flow weighted average of Outfalls 001, 007 and 008. Iron data are net limits reported after background concentrations are subtracted.

Table C-5.3

West Valley Demonstration Project

1986 SPDES Non Compliance Episodes

Date	Outfall #	Parameter	Limit	Value	Comments
June 1986	001	pH	6.0 - 9.0 std units	9.6	
		Total Suspended Solids	30.0 mg/L avg. 45.0 mg/L max.	39.2 53.8	maximum values caused average values to exceed limits
	007	pH	6.0 - 9.0 std units	9.5	3 occasions reported
	Sum 001, 007, 008	Iron	0.31 mg/L	0.65	
July 1986	007	pH	7.0 - 9.0 std units	9.1	
	Sum 001,007	Ammonia	2.1 mg/L	2.78	2 occasions reported
August 1986	007	pH	6.0 - 9.0 std units	9.5	7 occasions reported
		Total Suspended Solids	30.0 mg/L avg. 45.0 mg/L max.	59.2	3 occasions reported
		Settleable Solids	0.3 ml/L	2.5	2 occasions reported
Sept. 1986	001	Total Suspended Solids	30.0 mg/L avg. 45.0 mg/L max.	66.5 120.0	one excursion caused maximum value and average value to exceed limits
	007	pH	6.0 - 9.0 std units	9.1	5 occasions reported
		Settleable Solids	0.3 ml/L	0.4	
	Sum 001, 007, 008	Iron	0.31 mg/L	1.81	
Oct. 1986	007	pH	6.0 - 9.0 std units	9.3	3 occasions reported
Nov.1986	Sum 001,007	Ammonia	2.1 mg/L	3.39	

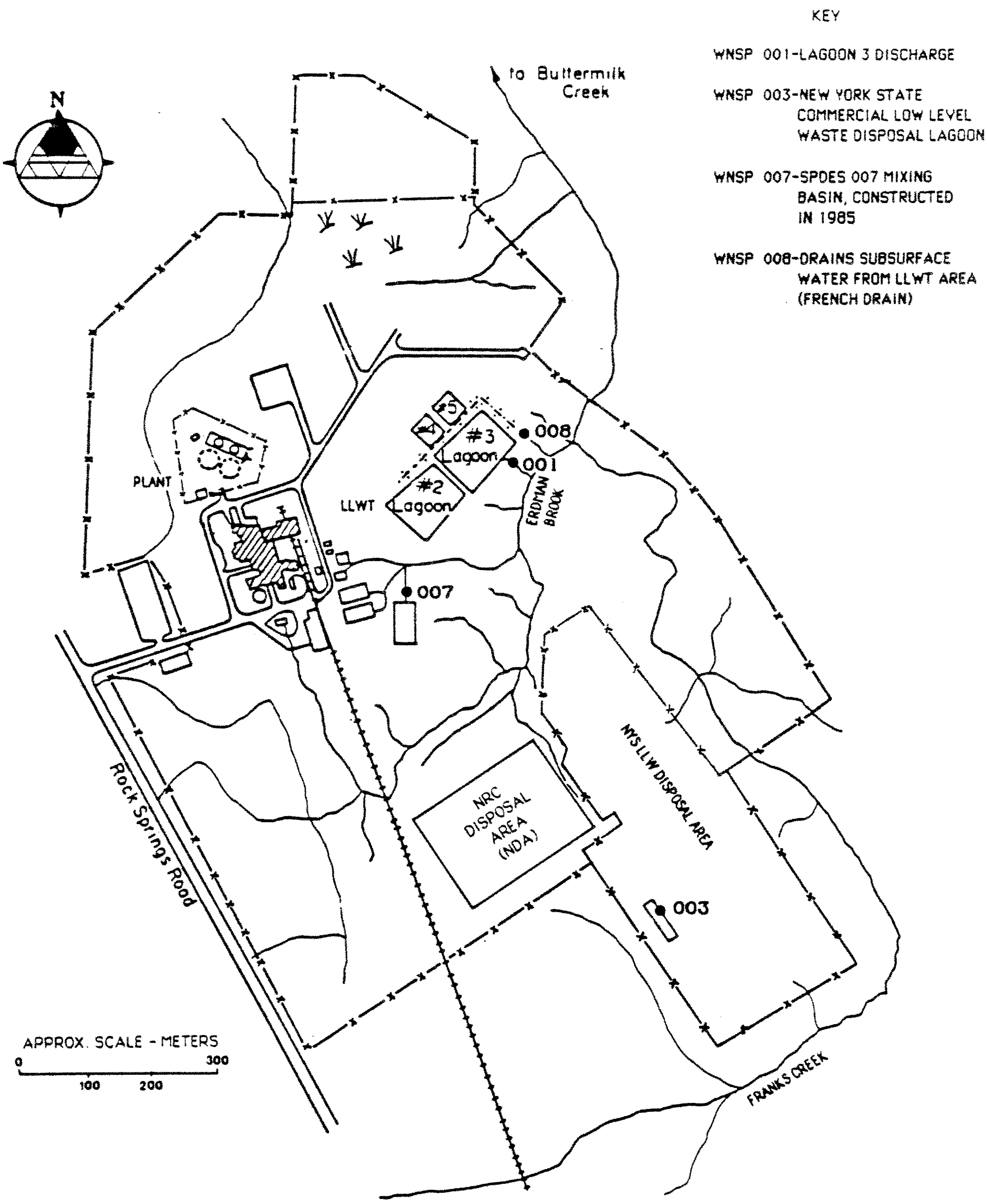


FIGURE C-5.1
Locations of SPDES Monitoring Points On-site

FIGURE C-5.2
BOD-5
OUTFALL 001

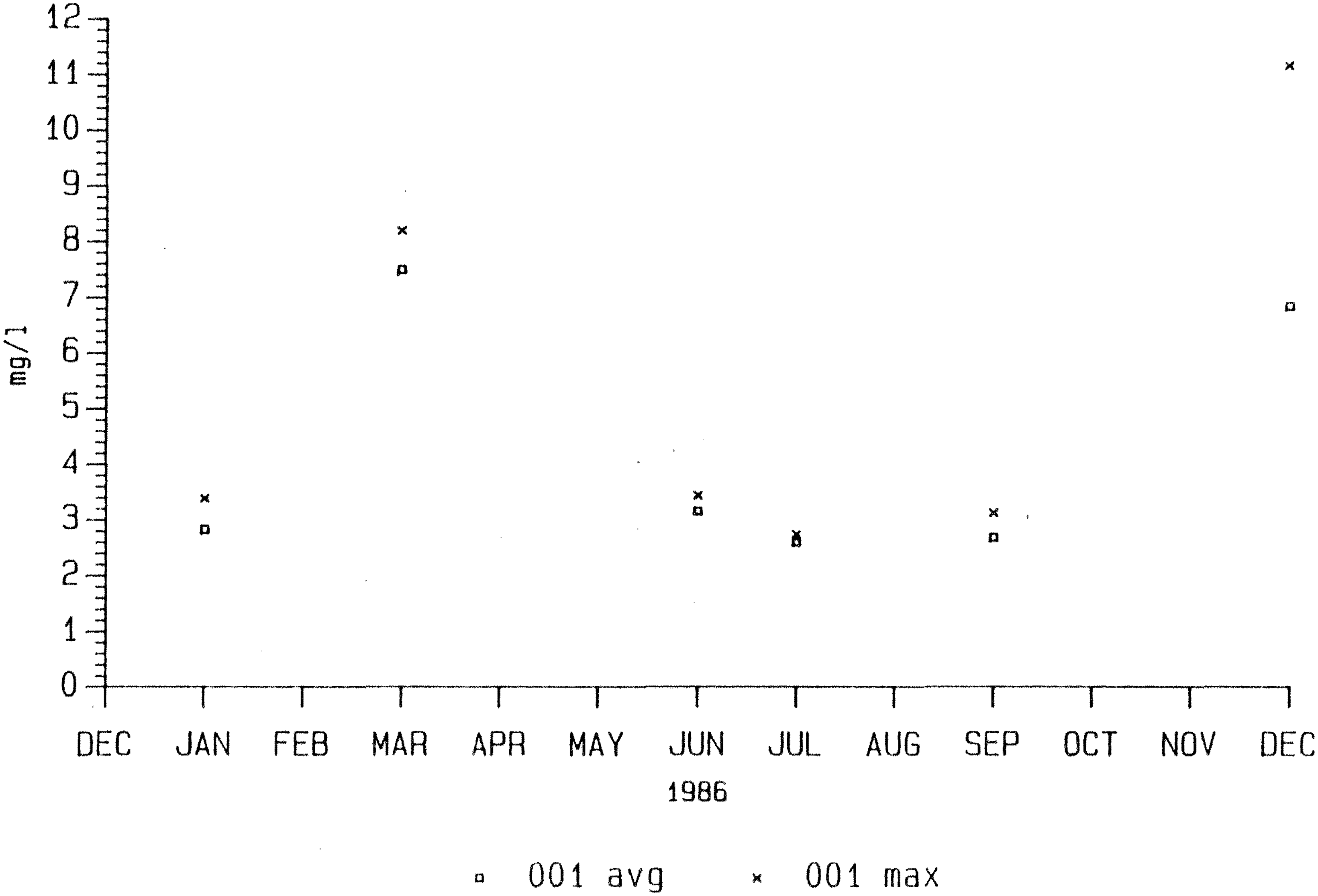


FIGURE C-5.3
BOD-5
OUTFALLS 007, 008

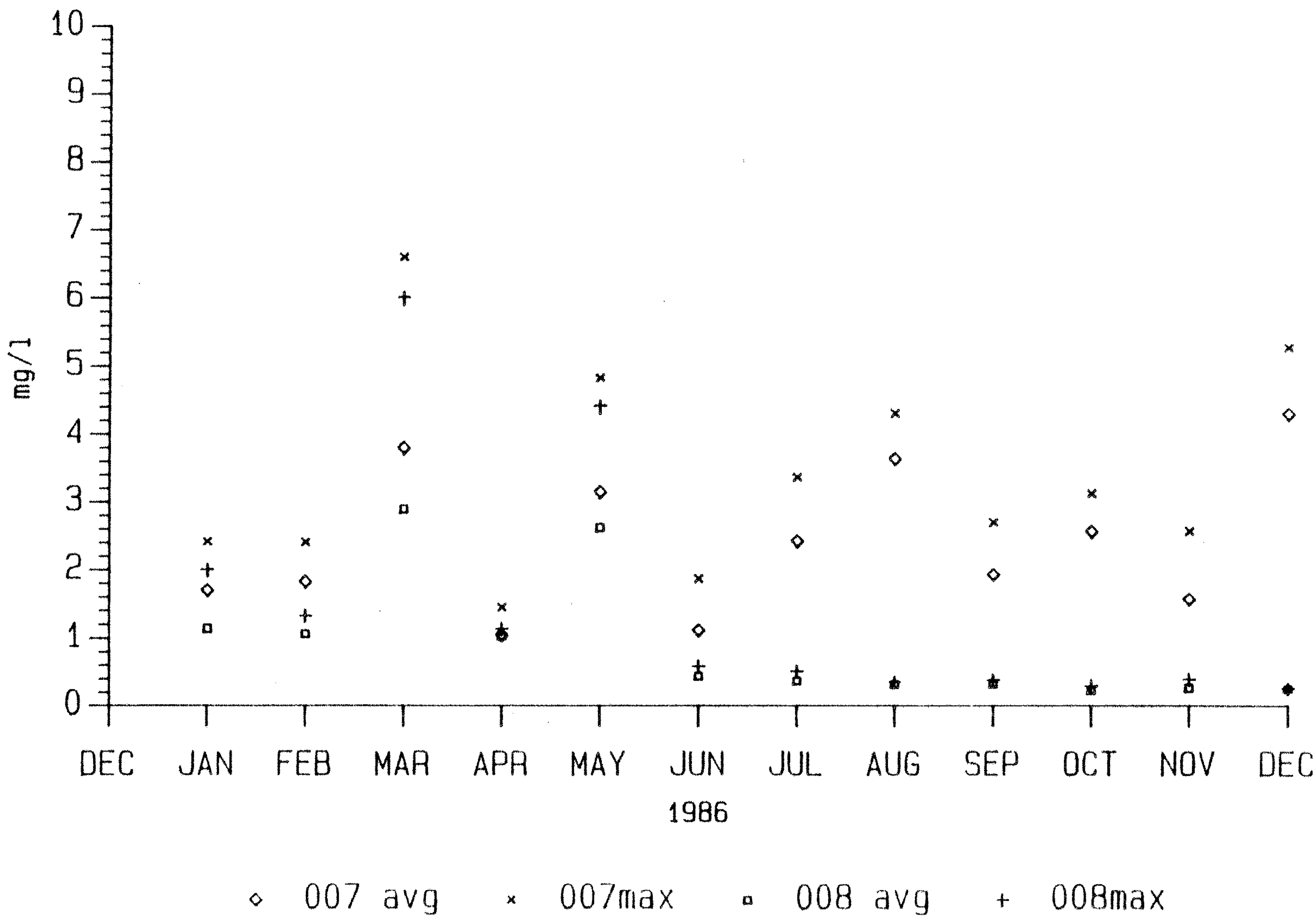


FIGURE C-5.4
SUSPENDED SOLIDS
OUTFALL 001

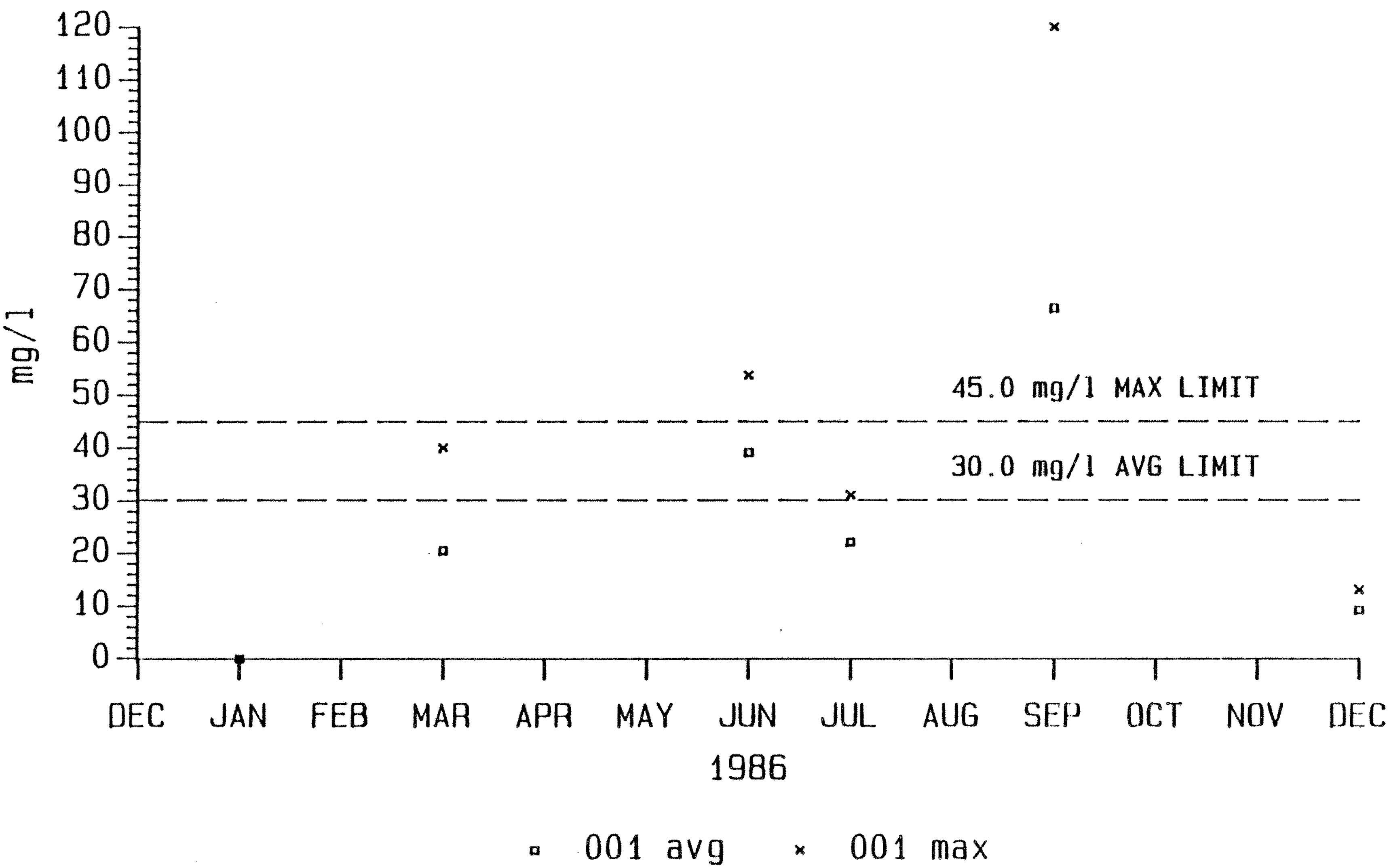


FIGURE C-5.5
SUSPENDED SOLIDS
OUTFALL 007

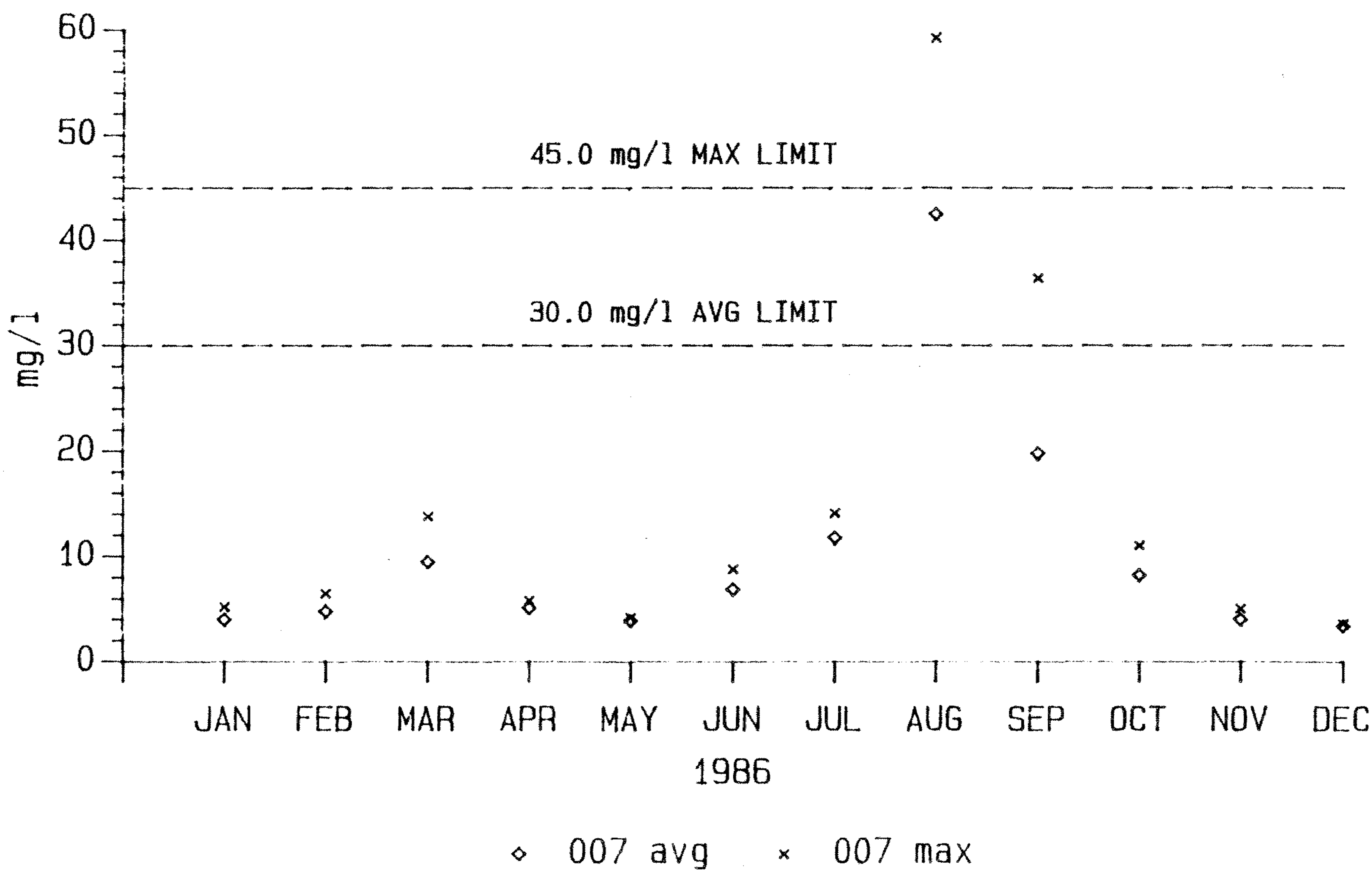


FIGURE C-5.6
SETTLEABLE SOLIDS
OUTFALL 001

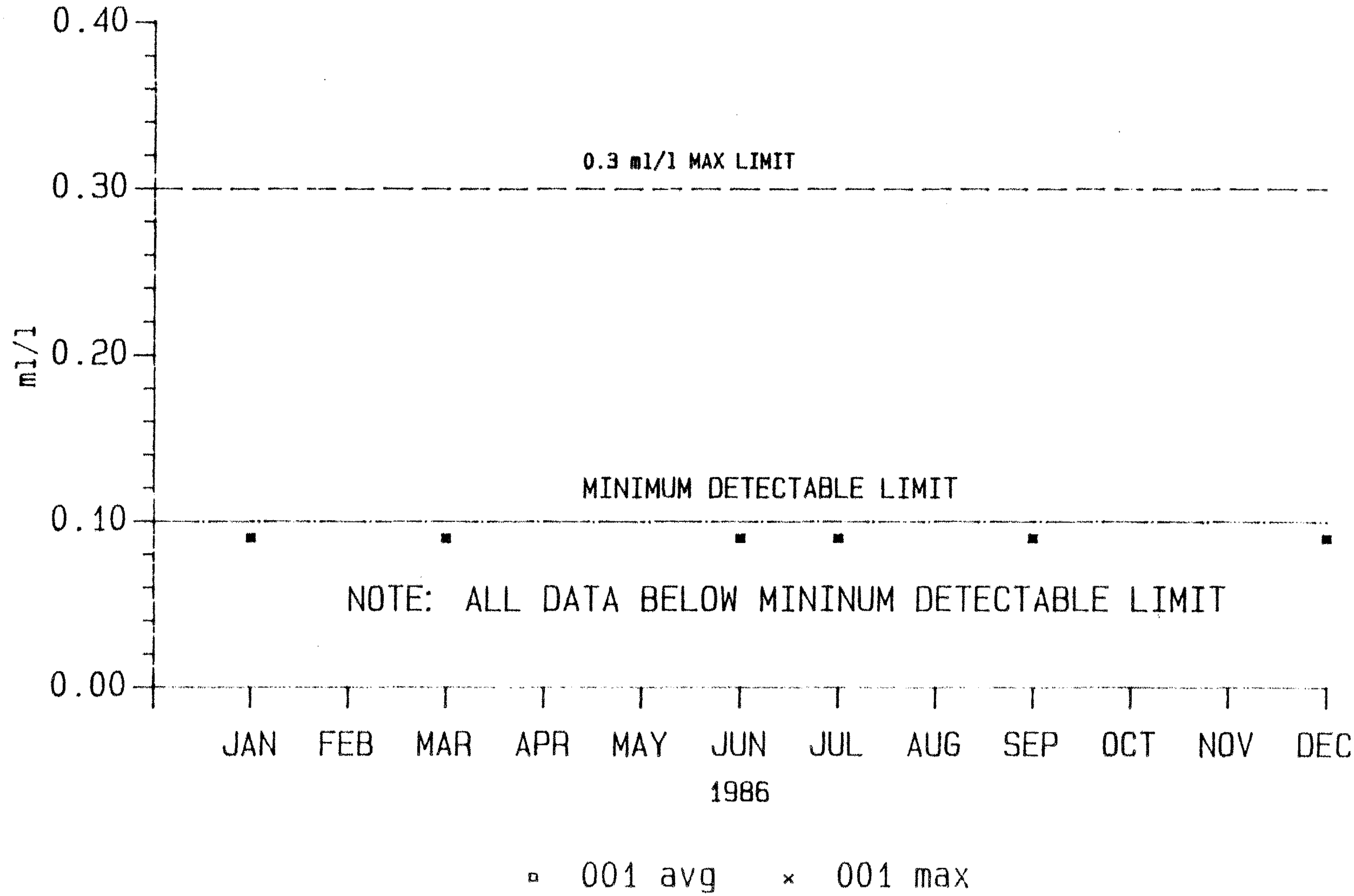


FIGURE C-5.7
SETTLEABLE SOLIDS
OUTFALL 007

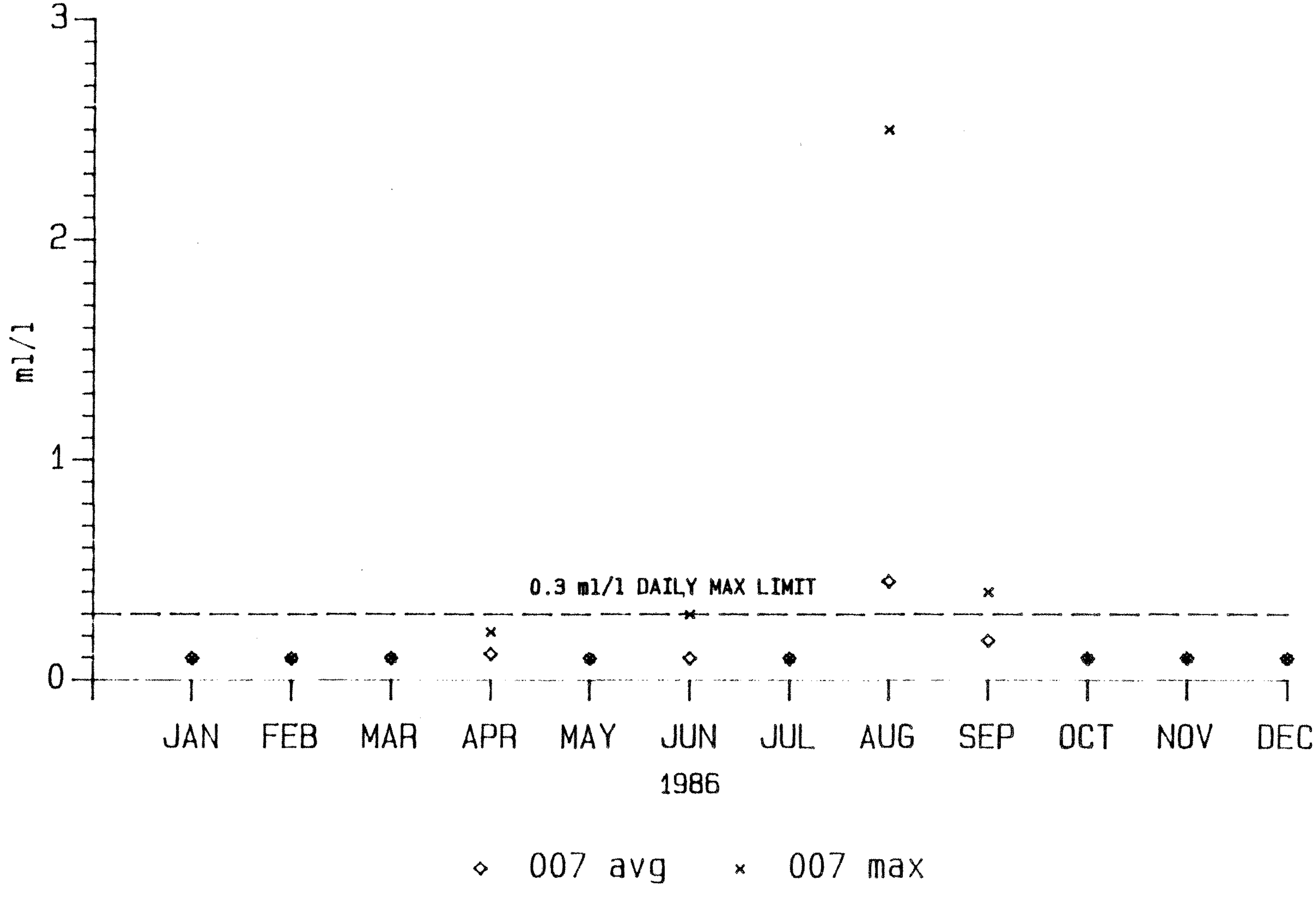


FIGURE C-5.8
AMMONIA
OUTFALL 001

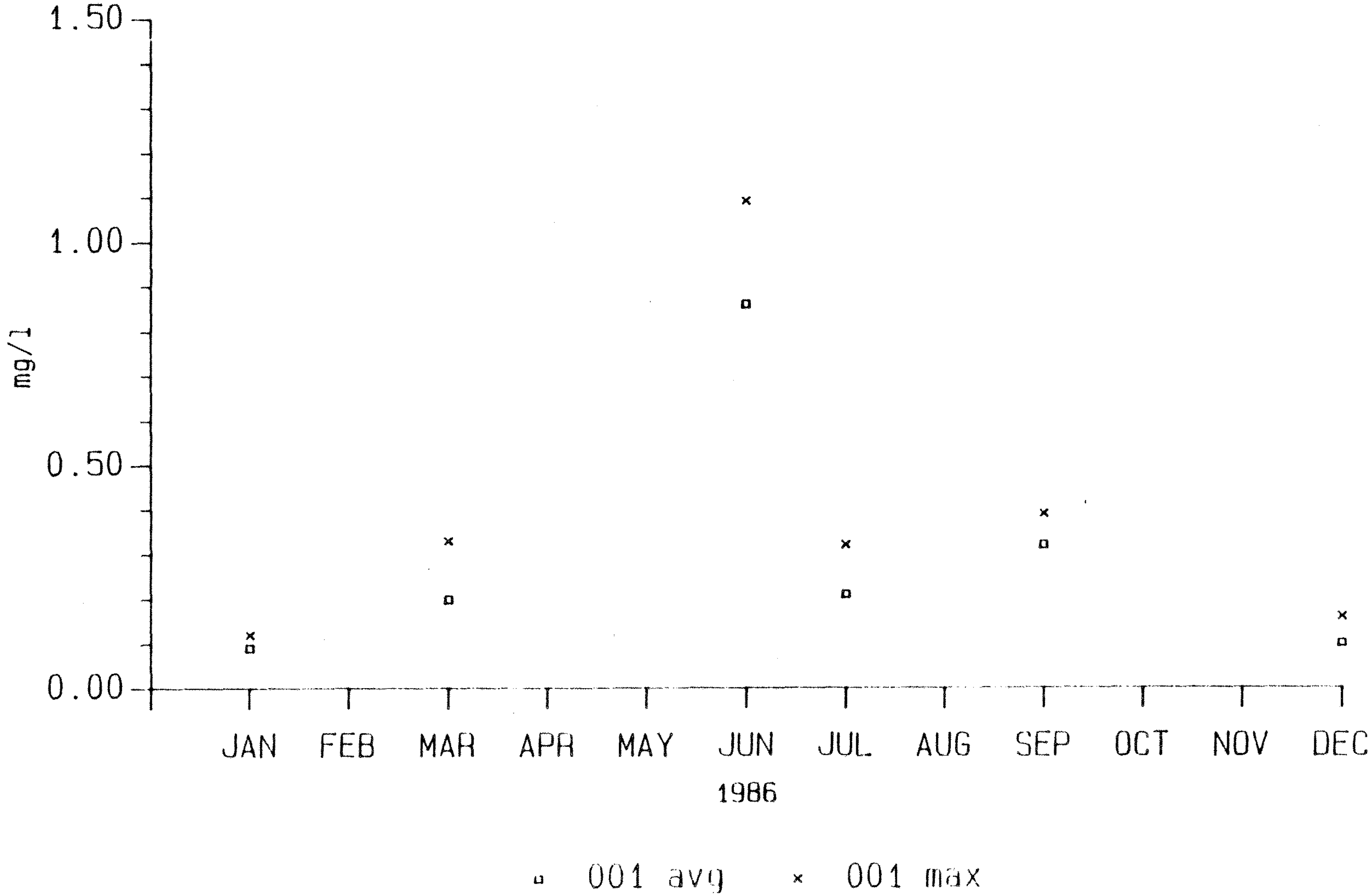


FIGURE C-5.9
AMMONIA
OUTFALL 007

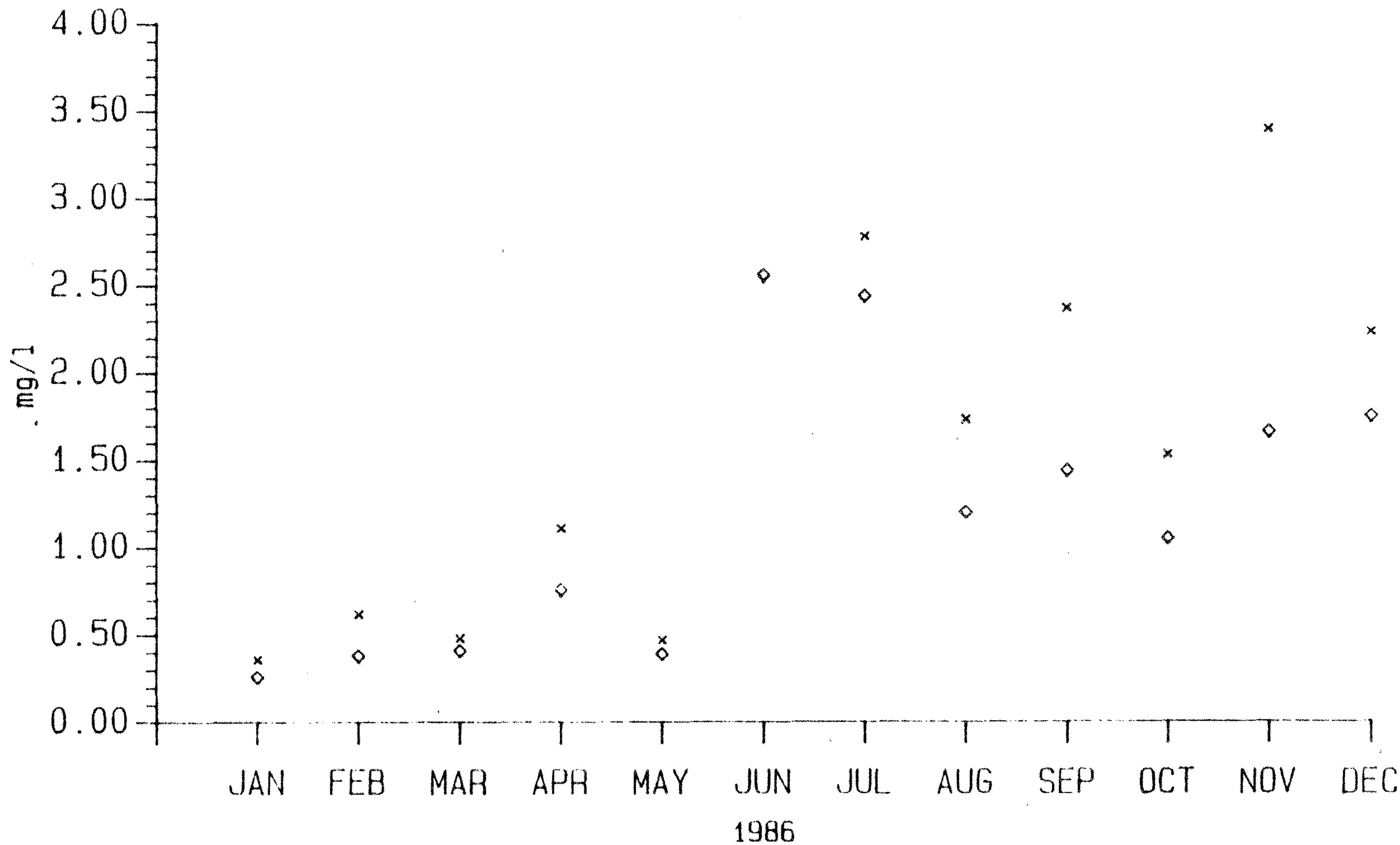


FIGURE C-5.10
METALS - Al
OUTFALL 001

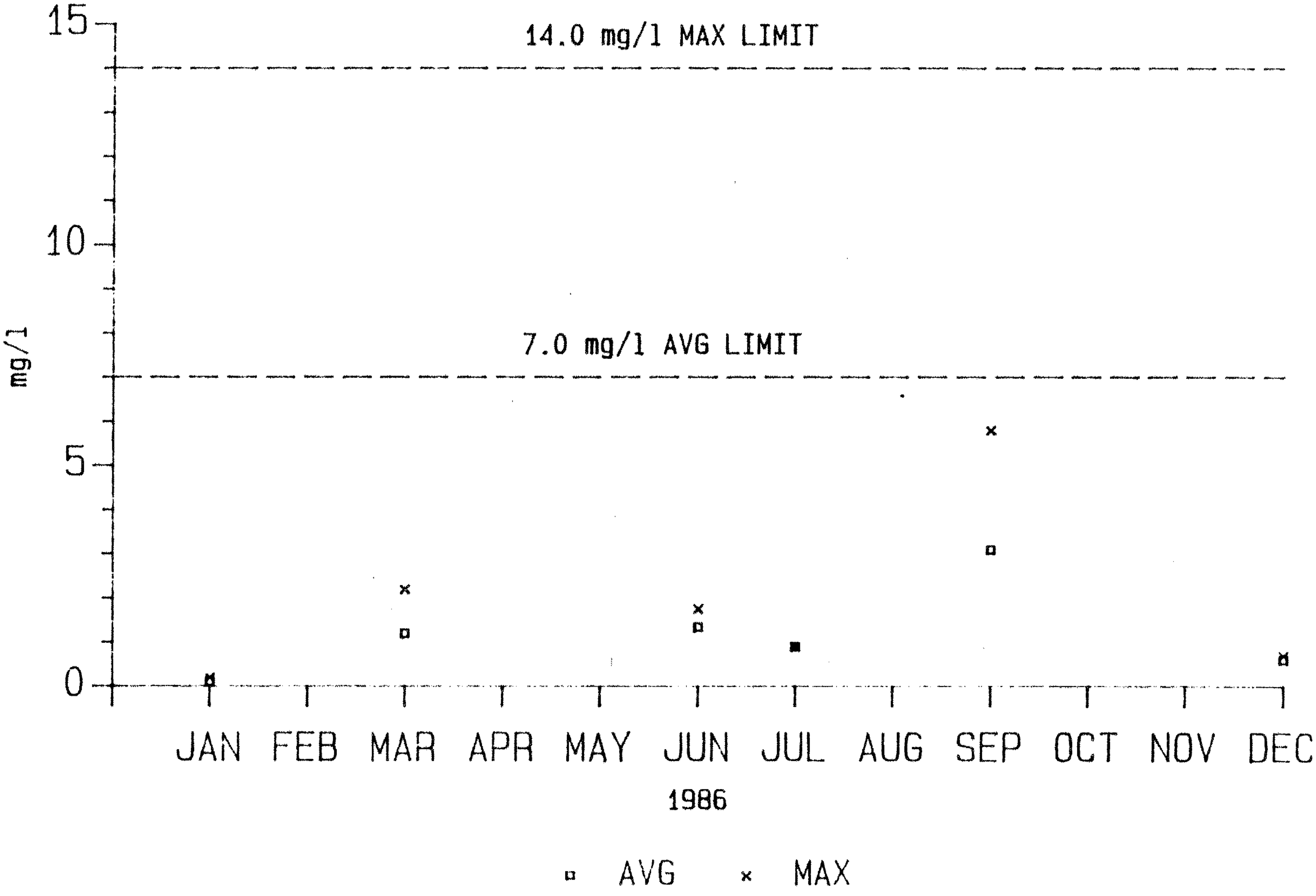


FIGURE C-5.11
METALS - Zn
OUTFALL 001

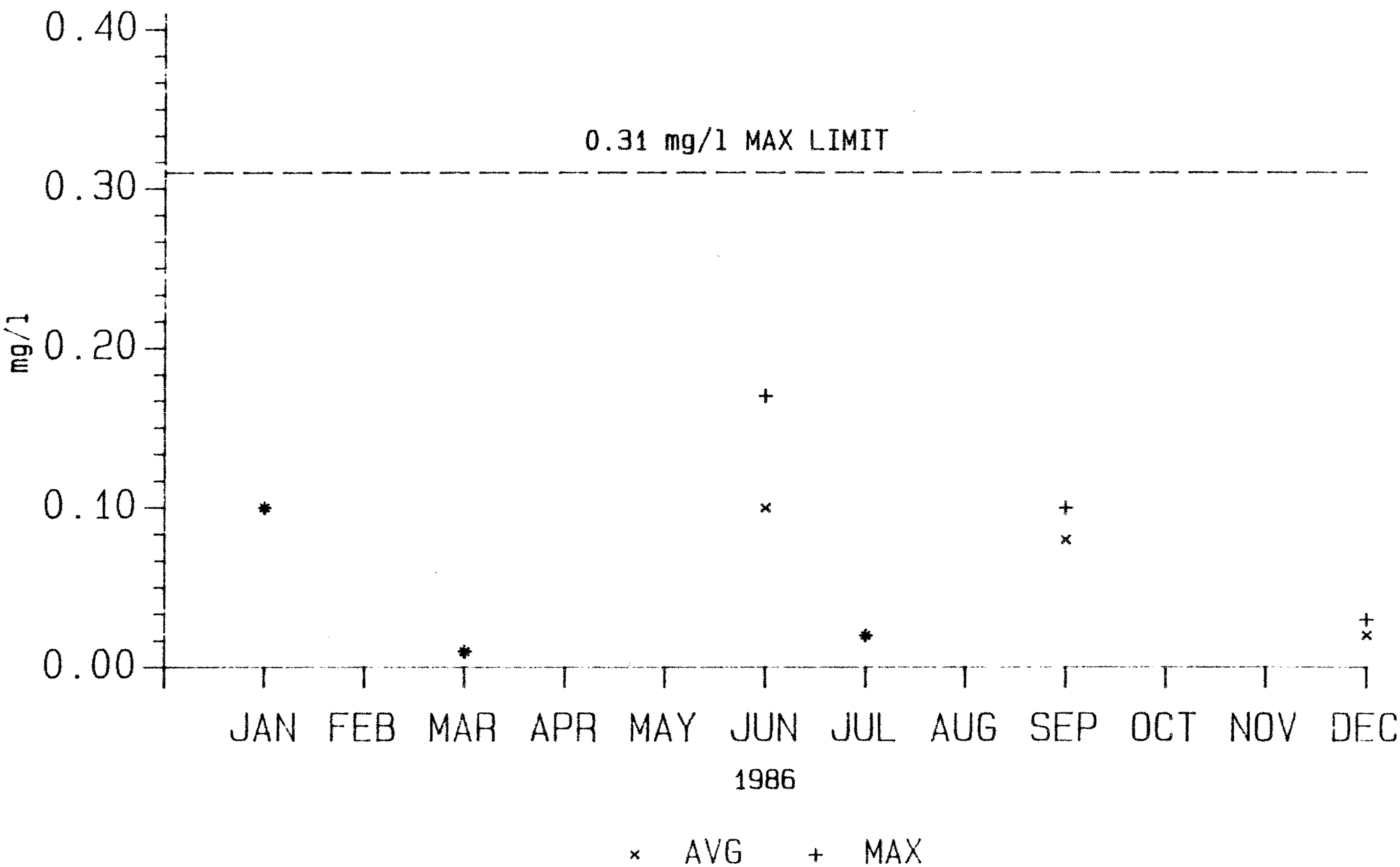


FIGURE C-5.12
METALS - Fe
OUTFALL 001

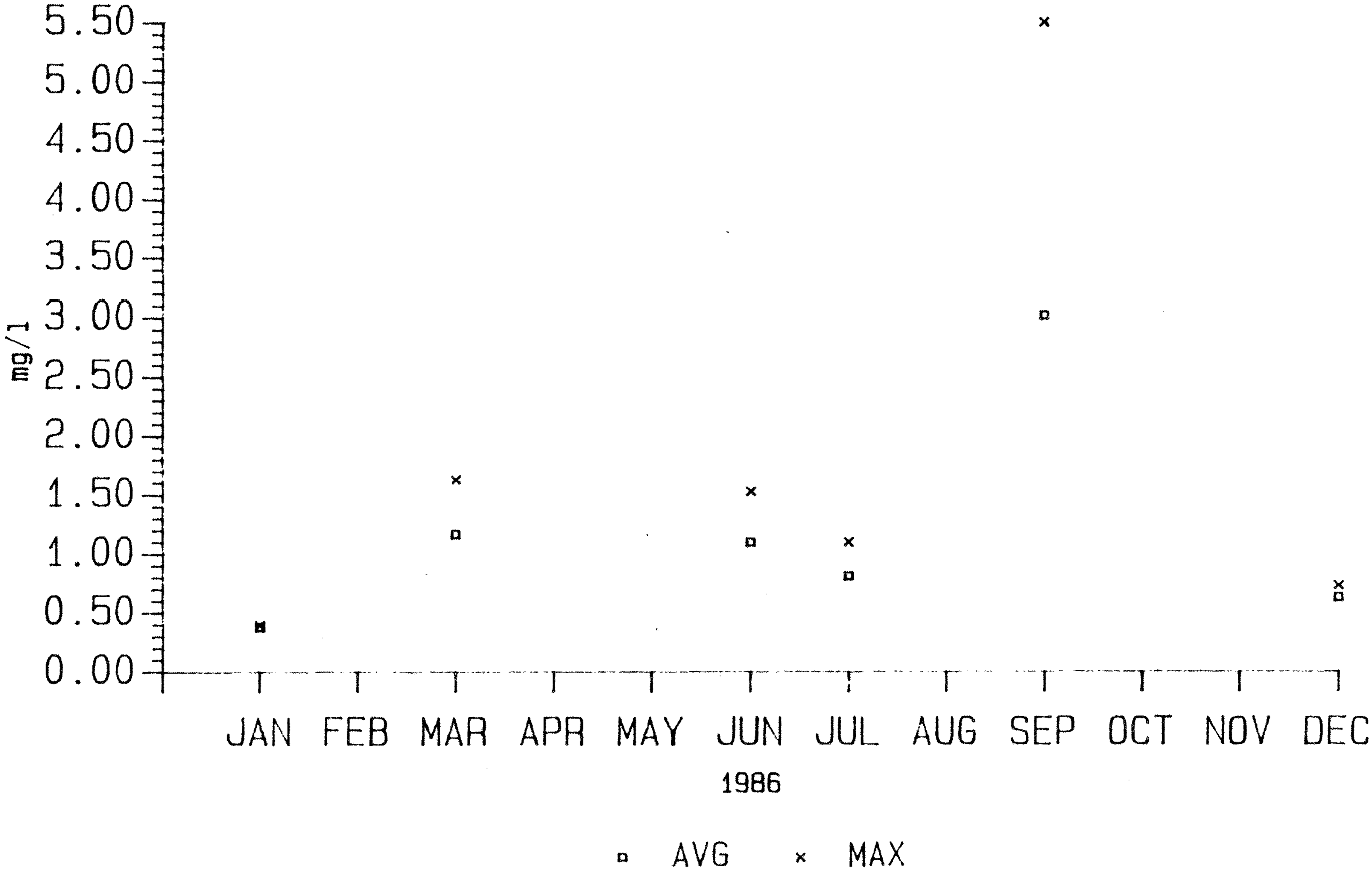
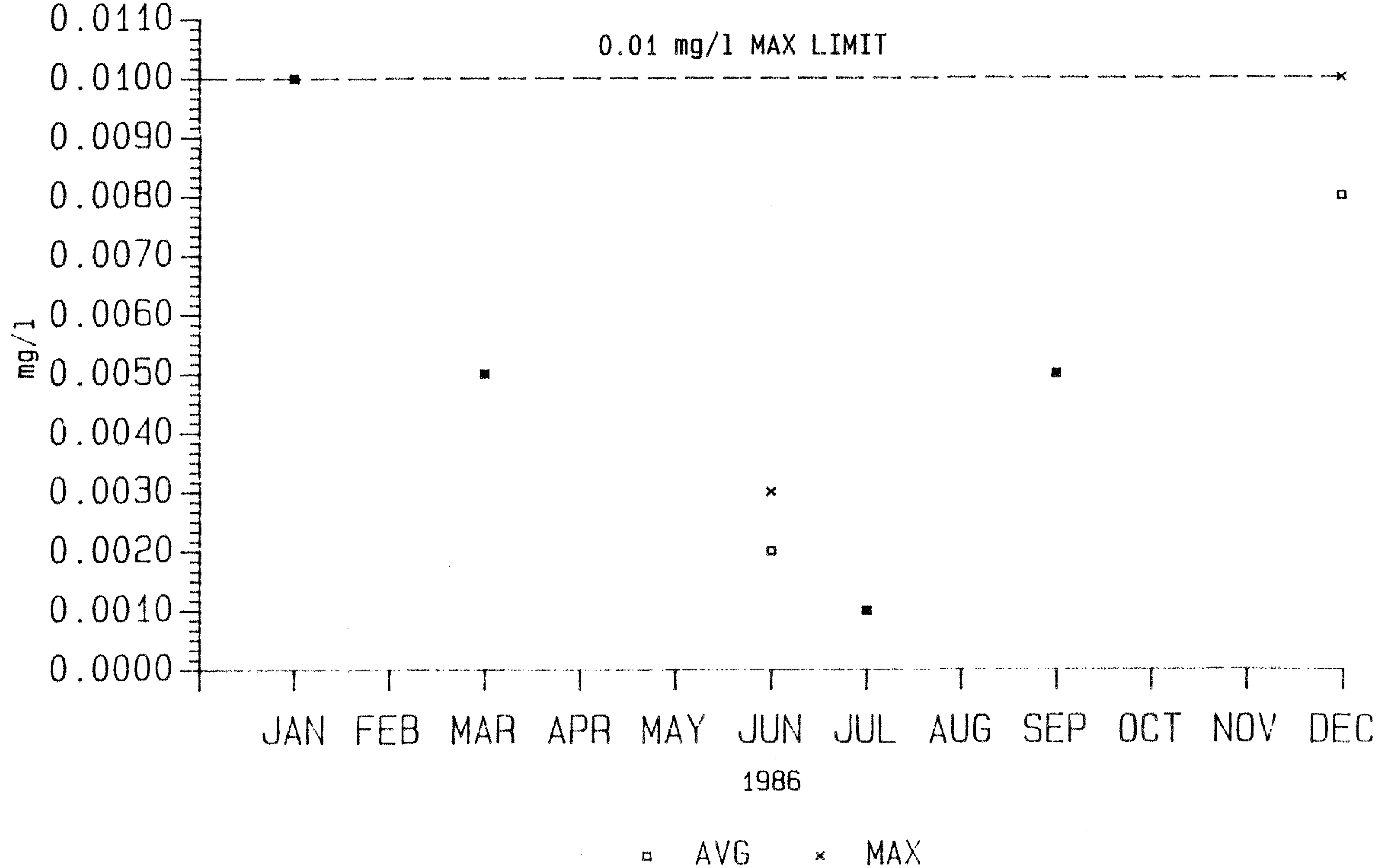


FIGURE C-5.13

METALS - As

OUTFALL 001



C5-20

FIGURE C-5.14
METALS - Fe
OUTFALLS 007, 008

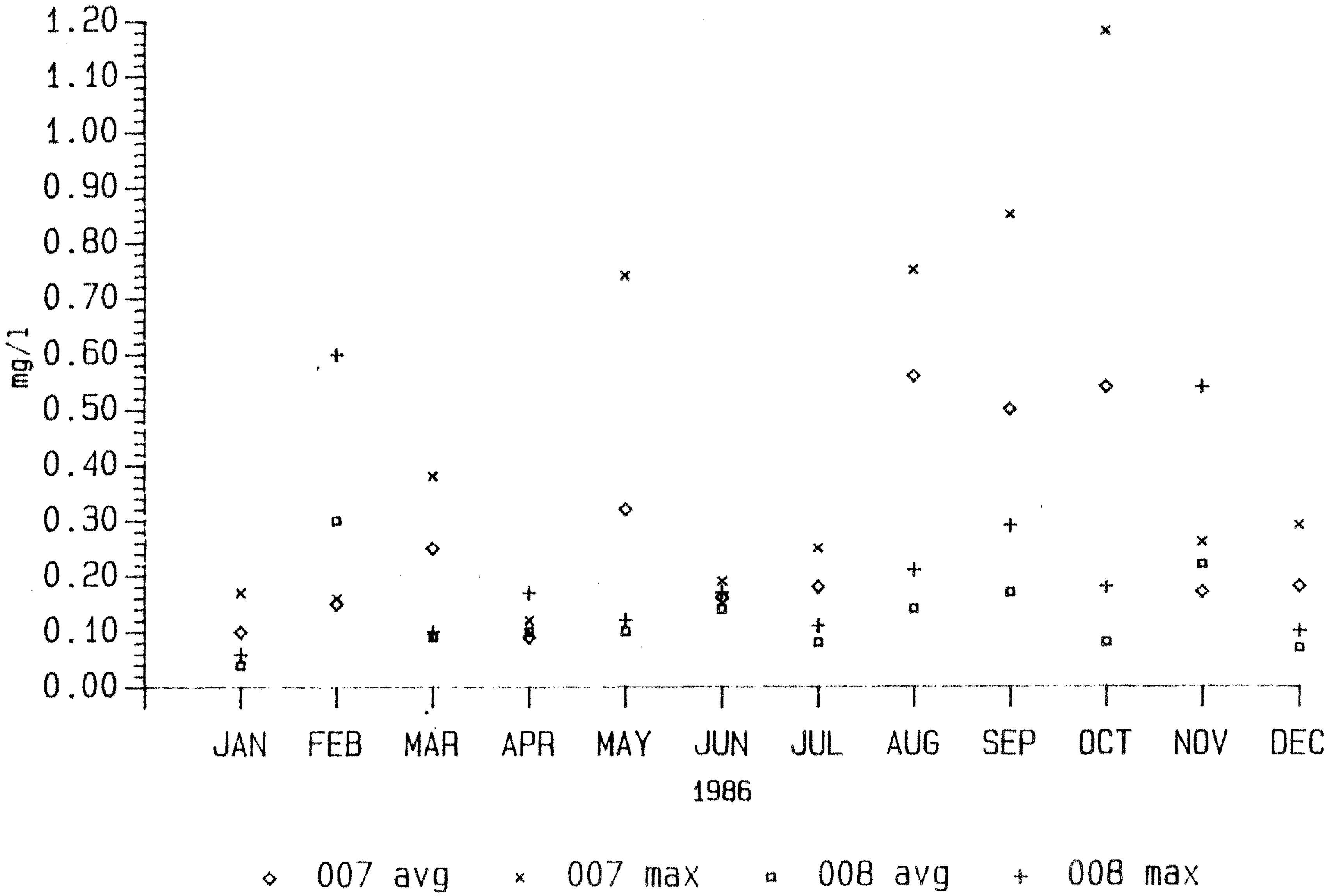
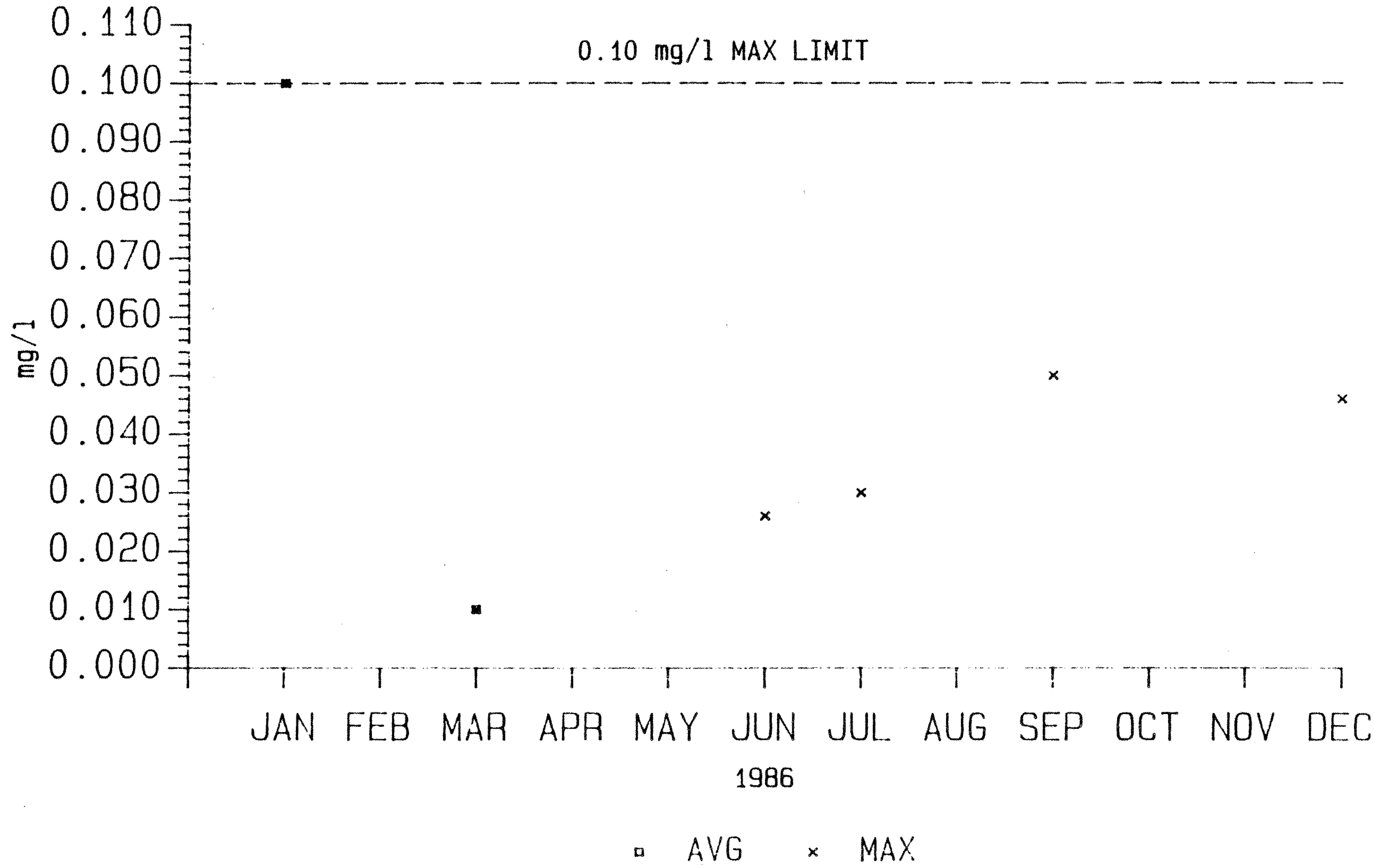


FIGURE C-5.15
CYANIDE
OUTFALL 001



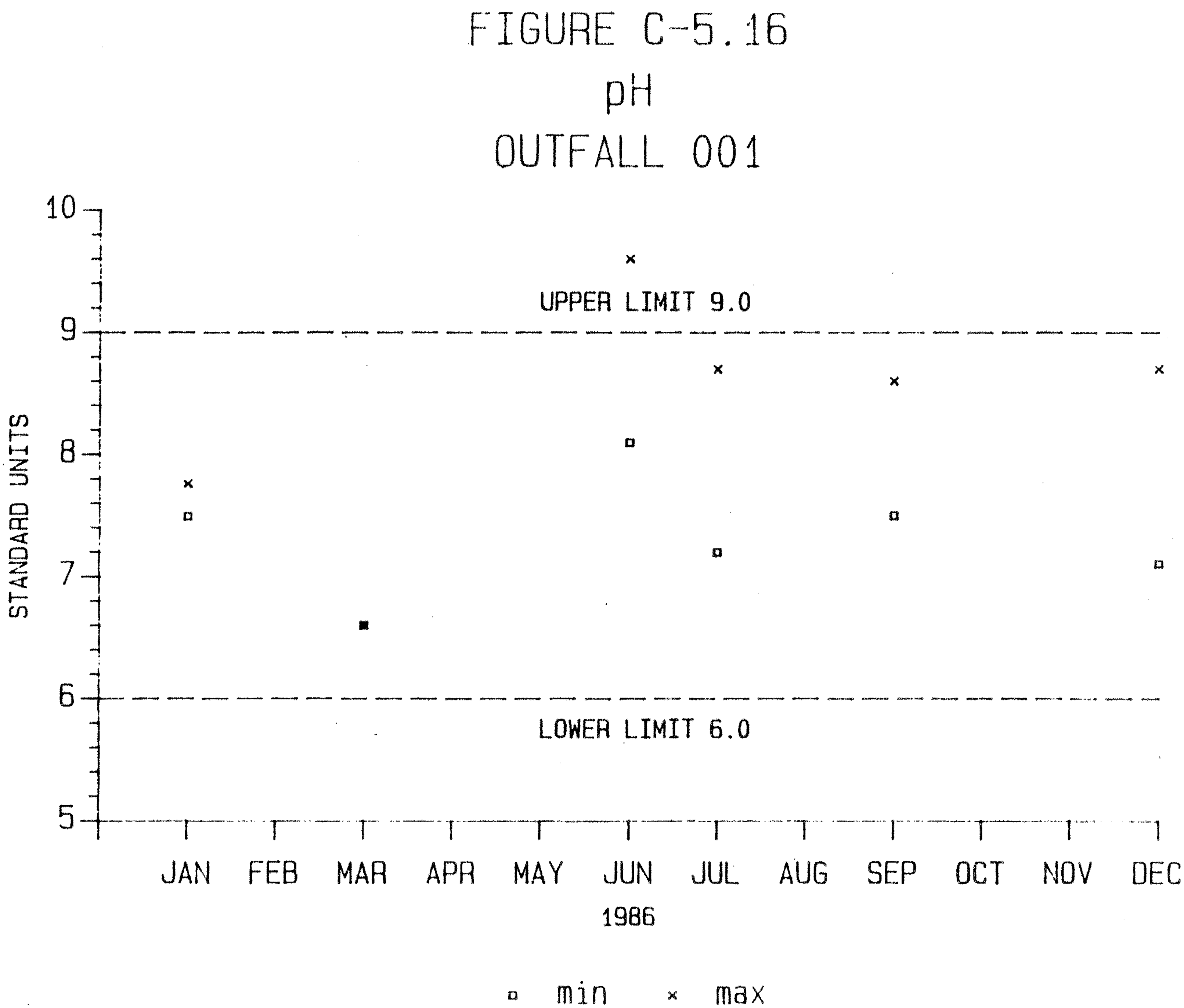


FIGURE C-5.16
pH
OUTFALL 001
STANDARD UNITS
10
9
8
7
6
5
UPPER LIMIT 9.0
LOWER LIMIT 6.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1986
min
max

FIGURE C-5.17
pH
OUTFALLS 007, 008

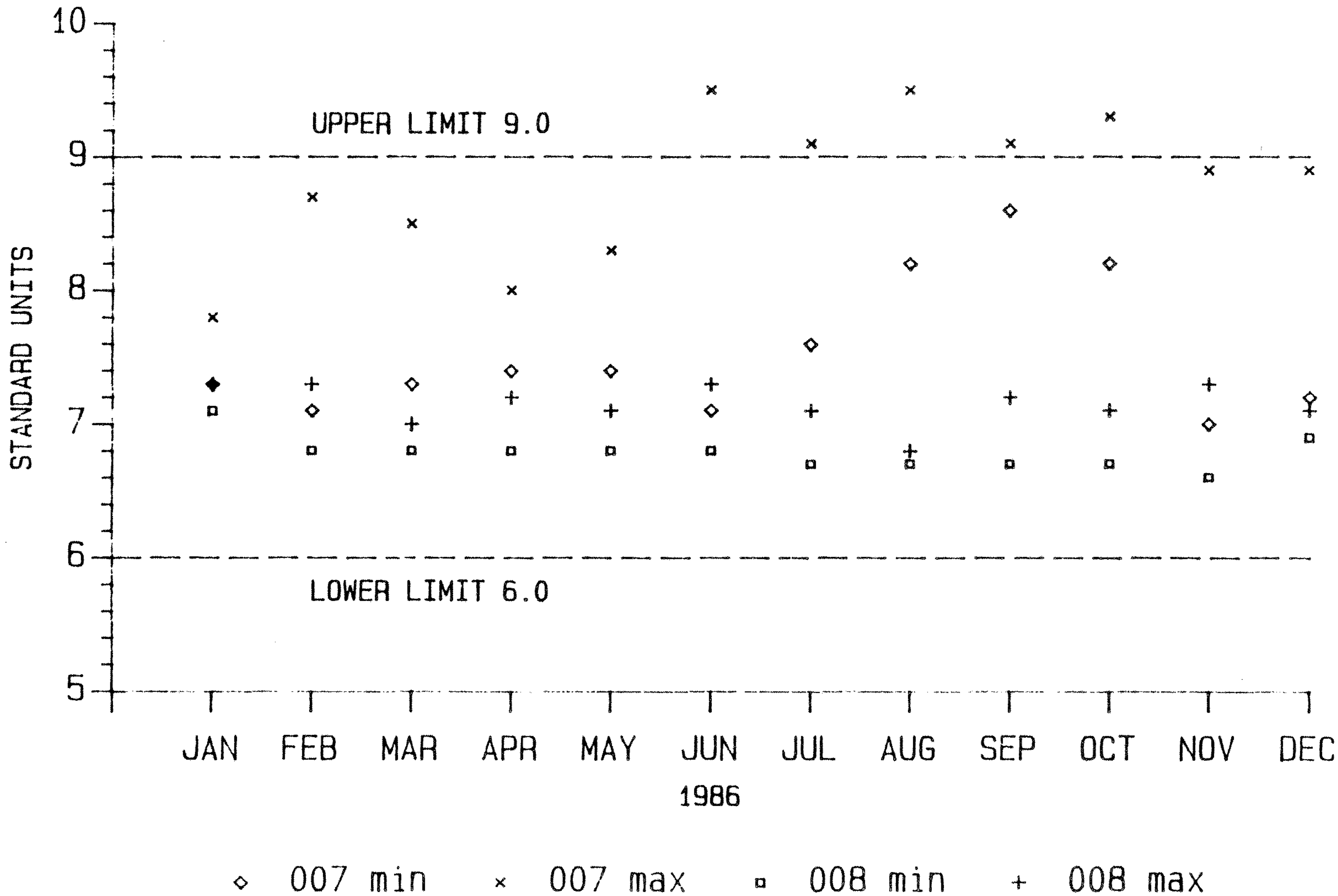


FIGURE C-5.18
OIL & GREASE
OUTFALL 001

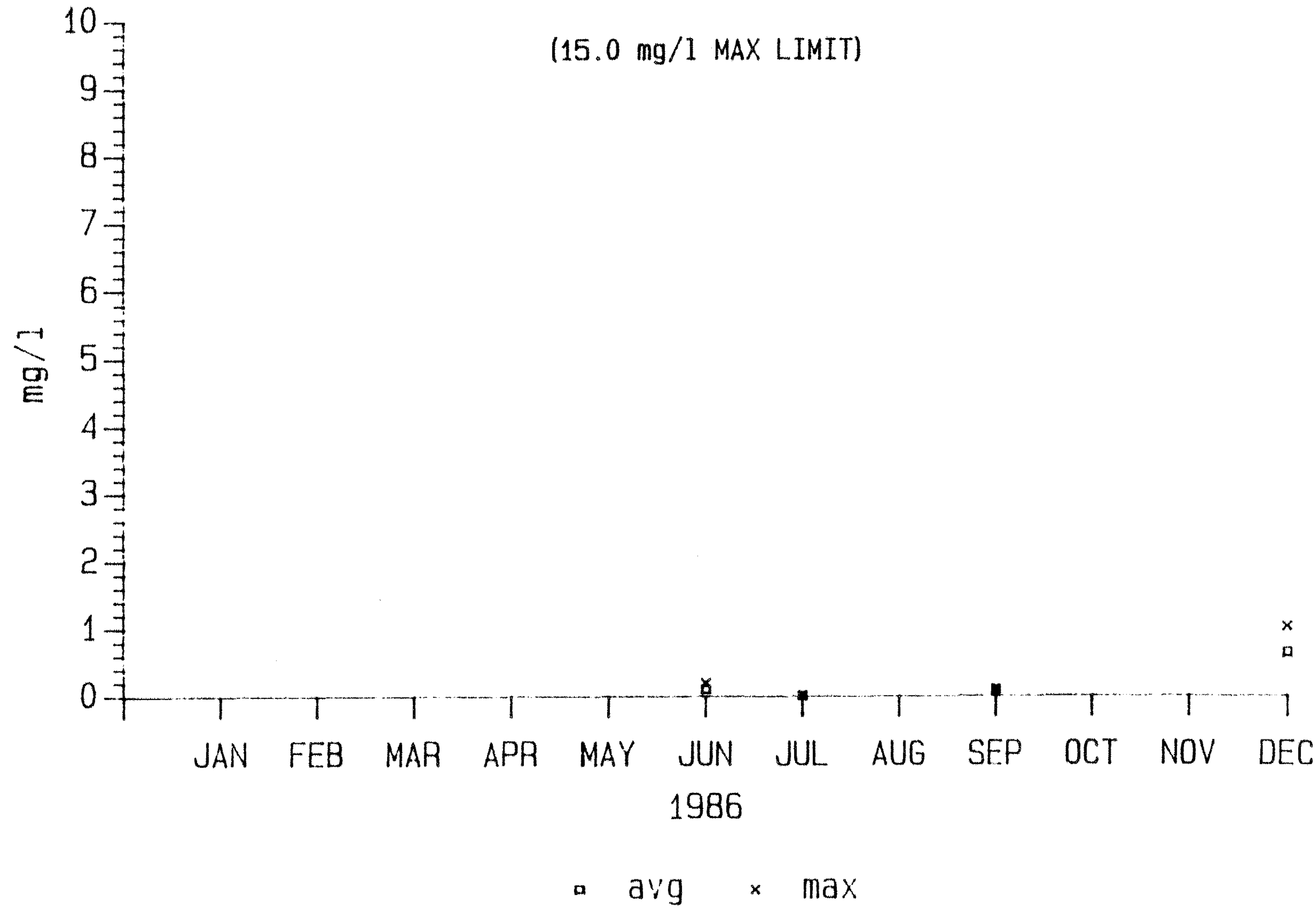


FIGURE C-5.19
DISCHARGE RATE
OUTFALL 001

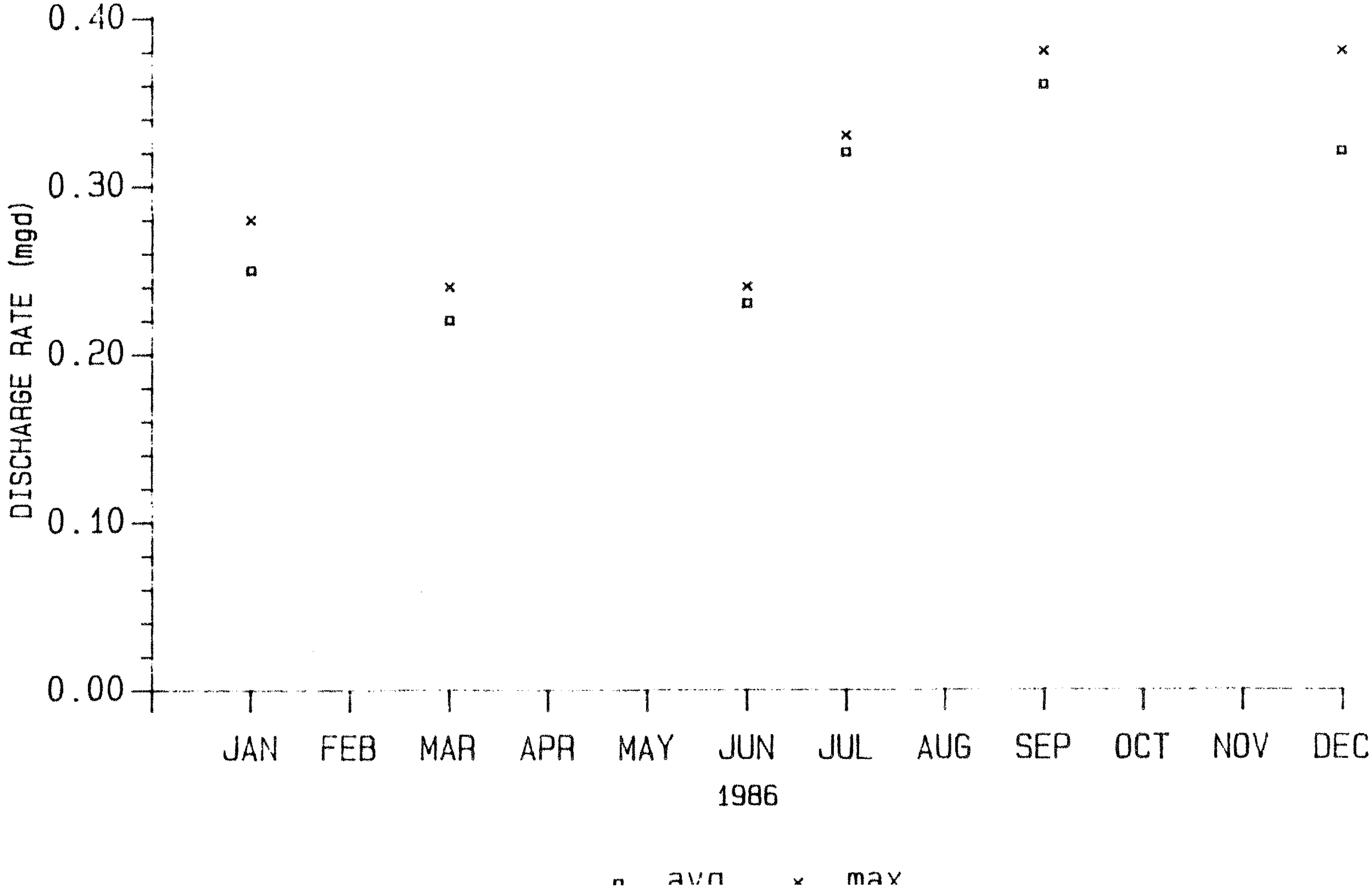


FIGURE C-5.20
DISCHARGE RATE
OUTFALLS 007, 008

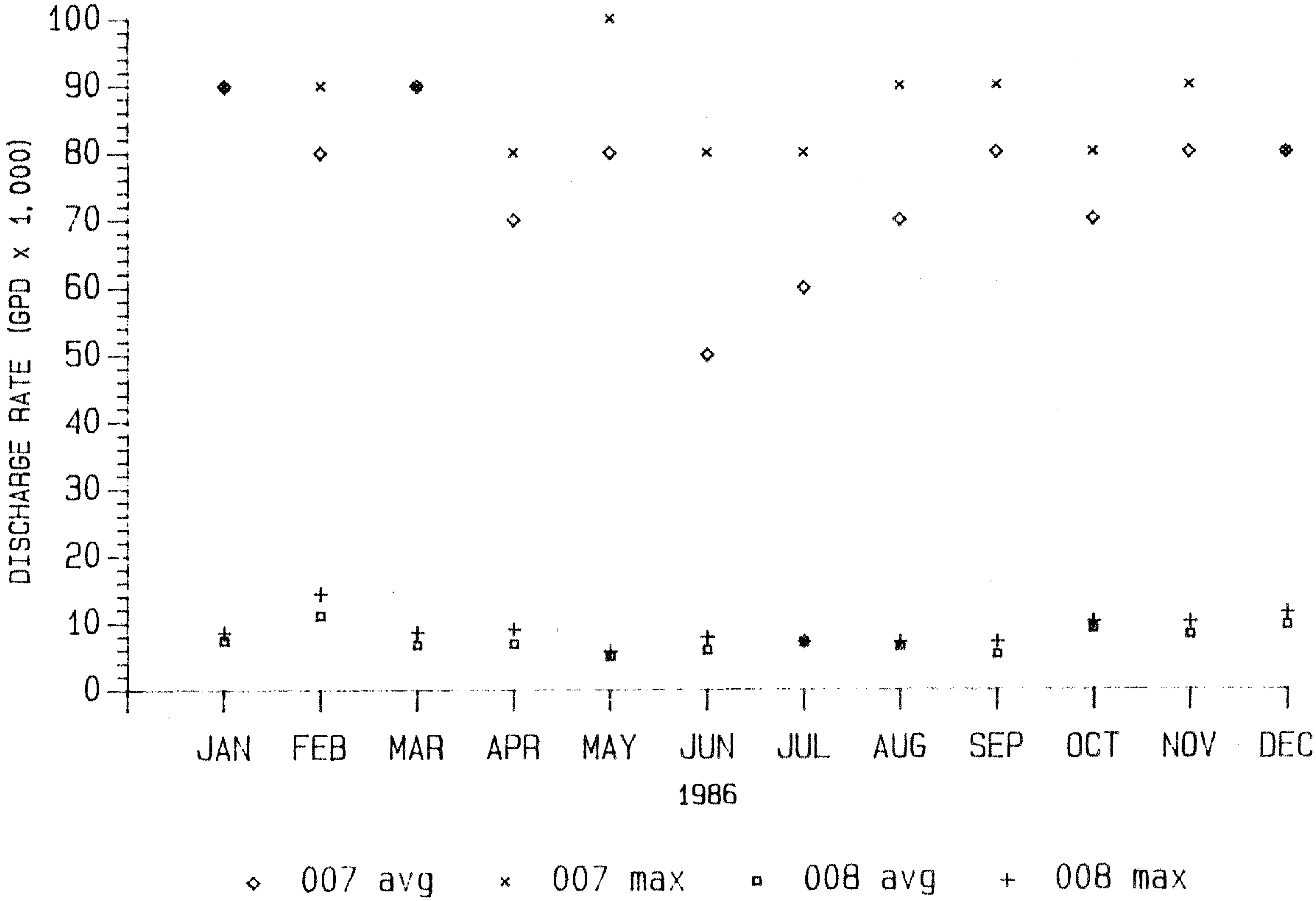


FIGURE C-5.21
FLOW WEIGHTED AVERAGES
AMMONIA
(OUTFALLS 001, 007)

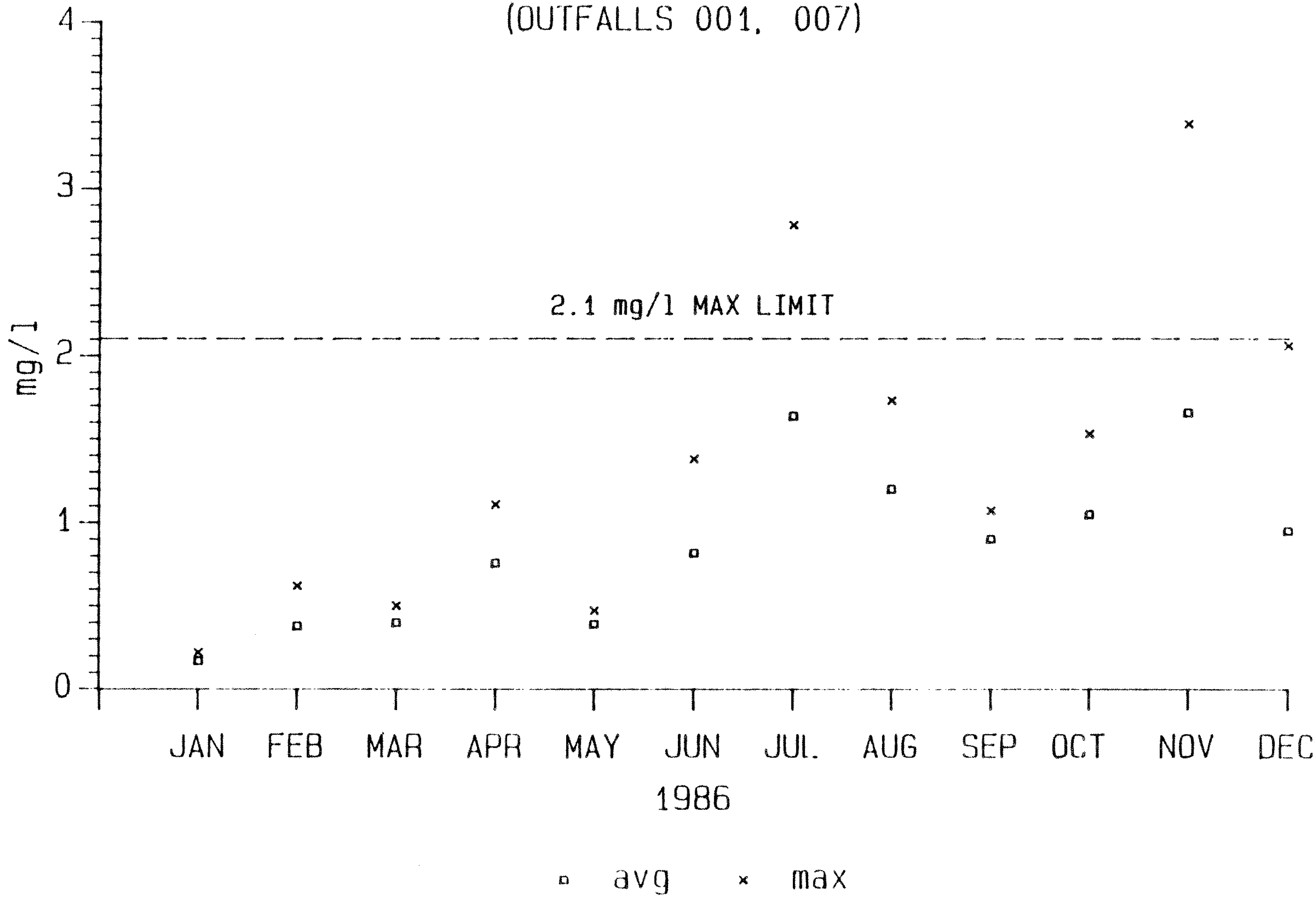


FIGURE C-5.22
FLOW WEIGHTED AVERAGES
BOD-5

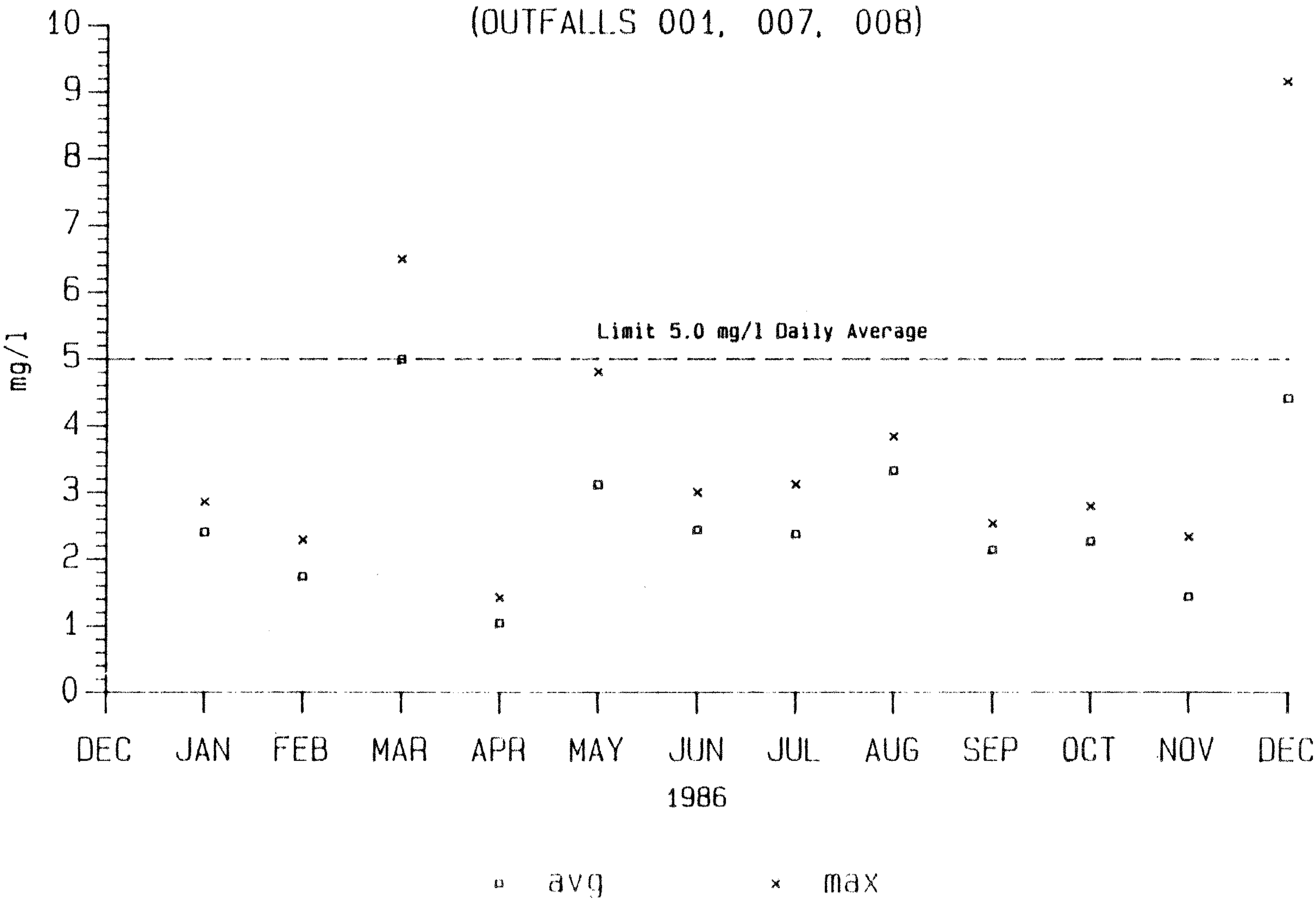
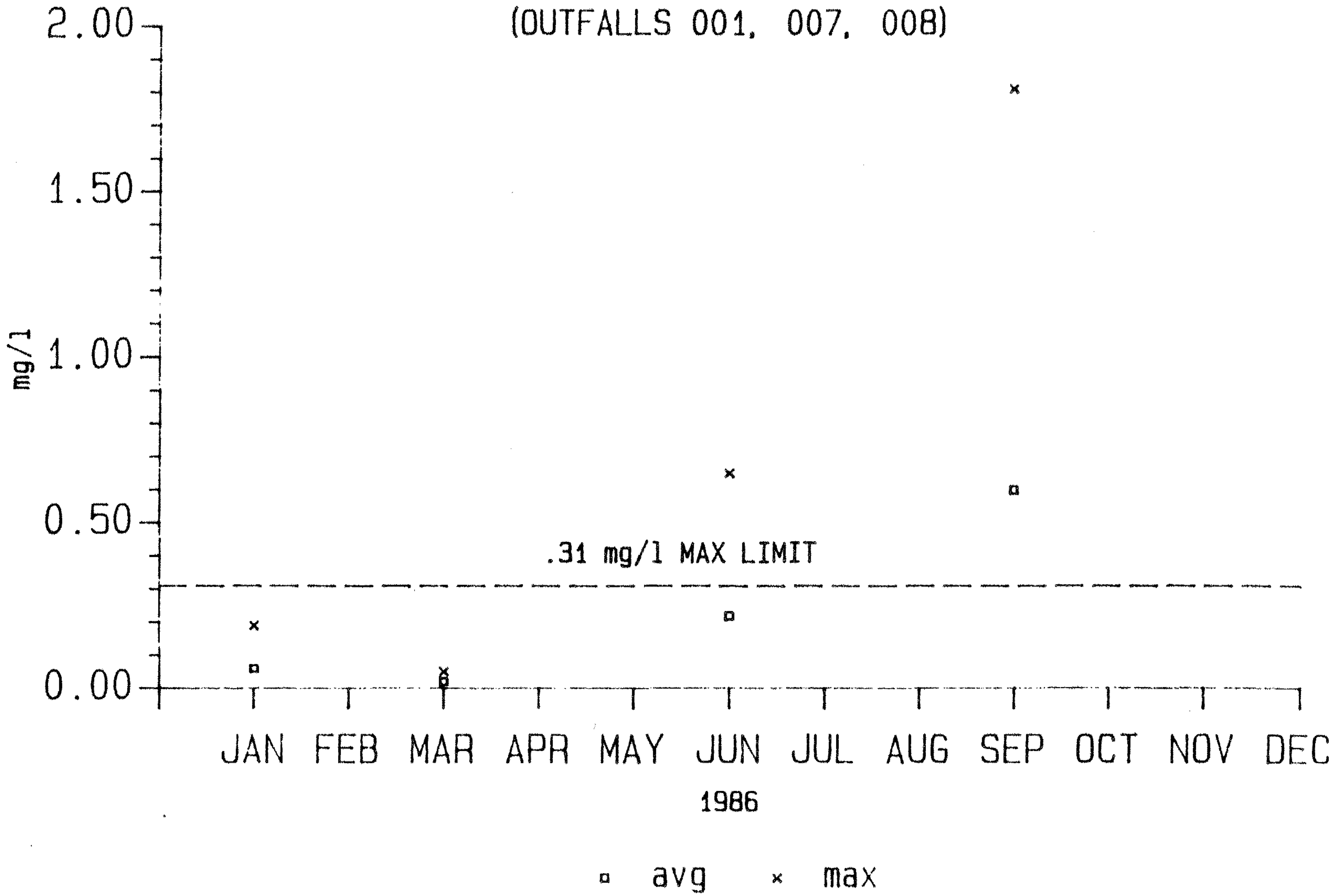


FIGURE C-5.23
FLOW WEIGHTED AVERAGES
METALS - Fe
(OUTFALLS 001, 007, 008)



APPENDIX F

SPECIAL MONITORING

1.0 Airborne Radioactivity from the Chernobyl Incident

Local special monitoring for airborne radioactivity from the nuclear reactor incident near Chernobyl, Ukraine, USSR, was initiated after the news media reports from Scandinavian monitoring programs in late April 1986. In order to assess the effect of the occurrence on our environmental monitoring parameters in Western New York State, routine sampling frequencies for some media were increased, and several special analyses and sampling locations were added. This special program was initiated the day following the media announcement in order to obtain background data and trend indication for any unusual radiological parameters. In addition, routinely collected samples of meat, deer, fish, vegetation, and milk were screened for the presence of isotopes from the Chernobyl fallout taken up during the 1986 growing season.

Routine on-going monitoring provided relevant data from fallout pots (open top collectors), particulate air samples both at near-site and remote locations, and a recording rain gauge. Additionally, a recording high pressure ion chamber (HPIC) was set up, and an additional air sampler with a triethylene di-amine (TEDA) - impregnated charcoal cartridge was placed near the HPIC location. It was not expected that any change in external dose rate high enough to be significant during the normal three month period of TLD exposure would be noted. Routine biological monitoring was maintained on the normal schedule.

The charcoal cartridge was analyzed daily for gamma isotopes, specifically I-131. Particulate air filters were counted daily for gross alpha and beta activity, and rain water samples were analyzed for the presence of gamma-emitting isotopes. Direct high pressure ion chamber radiation measurements were recorded continuously and correlated with rainfall events from the recording rain gauge.

Meat samples including beef, venison, and large predator fish showed positive uptake of isotopes such as Cs-134 and Cs-137 (Appendix C-3). These occurred in ratios indicative of fresh fission products, such as those released in the Chernobyl incident rather than the aged mixture present in Tank 8D-2. Both the control and near site samples had statistically similar radionuclide concentrations, indicating uptake from wide spread uniform deposition.

In order to track the appearance of any unusual airborne radioactivity on a daily basis without compromising the sensitivity and schedule of routine air sampling, additional sampling and monitoring equipment was deployed as noted above. The special air sampler consisted of a 47 mm diameter type AE glass fiber filter backed by a 40 mesh TEDA-impregnated 2¼" diameter by 1" thick charcoal cartridge operated at a flowrate of 64 standard litres per minute (SLPM). The sampler head was placed 1.5 m above the ground on the corner of a low shed. The charcoal was removed daily and counted for 600 seconds on a reverse electrode high purity germanium detector, then replaced in the sampler with a new glass fiber prefilter. The total time for this change-out process averaged about 18 minutes daily. The cumulative I-131 activity for the previous period was decay-corrected and subtracted to determine the daily increment of I-131 which was collected (Figure F-1.1). This method provided positive detection and more accurate daily tracking than would be possible if a new cartridge had been used daily with accumulated activity at or below the lower detection limit. The charcoal was changed weekly to preclude breakthrough.

The glass fiber filter was changed daily and gross alpha and beta activity counted one hour after removal (Figure F-1.2). A composite of these filters was also analyzed for identification of gamma-emitting isotopes over a 60,000 second counting period but, because of the low total volume, these results were less sensitive than gamma analysis of composites from all the routine perimeter samplers for a given weekly period.

An argon-filled high pressure ion chamber with an LCD readout and chart recorder was set up at 1 metre from the ground surface in the same vicinity as the special air sampler. The exposure rate was recorded in micro-roentgen per hour, with a relatively flat gamma energy response from 0.1 to 8 Mev. These data were plotted in correlation with rainfall events recorded by an on-site rain gauge (Figures F-1.3 and F-1.4).

The routine air particulate samples collected weekly were processed normally for gross alpha and beta activity, then composited by week for gamma counting. The seven filters included all perimeter and background air sampling stations in operation at that time. Each station draws air through a type AE 47 mm diameter glass fiber filter at 40 SLPM, with four sampler heads placed at 1.7 m and 3 sampler heads at 4 m above the ground. (Normal procedure includes a quarterly gamma scan and Sr-90 analysis on the 13 filters from each station.) Compositing the seven weekly filters provided a large volume (2,800 m^3) sample for increased analytical sensitivity.

Fallout pots which collect deposition (both wet and dry) normally are changed on the first of the month, but were collected one day early (April 30, 1986), and then collected again in two weeks. Any water present was analyzed for tritium, collected separately, then the pot was washed down with distilled water, which was added to the rain water sample, and analyses for gross alpha and beta activity were performed on the evaporated sample.

In addition to the routine collection of particulate samples, the main plant intake air was being sampled weekly as part of another on-site study. The intake is approximately 15 m above the ground, and the sampler flow rate was 70 SLPM. The particulate filter media is the same as for the previously described air particulate samplers (Table F-1.1).

A recently initiated tritium-in-air sampling program also provided indication of tritium as HTO in ambient moisture at one perimeter point and one remote location (Table F-1.3).

Collection of gamma exposure rate and charcoal media samples started on Tuesday April 29, 1986, the same day of the week that routine site air filter media were changed. Using the presence of I-131 on charcoal as ai indicator, the first effects of the Chernobyl incident were detected on May 10, 1986. The gross activity on the relatively low volume daily air samples, however, was not sufficiently elevated to be detected above natural airborne particulate background following a one hour decay.

Gamma exposure measured by the HPIC followed the expected pattern, with upward variations during rainfall events. No correlation was seen with the appearance of I-131 or other fission products on filter media, since similar variations were noted before and after the I-131 first was detected. The overall rate did not rise to any statistically measurable level above the normal background gamma dose rate due to the Chernobyl fallout, notwithstanding the distinct presence of unusual isotopes in many routine samples.

A composite of the air filters located upstream of the charcoal cartridg for over 15 days including May 10 was gamma counted. The gamma emitting isotopes which are normally found in particulate air samples near the Project do not include any fission products, but are limited to naturall occurring gamma emitters such as Be-7, Pb-210, and Bi-214. Fission products positively identified in this composite included Cs-137 and I-131, but a composite of filters from the routine perimeter samplers whic represented a higher volume provided a more accurate measurement of environmental contamination from Chernobyl (Table F-1.2).

A composite of the seven perimeter air filters removed on May 13 was counted immediately after the routine weekly change. Presence of the fission products found in the special filters was confirmed by this off-site sample of a larger volume.

Neither the gross activity nor the gamma scan of rainwater collected fro the four fallout pots on May 12, 1986, indicated any detectable increase in activity or specific fission products for the two week period preceding and including initial detection of I-131.

Due to the recent initiation of this type of collection, tritium activity in air could not be compared with historical data, but did not indicate a concentration above what would normally be expected, based on previous short-term tritium measurements.

2.0 Cattaraugus Creek Gamma Survey

During the summer and fall of 1984, a comprehensive aerial survey of the Western New York Nuclear Service Center (WNYNSC) including the West Valley Demonstration Project site was performed by EG&G under DOE sponsorship. Measurements utilized not only state-of-the-art gamma radiation instruments but also high resolution photography and multi-spectral scanning techniques. The final report is in preparation by EG&G and careful attention is being given to comparisons with previously acquired data from the same area.

In the course of previous reprocessing plant operation and the period of shut down maintenance operations which followed, low levels of treated radioactive liquids were discharged to the local stream within permitted concentrations. The amount of radioactivity released since the DOE Project commenced has been somewhat reduced due to a conscious effort to bring all discharges as low as reasonably achievable. Sediment analyses have shown, however, that the residual effects of the last 20 years are measurable above natural background in the drainage downstream of the site.

In 1969, a team of EG&G scientists sponsored by the U. S. Government performed an aerial measurement of gamma radiation at the WNYNSC. At that time it was noted, as expected, that residual radioisotopes were detectable along the stream (Franks Creek) from the plant site to Buttermilk Creek and down to Cattaraugus Creek. A resurvey of the same area in 1979 showed a reduction in the overall amount of detectable radioactivity, and using computerized processing, cesium-137 was specifically identified in several areas as the major man-made gamma-emitting isotope present.

The present environmental monitoring program for the West Valley Demonstration Project includes measurement of water, air, soil, direct radiation, and edible plant and animal tissue. Cattaraugus Creek water, fish, and sediments are sampled throughout the year, and results are examined for evidence of radionuclide concentration above background levels. Although there are traces of certain isotopes in some media, such as fish taken upstream of the Springville power dam in Cattaraugus Creek, these levels have trended slightly downward over the last five years since the Project has been collecting these data (Figure C-3.2).

Although at no time has there been indication of any radioactivity levels which might adversely affect animals or humans, there still remained the need to quantify the existing levels as accurately as possible. In order to provide a baseline for "before and after" comparisons, it was necessary to establish the concentrations of radionuclides such as cesium-137 which now exist not only near the Project, but in surrounding areas including Cattaraugus Creek.

In 1984, flyover gamma radiation measurements by the same EG&G specialists, coordinated by the U.S. Department of Energy and WVNS Environmental Monitoring personnel, included not only the previously measured site areas, but also the Cattaraugus Creek stream bed from upstream of the Buttermilk Creek confluence to Lake Erie. The aerial survey results verified that no major concentrations of radioactive contaminants exist in Cattaraugus Creek, but because of the difficulties in flying close to the stream in the Zoar Valley, and interference from natural radiation from exposed rock formations, an accurate measurement of near-background radioactivity concentrations from man-made radionuclides was not possible using the standard aerial survey data reduction techniques. A sediment sampling program and suitable equipment for measurement of stream sediments both in the field and the laboratory already existed at the West Valley Demonstration Project, and a special survey program was launched in 1986 to verify the findings of the aerial survey by "ground truthing".

Three measurement techniques were used for the ground truthing survey. First was the continuous gamma radiation measurement of the Cattaraugus Creek stream bed from the Rt. 240 bridge to the mouth of the creek at Lake Erie (Figure 2.4). This was done using a digital gamma rate meter with a remote sodium iodide gamma scintillation probe suspended eight feet from the side of the transport craft. The second method utilized a portable multi-channel analyzer and a large (4 x 5 inch) sodium iodide crystal to identify not only man-made and fission product radionuclides such as cesium-137, but also naturally-occurring isotopes such as potassium-40. In situ measurement with the multi-channel analyzer of areas of a sandbar, for example, which indicated a higher than average gamma radiation rate determined the specific isotopes responsible for the increase. Last, but most important, was laboratory analysis of samples of sediment collected from specific points along the creek (See Figures F-2.1 through F-2.3 for sample locations and Table F-2.1 for the radiological data). Accurate determination of a number of samples along with corresponding in situ readings is the basis for interpretation of the continuous stream bed gamma ratemeter log as well as the aerial survey data. This information tied all the data together such that an evaluation of the entire creek bed could be made based on these accurate reference measurements.

To perform the survey, a plan was devised and tested which provided consistent data in as safe and efficient a manner as practicable. Coordination with the Seneca Nation of Indians (SNI), through whose land Cattaraugus Creek flows for about 18 miles, was achieved by several meetings, and retaining an experienced SNI boatman to man the oars and handle logistics of white water boating. The "working platform" was a three-man flat-bottomed aluminum rowboat crewed by two persons. The oarsman directed the boat near the shore having the widest bank to allow the detector to "see" the deposited sediment. His responsibility also included water safety, prelaunch checks of instruments and support materials, and in situ instrument setup. The instrument technician, an environmental monitoring group person familiar with the equipment, recorded the readings and stream position, determined in situ measurement points and soil sample locations, and was responsible for all measurements, map location references, and communications. He also was the designated driver for vehicles used to transport personnel and equipment. A typical survey segment covered three to five stream miles and was completed in five hours of survey time, not including the launching, takeout, and travel time to and from the site Environmental Laboratory.

Prelaunch checkout at the Project Environmental Lab included instrument operational checks, supplies for sample collection, communications and safety equipment check, and vehicle readiness. The boat crew plus a support crew traveled to the launch site in two vehicles and launched the boat. The oarsman remained with the equipment while both vehicles traveled to the take-out location. The boat trailer and one vehicle were secured at that location downstream, and the remaining crew member and support personnel returned to the launch site to start the survey trip segment. When the crew reached the take-out point, the boat and equipment were portaged to the vehicle, and the crew returned to the Project site. Sediment samples collected that day were logged in for processing, and the equipment and data sheets prepared for the next trip. Depending on the location and personnel available, a midday radio communications check was used to relay crew progress to the site laboratory.

Several areas were identified from the aerial survey as requiring additional ground-level survey. These areas, mostly at or near the Springville dam, were re-surveyed although they had also been on the routine sediment sample collection schedule for several years. The remainder of the areas which indicated higher than background levels of gross gamma or Cs-137 radiation were associated with major stream bends where a silt and sand deposit existed, or with high side banks of 50 to 70 metres above the water.

The survey was performed during the month of October 1986, and required almost 90 man-days of effort to plan, test, execute, and prepare a report of findings. Results of this major ground truthing effort on Cattaraugus Creek were consistent with the preliminary data obtained from the aerial survey.

A plot of the continuous gamma count, which was recorded every 5 to 10 minutes of survey time and more frequently near sand bars, reflects the general shape of the gross gamma count plot recorded by the aerial survey team (Figures F-2.4 and F-2.5). It was noted, however, that since the gamma detection window was set for the 662 keV cesium-137 peak, a proportionally higher countrate was received when a larger percentage of the gross gamma exposure rate was due to Cs-137 than natural gamma emitters. The exception to this was in gorge areas with exposed shale sides and shale rock bottom, where very little gravel or sand was evident. In these cases the count rate was proportionally higher than would be expected compared to the aerial survey gross gamma counts, probably due to the radical change in geometry from above the gorge in an aircraft to inside the winding gorge with four sides presenting a natural radioactive source (e.g, Figure F-2.4, sheet 2 of 3, section 31-38).

The in situ gamma spectral measurements were not of sufficient resolution to detect any but the highest concentrations of Cs-137. The only detectable in situ Cs-137 was about 4 picocuries per gram (148 Bq/kg) in fine sediment (less than 35 mesh). The soil samples analyzed in the laboratory by gamma counting with a high purity, high efficiency germanium detector showed measurable cesium-137 in all the downstream fine sediments. The concentrations of Cs-137 downstream of the Springville dam to Lake Erie ranged from 0.74 to 0.13 pCi/g (27 to 5 Bq/kg). Several background sediment samples from feeder streams along Cattaraugus Creek contained 0.03 to 0.01 pCi/g (1.1 to 0.4 Bq/kg), a factor of 10 lower than the downstream sediments in Cattaraugus Creek.

Although there is positive identification of Cs-137 in Cattaraugus Creek, these preliminary survey data, together with analyses of fish in the creek downstream of the Project effluents, indicate that the radioactivity present could not cause exposure to any member of the general public which approached current Federal guidelines. It was noted that, as expected, no areas of concentrated radioactivity were found, and that the Cs-137 was associated with the fine sediments such as silt and clay. These data will be used and augmented with other information in any future assessments of radionuclides in the Cattaraugus Creek.

TABLE F-1.1

LONG-LIVED GROSS BETA ACTIVITY IN AIR (μCi/ml)*

Location of Sampler	Collection Date 4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
1.5 Km NW of facility	1.8 ± 0.4 E-14	2.5 ± 0.1 E-13	9.5 ± 0.7 E-14
29 Km S of facility	1.6 ± 0.3 E-14	2.5 ± 0.1 E-13	9.8 ± 0.7 E-14
Main facility intake air	4.3 ± 0.3 E-14	2.8 ± 0.1 E-13	1.0 ± 0.1 E-13

*1985 Gross beta activity averaged 2E-14 μCi/ml

TABLE F-1.2

GAMMA-EMITTING ISOTOPES IDENTIFIED IN AIR PARTICULATE FILTER COMPOSITES (μCi/ml)**

Collection Date:	4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
Sample Volume:	2.6 E+09 ml	2.6 E+09 ml	2.5 E+09 ml
Isotope			
Be-7	2.0 E-13	1.6 E-13	1.1 E-13
Ru-103	<1.4 E-15	2.8 E-14	2.3 E-14
I-131	<1.3 E-15	1.8 E-13	1.5 E-14
Cs-134	<1.3 E-15	6.5 E-14	2.6 E-14
Cs-136	<1.9 E-15	1.6 E-14	2.8 E-15
Cs-137	<1.6 E-15	1.6 E-13	6.2 E-14
La-140	<2.2 E-15	1.9 E-13	8.9 E-14

** Estimated systematic plus random uncertainty is ±50% (at 2σ) for positive indications. A "<" indicates the minimum detectable concentration value.

TABLE F-1.3

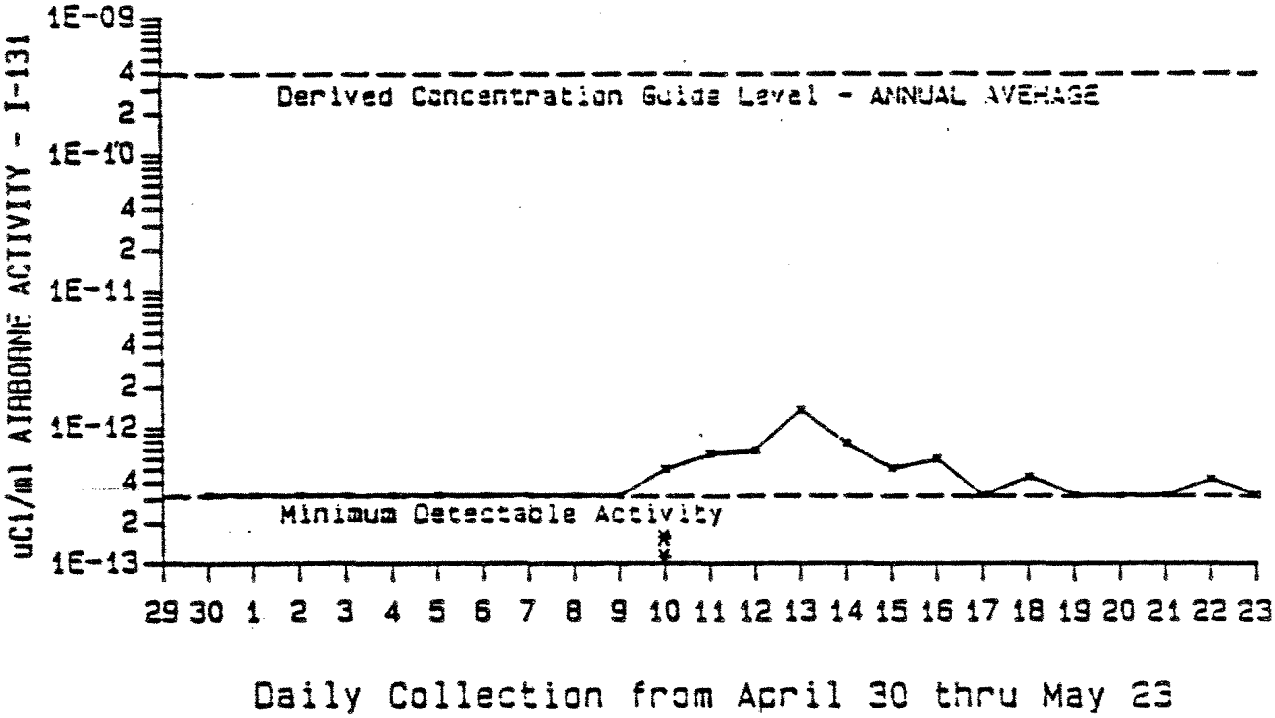
TRITIUM AS HTO IN AIR (µCi/ml)*

Location of Sampler	Collection Date 4/21 to 4/29	4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
1.5 Km NW of facility	<5.1 E-13	1.0 E-12	<6.1 E-13	<9.5 E-13
29 Km S of facility	<6.1 E-13	9.0 E-13	1.3 E-12	<1.0 E-12

* Estimated systematic plus random uncertainty is ±60% (at 2σ) for positive indications.

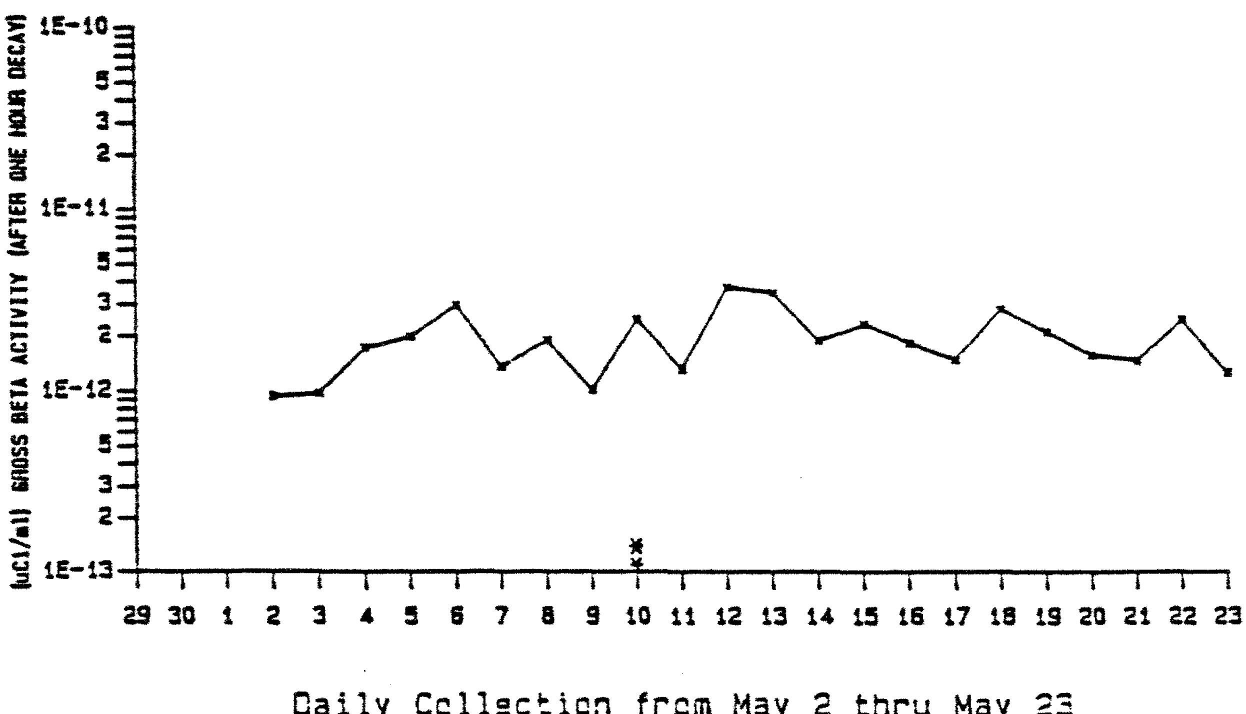
SPECIAL AIR SAMPLING FOR I-131 FISSION PRODUCT MAY 1986

FIGURE F-1.1



SPECIAL AIR SAMPLING FOR GROSS BETA RADIOACTIVITY MAY 1986

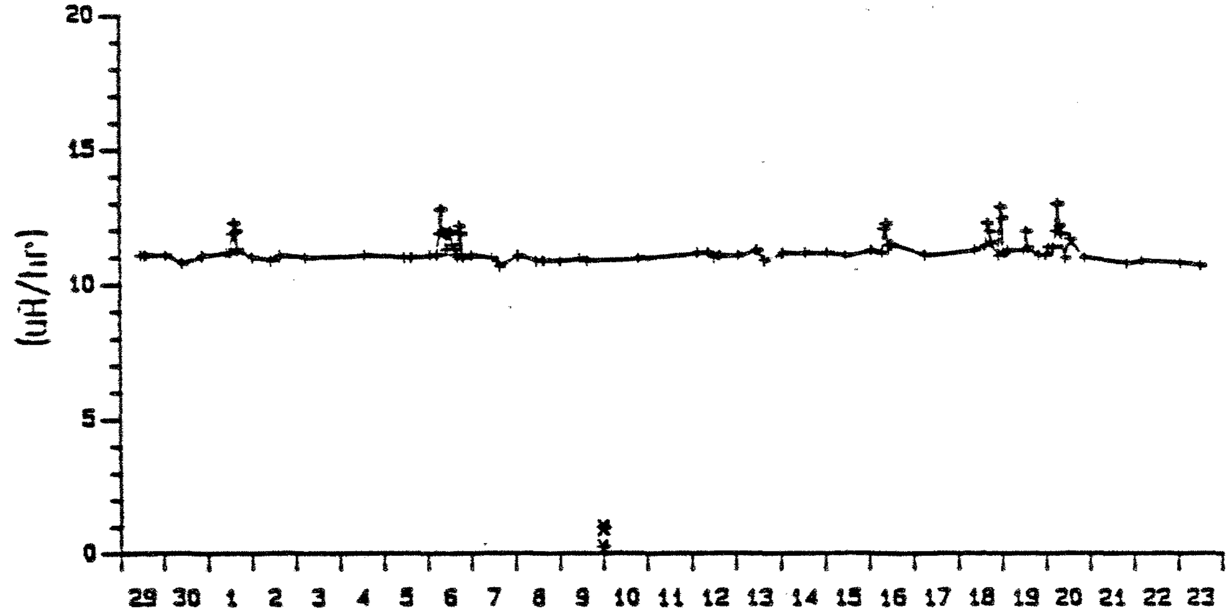
FIGURE F-1.2



** First incidence of detectable fission products

SPECIAL HPIC MONITORING
MAY 1986

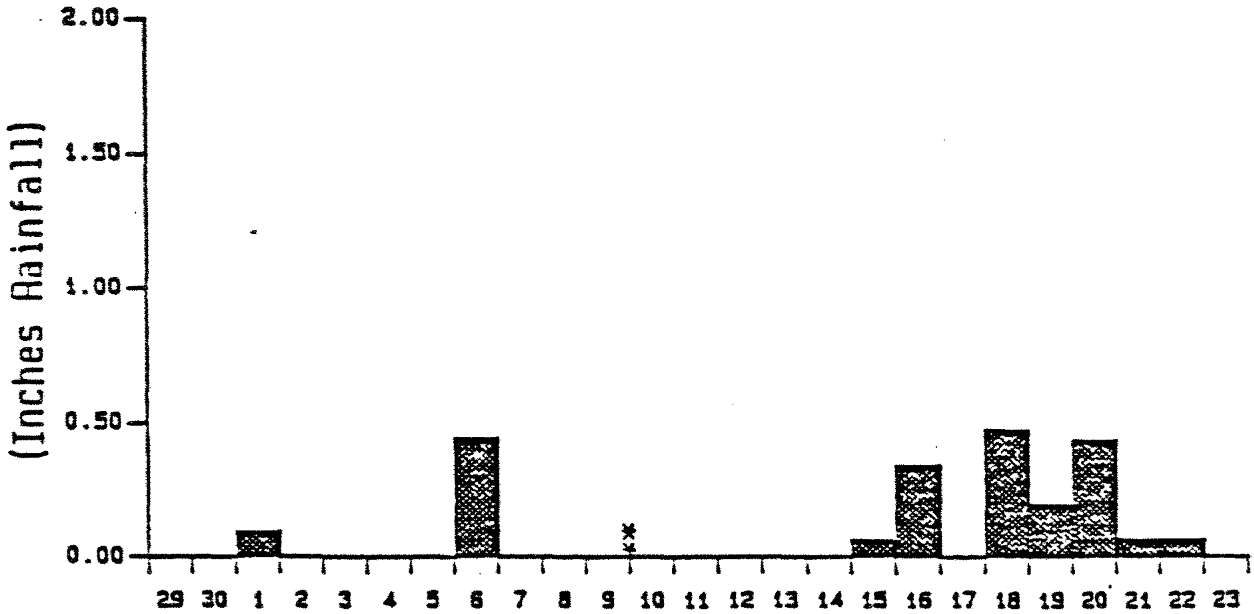
FIGURE F-1.3



Daily Monitoring from April 29 thru May 23

RAINFALL MONITORING
MAY 1986

FIGURE F-1.4



Daily Rainfall from April 29 thru May 23

* First incidence of detectable fission products

TABLE F-2.1

CATTARAUGUS CREEK SURVEY - 1986

LOCATION NUMBER (FIG F-2.1)	LOCATION CODE	SAMPLE DATE	Cs-137	K-40	Pb-214	Bi-214	LOCATION EXPOSURE RATE (uR/hr)
			<-----------	-----uCi/g Dry	Sediment-----	---------->	
		A - BACKGROUND CREEK SEDIMENT					
1	SFBCSED	12MAY86	6.32 ± 2.9 E-08	1.24 ± 0.1 E-05	4.91 ± 0.5 E-07	5.57 ± 0.6 E-07	
1	SFBCSED	16DEC86	3.33 ± 2.9 E-08	9.58 ± 0.4 E-06	4.71 ± 0.5 E-07	5.20 ± 0.6 E-07	
2	SFBISED	12MAY86	5.89 ± 3.5 E-08	1.10 ± 0.1 E-05	4.25 ± 0.6 E-07	5.11 ± 0.7 E-07	
2	SFBISED	16DEC86	<3.21 E-08	9.57 ± 0.5 E-06	4.27 ± 0.5 E-07	5.07 ± 0.6 E-07	
3	SFSPONRS.CR	4NOV86	<3.21 E-08	1.24 ± 0.1 E-05	3.84 ± 0.5 E-07	4.59 ± 0.6 E-07	10
4	SFSBRANCHCC	4NOV86	<3.21 E-08	1.12 ± 0.1 E-05	3.16 ± 0.5 E-07	3.55 ± 0.5 E-07	12
5	SFCLEAR.CR	4NOV86	6.68 ± 3.3 E-08	1.21 ± 0.1 E-05	4.04 ± 0.5 E-07	4.85 ± 0.6 E-07	9
		B - CATTARAUGUS CREEK SEDIMENT - DOWNSTREAM OF WVDP					
6	SF05N-SCC	13AUG86	3.95 ± 0.1 E-06	1.11 ± 0.1 E-05	3.24 ± 0.6 E-07	4.10 ± 0.6 E-07	14
7	SFCCSED	12MAY86	7.56 ± 0.3 E-06	1.03 ± 0.2 E-05	4.85 ± 2.8 E-07	7.77 ± 2.2 E-07	
7	SFCCSED	12DEC86	1.97 ± 0.1 E-06	8.70 ± 0.5 E-06	4.64 ± 0.6 E-07	5.80 ± 0.6 E-07	
8	SFSDSED	30JUN86	1.06 ± 0.2 E-06	1.18 ± 0.2 E-05	4.88 ± 1.9 E-07	5.34 ± 2.1 E-07	
8	SFSDSED	16DEC86	4.86 ± 0.4 E-07	9.88 ± 0.5 E-06	4.35 ± 0.5 E-07	5.02 ± 0.6 E-07	
9	SF14N-SCC	7OCT86	7.42 ± 0.4 E-07	9.98 ± 0.5 E-06	3.54 ± 0.5 E-07	4.06 ± 0.6 E-07	12
10	SF16N-NCC	7OCT86	4.74 ± 0.4 E-07	1.08 ± 0.1 E-05	2.65 ± 0.5 E-07	3.51 ± 0.5 E-07	10
11	SF22.5N-SCC	10OCT86	3.31 ± 0.4 E-07	1.08 ± 0.1 E-05	3.05 ± 0.5 E-07	3.13 ± 0.5 E-07	11
12	SF21S-NCC	10OCT86	3.87 ± 0.4 E-07	1.15 ± 0.1 E-05	3.97 ± 0.5 E-07	5.39 ± 0.6 E-07	15
13	SF31N-SCC	20OCT86	3.41 ± 0.4 E-07	9.24 ± 0.5 E-06	3.07 ± 0.5 E-07	4.12 ± 0.6 E-07	12
14	SF30S-NCC	20OCT86	2.84 ± 0.4 E-07	1.08 ± 0.1 E-05	3.56 ± 0.5 E-07	4.22 ± 0.6 E-07	15
15	SF31.5S-SCC	20OCT86	2.58 ± 0.3 E-07	1.06 ± 0.1 E-05	3.48 ± 0.5 E-07	3.76 ± 0.6 E-07	14
16	SF33S-NCC	20OCT86	2,49 ± 0.4 E-07	1.31 ± 0.1 E-05	4.49 ± 0.5 E-07	4.78 ± 0.6 E-07	19
17	SF35S-SCC	21OCT86	1.39 ± 0.3 E-07	1.03 ± 0.1 E-05	3.98 ± 0.5 E-07	4.57 ± 0.6 E-07	17
18	SF37S-NCC	21OCT86	1.65 ± 0.3 E-07	1.01 ± 0.1 E-05	3.35 ± 0.5 E-07	3.86 ± 0.6 E-07	12
19	SF42N-ROCK	4NOV86	<3.21 E-08	1.62 ± 0.1 E-05	5.84 ± 0.6 E-07	7.05 ± 0.6 E-07	19
10	SF45N-NCC	22OCT86	2.19 ± 0.4 E-07	1.12 ± 0.1 E-05	3.42 ± 0.5 E-07	4.34 ± 0.6 E-07	11
21	SF47N-SCC	22OCT86	3.15 ± 0.4 E-07	1.18 ± 0.1 E-05	5.45 ± 0.5 E-07	5.56 ± 0.6 E-07	9
22	SF51N-SCC	22OCT86	1.51 ± 0.3 E-07	1.01 ± 0.1 E-05	3.06 ± 0.5 E-07	3.29 ± 0.5 E-07	14
23	SF52N-NCC	24OCT86	1.43 ± 0.3 E-07	1.10 ± 0.1 E-05	3.27 ± 0.5 E-07	3.99 ± 0.6 E-07	13
24	SF59S-NCC	24OCT86	1.34 ± 0.3 E-07	1.08 ± 0.1 E-05	3.90 ± 0.5 E-07	4.56 ± 0.5 E-07	8
25	SF58N-SCC	27OCT86	6.09 ± 0.4 E-07	1.22 ± 0.1 E-05	4.48 ± 0.5 E-07	5.86 ± 0.6 E-07	11
26	SF61N-NCC	31OCT86	3.42 ± 0.4 E-07	1.13 ± 0.1 E-05	5.07 ± 0.5 E-07	6.13 ± 0.6 E-07	9
27	SF63N-MCC	31OCT86	1.41 ± 0.4 E-07	1.18 ± 0.1 E-05	3.84 ± 0.5 E-07	4.45 ± 0.6 E-07	
28	SFCCB.W.END	31OCT86	1.88 ± 0.3 E-07	1.14 ± 0.1 E-05	3.58 ± 0.5 E-07	3.79 ± 0.6 E-07	
29	SF69N-BCH	31OCT86	1.58 ± 0.3 E-07	1.09 ± 0.1 E-05	2.07 ± 0.5 E-07	2.87 ± 0.5 E-07	6

Location Code Key: Codes ending in SED refer to routine sampling locations (See Appendix A-1);
SFPONRS.CR = Spooners Creek; SFSBRANCHCC = South Branch Cattaraugus Creek; SFCLEAR.CR = Clear Creek
SF35S-SCC: 35S = South Bank Survey map location (See Fig F-2.3); SCC = South Bank sample
SF45N-NCC: 45N = North Bank Survey map location (See Fig F-2.2); NCC = North Bank sample

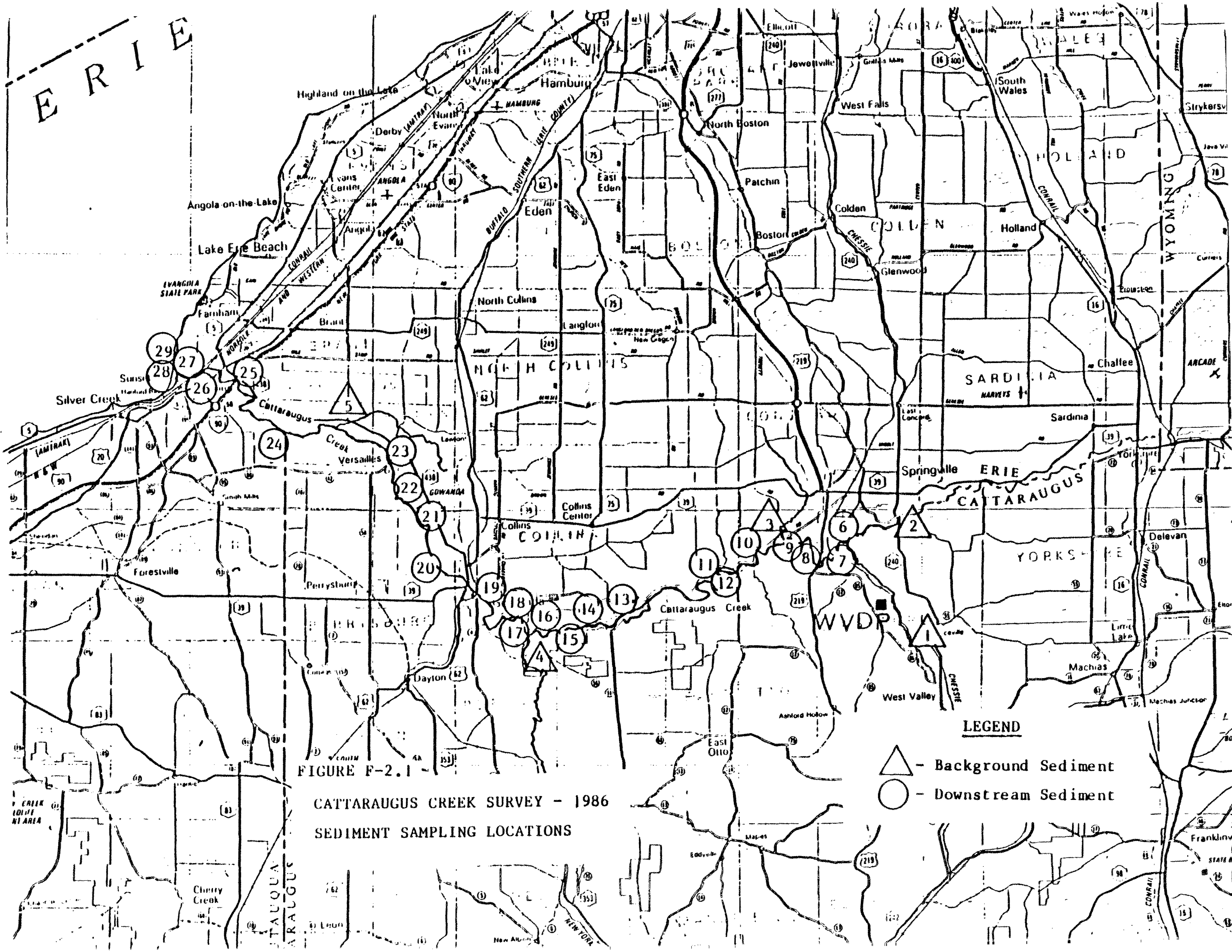


FIGURE F-2.1 - CATTARAUGUS CREEK SURVEY - 1986 SEDIMENT SAMPLING LOCATIONS

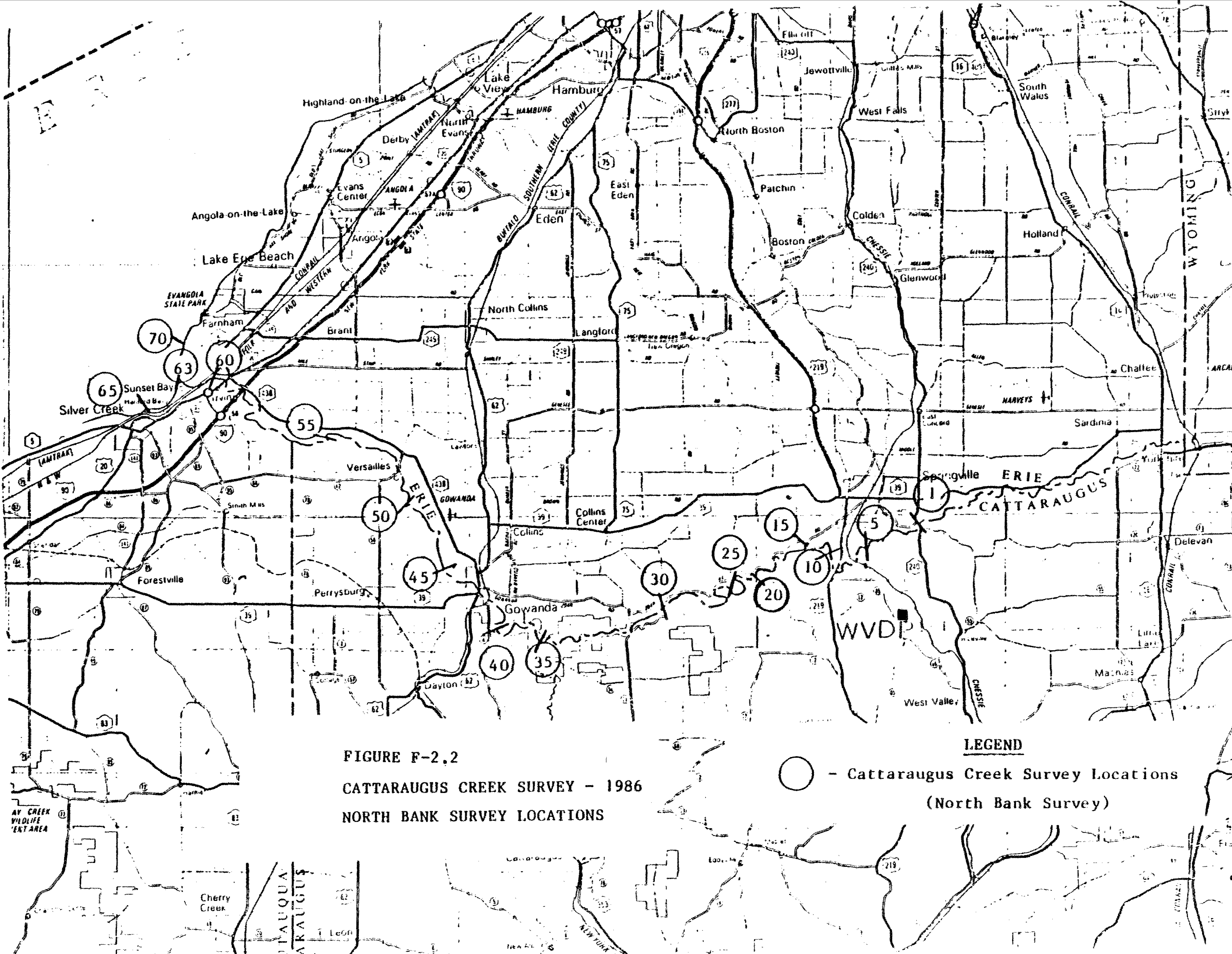


FIGURE F-2.2

CATTARAUGUS CREEK SURVEY - 1986

NORTH BANK SURVEY LOCATIONS

LEGEND

○ - Cattaraugus Creek Survey Locations (North Bank Survey)

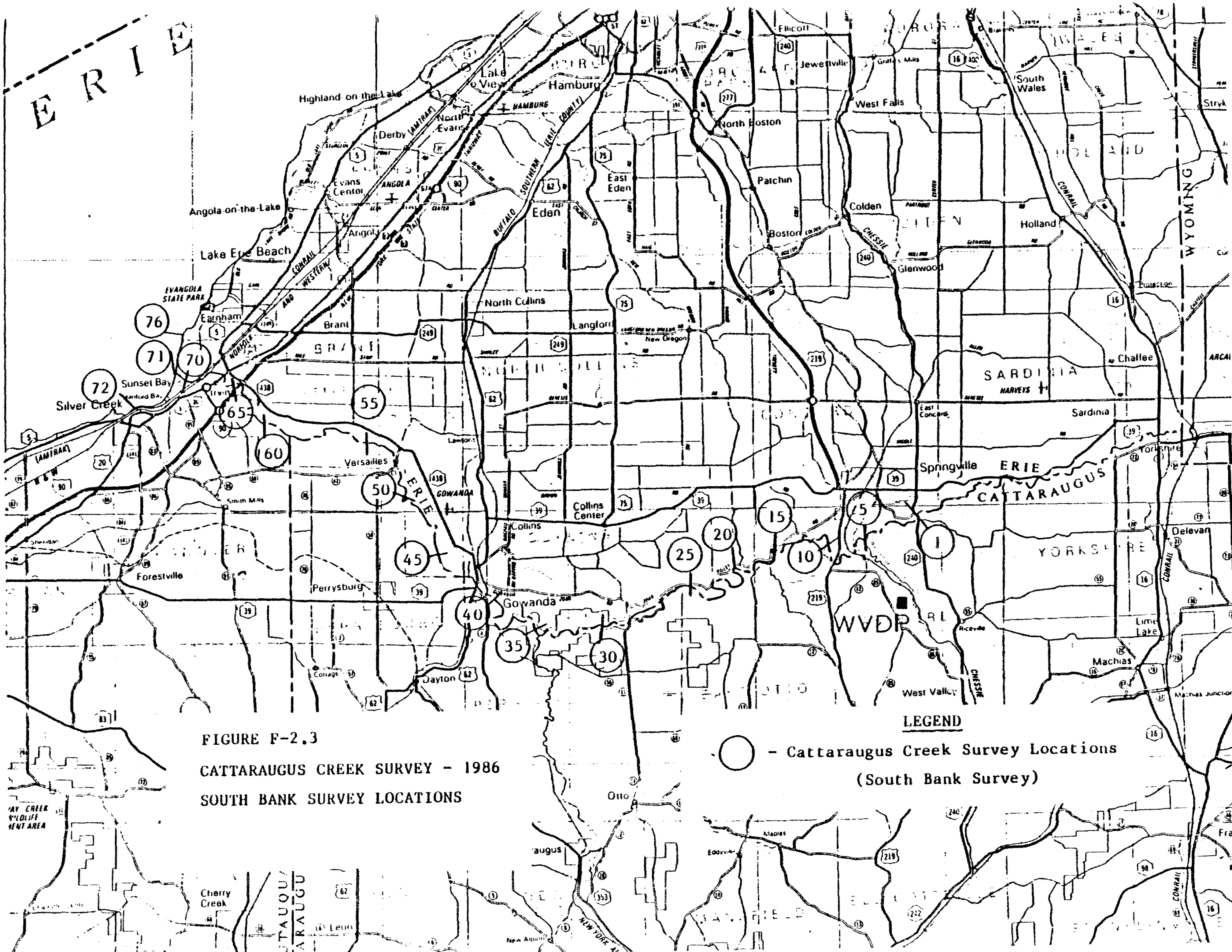


FIGURE F-2.3

CATTARAUGUS CREEK SURVEY - 1986

SOUTH BANK SURVEY LOCATIONS

LEGEND

◯ - Cattaraugus Creek Survey Locations (South Bank Survey)

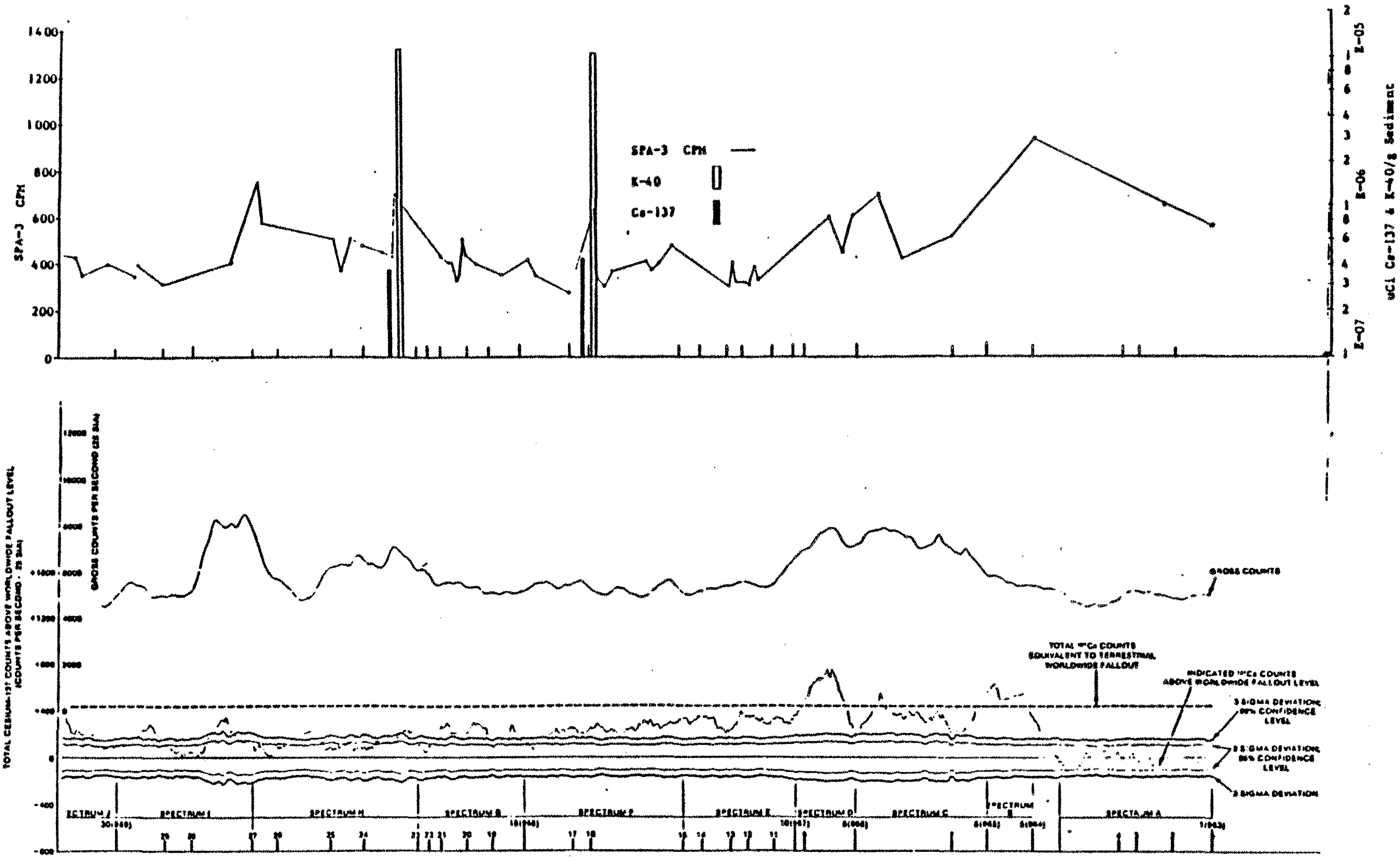


FIGURE F-2.4 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
North Bank Data - Sheet 1 of 3

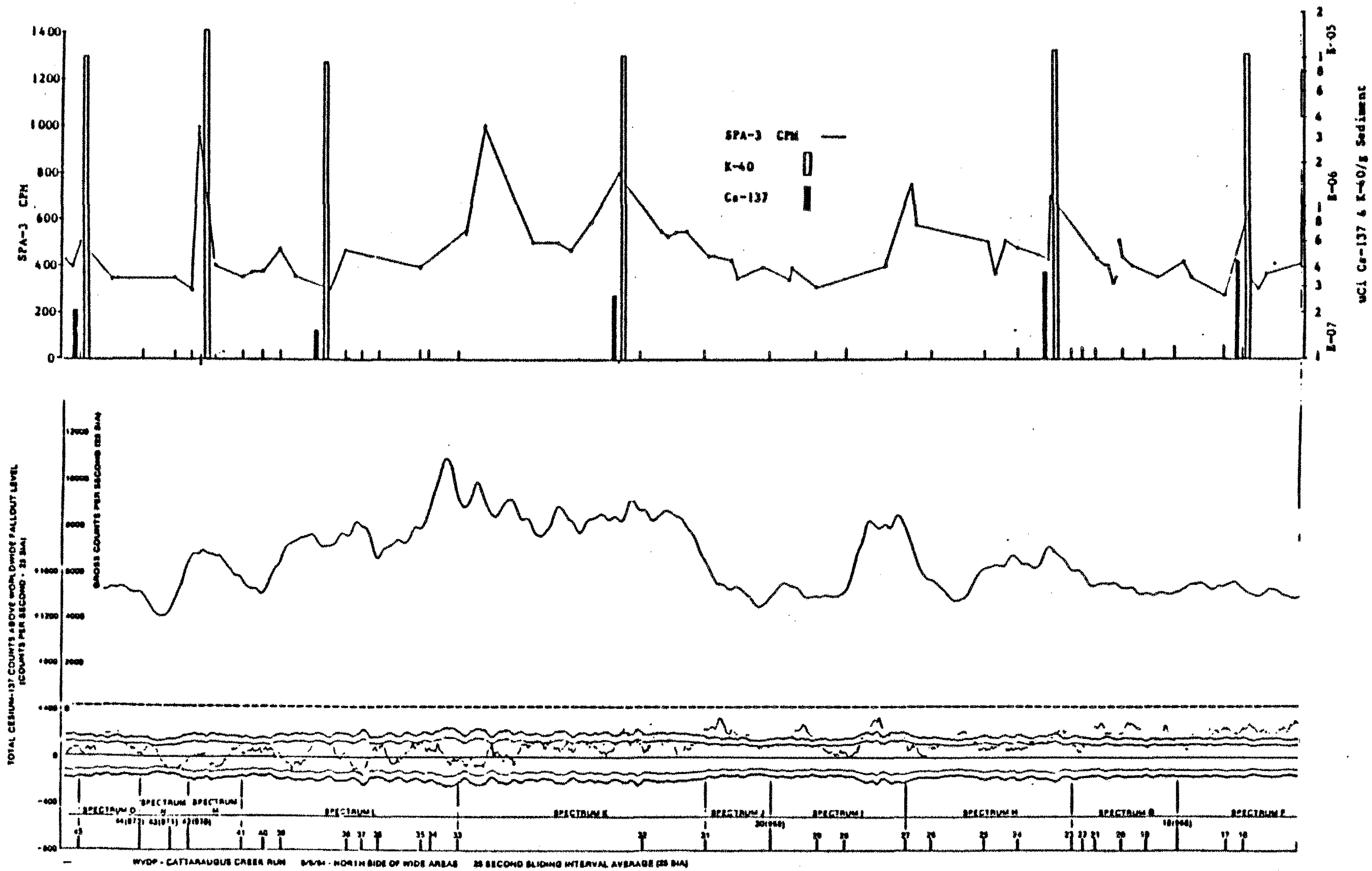


FIGURE F-2.4 CATTARAUGUS CREEK SURVEY - 1986

Aerial Survey (Bottom) Compared to Ground Level Survey (Top)

North Bank Data - Sheet 2 of 3

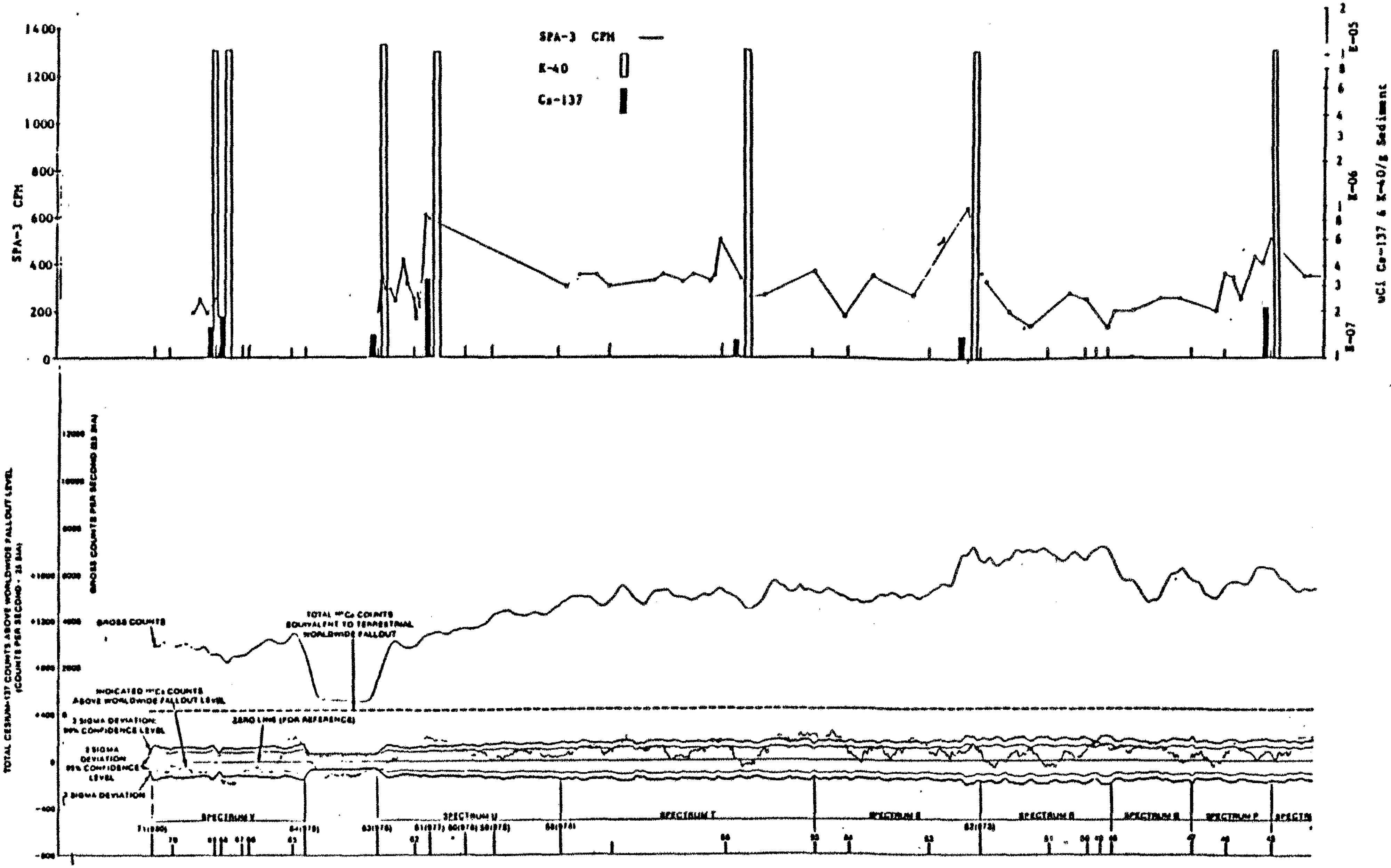


FIGURE F-2.4

CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
North Bank Data - Sheet 3 of 3

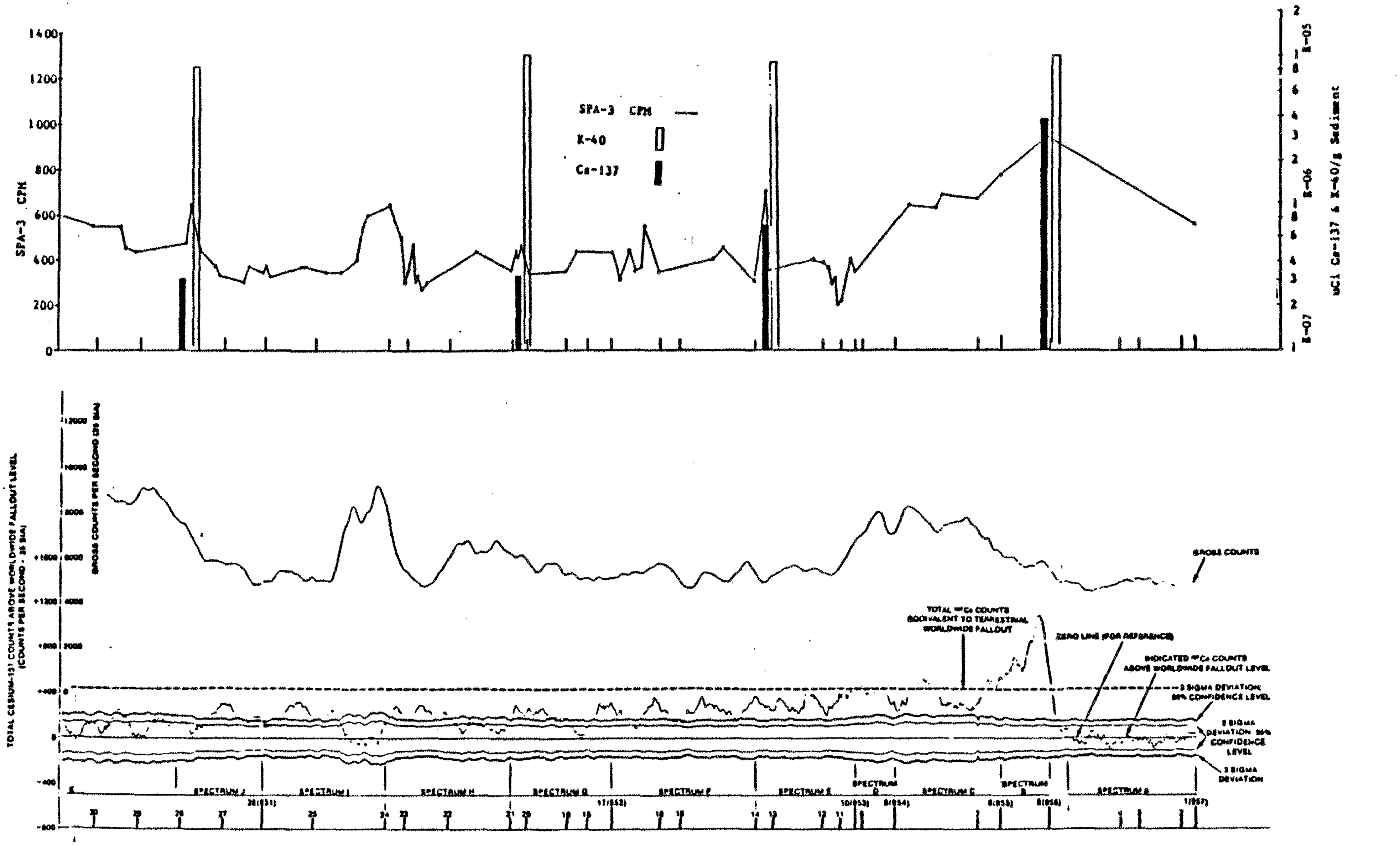


FIGURE F-2.5 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 1 of 3

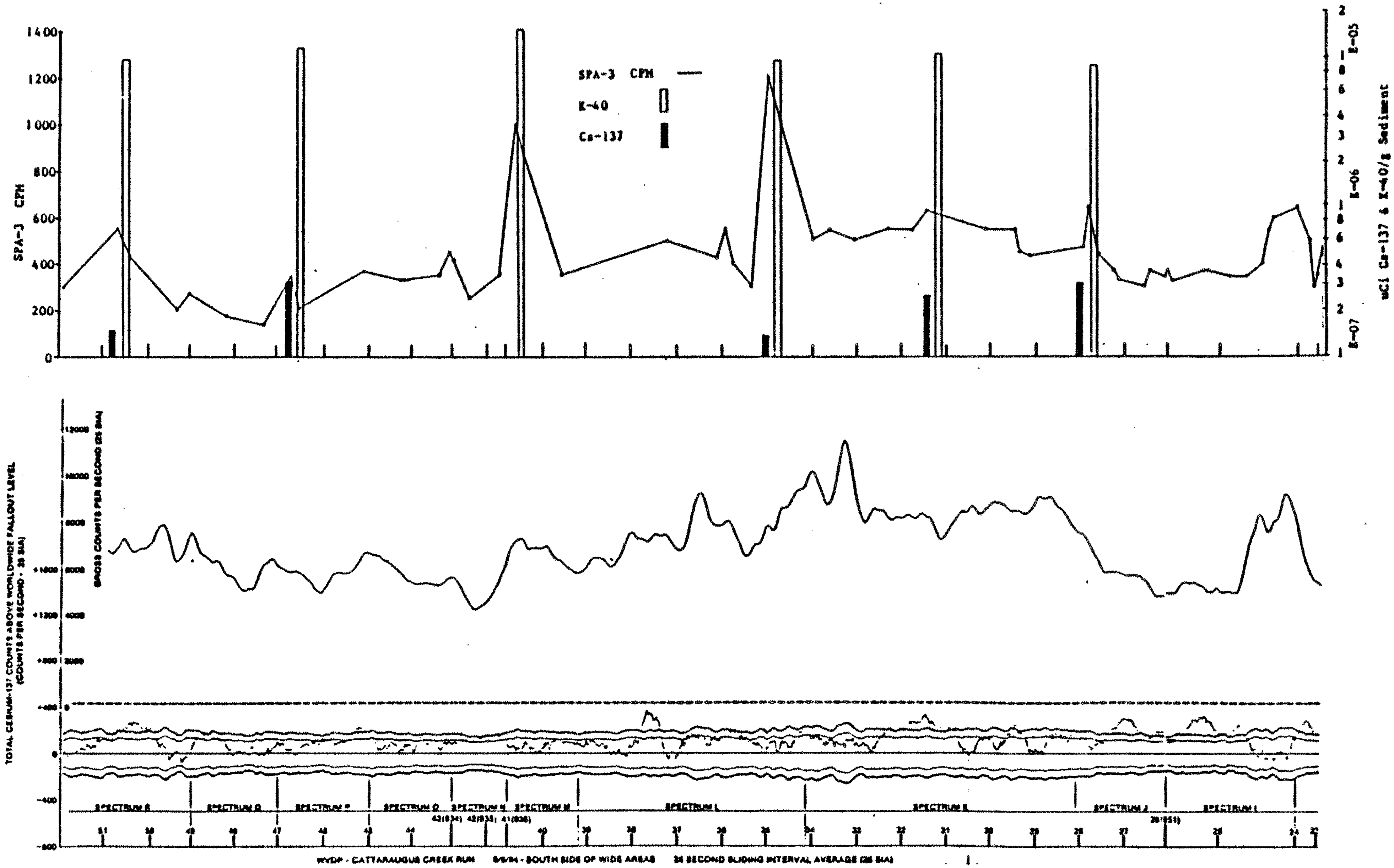


FIGURE F-2.5 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 2 of 3

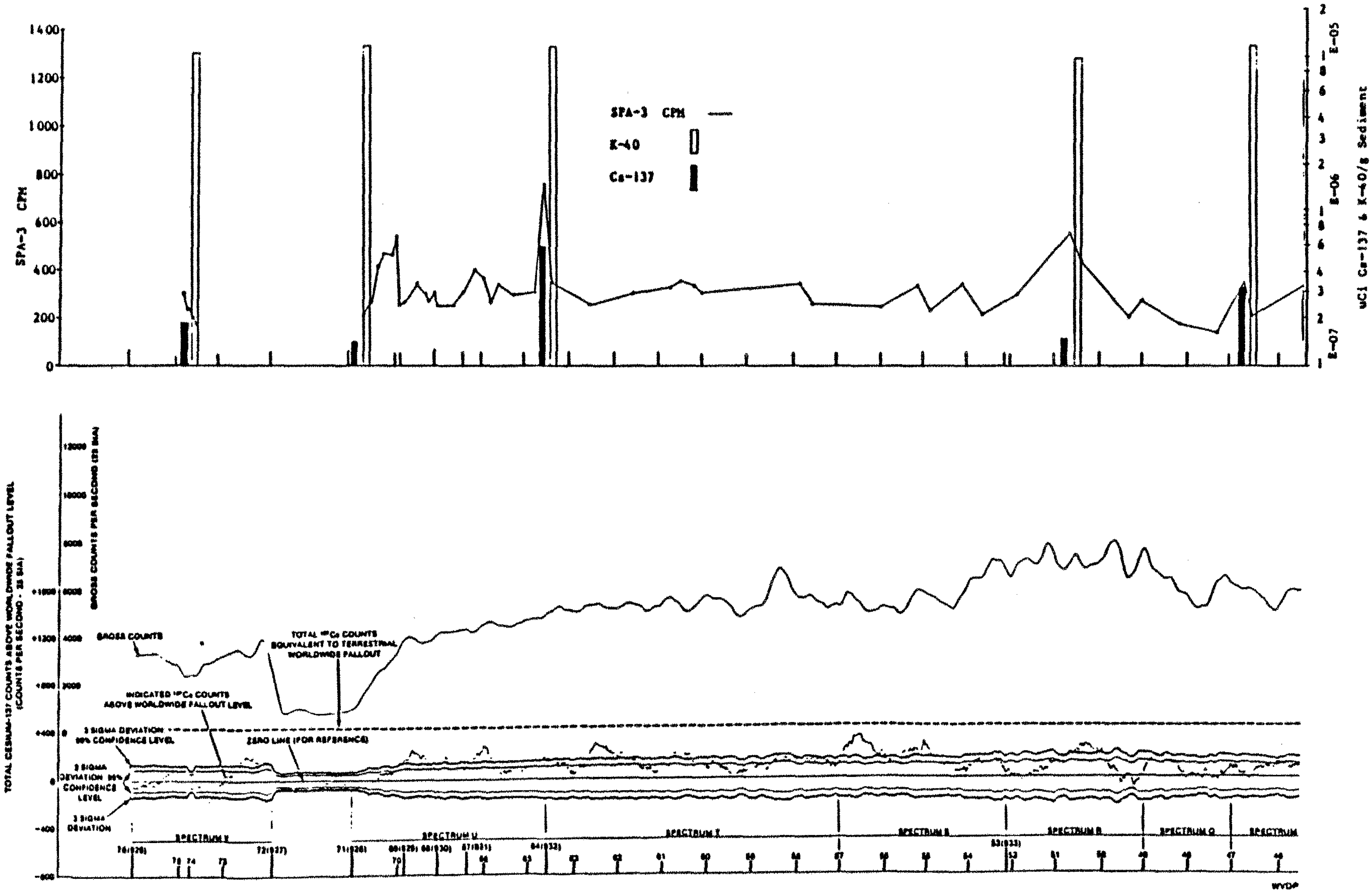


FIGURE F-2.5

CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 3 of 3