Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

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Site Environmental Report

For Calendar Year 1992

May 1, 1993

D. W. Grobe

Operated by Universities Research Association, Inc.
Under Contract with the United States Department of Energy,
Chicago Operations Office, Batavia Area Office

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FERMILAB

SITE ENVIRONMENTAL REPORT

FOR CALENDAR YEAR 1992

by

D. W. Grobe, Editor

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1.0 EXECUTIVE SUMMARY FOR CY-1992

This report summarizes the environmental status of Fermi National Accelerator Laboratory (Fermilab) for Calendar Year 1992 (CY-1992). It includes descriptions of the Fermilab site, its mission, the status of compliance with applicable environmental regulations, planning and activities to accomplish compliance, and a comprehensive review of environmental surveillance, monitoring, and protection programs. Throughout its development, the Fermilab facility has exhibited a concern for protection of the environment. This has led to a philosophy of respecting environmental protection concerns at all stages of design and operation. The surveillance program monitors the Fermilab policy to protect the public, employees, and the environment from any adverse effects due to Lab activities and to minimize environmental impacts to the greatest degree practiceable.

1.1 Compliance Summary

Fermilab continues to strive for compliance with Department of Energy (DOE) orders and other Federal, State, and local environmental laws and regulations. These include, but are not limited to, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Air Act (CAA), the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), the Toxic Substances Control Act (TSCA), the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), Executive Order 11988 "Flood Plain Management," and Executive Order 11990 "Protection of Wetlands." There were no abnormal occurrences which had an impact on the public, the environment, the facility or its operation in CY-1992. Details of Fermilab's compliance status can be found in the Compliance Summary, Section 3.0 of this report.

1.2 Environmental Program Information Summary

Monitoring and surveillance are critical elements of an effective environmental protection program. Fermilab has established and implemented comprehensive environmental monitoring and surveillance programs to ensure compliance with legal and regulatory requirements imposed by Federal, State, and local agencies and to provide for the measurement and interpretation of the impact of Fermilab operations on the public and the environment. The surveillance and monitoring activities are selected to be responsive to both routine and potential releases of penetrating radiation and liquid or airborne effluents. To evaluate the effects of Fermilab operations on the environment, samples of effluents and environmental media collected on the site and at the site boundary were analyzed and compared to applicable guidelines and standards. Surface water, air, groundwater, and soil/sediment were monitored for radionuclide concentrations. Surface waters were also analyzed for potential chemical constituents. External penetrating radiation and airborne emissions were estimated, providing information for the potential radiation doses to off-site populations. The results of the environmental

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surveillance program are interpreted and compared with environmental standards where applicable. The status of environmental protection activities and the progress on environmental restoration and corrective action activities are discussed in this report.

1.3 Environmental Radiological Surveillance Information

The total potential radiation dose equivalent to the general offsite population from operations during CY-1992 was 2.27 x 10^{-2} person-rem (2.27 x 10^{-4}person-Sv). A summary can be found in Table 1. This is significantly lower than the estimate of 7.61 person-rem (7.61 x 10^{-2} person-Sv) for CY-1991 due to the operations of the accelerator in the Collider mode and the resultant decrease in muon production. Refinements in confirmatory measurements also substantially reduced the estimated total dose due to Fermilab operations (see Section 1.3.1 for further discussion). Because the dose to the offsite population is comprised only of penetrating radiation and short-lived airborne radionuclides, the 50 year dose commitment from operations in CY-1992 will be the same as the effective dose equivalent received in CY-1992 reported here. Table 2 provides a summary of radioactivity released to the offsite environment in CY-1992.

1.3.1 Radioactive Airborne Emissions Summary

Airborne radionuclide emissions from Fermilab facilities are regulated by the Clean Air Act (CAA) and are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. As a result of accelerator operations, airborne radionuclides are released from target stations in the experimental areas and in the Antiproton Source to the atmosphere. During Calendar Year 1992 only the Antiproton Source received beam. Since there were no unplanned emissions, the Antiproton Source was the sole emissions source in CY-1992.

In response to recommendations by the Tiger Team, members of the Fermilab Radiation Physics Staff Group initiated a program to study the emissions from the Antiproton Stack. First it was learned that approximately 30% of the air being exhausted from the AP0 vault, where the Antiproton source is located, was exiting through the AP0 service building and Target Hall, and hence was not monitored. The remaining 70% was being exhausted from the AP0 stack as modeled in past reports.

Past studies of emissions from the AP0 stack had determined the radionuclide composition by fitting a multiple exponential function to the experimentally determined decay curve of a volume of stack gas confined to a lead pig. The lead pig negated the concomitant use of gamma ray spectroscopy in the experimental measurements. No method was used to evaluate how well the fitted function emulated the experimental measurements. The study program initiated this year employed concomitant

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gamma ray spectroscopy and used a χ^2 minimization to constrain the fitting function to the experimental data. The stack gas was taken from the stack in an approximately 20 ft. run of copper tubing whereas it was taken from a 40 ft. run of plastic (Tygon) tubing in previous studies. Flow rates in all studies were between 4 and 6 lpm.

The net result of these new studies is that we now believe Fermilab has seriously overestimated its airborne radionuclide emissions in past reports. Monitored releases for CY-1992 from the AP0 Stack were measured as 14.09 Ci (5.21 x 10^{11} Bq). Airborne radionuclides ^{11}C(58.7%), ^{13}N(37.6%), ^{38}Cl(1.0%), ^{39}Cl(1.1%), ^{41}Ar(1.5%), and ^{82}Br(<0.1%) were identified in the emissions from the AP0 Stack. Due to its extremely low concentrations, the ^{82}Br was difficult to observe, and was seen only on an activated charcoal filter placed in the sampling line. Unmonitored releases from the AP0 target hall and service building were estimated at 5.29 Ci (1.96 x 10^{11} Bq) by scaling emission rates per delivered proton from the AP0 Stack. Since these releases occurred approximately 20 minutes upstream of the AP0 stack, the relative % composition of each of the airborne radionuclides changed to ^{11}C(42.4%), ^{13}N(55.9%), ^{38}Cl(0.5%), ^{39}Cl(0.5%), ^{41}Ar(0.6%), and ^{82}Br(<0.05%).

Our present Illinois Environmental Protection Agency (IEPA) NESHAP (National Emission Standard for Hazardous Air Pollutants) air pollution permit application states that our releases will average 100 Ci/year (3.70 x 10^{12} Bq) with a maximum of 900 Ci/year (3.33 x 10^{13} Bq). Modeling our releases with the computer code CAP88-PC, version 1.0, yielded a maximum site boundary dose equivalent to a member of the public of 0.00937 mrem (9.37 x 10^{-5} mSv) in Calendar Year 1992. This is well below the Environmental Protection Agency (EPA) standard of 10 mrem/year (1 x 10^{-1} mSv/year). The threshold for requiring EPA-approved continuous monitoring is set at 0.1 mrem/year. The collective dose equivalent to the public due to air emissions in CY-1992 was calculated to be 2.27 x 10^{-2} person-rem (2.27 x 10^{-4} person-Sv).

1.3.2 Penetrating Radiation Summary

Other sources of ionizing radiation from accelerator operations are due to operation of the fixed target experimental areas. These operations produce ionizing radiation in the form of muons. The fixed target areas did not operate in CY-1992. The collider running mode was operative this year. During the collider run, the only potential muon source is the C0 Abort. However, muons due to Tevatron aborts at C0 are ranged out and therefore the potential dose from this source was inconsequential. A record of protons aborted at C0 was used to estimate the effective dose equivalent at the site boundary at 3.24 x 10^{-5} mrem (3.24 x 10^{-7} mSv) for CY-1992. No neutron fields of environmental significance were identified during CY-1992 operations.

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The maximum site boundary dose (fence line assuming 24 hr/day exposure) from the radioactive material stored at the Railhead (Figure 1) was 1.45 mrem (1.45×10^{-2} mSv) for CY-1992. The Railhead is closer to the site boundary than is the nearest house, making the actual maximum radiation dose to an individual offsite much lower. The maximum individual potential radiation dose due to radiation from the Railhead was 0.30 mrem (3×10^{-3} mSv) during CY-1992.

1.3.3 Summary of Radioactive Discharges to Surface Water

The offsite release of tritium (^3H) in surface water totaled approximately 203 mCi (7.5×10^9 Bq), compared to 3646 mCi (1.4×10^{11} Bq) in CY-1991 (Gr92). The decrease was the result of less water from reportable discharges leaving the site during CY-1992. Water left the site via the Kress Creek spillway for 35% of the year in CY-1992 as compared with 63% the year before. The primary source of tritium in water reaching Casey's Pond from drainage ditches in the Research Area continues to be tritiated water discharged from an underdrain system beneath the Neutrino Target Service Building, a target, and a beam dump system. At one time the target was the primary target in the Neutrino Area, receiving most of the protons accelerated by Fermilab. After the CY-1982 operating period ended, the target was moved to a new location with a different underdrain system. Thus, the tritium released in CY-1992 from this area was essentially from operations before CY-1983.

1.4 Environmental Non-Radiological Surveillance Program Information

1.4.1 Airborne Emissions

Conventional air pollutant emission from Fermilab facilities are regulated under the Clean Air Act (CAA) and its amendments. Operating permits have been obtained as required for all identified sources of airborne emissions. Operations are reviewed at least annually to ensure that permitted equipment continues to operate and to be maintained in accordance with permit conditions. Fermilab is not a large source of air pollutants. Air pollution permits at Fermilab contain conditions for open burning, restrictions on amounts of nitrogen oxides that can be emitted from boilers, and limits on total organic emissions from freon degreasers. Some emissions testing was conducted at the Magnet Debonding Oven in conjunction with its refurbishment. There were no known instances of non-compliance emissions in CY-1992. Tables 3 and 4 summarize permits held by Fermilab.

1.4.2 Surface Waters

Fermilab does not have a NPDES (National Pollution Discharge Elimination System) permit to discharge process wastewater to surface waters and therefore it is prohibited. The Laboratory has

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submitted permit applications to the IEPA that will cover on-going releases of comingled non-process, non-contact cooling water and stormwater runoff to surface waters. In conjunction with the NPDES application, surface waters have been sampled for various chemical constituents. Annual samples of surface water are also taken from selected bodies of water onsite and analyzed for trace metals, and selected organics. Analysis parameters were selected based on contaminants from possible, yet improbable onsite sources. In CY-1992 surface water monitoring for chemical contaminants was limited to Kress Creek and the Fox River Inlet to Kress Creek. Table 5 summarizes sampling results. The Kress Creek watershed collects stormwater runoff from the experimental beamline areas. Samples taken as water entered the site via Kress Creek intake exceeded general water quality standards. These samples showed iron concentrations in excess of the standard. The sample taken of Kress Creek at the point where it leaves the site also exceeded general water quality standards for iron, but showed an improvement in iron concentration as compared to the water entering the site.

1.4.3 Groundwater

Water samples from wells used to monitor for chlorides and chromates in an old perforated pipe field yielded measurable levels of total chromium, hexavalent chromium, chloride, lead, silver, and copper. Some parameters exceeded Illinois Ground Water Quality Standards (Il91). Results are summarized in Table 6. While it is believed that it is improbable that these contaminant levels pose a health risk, this issue will be further investigated.

2.0 INTRODUCTION

2.1 Site Mission

Fermilab is a national laboratory managed by Universities Research Association, Inc. (URA) for the U.S. Department of Energy (DOE). The Lab's mission is to provide resources to conduct basic research in high-energy physics and related disciplines. The Fermilab facility consists of a series of proton accelerators which became operational in 1972, producing higher energy protons than any other accelerator in the world.

2.2 Major Activities

2.2.1 Accelerator History

From 1976 through 1982 substantial improvements allowed the accelerator to gradually increase its routine operation from the original design energy of 200 GeV (billion electron volts) to 400 GeV. In 1982, the addition of superconducting magnets allowed the particle energy to be doubled

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once again to 800 GeV. Studies initially involved only fixed-target configurations, but in 1987, collisions of 900 GeV protons and anti-protons became possible. Such colliding beam collisions are now an important part of the research program at Fermilab.

2.2.2 Current Operations

To carry out its mission, the Laboratory operates an 8 GeV anti-proton source that provides anti-protons for the colliding beam studies program as well as several internal fixed-target experiments. A 2 TeV center-of-mass proton-anti-proton collider and two general purpose collider detectors support the collider program. Fermilab's 800 GeV proton synchrotron and the unique array of high-energy secondary beams available are utilized for fixed-target experiments. When the proton beam is extracted for fixed target physics from the 1.2 mile (2 km) diameter main accelerator, the protons are delivered to three different experimental areas onsite: the Meson, Neutrino, and Proton Laboratories located in the Research Area (Figure 1). For colliding beam studies, antiprotons are produced by extracting 120 GeV protons from the ring of conventional magnets inside the main accelerator tunnel. These protons strike a fixed target at the Antiproton Area (Figure 2) and negatively charged antiprotons are collected. There are numerous other activities conducted at the Lab in support of accelerator operation and site maintenance. When not providing beam for high energy physics experiments, 66MeV protons from the linear accelerator (Linac) are frequently used to produce neutrons for cancer patient treatment at the Neutron Therapy Facility (NTF).

During CY-1992, operation of the high-energy accelerators at Fermilab consisted of a Collider run using 800 GeV beams of protons and antiprotons. This period of operations began in April 1992 and continued with beam being delivered to these areas through April 1, 1993.

2.3 Site Description

Fermilab is located in Kane and DuPage Counties in the greater Chicago area (Figure 3). It covers 10.6 square miles (27.5 square kilometers) in an area which is rapidly changing from farming to residential use. There are many municipalities in the vicinity, resulting in a distinct pattern of increasing population concentration eastward toward Chicago (Figure 4).

The land within the Fermilab boundaries was primarily farmland when the State of Illinois acquired it for the Department of Energy (DOE). Much of the land, approximately 1680.8 acres (6.8 km^2) in CY-1992, has remained in crop production, primarily corn (Figure 10). The site also includes areas of upland forest, floodplain woods, oak savanna, prairie remnant, non-native grassland, old fields, pastureland, fence rows, and various types of wetlands. In addition to the research accelerators, man-made structures onsite include various

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administrative, research, storage, and other support facilities. The small village of Weston, population 380 at the time the land was acquired for Fermilab, was located on the eastern side of the property (Figure 1). The remaining housing complex, known as the Village, now provides residences for visiting scientists.

In the early 1970's, Fermilab began a prairie reconstruction project on a 388 acre (1.57 square km) plot inside the Main Ring Accelerator. Beginning in 1984, additional plots outside the ring have been planted, resulting in a current total of approximately 918 acres (3.71 km^2) of native grasses.

Phase I archaeological surveys of both prehistoric and historic cultural resources have now been completed for the entire site (Lu90). With the addition of the five sites identified in CY-1990, the total number of known prehistoric archaeological areas at Fermilab is now thirty-two. The report on the historical survey is being reviewed.

2.4 Surface Characteristics of the Site

Two major environmental features near the Laboratory are the Fox River to the west, and the West Branch of the DuPage River which passes east of the site (Figure 3). The Fox River flowed south with an average of 5.39×10^8 gallons (2.04×10^9 liters) per day as measured at Algonquin, IL in CY-1992. The West Branch of the DuPage River flowed south at an average rate as measured near Warrenville of 4.76×10^8 gallons (1.8×10^9 liters) per day for the same period (Figure 3). Kress Creek, which flows to the West Branch of the DuPage River, averaged 6.13×10^6 gallons (2.32×10^4 liters) per day at West Chicago. Average daily flow rates were obtained from the U.S. Department of the Interior, Water Resources Division (Du93). The rainfall in the vicinity of Fermilab, taken at O'Hare International Airport, during 1992 was 30.12 inches (76.5 cm) (NOAA 92). The land on the site is relatively flat as a result of past glacial action. The highest area, with an elevation of 800 ft (244m) above mean sea level (MSL) is near the western boundary. The lowest point, with an elevation of 715 ft (218 m) above MSL, is in the southeast. There are three watersheds that collect water onsite: Kress Creek (to the north), Indian Creek (in the southwest), and Ferry Creek (in the southeast). Kress and Ferry Creeks are tributary to the West Branch of the DuPage River, while Indian Creek flows to the Fox River.

2.4.1 Industrial Cooling Water Ponding Systems

There are several water systems used for cooling magnets and for fire protection:

The Industrial Cooling Water (ICW) System consists of Casey's Pond (Figure 2) at the end of the Neutrino Beamline and underground mains to fire hydrants and sprinkler systems throughout the

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Central Laboratory Area and Experimental Areas. Casey's Pond is supplied by surface drainage and can be supplied by pumping from the Fox River. The pond holds 18,000,000 gallons (68,000,000 liters).

The Swan Lake/Booster Pond System (Figure 2) is used for cooling purposes at the Central Utility Building (CUB). Water is pumped from the Booster Pond into a ditch in which it runs by way of West Pond into Swan Lake. The water then flows to the Booster Pond through a return ditch. Water is also pumped from Swan Lake to NS1 Service Building (near G9 in Figure 6) for cooling purposes, from which it returns by a surface ditch. This system can be supplied water from the ICW System and it overflows into Indian Creek (Figures 2 and 5).

The Main Ring Ponding System consists of a series of interconnecting canals completely encircling the interior of the Main Ring and including a large reservoir pond (Figure 2). This water is used in heat exchangers at the service buildings for cooling the Main Ring magnets. The system is generally supplied by surface drainage, although make-up water can be pumped from Casey's Pond. The system overflows into Lake Law (Figures 2 and 5).

2.5 Sewage Treatment

Until late 1986 the Village sewage was treated onsite in the Village Oxidation Pond. This required an NPDES permit. In December 1986, the Village was connected to the City of Warrenville Sewer/Naperville (Springbrook Treatment Plant) system. The Naperville plant is a modern sewage treatment system with ample capacity. The IEPA terminated the NPDES permit for the Village Oxidation Pond on May 12, 1987, at the Department of Energy's request. The Main Site sewer system serving the Wilson Hall area was connected to the City of Batavia system on June 26, 1979.

2.6 Drinking Water Supplies

The primary drinking water supply at Fermilab is provided by a well that taps the shallow Silurian aquifer, pumping from depths of approximately 65 ft. to 220 ft. (19.8 - 67.1 m) deep (Sa82). This well, W-1 in Figure 7, is located in the Central Laboratory Area. A second well, W-3 in Figure 7, pumps from the same aquifer and supplies water to the Main Site system when demand exceeds the capacity of Well W-1. Since January 28, 1987, the Village drinking water has been supplied from Warrenville, the neighboring community to the east. Well W-5 in Figure 7, became operational in November 1988, supplying water to the Colliding Beams Experiment Facility at D0. Seven additional shallow water wells serve individual buildings at outlying facilities onsite. These are wells formerly associated with the farm sites that existed when the land was acquired for the Fermilab site.

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The Main Site system is chlorinated at the Central Utility Building (CUB) when Well W-1 is providing water. The alternate supply source, Well W-3, has its own reservoir and chlorinator. The system at D0 is also a chlorinated system but uses sodium hypochlorite rather than chlorine gas. The chlorine level in these drinking water supplies is tested each workday. The average daily use from Well W-1 and Well W-3 combined was approximately 69,430 gallons during CY-1992. Well-5 supplied an average of 1211 gallons/day to D0, while an average of 59,379 gallons was purchased daily from Warrenville for the Fermilab Village.

2.7 Subsurface Characteristics of the Site

A number of studies have documented the subsurface characteristics in the vicinity of the Fermilab site (DOE88, Pf74, Sa82, Vi85, Vi88). The upper geology of the site is characterized by 60 to 100 feet (18.2 - 30.5 m) of glacial till overlying bedrock of Silurian dolomite (Sa82). Beneath this upper bedrock are older sedimentary formations of Cambrian and Ordovician dolomite and sandstone. The lower bedrock units are effectively confined from the upper bedrock by the Maquoketa shale group.

The till unit is composed primarily of low permeable clays interspersed with areas of higher permeable sand and gravel. The clays act as an impedance to ground water flow through the till, but the sporadic occurrence of the higher permeable regions and the existence of extensive, undocumented drain tile lines from past agricultural use make localized predictions of ground water flow difficult. The water table fluctuates seasonally between 5 and 15 feet (1.5 - 4.6 m) below the ground surface. This region and the fractured upper 10 feet (3 m) of the Silurian dolomite formation yield sufficient quantities of water for private production wells.

The direction of natural ground water flow beneath Fermilab is generally toward the south/southeast. Flow is heavily influenced, however, by ground water extraction wells used to supply drinking water to the majority of the site. Figure 8 is a piezometric contour map for this aquifer. The well at F62 is no longer in production and is currently slated for decommissioning. Well W-3 is maintained for backup supply to W-1, which is now the primary water supply and influence on the piezometric contour. A new well, Well W-5, was installed in the southeast corner of the Main Ring to supply the D0 Experimental Hall. Its influence on the piezometric contour has not yet been mapped. The Village area in the east part of the site is supplied by groundwater from the City of Warrenville distribution system. The majority of ground water supplies used in community systems surrounding the Fermilab site are withdrawn from the sandstone aquifer in the Cambrian/Ordovician formations at depths of approximately 1200 feet (366 m). Recent changes to the use of surface water supplies drawn from Lake Michigan by communities east of Fermilab is reducing the demand on these lower formations. The shallow Silurian dolomite aquifer is used heavily to supply water to private wells in the area. In the past heaviest withdrawals have occurred in DuPage County, east of Fermilab, where the estimated 1984 pumping rates (not including rural domestic and livestock wells) exceeded the withdrawal rate

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from the deeper Ordovician aquifer (Ki85). Quarry operations and heavy pumping for general use have partially dewatered large areas of the Silurian dolomite formation.

2.8 Demography

Fermi National Accelerator Laboratory is located in the densely populated Chicago area. There are about eight million people living within 50 mile (80 km) of the site. There are 483,325 people within 10 miles (16 km) of the center of the Main Ring Accelerator, based on the 1990 census results. The detailed distribution of population as a function of distance and direction from Fermilab is given in Table 7 (Wi92). The population distribution close to Fermilab, according to the 1990 Census, is shown in Figures 3 and 4. The 1990 census results reveal that communities in the vicinity of Fermilab continued to experience significant population growth between 1980 and 1990. Adjacent to the Laboratory boundaries are the cities of Batavia, Warrenville, West Chicago, and Aurora.

3.0 COMPLIANCE SUMMARY

This summary addresses the status of compliance with applicable regulations at Fermi National Accelerator Laboratory.

Clean Air Act (CAA) - The major Federal Law regulating the air emissions of the Department of Energy's (DOE's) processes and facilities is the Clean Air Act (CAA). Fermilab has ten air pollution permits covering seven non-radiological and three radiological emission sources onsite. Table 3 summarizes Fermilab air pollution permits. Four existing permits were renewed during CY-1992. Based on process knowledge there were no known instances of noncompliant air emissions on or offsite in CY-1992.

National Ambient Air Quality Standards (NAAQS) - Under the authority of the CAA and its amendments, the Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards for concentrations of the criteria pollutants: sulfur dioxides, particulate matter, carbon monoxide, ozone nitrogen oxides, and lead.

Clean Air Act Amendments of 1990 (CAAA) - The Clean Air Act Amendments of 1990 authorized the EPA to designate non-attainment areas for ozone, carbon monoxide, and particulate matter, and to classify them according to severity. Classification triggers State control requirements to bring non-attainment areas into attainment by specified dates. Fermilab is located in an area that has been designated a "Severe-17" non-attainment area for ozone.

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National Emissions Standards for Hazardous Air Pollutants (NESHAPs) - The National Emissions Standards for Hazardous Air Pollutants have been established to control emissions of listed hazardous air pollutants (e.g., radionuclides, asbestos). Fermilab has obtained Illinois Environmental Protection Agency (IEPA) operating permits for the construction and operation of onsite radiological emission sources. There are no major NESHAP release points at Fermilab that require continuous monitoring under 40 CFR 61.93 (b). Beam tunnel ventilation stacks are minor sources of radionuclide emissions and are therefore subject to periodic confirmatory monitoring requirements. In CY-1992, the only radionuclide air emissions at Fermilab were those related to the operation of the Collider and its antiproton source. The releases from the Anti-Proton stack were continuously monitored. A program of confirmatory measurements is planned for the next fixed target mode run in 1994, when other minor sources will be identified. Although a Specific Quality Implementation Plan (SQIP) addressing the measurement and reporting of air emissions was completed in CY-1992, the Quality Assurance Program does not yet completely meet the requirement of Appendix B (Method 114) of 40 CFR 61. Full compliance is expected by the end of CY-1993. Radiological air emissions are reported annually to the United States Environmental Protection Agency (USEPA) and to the Department of Energy (DOE).

An application for a permit to construct a modified NESHAP source was submitted for the Fermilab Main Injector. While an IEPA permit to construct this new source of radionuclide emissions was granted by the IEPA in April 1991 and by the USEPA in May 1991, because a continuous program of construction or development had not started by the expiration date of that permit, a modification to extend the expiration date was sought and approved in January 1992.

NESHAP Asbestos Removal Program - While the NESHAP standard does not set a numerical threshold for asbestos fiber emissions, it requires those conducting asbestos-related activities, such as demolition and renovation, to follow approved procedures, and to adopt specific work practices to prevent release of asbestos to the air. A team of Fermilab employees is trained in the proper methods of asbestos removal. Asbestos is properly removed and disposed of during maintenance and renovation of equipment and buildings.

Clean Water Act - Under the authority of the Clean Water Act (CWA), the United States Environmental Protection Agency (USEPA) has promulgated regulations for monitoring liquid effluent discharges to surface water bodies and to publicly-owned treatment systems. Under Section 402 of the Act, the National Pollutant Discharge Elimination System (NPDES) is established, whereby facilities that directly discharge pollutants to the waters of the United States must obtain a permit to do so. The USEPA has delegated the authority to implement this program to the Illinois Environmental Protection Agency (IEPA). Fermilab operations result in a discharge of cooling, storm, and certain treated waters to the surface waters onsite. Accordingly, Fermilab submitted a preliminary application to the IEPA for a NPDES permit to discharge non-process, non-contact, cooling water on April 21, 1992. The application is being supplemented with information on stormwater discharges from identified solid waste management unit sites being

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investigated under the Resource Conservation and Recovery Act Facility Investigation (RFI). In October 1992, Illinois published a General NPDES Permit for discharge of stormwater associated with construction activities. The Laboratory notified the IEPA of its intention to be covered under this general permit as of October 1, 1992, and as required, a Stormwater Pollution Prevention Plan was developed for the Main Injector project, a construction activity involving disturbance of more than five acres.

A pretreatment permit application has been prepared for the Central Utility Building regeneration process and has been submitted to the City of Batavia. It will be submitted to the IEPA requesting approval to release a treated effluent to the Batavia sanitary system. The acquisition of this permit, along with the many improvements made to the regeneration process, should make it possible to discharge this effluent to the sanitary sewer, allowing the closure of the Class V injection well that currently receives the effluent.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) -- Title I - The CERCLA legislation establishes a program to identify sites where hazardous substances have been released into the environment and to ensure the cleanup of these sites. The intent of CERCLA is to provide for response to and cleanup of environmental problems that are not adequately covered by the permit programs of other environmental laws including the CAA, CWA, SDWA, and RCRA. CERCLA site notification was filed for two sites at the Laboratory: the Meson Hill where asbestos was deposited from 1970 to 1980, and the old Main Ring Perforated Pipe Field where chromate contamination associated with cooling tower "blowdown" containing zinc chromate was discharged from 1974 to 1976. A preliminary assessment report on the Main Ring Perforated Pipe Field was submitted to the USEPA in CY-1990. Further investigation of both of these sites has been included in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan, prepared as a condition of obtaining our Part B permit. More information about the RFI is included in the RCRA discussion.

Endangered Species Act and the Fish and Wildlife Coordination Act - The Endangered Species Act of 1973, as amended, provides for the designation and protection of wildlife, fish, and plants in danger of becoming extinct. The act also conserves the ecosystems on which such species depend. In conjunction with the Fermilab Main Injector (FMI) Environmental Assessment, numerous field surveys were conducted at the proposed project site. Findings indicated that there were no state or federally listed endangered or threatened species that would be affected by construction. No compliance issues were identified in CY-1992 at Fermilab.

Executive Order 11988, "Floodplain Management" - This order was established to avoid long- and short-term impacts associated with the occupancy and modification of floodplains. Planning for the Fermilab Main Injector, located in a floodplain, addressed the requirements of Executive Order 11988. A public notice of "Floodplain and Wetland Involvement Notification for Proposed Construction of the Main Injector at Fermi National Accelerator Laboratory, Batavia, Illinois," was published in the Federal Register on June 11, 1991. Approximately 40.9 acre-feet of

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floodwater storage volume has been provided to compensate for the floodplain areas to be disturbed in future FMI construction activities. Evaluation of the impact of Fermilab activities on floodplains is ensured through the NEPA process. A Tiger Team finding has required that this program and its implementation be formalized.

Executive Order 11990, "Protection of Wetlands" - Executive Order 11990 was established to ensure that adverse impacts of wetlands are avoided when possible and responsibly mitigated when construction activities involve the destruction of wetlands. Pursuant to permit requirements, a Wetland Mitigation Action Plan was prepared for the FMI project and approved by the United States Corp. of Engineers. Approximately 10.3 acres of new wetlands have been constructed to replace the wetlands that will be lost in the FMI construction. Evaluation of Fermilab activities in wetlands is ensured through the NEPA review process. A Tiger Team finding has required that this program and its implementation be formalized.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) - This act applies to storage and use of herbicide and pesticides at Fermilab. It restricts the application of pesticides through a certification program. Fermilab controls pesticide use onsite and requires that certified applicators oversee the application of these substances. In CY-1992, the use of pesticides/herbicides at Fermilab were handled in accordance with FIFRA.

The Migratory Bird Treaty Act - An ornithologist was employed to prepare recommendations and precautions for the protection of a great blue heron rookery that existed inside the Fermilab Main Injector site. Although this area will not be directly disturbed by construction activities, these recommendations and precautions ensure that the project will have no significant impact on the heron rookery or on other migratory birds. The herons did not return to the rookery at the FMI site in CY-1992, nesting instead at a new site in the center of the Main Ring.

National Environmental Policy Act (NEPA) - This act requires the evaluation of proposed federal activities for their potential environmental impacts and the examination of alternatives to those actions. These evaluations are to be reported in documents such as Environmental Evaluations (EEs), Environmental Assessments (EAs), or Environmental Impact Statements (EISs). In February 1990, the Secretary of Energy issued SEN-15-90, which specified increased formality in reviewing all DOE actions under NEPA. A Final Rule and Notice for "NEPA; Implementing Procedures and Guidelines Revocation" was published in April 1992 (57FR15122). Fermilab has responded to the procedures specified by DOE by implementing a program of reviewing all of its activities for NEPA compliance. In CY-1992, 14 requests for categorical exclusions were submitted to DOE. Of these, all were approved. The Environmental Assessment prepared for the Fermilab Main Injector project resulted in a Finding of No Significant Impact (FONSI).

National Historic Preservation Act (NHPA), Archaeological Resources Protection Act - Compliance with these Acts was accomplished through the NEPA review process which included an evaluation of all proposed land-disturbing projects in CY-1992 to assess any potential impacts on cultural resources. No new compliance issues were identified in CY-1992. The Tadpole site in the vicinity of the Fermilab Main Injector was re-evaluated by a consultant archaeologist to confirm that the proposed location of cooling ponds would not disturb the site. The Illinois Deputy State Historical Preservation Officer determined in CY-1991 that the FMI project would have no effect on historical properties listed on, or eligible for the National Register of Historic Places (NRHP).

Resource Conservation and Recovery Act of 1976 (RCRA) - This act provides for the safe treatment and disposal of hazardous waste and regulated hazardous waste management practices for generators, transporters, and owners and operators of treatment, storage, and disposal facilities. Generators of hazardous waste, such as Fermilab, must follow very specific requirements for handling these wastes.

RCRA required that owners and operators of interim status hazardous-waste management facilities obtain operating permits for many waste management activities or officially initiate closure for the units by November 8, 1992. Fermilab received a RCRA Part B operating permit for building WS-3 at the Fermilab Hazardous Waste Storage Facility (HWSF) on October 28, 1991. Fermilab submitted a revised closure plan for the Site 55 Hazardous Waste Storage buildings WS-1 and WS-2 in March 1992. Subsequent IEPA comments resulted in modifications to the closure plan. The revised closure plan was resubmitted and received final approval in February 1993.

As a condition of the RCRA Part B permit, a RCRA Facility Investigation (RFI) is required. The purpose of the RFI is to investigate whether hazardous constituents have been released to the environment from 15 identified Solid Waste Management Units (SWMUs) located onsite. A Phase I Workplan for this investigation was prepared and submitted to the IEPA in February 1992. Subsequent IEPA comments have resulted in modification to the workplan. Fermilab is currently awaiting comments or approval of the revised RFI workplan.

In May 1991, DOE issued a moratorium prohibiting the offsite shipment of RCRA-hazardous and TSCA-regulated waste originating in radioactive material management areas to commercial facilities not licensed by the Nuclear Regulatory Commission or an Agreement State. To lift this moratorium, DOE requires that Fermilab prepare and obtain DOE approval of a release criteria developed following DOE Performance Objective guidance. Fermilab submitted this documentation and has most recently received DOE/EM comments on March 9, 1993. DOE/EM-30 has continued, on a case-by-case basis, to allow the Lab to remain in compliance with hazardous waste regulations by allowing exceptions and approving offsite shipments during CY-1992. Five such shipments were made in CY-1992. It had been suggested that Fermilab modify its RCRA Part B permit to allow permitted storage of moratorium waste. Fermilab decided not to expand its permit for the storage of hazardous waste due to the pending approval of Fermilab's release criteria and DOE's approval to ship on a case-by-case basis.

There are four remaining underground storage tanks onsite. The Laboratory continues to monitor two underground storage tanks (USTs) at Site 38 for petroleum releases through monthly inventory control measures and annual tank tightness testing. The removal of two other USTs at the Central Utility Building is anticipated in CY-1993.

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Safe Drinking Water Act - The Safe Drinking Water Act (SDWA) of 1974 was established to provide safe drinking water to the public. To comply with this Act, the EPA has established National Primary Drinking Water Regulations (NPDWR) applicable to public water supplies. These regulations set maximum contaminant levels (MCLs) on bacteriological, chemical, and physical contaminants that may have an adverse effect on consumer health if found in public water systems. Illinois has obtained primary responsibility for enforcement and administration of national SDWA regulations by adopting the NPDWRs through the Illinois Environmental Protection Act. Primary responsibility for the drinking water portions of the State Act has been delegated to the IEPA. In Illinois, non-transient, non-community wells (NTNC) are regulated by the Illinois Department of Public Health (IDPH). Fermilab provides drinking water to its employees through three public water supplies, two NTNC supplies and a satellite supply connected to the City of Warrenville public water supply.

Fermilab public water supplies were sampled for bacteriological and chemical contaminants in CY-1992. One coliform violation occurred at the D0 water supply in August of 1992. This issue was resolved with resampling. The Main Site public water supply was sampled in July 1992, October 1992, and January 1993 for volatile organic chemicals (VOCs) as required by the Phase II NPDWR. The D0 and Main Site supplies were also sampled for chemicals in November 1992. There were no instances of non-compliance in chemical sampling results.

A water sample was taken from a utility sink at C0 Service Building to investigate a concern of possible organic contamination of the water. Well 55 a semi-private water supply, provides water to C0 Service Building and buildings at Site 55. The tap sample indicated slightly elevated benzene levels. Subsequent resampling of water from the wellhead and at Site 55 buildings failed to show detectable levels of benzene. Meanwhile, as investigations continue, the carbon absorption filters that have been installed on the waterlines to C0 have successfully eliminated organics in the water.

Lead and copper sample site plans were submitted to the IEPA in February 1992 and then resubmitted in a new format as requested by the IEPA in February 1993. The plans were accepted by the IEPA in March 1993 with lead/copper sampling to begin in April 1993. An IEPA Engineering Evaluation was performed for the Village, D0, and Main Site public water supplies on May 20, 1992. The engineer found the D0 and Village water supplies to be "in general compliance with regulatory requirements." We have not yet received the report on the Main Site evaluation.

Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) or SARA TITLE III - This act was designed to address concerns about the effect of chemical releases on communities. These regulations require us to provide the EPA and state officials with an annual accounting of hazardous chemicals and extremely hazardous chemicals used or stored in quantities greater than a given threshold. Annual reports are submitted as required.

Toxic Substance Control Act (TSCA)-The application of TSCA requirements to Fermilab involves the regulation of PCBs and asbestos. At twenty-four sites around the Main Ring, transformer oil containing 2-5% PCBs was drained onto the ground as part of past sampling procedures to verify that dielectric properties had not deteriorated. A characterization study was conducted at two of the buildings in FY 1989-1991. Because these were "historical spills" that occurred prior to the effective date of USEPA's PCB spill cleanup policy, criteria for cleanup will be established at the discretion of EPA Region V, in accordance with 40 CFR 761.120(a)(1) and possibly CERCLA. With Region V's agreement, a consultant was hired in FY 1991 to conduct a risk assessment to assist EPA in determining criteria for cleanup as well as an appropriate schedule. The consultant's report indicates that there is very little risk to the public from the contamination in its current configuration, since it is contained in relatively small volumes, does not appear to be migrating, and is located in areas for which public access is restricted. In February 1993, the consultant's report was transmitted to EPA for review and comment. Fermilab proposes to decontaminate the service building transformer sites at a rate of about two buildings per year, which can probably be accomplished within expected budget limitations and without interfering with accelerator operations.

Fermilab's program to phase out PCBs in the Main Ring transformers and to eliminate them as potential PCB spill sources by retrofilling and/or chemical detoxification continues. In FY 1992, two transformers were disposed and 15 others were chemically treated by a process that destroys PCBs while allowing the units to remain in service. In one case, treatment was not completely successful and will be repeated by the subcontractor during the summer of 1993. Formal reclassification of 27 transformers, completed during early 1993, leaves 8 PCB transformers and 1 PCB-contaminated transformer in the Main Ring. The contaminated unit will be reclassified to non-PCB status after further treatment, and the others will be disposed of in FY 1996 when the accelerator is shut down for construction of the Main Injector interface enclosures.

3.1 Current Issues and Actions - A Summary for January 1 through April 1, 1993

Efforts to address environmental protection issues are continuing in CY-1993 including the following:

Representatives from Fermilab met with the IEPA on January 25, 1993 in order to reach consensus on outstanding issues regarding the NPDES permit application submitted in April 1992. Agreements were reached concerning the characterization of sampling outfalls and the amendment of the original application. Additionally, Fermilab agreed to provide the IEPA with analytical information on the stormwater runoff from our RCRA-permitted facility and several Solid Waste Management Units (SWMUs) where sampling was feasible. A consultant was employed to carry out the sampling.

An ad hoc groundwater committee has been formed to reevaluate the current method used to model the migration of radionuclides from activated soil to groundwater and to propose a new model for making those calculations. An environmental consulting firm specializing in groundwater migration studies has been

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commissioned to assist the committee in this study. The initial emphasis was on a thorough examination of available literature and site-specific hydrogeologic data. Hundreds of boring logs were reviewed and fence diagrams were constructed to characterize the geologic regime. A water table map was developed using the existing well data. Hydrogeologic properties were established using the aforementioned information in conjunction with extensive regional and site-specific geologic and hydrogeologic literature. Upon completion of this portion of the study, the consultant will model the migration of tritium from the source points using computer programs designed to model groundwater transport.

Other sections of this report document continued environmental monitoring efforts and progress in the solution of the problems described in this chapter. Especially pertinent are efforts to address the recommendations of the DOE Tiger Team Assessment conducted in May 1992.

We anticipate receiving IEPA's comments on the RFI workplan soon. Once we have reviewed their comments, we plan to meet with the IEPA to resolve any remaining concerns before the workplan is initiated.

We are currently in the midst of closure activities for Hazardous Waste Storage Facilities WS-1 and WS-2. Completion is anticipated by September 1, 1993.

In February 1993, notification was provided to the IEPA regarding Fermilab's hazardous chemical inventory. This is required under Section 312 of SARA.

DOE gave approval to proceed with the preparation of an Environmental Assessment for the construction of a radioactive waste processing building in February 1993. An Environmental Assessment was prepared for the "Kaons at the Tevatron" (KTeV) project and sent to DOE for initial review in April 1993.

3.2 Appraisals and Assessments

The Tiger Team Assessment Report identified a total of 193 findings and concerns. Two of these were classified as Category II findings by the Safety and Health Team and these were addressed immediately. The remainder were addressed by 246 tasks in a comprehensive Corrective Action Plan (CAP). We are currently awaiting DOE approval of the CAP.

DOE-ER conducted an ES&H Management Appraisal on February 19-20, 1992 in preparation for the Tiger Team.

IEPA RCRA inspections were conducted on February 21, 1992 and January 14, 1993. They included a review of waste manifests, annual reports, training records, the contingency plan , the closure plans, the Part B

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permit, and operating records. Four satellite waste accumulation areas and the Hazardous Waste Storage Facility were visited. No deficiencies were cited.

DOE Chicago Field Office conducted a review entitled "ES&H Assessment of Fermilab" in March and April 1992.

The Magnet Debonding Oven, a permitted air pollution source, was refurbished and emissions were measured in late CY-1992 and early CY-1993.

3.3 Environmental Permits

Fermilab now has 8 operating permits for air pollution emission sources, 2 air pollution permits for open burning, 2 permits to construct/operate public water supplies, and a RCRA Part B permit , all issued by the IEPA. A NPDES permit application has been submitted to the IEPA to cover the discharge of non-process, non-contact cooling water to surface waters. Other permits have been obtained in conjunction with the construction of the Fermilab Main Injector, including a general NPDES permit for stormwater releases related to construction activities. The air pollution permits cover radionuclide emissions associated with the operation of the Tevatron, the operation of 8 boilers used for heating buildings, a vapor recovery system on gasoline dispensing tanks, 2 vapor degreasers, and a grit blaster. The open burn permits cover the conduct of prairie burning in connection with land management and the large-scale prairie reconstruction project, and the burning associated with firefighting training. Recent inspections by IEPA and the USEPA have identified no noncompliances with conditions of these permits. Permits are summarized in Tables 3 and 4.

4.0 GENERAL ENVIRONMENTAL PROGRAM INFORMATION

4.1 Environmental Program Description

The National Environmental Policy Act of 1969, as amended, mandates the Federal Policy to restore and enhance the environment and to attain the widest range of beneficial use without degradation. Since its inception, Fermilab has endeavored to protect and enhance the environment. A number of programs and organizations exist at Fermilab to ensure compliance with applicable environmental statutes, regulations, and standards. Fermilab operations are monitored to evaluate their impact on the environment.

The emphasis of the routine sitewide monitoring has been placed on potential environmental exposure pathways appropriate to high-energy physics laboratories. These pathways include external exposure and internal exposure. The external exposure potential is from direct penetrating and airborne radiation. The internal exposure pathway is from ^{3}H and ^{22}Na in potential drinking water. There is one unique characteristic at Fermilab which requires closer consideration. Large volumes of sand and gravel were used in two locations to assist in stopping high-energy protons and secondary particles. Protection for the groundwater beneath these two areas is afforded by water-impervious membranes or by underdrain systems that were designed to collect the water leaching through activated soil. Radiological monitoring of soil and water in this vicinity has been conducted to evaluate the potential for groundwater contamination. Monitoring results are also reported for nonradioactive pollutants.

4.2 Summary of Environmental Monitoring Performed in CY-1992

Fermilab has a comprehensive sitewide monitoring plan that assesses the effect of past, current, and future Fermilab activities by measuring and monitoring effluents from Fermilab operations and by surveillance through measuring, monitoring and calculating the effects of those operations on the environment and public health. Monitoring is conducted to verify compliance with applicable Federal, State, and local effluent regulations and DOE Orders; to determine compliance with commitments made in Environmental Assessments, and other official documents; to identify potential environmental problems and to evaluate the need for remedial actions or mitigative measures. Determination of sampling frequency and type is based upon specific facility needs. Sampling is conducted in a manner that adequately characterizes effluent streams. Standard collection and analysis methods are used where applicable and are documented in the Environmental Protection Procedures Manual. The Fermilab environmental and effluent radiological monitoring program attempts to follow the guidance given in the Department of Energy (DOE) 5400 series of Orders (DOE 90d) and in the guidance Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 91). This includes adherence to the standards given in other existing DOE orders. The Environmental Protection Group in the Environment, Safety, and Health Section is the Laboratory organization who is responsible for the routine environmental monitoring program at Fermilab.

Fermilab performed extensive environmental monitoring in CY-1992, to measure three phases of accelerator-produced radiation: penetrating, airborne, and waterborne. During this year of operation the predominant source of offsite penetrating radiation was due to the storage of radioactive materials at the Railhead. Radioactive air emission sources were monitored for ^{11}C, ^{13}N, ^{38}Cl, ^{39}Cl, ^{41}Ar, and ^{82}Br as continuously operating stack monitors recorded the concentration released. Surface water and groundwater samples were analyzed to determine concentrations of tritium (^{3}H) and other accelerator-produced radionuclides, ^{22}Na, ^{7}Be, ^{60}Co, ^{45}Ca, and ^{54}Mn. The fraction of the year the water left the site was determined by weekly inspections of the Kress Creek spillway. Additional monitoring for radionuclides in soil and sediment on the site was conducted to investigate other possible pathways to the offsite environment.

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Data on radioactive effluents was reported to the Department of Energy via the Effluent and Onsite Discharge Information Systems (EIS/ODIS) operated for the Department of Energy by EG&G, Idaho.

Monitoring results during operations in CY-1992 indicated compliance with the applicable standards in every case. In particular, the highest site boundary penetrating radiation level was much less than 1% of the 100 mrem (1m Sv) relevant standard in CY-1992. Airborne radionuclide concentrations at the site boundary were so low as to be immeasurable. Low levels of tritium were detected (<1.0 pCi/ml) for the first time in two of three creeks leaving the site. See Section 8.0 for applicable standards.

Monitoring for bacterial and chemical pollutants in onsite drinking water systems was accomplished in CY-1992. Public water supplies were sampled monthly for coliform in accordance with the sampling plan submitted to IEPA. One coliform violation occurred.

Samples from three surface water outfalls were analyzed for a number of parameters in conjunction with the NPDES application. At IEPA's request, in April 1993 stormwater runoff samples were taken at specified SWMUs and at the RCRA Part B permitted facility.

Analysis of water from wells installed to monitor the Central Utilities Building (CUB) Tile Field showed both radiochemical and chemical constituents.

4.3 Description of Environmental Permits

A list of Fermilab's environmental permits, including current issue and expiration dates can be found in Table 3.

Emco Wheaton coaxial vapor recovery systems have been installed on all gasoline dispensing equipment at Fermilab under a permit (I.D. No. 043807AAI, Application No. 86020057) issued by the Illinois Environmental Protection Agency (IEPA).

Fermilab has an IEPA permit (I.D. No. 043807AAI, Application No. 87110096) for three natural gas boilers at the Central Utility Building (Figure 2), two natural gas boilers at the Wide Band Lab in the Proton Area (Figure 2), and one propane gas boiler at Industrial Building #2 in the Industrial Area (Figure 1). A grit blast operation at Industrial Building #2 is also included on this permit. This permit was renewed September 9, 1992.

Fermilab has a permit (I.D. No. 043807AAI, Application No. 89090071) for two natural gas fired hot water boilers, one at Lab A (Neutrino Area) and the other at the Meson Detector Building.

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Fermilab has renewed a permit (I.D. No. 043807AAI, Application No. 88010042) for the operation of an open top vapor degreaser at Industrial Building #3 in the Industrial Area. Also a permit to construct and operate an open top vapor degreaser in the Transfer Hall South (I.D. No. 043807AAI, Application No. 91100025) was obtained in CY-1991.

The magnet debonding oven and its associated afterburner has an Illinois Environmental Protection Agency permit (I.D. No. 043807AAI, Application No. 79070012). This oven is a potential source of radionuclide emissions. This facility debonds failed magnets prior to repair by decomposing epoxy at a high temperature (800°F). This oven did not operate in CY-1992.

Fermilab also has an IEPA permit (I.D. No. 043807AAIAAD, Application No. 89080089) for radionuclide emissions associated with accelerator operations and also for construction of the FMI (I.D. No. 043807AAI, Application No. 91030001).

Fermilab has renewed an IEPA air pollution open burning permit (I.D. No. 043807, Application No. B9208029) for prairie and land management. Burning occurred on a number of the prairie tracts. Open burning was conducted in such a manner as not to create a visibility hazard on roadways, railroad tracks, or airfields. Other standard conditions for open burning were also carried out. Because of the large size of the Laboratory property (6800 acres), the smoke from the fire caused no offsite problems.

Also, Fermilab has an IEPA permit (I.D. No. 043807, Application No. B9212022) to allow burning of one gallon of motor fuel per session of firefighting instruction.

Fermilab has obtained a permit (IEPA 0890105010; USEPA IL6890030046) under the Resource Conservation and Recovery Act (RCRA) (Part B Permit) to operate the onsite Hazardous Waste Storage Facility. Regulated chemical wastes are stored in this facility, as well as a limited quantity of radioactive mixed waste. Typical regulated chemical wastes are hazardous wastes, polychlorinated biphenyls (PCBs), and used oil. Wastes generated by Fermilab are stored at the facility until proper off-site disposal can be arranged.

In 1991 a permit was received from the IEPA to construct a second water supply line from Warrenville to the Fermilab Village (ID# 0099).

The Lab has a permit from the Illinois Department of Public Works (Permit No. 12170) that allows water to be taken from the Fox River for use onsite.

In 1988, a construction/operating permit was obtained for the public water supply at D0.

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No permit was needed for the septic field installed near D0 (north of W-5 in Figure 7). It was classified as a Class 5W32 injection well in CY-1988. The CUB tile field (Figure 2) was also classified as a Class 5W20 injection well in the same year.

Fermilab has submitted an application to the IEPA for a sitewide NPDES permit governing the release of storm, and non-process, non-contact cooling water to surface waters. A Notice of Intent to be covered under the State's General Permit for the Discharge of Stormwater Associated with Construction Activity was filed prior to the October 1, 1992 deadline.

4.4 Fermilab Main Injector Project

The groundbreaking ceremony for the Fermilab Main Injector (FMI) project was held on March 22, 1993. Based on the Environmental Assessment (EA), DOE determined that the construction and operation of the FMI did not constitute a major Federal action significantly affecting the quality of the human environment and issued a Finding of No Significant Impact (FONSI) on July 6,1992, with the wetland mitigation commencing soon thereafter. The FMI project is being constructed in accordance with a Mitigative Action Plan (MAP) approved by the COE.

In CY-1992 the FMI project did not create any negative environmental consequences not already anticipated in the EA and the FONSI. Favorable weather conditions in the fall allowed the completion of all of the planned earthmoving work in the wetland/floodplain. The sedge meadow needed to be relocated when the soil in the original location was found to be unsuitable. This change was made after receiving COE approval. Although fall seeding for soil erosion was accomplished in accordance with the Stormwater Pollution Prevention Plan, heavy rains delayed planting of the newly created 8 acres of wetland until spring. Spring planting is now underway and a five year monitoring program, as required by the COE, is being implemented. The FMI is scheduled for completion in 1997.

4.5 Pollution Prevention Awareness and Waste Minimization

In Illinois, pollution prevention has been encouraged through passage of the Toxic Pollution Prevention Act (TPPA) in 1989, the Solid Waste Management Act, and most recently with the Illinois Pollution Prevention Act of 1992. This year a Waste Minimization Subcommittee was formed at Fermilab to discuss, review, suggest, and implement waste minimization ideas. Equipment to recover Freon from air conditioners, chillers and refrigerators has been purchased and personnel have been trained in its use. Products containing methylene chloride were removed from the stockroom. Purchase orders for chemicals are being reviewed in an effort to encourage accountability for hazardous chemicals used on site. Freon 113 is being

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replaced with water/surfactant systems where feasible. In conjunction with EPA's 33/50 Program, toxic air pollutant chemicals (e.g. methyl chloroform) are being replaced with less hazardous chemicals (Micro cleaner and water). Fermilab is developing a video to heighten awareness about pollution prevention. Unneeded chemicals are being surplused to encourage use.

Waste minimization certifications and waste reduction reports were included, as required by RCRA, in the annual Hazardous Waste Report submitted to the IEPA.

4.6 National Environmental Research Park (NERP)

During CY-1992, three National Environmental Research Park projects were completed, five new projects were approved by the Environmental Advisory Committee (EAC), and four projects continued (Table 8). These projects will add to the accumulation of baseline data on the site and address land management and specific ecological questions.

Planning continued for the N-3 Experimental area project, a twenty-year project (RS016) to create a large series of replicated plots for the study of prairie and grassland ecosystem processes. Seed selection and planting plans were finalized for the planting of the first four areas in RS016 in Spring 1993. A comprehensive survey of plant community characteristics, especially within the prairie restoration project, was initiated. Over 2000 individual plant samples were recorded.

4.7 Environmental Training

Fermilab personnel involved in hazardous waste management operations receive training which is tailored to their particular needs. Hazardous Waste Storage Facility personnel are trained in accordance with the requirements identified in the Part B RCRA storage facility operating permit. Waste Coordinators also received training in CY-1992. Fermilab personnel expected to identify and respond to spills are trained annually in the contents of the Spill Prevention Control and Countermeasures (SPCC) Plan.

4.8 RCRA Facilities Investigation (RFI)

Fermilab was issued a RCRA Part B Permit for its Hazardous Waste Storage Facility (HWSF) by the Illinois Environmental Protection Agency (IEPA) on October 28, 1991. This permit allows the HWSF to store certain specified hazardous wastes for greater than ninety (90) days. Prior to granting the Part B Permit, the IEPA performed a RCRA Facility Assessment (RFA) of Fermilab. During the RFA, the IEPA identified onsite solid waste management units (SWMUs) and has required that seventeen (later consolidated to fifteen) of these be addressed in an RFI to determine if any require corrective action to protect human health and the environment

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from the potential release of any of the hazardous constituents listed in Appendix H of 35 Illinois Administrative Code Part 721. PRC Environmental Management was selected through a competitive bidding process to initiate the RFI. RFI work began in November 1991 and an RFI Work Plan was submitted to the IEPA in February 1992. Subsequent IEPA comments have resulted in a revised workplan which is currently under IEPA review.

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

Three types of accelerator-produced radiation are monitored: penetrating radiation, airborne radioactivity, and waterborne radioactivity. These radiations could have direct pathways to the offsite population. Other more indirect and improbable pathways, such as through the food chain, have received much less attention. The decision to monitor is based on the type of operation, the radionuclides released, the potential hazard, and experience from previous monitoring results here and at other high-energy physics laboratories.

5.1 Penetrating Radiation

A network of detectors is used to monitor penetrating radiation. Typically, there are approximately 100 detectors deployed around the site with the primary purpose of monitoring onsite radiation. The majority of these detectors are connected to a data logger which automatically records the radiation levels for subsequent examination (Aw71). In CY-1992, three detectors logged information for possible use in environmental radiation monitoring. One was a large volume, 110 liter, ionization chamber (called a Hippo) used to detect gamma rays and charged particles at its location near the Boneyard at the Railhead (Figure 2). Another Hippo was located at Site 3 (Figure 2) near the site boundary. The last was a tissue-equivalent ion chamber located at 14 Shabbona in the Village (Figure 2). Approximately 70 environmental TLDs were exchanged and read each quarter, providing additional information on radiation levels sitewide and at the site boundaries.

During CY-1991, the Tevatron was operated in the Fixed Target mode. The CY-1991 Fixed Target run of the Tevatron actually extended through the first few days of January 1992. Only approximately 5% of the Fixed Target operations during the run, as measured by the integrated Tevatron beam intensity delivered to the experiment areas, occurred during the first few days of CY-1992. The environmental dose equivalents due to these few days of operations were included in the totals given for CY-1991.

The Collider running mode was operative for the remainder of CY-1992. Because above ground muon fields during Collider operations are minimal, the primary contribution to offsite radiation exposure in CY-1992 was from gamma rays emitted from radioactive material stored at the Railhead. Activated accelerator components and shielding, primarily iron and concrete, are stored in the Boneyard at the Railhead (Figure 1) for

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future disposal or for reuse following radioactive decay. As shown in Figure 2, the Boneyard lies close to the site boundary. In 1987 radioactive material was moved into a cave constructed at the southwest corner of the Boneyard. In addition, there is an area nearby designated for storage of equipment for future use. A large amount of this equipment contains low-level, beam-induced radioactivity. The site boundary dose for CY-1992 was determined using measurements made with thermoluminescent dosimeters (TLDs) and the large volume ion chamber (Hippo) at the Railhead. Previously obtained measurements made with a hand-held NaI (Tl) scintillator were used to establish the rate of decrease with distance (Cu89) in order to extrapolate a site boundary dose. The dose equivalent at the nearest point on the site boundary was estimated to be 1.45 mrem (1.45×10^{-2} mSv) for CY-1992. The maximum dose to the individual living closest to that point on the site boundary would have been 0.30 mrem (3×10^{-3} mSv) for CY-1992, assuming 24 hour per day occupancy. Since the distance from the site boundary to the residence is 1500 ft (460 m), the dose to a member of the public from the Boneyard was lower than the site boundary (fence line) dose.

The muon fields on and near the Fermilab site boundary are measured using scintillation counters mounted in a vehicle, the Mobile Environmental Radiation Laboratory (E188a, E188b). The raw data consists of measurements of the normalized muon fluence (muons/cm^2 per 10^{12} protons) obtained during scans conducted transverse to the muon trajectories. The data is based on average counts (background-corrected) in each of two plastic scintillation paddles. The fluence is converted to effective dose equivalent per calendar year by multiplying this normalized fluence by the total number of protons delivered during the year and using a fluence-to-dose conversion factor determined by G.R. Stevenson (St83). This factor has a value of 1 mrem/25000 muons/cm^2 (or 40 fSv-m^2).

During the CY-1992 Collider run, the only potential source of muons was the C0 Abort. The effective dose equivalent at the site boundary due to this source was estimated to be 3.24×10^{-5} mrem (3.24×10^{-7} mSv) by using a record of protons aborted to calculate a potential dose based upon fluence measurements conducted previously.

5.2 Monitoring Airborne Radioactivity

Wherever the proton beam and secondary particles produced by the interaction of the beam with matter pass through the air, radioactivation of air occurs in measurable concentrations. The beam is generally delivered to the targeting areas via evacuated beam pipes. In this way, unacceptable beam loss is prevented by minimizing the interactions of the protons with air. At the target stations, where these beams of protons produce low intensity secondary beams, there are areas where the protons and secondary particles must travel through air. This is why the radioactivation of the air is concentrated at the major target stations. Figure 9 shows the location of principle points of radionuclide airborne emissions related to accelerator operations.

During CY-1992, protons were focused onto a target (Antiproton Source in Figure 9) to produce antiprotons. This target was the only radioactive air emission source. Because this target is heavily shielded and the air volume is small, there were also many thermal neutrons that contributed to the radioactivation of the air. The result was the production of a mixture of primarily ^{11}C and ^{13}N with smaller amounts of ^{38}Cl, ^{39}Cl, ^{41}Ar, and ^{82}Br. The interaction of high-energy secondary particles with nitrogen and oxygen in the air produces the ^{11}C (20 minute half-life) and the ^{13}N (10 minute half-life). The ^{41}Ar, half-life of 1.8 hours, is produced by neutron capture in ^{40}Ar. Air contains about 1% argon which is essentially ^{40}Ar. The interaction of high energy neutrons with argon in the air is probably the source of ^{38}Cl (37 minute half-life) and ^{39}Cl (58 minute half-life) New studies conducted in CY-1992 indicate that Fermilab had previously overestimated its airborne radionuclide emissions due to errors in assumptions about radionuclide composition and in the calibration factor used to convert count-rate to released activity from the stack (Va93). Emissions from the AP0 stack were recorded by a stack monitor equipped with a Geiger-Miller tube. The stack monitor output was logged continuously to record emissions. Table 8 summarizes the airborne radioactivity released due to accelerator operations conducted during CY-1992. This table not only includes releases for monitored stacks, but also contains estimates for unmonitored fugitive releases of airborne radioactivity from the AP0 Target Hall and Service Building.

As can be seen in Table 2, airborne emissions are by far the largest contributor to Fermilab releases of radioactivity. Even so, dose equivalents to offsite populations are well below EPA standards. Site boundary airborne radionuclide concentrations for CY-1992 were calculated using the computer program CAP88-PC, a Gaussian plume diffusion model. Meteorological input is received from the nearest National Oceanic and Atmospheric Administration monitoring station at O'Hare Airport, approximately 27 miles (43 km) away. The maximum effective dose equivalent to a member of the population residing offsite due to CY-1992 Fermilab radioactive air emissions was determined to be 0.00937 mrem (9.37×10^{-5} mSv). This value amounts to 0.094% of the 10 mrem/year (1×10^{-1} mSv/year) limit. With the promulgation of the National Emission Standard for Hazardous Air Pollutants (NESHAP) for radionuclides on December 15, 1989 in 40 CFR 61, Subpart H, this limit replaced the former 25 mrem/year limit. The reported effective dose equivalents due to the release of airborne radionuclides have been calculated for the site boundary assuming the nearest resident to be present at that location. This is conservative given the relatively low population density at this location 800 meters to the south southwest of AP0. Stack monitors use EPA-approved monitoring procedures even though strict conformance with the monitoring requirements specified in the regulations are required only for release points which have the potential of exceeding 1% of the standard (0.1 mrem/year). The collective dose equivalent to the public for CY-1992 for airborne radionuclide emissions was calculated to be 2.27×10^{-2} person-rem (2.27×10^{-4} person-Sv).

The magnet debonding oven was not in use in CY-1992 and therefore was not an emission source for airborne radionuclide release.

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5.3 Groundwater Radiological Surveillance

Radioactivation of soil is possible near the primary beam targeting and beam dump areas. Older targeting stations and dumps have "bathtubs" designed to contain radionuclides produced in these areas and thus prevent their migration to the aquifer. Later design strategies substituted massive concrete and steel shields within beam enclosures to minimize soil radioactivation and groundwater contamination. Many of the groundwater samples are taken from old out-of-service farm wells onsite. Sampling of water supply wells draws water from beneath much of the aerial extent of the site, providing some information on the overall quality of groundwater that reaches this aquifer. It is recognized that this method is only able to measure those contaminants that, after being subjected to dilution, reach the drinking water aquifer in detectable concentrations. This method would not, in a timely manner, detect potential contaminants migrating vertically through the glacial till that overlies the aquifer nor would it see those moving horizontally in sand lenses or in layers within the till. A Fermilab committee, with the assistance of a qualified hydrogeolgic consultant, is researching a new method for modelling radionuclide migration in groundwater Further discussion can be found in Section 3.1 of this report. Groundwater monitoring for radiochemicals has been improved by adding shallow groundwater monitoring in the two areas where soil radioactivation could be a potential source for groundwater contamination. Fermilab's groundwater protection strategies are documented in The Fermilab Groundwater Protection Management Plan (GPMP).

Water samples from approximately 40 onsite wells/monitoring holes are analyzed at least once and as often as four times per year with sampling frequency determined by a well's proximity to areas of soil activation. These samples are analyzed for accelerator-produced radionuclides (^{3}H, ^{7}Be, ^{22}Na, ^{45}Ca, ^{54}Mn, ^{60}Co) at groundwater sensitivities (Table 10). Procedures are documented in the Environmental Protection Procedures Manual (EPPM). Sampling frequency is based on the following rationale:

1) Wells located the closest to areas of maximum soil activation (targets and dumps) and/or those in the direction the water is expected to flow in the aquifer are sampled quarterly (Wells 39A, 43, 45A, 49, 59, 78, 79, 80, S-1059, S-1087, S-1088).

2) The following wells located near the Main Ring or Fixed Target Beamlines are sampled semiannually (Wells W-1, W-5, 5, 17A, 20, 24B, 29, 55B, and S-1089). These are sampled less frequently than those above because of reduced potential for radioactivation.

3) Wells located near the site boundary, backups to more frequently sampled wells, and drinking water supplies other than those already listed are sampled annually (Wells 7A, 12, 52, 56, 58, 64, 68, 74, 75A, W-4, W-3).

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To date, no measurable (Table 10) concentrations of these radionuclides have ever been confirmed in groundwater samples. In all cases, the lower limit of detection has been at least an order of magnitude below the applicable Derived Concentration Guide (DCGs) for accelerator-produced isotopes as taken from the DOE Order 5400.5 and EPA Regulations set forth in 40 CFR 141. The DOE DCGs correspond to the delivery of a committed effective dose equivalent of 4 mrem per year (4 X 10^{-2} mSv per year) to a person drinking only from that source.

5.4 Monitoring Surface Water for Radioactivity

Water collected by underdrains within the beamline"bathtubs" is received in retention pits. Other underdrains collect water from outside "bathtubs" and from around footings of buildings and beam enclosures, discharging it to onsite surface waters via ditches. Radionuclide concentrations are monitored in selected sumps, ditches, and surface waters (Figure 6). An annual routine sampling plan is developed by the ES&H Section Environmental Protection Group in consultation with Accelerator Division and Research Division Radiation Safety Officers. Sample sites are selected for their proximity to target areas, closed loop (recirculating) cooling systems, and areas of soil radioactivation resulting from accelerator operations. Generally speaking, sumps closest to areas of maximum soil activation are sampled most frequently. Although radionuclides associated with Fermilab operations are routinely identified in sumps discharging into ditches onsite, concentrations are well below applicable standards and remain barely detectable (Table 10) in ditch, pond, creek, and lake sampling locations. Samples are taken annually from waterways onsite (Figure 6) including locations where creeks enter and exit the site. These samples are analyzed for accelerator-produced radionuclides (^{3}H, ^{7}Be, ^{22}Na, ^{45}Ca, ^{54}Mn, and ^{60}Co). Sampling procedures are site-specific and are documented in the Environmental Protection Procedures Manual (EPPM).

Casey's Pond and the ditches that receive water from the experimental areas are sampled annually for accelerator-produced radionuclides. Kress Creek is sampled every week that the water is observed leaving site via the Kress Creek spillway. Surface water from the experimental areas (Figure 5) left the site via Kress Creek for approximately 35% of the year in CY-1992.

5.5 EIS/ODIS Reporting

Annual estimates of onsite and offsite releases of radioactive effluents are reported to the DOE through the Effluent Information System/ Onsite Discharge Information System (EIS/ODIS). Three liquid discharge points and three liquid effluent releases were reported for CY-1992. The sumps/retention pit reported as contributing to these discharge points were M01SP3, N01SP4, NW4SP1, and N01RP1. The reported discharge points were the ditches receiving the waters from these sumps and emptying into Kress Creek. A summary of sumps showing detectable (Tables 10) tritium concentrations can be found in Tables 11 and 12.

The total offsite release to surface waters attributable to these sumps, though barely measurable in surface water samples, is calculated based on average radionuclide concentrations found in sumps and estimated sump discharge volumes. In CY-1992 these sumps released an estimated total of 203 mCi (7.5 X 10^9 Bq) of tritium offsite. This is a substantial decrease over the 3646 mCi (1.4 X 10^{11}Bq) of tritium reported in CY-1991. The decreased release can be somewhat contributed to a 28% reduction in water leaving the site in CY-1992 as compared to the previous year. There were no one time releases of waters with concentrations greater than 1000 pCi/ml (37 Bq/ml) of tritium in CY-1992. The mean concentration of tritium during the period of release was less than one percent of the Derived Concentration Guide for prolonged exposure to the general population. Drinking water in the area is taken from wells rather than from the creeks receiving the discharge. Hence, the dose from these releases is negligible.

The AP0 beamline tunnel ventilation stack and unmonitored releases from the AP0 Target Hall and Service Building were reported as EIS/ODIS air effluents in CY-1992.

5.6 Soil/Sediment Sampling

Surface soil samples are collected annually at selected locations. The purpose of the annual soil sampling is to detect the possible build-up of contaminants from the deposition of airborne and waterborne radioactive effluents released from the Lab. An assessment of contributions from operations is made by comparing results from samples collected near release points onsite with those collected from onsite background locations. In addition, results obtained from each location are compared to results obtained from the same location in previous years. In CY-1992 the radiochemical composition of soil/sediment was measured at 13 sample sites. At each ventilation stack location one composite sample of soil was taken. Sampling procedures are documented in the Environmental Protection Procedures Manual (EPPM). The CY-1992 soil/sediment sampling results are summarized in Table 13. The radionuclides ^{60}Co, ^{7}Be, ^{22}Na, ^{57}Co and ^{54}Mn are accelerator-produced and would be expected to be present at these locations. The ^{3}H measured in soil near ventilation stacks is also accelerator-produced. The CY-1992 results showed no unexpected depositions.

5.7 Monitoring Radioactivity in the Central Utilities Building (CUB) Tile Field

Both ^{3}H (12.3 year half-life) and ^{7}Be (53.3 day half-life) are produced in the closed-loop cooling water systems. The ^{7}Be is chemically active and is easily removed from the water by the resins used to maintain water purity. The tritium remains in the cooling water system. The resins are regenerated at the Central Utility Building (CUB). The effluent from this regeneration system is sent to a settling tank for removal of suspended solids and most of the radioactivity before it is sent to a clay tile field (Class 5 underground injection well) inside the Main Ring (see Section 6.4 and Figure 2). Here the discharge percolates into the soil about 2 ft.

(60 cm) below the surface. Trace amounts of accelerator-produced radionuclides were detected in the 1992 CUB Tile Field soil sample (Table 13). Significant gains were made in CY-1991 in improving the CUB resin regeneration process and in cleaning up the effluent. It is hoped that this effluent can be sent to the City of Batavia sewer system. A pretreatment permit application has been prepared and transmitted to the City of Batavia for review and approval. Following approval by the City of Batavia, it will be forwarded to the IEPA.

5.8 A Summary of Assessments of Potential Radiation Dose to the Public

The effective dose equivalent at the site boundary due to the Boneyard was 1.45 mrem (1.45×10^{-2} mSv) during CY-1992 but decreased to only 0.30 mrem (3.0×10^{-3} mSv) at the nearest residence to the north of the site. The maximum effective dose equivalent at the site boundary due to airborne radioactivity was 0.00937 mrem (9.37×10^{-5} mSv) to the southwest of the site. Thus the two principle sources of radiation exposure at the site boundary are located at different places, neither resulting in significant exposure to offsite residents.

The potential radiation dose to the general population from operation of Fermilab in CY-1992 was approximately 2.27×10^{-2} person-rem (2.27×10^{-4} person-Sv). This is summarized in Table 1. This dose was primarily from airborne radionuclides, with a small contribution from penetrating radiation from the C0 Abort and the Railhead. This total is to be compared with a total of approximately 2.4×10^{6} person-rem (2.4×10^{4} person-Sv) to the population within 50 miles (80 km) from natural background radioactivity. Based on typical United States radiation exposures from diagnostic x-rays, nuclear medicine treatments, and other artificial sources an additional 5×10^{5} person-rem (5×10^{3} person-Sv) would be expected for the population within 80 km (50 mile) of Fermilab in CY-1992 (NRC90). (NOTE: Natural background doses taken from this reference (NRC90) include the effects of improved understanding of the indoor radon problem.)

6.0 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

6.1 Criteria Air Pollutant Emissions

Monitoring of criteria air pollutant emissions is conducted in accordance with the requirements of applicable Federal, State, and local regulations authorized by the Clean Air Act (42 U.S.C. 7401, et. seq.), Section 118. Operating permits have been obtained from the Illinois Environmental Protection Agency (IEPA), Division of Air Pollution Control, for all applicable Fermilab sources of airborne emissions (Table 3). Permitted equipment operates as described in the application on file with the IEPA. Operations are, at a minimum, reviewed annually. One review takes place at the time the annual Air Emission Reports is submitted as required by IEPA (Ill. Adm. Code 201.302). Equipment owners/operators are required to ensure that the permitted equipment

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continues to operate and be maintained in accordance with permit conditions. Operations are also reviewed when applying for renewal of an existing operating permit. The annual emissions reports that are submitted to IEPA indicate whether maximum emissions have increased, remained the same, or decreased as compared to operating parameters in the application on file with that agency.

6.2. Cooling Water System Treatment

In addition to the routine chlorination of the Main Site water system and the swimming pool, a chlorination system for the Swan Lake cooling pond system has proved successful in controlling biological fouling of heat exchanger surfaces. Chlorine is added to the cooling water for a period of 30 minutes four times a day at a rate which results in a chlorine concentration of 0.5 ppm as the cooling water leaves the equipment. Only one piece of equipment within the plant is chlorinated at a time. Consequently the concentration of chlorine entering the Swan Lake system is significantly less than 0.5 ppm. Twenty-one hundred pounds (953 kg) of chlorine were used in CY-1992.

As the chlorinated Swan Lake cooling pond water is passed through the cooling system, a surfactant, Nalco 7349, is added to lift deposits from the metal surfaces, allowing them to be oxidized by the chlorine thus assisting in limiting biological fouling. Nalco 7349 is applied at a rate of 8 ml/min for 60 minutes per day with a 20 mg/liter residual. Nalco 7349 is a polyglycol manufactured by Nalco Chemical Company. Another Nalco product, Nalco 1332, is applied at a rate of 9 to 21 ml/minute with a peak residual of 1 to 2 ppm. Nalco 1332 is an organophosphorus compound which prevents scale formation. It does not have the toxic properties of organic phosphorus esters found in some restricted-use pesticides (Wo81). In CY-1992, a total of 1595 gallons (6037 liters) of Nalco 1332 and 50 gallons (189 liters) of Nalco 7349 were used.

Bromine was used for the first time in 1987 for water treatment at Fermilab. Water pumped from Casey's Pond was treated with a 1-Bromo-3-chloro-5,5-dimethyl hydantoin chemical in a pellet form. This chemical, Nalco 85WT-037/7343, is supplied by Nalco Chemical Company. The bromamines formed when the chemical reacts with agricultural-based amines are more effective biocides than chloramines. This treatment discourages biological fouling of the industrial cooling water (ICW) distribution system and equipment utilizing the (ICW) for cooling. A comprehensive monitoring program to minimize the amount of chemical required has been initiated. The total available halogen in the water is adjusted to be 0.2 mg/liter or less as it leaves the heat exchangers. This product was only used during summer months, June 19, 1992 through October 27, 1992. It was fed for two hours per day, for a maximum of three days per week. The total amount of Nalco 85WT-037 used in CY-1992 was only 200 lbs (91 kg).

Although it was also necessary to chemically treat some waters to control the growth of algae and weeds during CY-1992, efforts were made to keep these treatments as low as possible in order to protect wildlife

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and fish. Copper was applied to Fermilab surface water for algae control. It was applied as a copper-ethanolamine complex which prevents the copper from precipitating out with carbonates and bicarbonates in the water. See Section 6.3.1 for further discussion. Algicide applications to surface waters in CY-1992 are listed in Table 14.

6.3 Pesticides

Pesticides were used on-site during CY-1992 by licensed Fermilab personnel and outside contractors as part of Fermilab's pest control program. All pesticides were EPA-registered and applied according to the manufacturer's instructions, Federal, State, and local laws. Licensed Fermilab personnel applied pesticides onsite for control of aquatic algae, annual and perennial weeds and grasses, and stumps of trees and brush. Tables 14, 15, 16 and 17 summarize pesticide use in CY-1992.

6.3.1 Aquatic Pesticide Applications

The following pesticides were applied to control and maintain water quality onsite by inhibiting the growth of algae and cattails. Applications of aquatic algicide were made to no more than half of a body of water at one time. This was done to avoid stressing fish populations due to oxygen depletion in the water from decaying algae.

Cutrine Plus (EPA #8959-10AA) Cutrine Plus, containing 9% of the active ingredient copper, was applied to some surface waters to control algae in CY-1992. The copper was contained in a mix of copper-ethanolamine complexes. The ethanolamines prevent the precipitation of copper with carbonates and bicarbonates in water, eliminating the problem of toxic accumulations of copper in the sediments that can occur with non-chelated copper compounds like copper sulfate. See Table 14.

Aquazine (EPA #100-570) Aquazine, containing 80% of the active ingredient Simazine was used to control weeds in ditches and waterways. See Table 14 for application information.

6.3.2 Pesticides Applied to Annual and Perennial Weeds, Grasses, Trees and Stumps

The pesticides Roundup (EPA #524-308-AA) Isopropylamine Salt of N-(phosphonomethyl) Glyphosate, 41.0% and Surflan AS (EPA #1471-113) Oryzalin (3.5-dinitro-N^4, N^4-dipropyl-sulfanilamide), 40.4% were applied as a mix around the bases of trees, sign posts, foundations, LP gas tanks, electrical transformers, air conditioners, hardstands and fire hydrants in the following areas for landscape maintenance: Fermilab Village and Sauk Circle, East Gate Area, Batavia Road, D Road,

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Pine Street, Wilson Hall, CDF, Industrial Areas, D0 Assembly Building, CHL, Bison pasture fences and corrals, Master Substation, Lab G, propane tanks sitewide, RF Building, Feynman Computer Center, Reflecting Pond edges, Giese Road Substation, Tag Photon Lab (TPL), Railhead, A-0 and Sites 29, 38, 52 and 55. Equal amounts of each pesticide (1.5 oz.) were mixed in a tank and applied at a rate of one tank per 1000 ft^2. The total amount used was 31 gallons (117.3 liters). Roundup was also applied separately along Swenson Farm Road, at various areas in the Main Ring, at the Kirk Road boundary, along south Kautz Road, east Wilson Road, at the Butterfield Road boundary, and between Wilson and Batavia Roads. It was applied as a 2.5 oz/gal. mix with water. The total amount applied was 1 quart (0.95 liter). A pesticide named 2,4-D Amine (EPA #1386-43-534) Dimethylamine salt of 2,4-Dichlorophenoxyacetic acid, 47.2% was applied once to 28 acres of the Bison pasture. It was applied at a rate of 2 pints per acre. The total amount applied was 7 gallons (26.5 liters). Pathfinder (EPA #62719-176) Trichlopyr (((3,5,6-trichloro-2-pyridinyl)oxy)acetic acid) butoxy ethyl ester, 16.7% was applied to the stumps of brush and trees on the Main Ring berm, in the woods between the Education Center and Swan Lake, and in the field west of Meson between Wilson Road and Batavia Road. It was also used on poison ivy at the Education Center and the berm at the Tagged Photon Lab (TPL).

6.3.3 Miscellaneous Pest Control

A licensed contract exterminator was retained during CY-1992 for miscellaneous pest control in kitchens, laboratories, and living areas throughout the site. Table 15 summarizes the pesticides applied by this contractor.

6.3.4 Agricultural Pest Control Program

During CY-1992 Fermilab leased 1680.8 acres (6.8 km^2) of land to farmers for agricultural production. The leasees hired subcontractors to perform their pesticide applications The pesticides applied are summarized in Tables 16 and 17.

6.4 Chlorides in CUB Tile Field

Chloride levels in water extracted from monitoring wells in the CUB Tile Field in CY-1992 exceeded the IEPA groundwater quality standard (II91). High chloride concentrations are released to the Tile Field Class V injection well with the CUB regeneration process effluent. The levels seen in CY-1992 are not unlike those seen for the past three years. Chlorides plumes and concentrations will be studied further. Efforts are underway to get permission to release this process wastewater to a municipal sewer system.

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6.5 SARA Title III Chemical Inventory

Fermilab conducted a sitewide chemical inventory in accordance with the reporting requirements for CY-1992 for SARA Title III. Additional information on quantities and onsite locations was also collected to facilitate reporting for:

Section 304:	Emergency Notification;
Sections 311-312:	Community Right to Know Requirements; and
Section 313:	Toxic Chemical Release Reporting.

Reporting has been completed under Section 311-312 for hazardous chemicals used in quantities greater than or equal to 10,000 lbs (4536 kg) and for extremely hazardous substances in quantities greater than or equal to 500 lbs (227 kg) or the threshold planning quantities, whichever was lower. The majority of these chemicals are used in the Central Utility Building, Sites 38, 43, 65, the transformers for the Main Ring and utilities, Meson, Neutron, and Proton areas. Lists of other chemicals for which we have received MSDS's are available to local emergency planning committees and the State Emergency Response Commission. These lists are updated monthly. An inventory of all hazardous chemicals, regardless of quantity, is in progress. This information is available to the local Fire Department, and includes the location and quantities of all flammable, corrosive, toxic, and reactive chemicals. This information is used primarily to protect emergency response personnel in case of a fire or other emergency onsite. A list of the large quantity chemicals used at Fermilab during CY-1992 can be found in Table 18. Section 313 chemicals stored/used in CY-1992 will be reported by July 1, 1993. Database tracking systems for chemical management are being evaluated.

6.6 Environmental Occurrences

In March 1992, approximately 25 gallons of transformer oil was spilled on a road near the F1 Service Building during purification of transformer oil from the F1-1 transformer. The spill was contained, cleaned up, and an occurrence report was filed.

In May 1992 another spill occurred when insulators broke off an oil-filled transformer that was being scrapped. Approximately 10 gallons of transformer oil leaked on to the gravel parking lot. The spill was contained and remediated. An occurrence report was filed.

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7.0 QUALITY ASSURANCE IN CY-1992

Routine environmental water samples collected by the Environment, Safety, and Health Section's Environmental Protection (EP) Group were analyzed for radiochemicals by TMA/Eberline. Other samples were counted at the Fermilab Activation Analysis Laboratory (AAL).

In CY-1992, Fermilab contracted with Industrial and Environment Analysis, Inc. (IEA) to provide general chemical analysis on samples that were not radioactive. Samples containing radioactivity were sent to Controls for Environmental Pollution, Inc. (CEP) for chemical analysis.

The Fermilab Quality Assurance Program (FQAP) was issued in April 1992. Implementation of this program required the creation of numerous Specific Quality Implementation Plans (SQIPs). A SQIP for Environmental Monitoring and for Radionuclide Air Emissions Monitoring (Cu92) were completed this year.

7.1 Quality Assurance in Sampling Procedures

The EP Group of the ES&H Section has developed an Environmental Protection Group Procedures Manual (EPPM) that documents all routine monitoring and surveillance procedures. Specific procedures have been developed in accordance with established standards, practices, and protocols. Samples at all locations are collected using documented procedures. These procedures ensure that samples are representative of the media from which they are collected and will yield reliable and consistent results.

Most chemical analysis samples taken by other groups at the Lab are of liquid process streams. Grab samples are usually taken directly or with a disposable glass coliwasa. Surface soil samples are taken with contaminant-inert scoops.

7.2 Quality Assurance in Analysis

Samples are analyzed using standard analytical procedures. Data quality is verified by a continuing program of analytical laboratory quality control, participation in interlaboratory cross-checks, and replicate sampling and analysis. The Environment, Safety and Health Section reviews all analytical data for samples analyzed under its contracts with CEP and IEA. The results are reviewed relative to the accompanying QA/QC results and compared with regulatory limits for acceptability. These reviews include inspection of chain-of-custodies, sample stewardship, sampling handling and transport, and sampling protocols. When applicable to analysis requested, analytical labs must be certified. Several inspection visits were made to IEA (Illinois) in order to approve their procedures. CEP (New Mexico) was evaluated based on written procedures and telephone conversations. Ongoing precision and accuracy is monitored by analysis of the following with each batch of

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samples: laboratory standards, duplicate determinations, matrix spikes, and matrix spike duplicates. This data is used to calculate recovery and relative standard deviation. The quality of the data is then evaluated and compared to regulatory limits to determine acceptability. A range of radiochemical spikes is used to test the vendor's ability to achieve the required sensitivity for each parameter and their reliability in detecting accelerator-produced radionuclides at or below the concentration guide standards (Table 10). Fermilab's Activation Analysis Laboratory (AAL), formerly called the Nuclear Counting Lab (NCL), and the primary vendor contracted for radioanalysis, TMA/Eberline, both participated in DOE's EML quality assurance program. Both chemical analysis labs, IEA and CEP, participated in the USEPA's quality assurance program for analysis of water supplies (WS) and water pollutants (WP) and have obtained state certification. The WS/WP Round Robin data generated by these labs was reviewed and deemed acceptable by Fermilab staff. In CY-1992, a Specific Quality Implementation Plan (SQIP) was written for offsite chemical analysis.

Fermilab and TMA results in the DOE Environmental Measurements Laboratory (EML) quality assurance program are found in Tables 19, 20, and 21. The results of both TMA/Eberline and the AAL in Fermilab's radiochemical spike quality assurance program can be found in Table 22.

8.0 REFERENCES

The appropriate Radiation Protection Standard for penetrating radiation applied to individuals in uncontrolled areas was taken from the DOE Order 5400.5 (DOE 90a). The annual dose limit for whole body exposure is 100 mrem (1 mSv) including all exposure modes.

The Concentration Guides used in the analyses of the surface water samples (Table 10) for radioactivity were taken from DOE Order 5400.5 (DOE90a) and Derived Concentration Guides (DCGs): Concentrations of Radionuclides in Water and Air that could be Continuously Consumed or Inhaled, Respectively, and Not Exceed an Effective Dose Equivalent of 100 mrem/year (1 mSv/year). These Derived Concentration Guides are based on guidance given in International Commission on Radiological Protection (ICRP) Publications 23, 26, and 30, Pergamon Press, New York.

In analysis of groundwater samples for all radionuclides other than tritium, 4% of the Derived Concentration Guide values specified in DOE Order 5400.5 (DOE90a) were used as concentration guides. These correspond to 4 mrem/year (4×10^{-2} mSv/year) to a full-time consumer of such water to be consistent with the USEPA's limit specified in 40 CFR 141 pertaining to community drinking water systems. For tritium, however, 40 CFR 141 specifically states a limit of 2×10^{-5} µCi/ml (compared with 8×10^{-5} µCi/ml obtained as 4% of the DOE 5400.5 DCG). The smaller value as specified by USEPA is used as the concentration guide for that radionuclide. The specified sensitivity and precision of the analyses are sensitive at 10% or less of these concentration guides.

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TABLES

Table 1

Summary of Collective Dose Equivalent for CY-1992
Within a 50 mile (80 km) Radius of Fermilab

Source	Collective Dose Equivalent person-rem	person-Sv
Penetrating radiation from the Railhead	7.07×10^{-6}	7.07×10^{-8}
Airborne radioactivity from the target stations	2.27×10^{-2}	2.27×10^{-4}*
Total	**2.27×10^{-2}**	**2.27×10^{-4}**

*Population dose from airborne radioactivity was calculated using CAP88-PC, version 1.0.

Table 2

Summary of Radioactivity Released to the Offsite Environment in CY-1992

Release Point	Pathway	Radionuclide	Half-Life	Release in (Ci)	Release in (Bq)
AP0 Beam Tunnel Ventilation Stack	Air	^{13}N	9.97 minutes	5.3	2.0×10^{11}
		^{11}C	20.38 minutes	8.3	3.1×10^{11}
		^{41}Ar**	1.83 hours	5.0×10^{-1}	1.85×10^{10}
Unmonitored Releases from the AP0 Target Hall	Air	^{13}N	9.97 minutes	3.0	1.1×10^{11}
		^{11}C	20.38 minutes	2.2	8.1×10^{10}
		^{41}Ar**	1.83 hours	9.0×10^{-2}	3.3×10^{9}
Debonding Oven	Air	^{3}H	12.3 years	0*	0*
Kress Creek Spillway	Water	^{3}H	12.3 years	0.203	7.5×10^{9}

* Not operated in CY1992

** ^{38}Cl and ^{39}Cl, with each comprising less than 1% of the emissions, are modelled as ^{41}Ar

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Table 3

List of Fermilab Environmental Permits

Issuing Agency Type, and No.	Description	Current Issue Date	Expiration Date
IEPA-air Appl.#86020057	Gasoline Dispensing Tanks	10/19/90	10/16/95
IEPA-air Appl.#87110096	5 Gas-Fired Hot Water Boilers 1 Propane-Fired Boiler 1 Grit Blaster	9/9/92	9/9/97
IEPA-air Appl.#89090071	2 Gas-Fired Hot Water Boilers (Lab A & Meson Detector Building)	11/28/89	11/20/94
IEPA-air Appl.#88010042	Open Top Vapor Degreaser (IB-3)	3/16/93	3/16/98
IEPA-air Appl.#79070012	Magnet Debonding Oven with Afterburner	11/2/89	3/5/94
IEPA-air Appl.#89080089	Radionuclide Emissions from TeV Operations	10/30/89	8/28/94
IEPA-open burn Appl.#B920829	Prairie/Land Ecological Management	8/28/92	10/24/93
IEPA-open burn Appl.#B9212022	Fire Fighting Instruction	12/30/92	4/17/94
IEPA I.D.890105010 USEPA.IL6890030046	RCRA Hazardous Waste Storage Facility	9/23/91	10/28/2001
IL Dept of Public Works Permit No. 12170	Water intake from Fox River	1/7/69	12/31/2009
Warrenville Water Supply II Permit #0099	Operating Permit	2/1/91	Until Revoked
D0 Water Supply Construction/ Operating Permit	Operating Permit	11/12/88	Until Revoked
IEPA - NPDES Appl.# ILR100000	General Permit for Discharge of Stormwater Associated with Construction Activities	10/1/92	
IEPA - NPDES Appl.# IL0025941	For the Discharge of Non-Contact, Non-Process Cooling Water	Pending	
IEPA - Air Appl. #91030001, ID#043807AAI	Fermilab Main Injector Construction Permit for Radionuclide Emissions	1/21/92	4/1/93 If construction has not commenced*
IEPA - Air Appl #91100025, ID#043807AAI	Open Top Vapor Degreaser-Transfer Hall S. (Construction & Operating)	10/17/91 (Operating)	10/09/96

* Construction had commenced by 4/19/93

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Table 4

Fermilab IEPA Air Pollution Permit Conditions

Application No.	Description	Special Conditions
B9212022	Open burning for firefighting instruction	Close abandoned water wells
B9208029	Open burning for prairie/land management	
86020057	Gasoline dispensing tanks	
87110096	5 gas-fired hot water boilers; 1 propane-fired boiler; 1 grit blaster	WBL boilers restricted to <1.2 tons/yr nitrogen oxides
89090071	2 gas-fired hot water boilers (Lab A & Meson Detector Bldg)	Lab A <0.12 lb/hr nitrogen oxides Lab A <0.45 tons/yr nitrogen oxides Meson Det. Bldg. <0.26 lb/hr nitrogen oxides Meson Det. Bldg. <0.98 tons/yr nitrogen oxides
91100025	Open top vapor degreaser (Transfer Hall South)	Nominal organics emission rates must be 0.1 lb/hr and <0.44 tons/yr. Maintain records of solvent purchase and use to calculate actual VOC emissions
88010042	Open top vapor degreaser (IB3)	<1 ton/yr organic emissions
79070012	Magnet debonding oven with afterburner (IB2)	25 mrem/yr whole body* 75 mrem/yr critical organ to any member
91030001	Fermilab Main Injector construction permit for radionuclide emissions	Radionuclide emissions shall not exceed those that would cause an annual effective dose equivalent of 10 mrem/yr to any member of the public
89080089	Radionuclide emissions TeV operations	25 mrem/yr whole body* 75 mrem/yr critical organ to any member

*Conditions superseded by more stringent provisions of 10 CFR 61, Subpart H.

1992

Table 5

Kress Creek Chemical Analysis Results For 1992
(All results are in mg/L)

Parameter	General Use Standards*	Kress Creek On-Site	Kress Creek Off-Site	Fox River Inlet
Hardness		370	340	310
oil-grease	**	<5	<5	<5
Cyanide	0.022	<0.01	<0.01	<0.01
Al	–	1.5	0.89	0.48
Ag	0.005	<0.01	<0.01	<0.01
Cd	0.03***(a)	<0.005	<0.005	<0.005
Cr (total)	4.0***(b)	<0.01	<0.01	<0.01
Cu	0.045***(c)	<0.025	<0.025	<0.025
Fe	1.0	2.1	1.2	0.74
Pb	0.400***(d)	<0.05	<0.05	<0.05
Mn	1.0	0.18	0.26	0.09
Ni	1.0	<0.03	<0.03	0.03
Zn	1.0	0.02	0.02	0.02
PCB's	—	U	U	U

* From State of Illinois Rules and Regulations Title 35, Subtitle C, Chapter I, Part 302, Subpart B, as amended through December 18, 1990. Concentrations are the acute standard for these parameters. The acute standard for the listed chemical constituents shall not be exceeded at any time (Section 302.208).

** Section 302.203 Offensive Conditions
Waters of the State shall be free from ...visible oil...of other than natural origin.

*** The following formula, based on the Hardness of the surface water, was used to calculate the acute standard concentration of these parameters.

$\exp[A + B\ln(H)]$
H = Hardness (mg/L)

(a) A = -2.918
B = 1.128
Standard concentration is not to exceed 0.05 mg/L

(b) A = 3.688
B = 0.8190

(c) A = -1.464
B = 0.9422

(d) A = -1.460
B = 1.273

U = Undetected
< 0.0005 mg/L for Aroclor 1016,1221,1232,1242, and 1248.
< 0.001 mg/L for Aroclor 1254 and 1260.

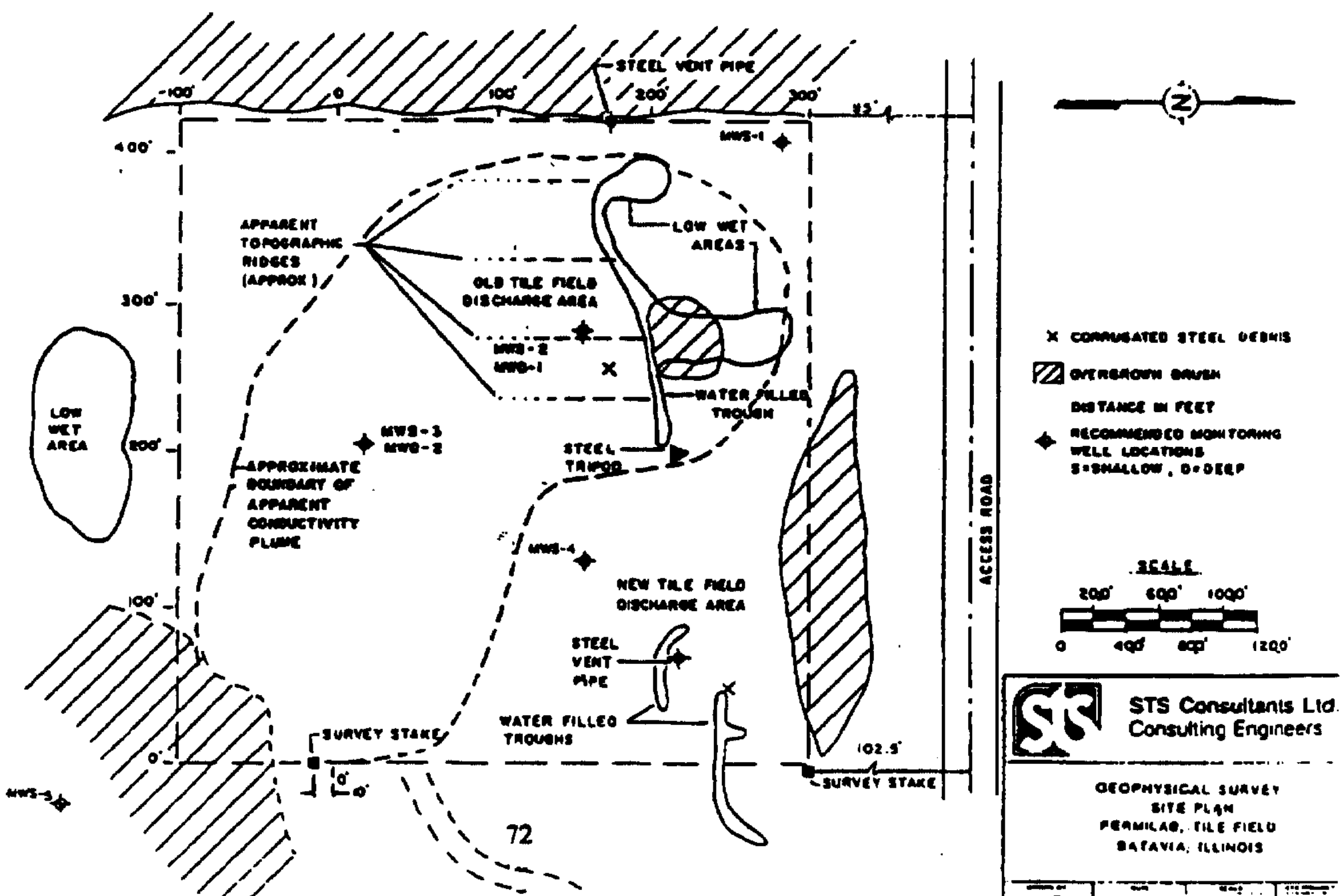
1992

Table 6

CY-1992 CUB Tile Field Monitoring Results
(Post-purge)

Parameter	Units	MWS1	MWS2	MWS3	MWS4	MWS5	MWD1	MWD2***
Ag	mg/l	<0.01	<0.01	<0.01	<0.1*	0.02	<0.01	<0.01
Cl	mg/l	1200	1400	650	NA	2	250	2
Cr,total	mg/l	<0.01	<0.01	<0.01	0.18	0.24	<0.01	0.023
Cu	mg/l	<0.025	<0.025	<0.025	0.45	0.41	<0.025	<0.025
Hardness	mg/l	1100	1100	1100	34000**	NA	710	79
Pb	mg/l	<0.05	<0.05	<0.05	0.6	0.26	<0.05	<0.05
H-3	pCi/ml	0.756	0.433	0.494	<0.346	<0.375	<0.323	<0.324
Be-7	pCi/ml	<0.305	<0.277	<0.284	NA	NA	<0.297	<0.319
Na-22	pCi/ml	<0.014	<0.013	<0.012	NA	NA	<0.013	<0.014
Ca-45	pCi/ml	<0.684	<0.668	<0.667	NA	NA	<0.733	<0.680
Mn-54	pCi/ml	<0.014	<0.013	<0.012	NA	NA	<0.013	<0.012
Co-60	pCi/ml	<0.014	<0.013	<0.014	NA	NA	<0.015	<0.014

NA Not Available due to low sample yield.
* High detection limit due to high mineral concentration.
** Pre-purge value due to low sample yield.
*** Pre-purge values. Well is not purged because of high pH conditions.



1992

Table 7

Incremental Population Data in Vinicity of Fermilab, 1990

Latitude = 41°, 50 minutes, 0 seconds
Longtitude = 88°, 15 minutes, 0 seconds

Distance, Kilometers	0-16	16-32	32-48	48-64	64-80	80-97	97-113	113-128
Distance, Miles	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
N	2089	87415	91726	82233	47449	40045	32429	196267
NNE	21917	166874	160005	150130	154133	101765	130460	93160
NE	43752	113168	357243	107609	0	0	0	0
ENE	62241	196032	827290	524318	0	0	0	0
E	41712	186062	976520	695707	0	0	16428	47516
ESE	45485	141995	328815	579674	337302	191967	88206	20935
SE	59613	67595	105945	134451	42548	29546	13853	11368
SSE	15573	28592	114436	6165	22319	61408	9818	10126
S	12189	10150	21310	19396	7762	8550	2962	11951
SSW	60844	10074	2760	15139	6636	23354	16186	8112
SW	42105	10932	9544	4875	28479	31635	11556	8311
WSW	11461	5342	7864	4890	10477	6100	11706	9996
W	5551	3190	3133	3802	14119	7683	26524	38543
WNW	14870	5171	51081	4389	20166	33921	11767	36862
NW	19352	9424	8276	4943	74962	160650	72098	25555
NNW	24571	34138	15233	28241	14856	32552	23120	53682
Total	**483325**	**1076154**	**3081181**	**2365962**	**781208**	**729176**	**467113**	**572384**
Cummulative Total	483325	1559479	4640660	7006622	7787830	8517006	8984119	9556503

1902

Table 8

National Environmental Research Park Projects

Investigator(s)	Institution	Project Description	Status
Bronikowski	University of Chicago	Avian Predation on Vole Models in Two Habitat Types	Completed
Brown	Argonne National Laboratory	Herpetofauna of Fermilab Restored Prairie Areas	Approved
Hennen	Chicago Academy of Science	Aspects of the Breeding Biology and Productivity of Eastern Bluebirds . . .	Continuing
Jastrow and Miller	Argonne National Laboratory	Changes in Soil Structure Under Restored Prairie	Continuing
Jastrow and Walton	Argonne Naitonal Laboratory and Fermilab	Long Term Prairie Restoration and Succession Study	Continuing
Jewell	Miami University (Ohio)	Small Mammal Community Structure and Habitat Use in Remaining and Restored Prairies	Completed
Juliano	Illinois State University	Geographic Variation in the Mosquito, Aedes triseriatus	Continuing
Kuperman	Ohio State University	Long Term Monitoring of Soil Invertebrates . . .	Approved
Norton and Waugh	College of St. Catherine	Plant Species Diversity and Soil Quality Differences in the Midwestern Prairie in Restored vs. Non-Restored Areas	Completed
Weis	University of California (Irvine)	Insect Herbivore Density and Variable Selection on Components of Plant Defense	Approved
Whelan	Morton Arboretum	Effects of Smoke from Prairie Fires on Seed Germination	Approved
Younger	Northern Illinois University	Biotic Interactions and the Control of Small Mammal Populations	Approved

Table 9

Airborne Radioactivity Released Due to Accelerator Operations During CY-1992

Stack Monitor	Activity Released (Curies)	(Becquerel x 10^{11})
Antiproton Source	14.09	5.21
Unmonitored Releases from AP0		
Target Hall and Service Building	5.29	1.96
Total	**19.38**	**7.17**

1992

Table 10

Specifications for the Analyses of Accelerator-Produced Radionuclides in Water

Radionuclide	Half-Life	CONCENTRATION GUIDE FOR POPULATION (pCi/ml) Surface Water	Groundwater	SPECIFIED SENSITIVITY AND PRECISION* (pCi/ml) Surface Water	Groundwater
^{3}H	12.3 years	2000	20***	3.0	1.0
^{7}Be	53.3 days	1000	40	0.5	0.5
^{22}Na	2.6 years	10	0.40	0.3	0.22
^{45}Ca	165 days	50	2	0.3	0.02
^{54}Mn	312 days	50	2	0.1	0.07
^{60}Co	5.27 years	5	0.2	0.1	0.02

* The precision and sensitivity are stated for the 95% confidence level (approximately two standard deviations). The precision required is the value specified or ±10 percent, whichever is the lesser precision. The sensitivity is taken to be the minimum concentration which can be detected within the 68 percent confidence level.

** Taken from DOE Order 5400.5 (6/5/90)

*** Taken from EPA Drinking Water Regulations 40 CFR 141

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Table 11
Tritium Detected in Sump Water Samples (CY-1992)

Collection Point	Number of Samples	Units	Maximum Concentration*	Minimum Concentration**	Mean Concentration***	Percentage of Concentration Guide (%)****
AP0 Prevault	4	pCi/ml	2.33E+01	1.36E+00	9.09E+00	4.55E-01
		Ci/ml	2.33E-11	1.36E-12	9.09E-12	
		Bq/ml	8.63E-01	5.04E-02	3.36E-01	
AP0 Transport	1	pCi/ml	6.59E-01	6.59E-01	6.59E-01	3.30E-02
		Ci/ml	6.59E-13	6.59E-13	6.59E-13	
		Bq/ml	2.44E-02	2.44E-02	2.44E-02	
AP50	1	pCi/ml	5.43E-01	5.43E-01	5.43E-01	2.72E-02
		Ci/ml	5.43E-13	5.43E-13	5.43E-13	
		Bq/ml	2.01E-02	2.01E-02	2.01E-02	
B0	1	pCi/ml	4.68E-01	4.68E-01	4.68E-01	2.34E-02
		Ci/ml	4.68E-13	4.68E-13	4.68E-13	
		Bq/ml	1.73E-02	1.73E-02	1.73E-02	
B45	1	pCi/ml	3.43E-01	3.43E-01	3.43E-01	1.72E-02
		Ci/ml	3.43E-13	3.43E-13	3.43E-13	
		Bq/ml	1.27E-02	1.27E-02	1.27E-02	
E0	1	pCi/ml	3.28E-01	3.28E-01	3.28E-01	1.64E-02
		Ci/ml	3.28E-13	3.28E-13	3.28E-13	
		Bq/ml	1.21E-02	1.21E-02	1.21E-02	
M01SP2	4	pCi/ml	5.06E+00	8.90E-01	2.10E+00	1.05E-01
		Ci/ml	5.06E-12	8.90E-13	2.10E-12	
		Bq/ml	1.87E-01	3.29E-02	7.75E-02	
M01SP3	6	pCi/ml	4.14E+01	1.44E+01	2.72E+01	1.36E+00
		Ci/ml	4.14E-11	1.44E-11	2.72E-11	
		Bq/ml	1.53E+00	5.33E-01	1.01E+00	
N01RP1	4	pCi/ml	3.72E+01	1.48E+01	2.92E+01	1.46E+00
		Ci/ml	3.72E-11	1.48E-11	2.92E-11	
		Bq/ml	1.38E+00	5.49E-01	1.08E+00	
N01SP1	3	pCi/ml	2.93E+01	4.93E-01	1.01E+01	5.05E-01
		Ci/ml	2.93E-11	4.93E-13	1.01E-11	
		Bq/ml	1.08E+00	1.82E-02	3.74E-01	
N01SP2	4	pCi/ml	6.00E-01	<3.80E-01	4.54E-01	2.27E-02
		Ci/ml	6.00E-13	<3.80E-13	4.54E-13	
		Bq/ml	2.22E-02	<1.41E-02	1.68E-02	
N01SP3	2	pCi/ml	2.67E+00	2.53E+00	2.60E+00	1.30E-01
		Ci/ml	2.67E-12	2.53E-12	2.60E-12	
		Bq/ml	9.88E-02	9.37E-02	9.62E-02	
N01SP4	6	pCi/ml	1.47E+02	4.93E+01	9.22E+01	4.61E+00
		Ci/ml	1.47E-10	4.93E-11	9.22E-11	
		Bq/ml	5.45E+00	1.82E+00	3.41E+00	
NM1SP	5	pCi/ml	1.61E+01	3.93E+00	7.74E+00	3.87E-01
		Ci/ml	1.61E-11	3.93E-12	7.74E-12	
		Bq/ml	5.96E-01	1.45E-01	2.86E-01	
NM2SP1	2	pCi/ml	1.54E+00	<2.97E-01	7.68E-01	3.84E-02
		Ci/ml	1.54E-12	<2.97E-13	7.68E-13	
		Bq/ml	5.68E-02	<1.10E-02	2.84E-02	

* The highest concentration detected in a sample from that location.
** The lowest concentration detected in a sample from that location.
*** The average concentration for samples taken from that location.
**** Concentration Guide for Tritium is 2.0 x E-9 Ci/ml (74 Bq/ml). Percentage is calculated from the mean concentration.

Table 12

Tritium Detected in Sump Water Samples (CY-1992)

Collection Point	Number of Samples	Units	Maximum Concentration*	Minimum Concentration**	Mean Concentration***	Percentage of Concentration Guide (%)****
NM2SP2	2	pCi/ml	4.60E-01	4.05E-01	4.33E-01	2.17E-02
		Ci/ml	4.60E-13	4.05E-13	4.33E-13	
		Bq/ml	1.70E-02	1.50E-02	1.60E-02	
NM2SP3	2	pCi/ml	1.66E+00	5.59E-01	8.63E-01	4.32E-02
		Ci/ml	1.66E-12	5.59E-13	8.63E-13	
		Bq/ml	6.14E-02	2.07E-02	3.19E-02	
NM3	2	pCi/ml	3.45E+00	2.73E+00	3.09E+00	1.55E-01
		Ci/ml	3.45E-12	2.73E-12	3.09E-12	
		Bq/ml	1.28E-01	1.01E-01	1.14E-01	
NMK	2	pCi/ml	4.18E-01	<3.71E-01	2.09E-01	1.05E-02
		Ci/ml	4.18E-13	<3.71E-13	2.09E-13	
		Bq/ml	1.55E-02	<1.37E-02	7.73E-03	
NTSBSP1	4	pCi/ml	3.96E+01	3.14E+00	1.87E+01	9.33E-01
		Ci/ml	3.96E-11	3.14E-12	1.87E-11	
		Bq/ml	1.47E+00	1.16E-01	6.91E-01	
NTSBSP2	4	pCi/ml	5.69E+00	1.08E+00	2.56E+00	1.28E-01
		Ci/ml	5.69E-12	1.08E-12	2.56E-12	
		Bq/ml	2.11E-01	4.01E-02	9.49E-02	
NW4SP1	5	pCi/ml	7.56E+01	2.77E+01	4.51E+01	2.25E+00
		Ci/ml	7.56E-11	2.77E-11	4.51E-11	
		Bq/ml	2.80E+00	1.02E+00	1.67E+00	
PC4SP1	2	pCi/ml	3.40E+00	2.03E+00	2.72E+00	1.36E-01
		Ci/ml	3.40E-12	2.03E-12	2.72E-12	
		Bq/ml	1.26E-01	7.50E-02	1.00E-01	
PC4SP2	6	pCi/ml	4.38E+00	2.70E+00	3.34E+00	1.67E-01
		Ci/ml	4.38E-12	2.70E-12	3.34E-12	
		Bq/ml	1.62E-01	9.99E-02	1.24E-01	
PE3SP2	2	pCi/ml	2.56E+00	2.17E+00	2.37E+00	1.18E-01
		Ci/ml	2.56E-12	2.17E-12	2.37E-12	
		Bq/ml	9.49E-02	8.02E-02	8.75E-02	
PW5SP3	2	pCi/ml	1.00E+00	8.75E-01	9.39E-01	4.70E-02
		Ci/ml	1.00E-12	8.75E-13	9.39E-13	
		Bq/ml	3.71E-02	3.24E-02	3.47E-02	
PW6SP2	2	pCi/ml	1.41E+00	<3.41E-01	7.06E-01	3.53E-02
		Ci/ml	1.41E-12	<3.41E-13	7.06E-13	
		Bq/ml	5.22E-02	<1.26E-02	2.61E-02	
PW6SP3	2	pCi/ml	1.07E+00	<3.73E-01	5.36E-01	2.68E-02
		Ci/ml	1.07E-12	<3.73E-13	5.36E-13	
		Bq/ml	3.97E-02	<1.38E-02	1.98E-02	

* The highest concentration detected in a sample from that location.
** The lowest concentration detected in a sample from that location.
*** The average concentration for samples taken from that location.
**** Concentration Guide for Tritium is 2.0 x E-9 Ci/ml (74 Bq/ml). Percentage is calculated from the mean concentration.

1992

Table 13

CY-1992 Soil/Sediment Results

LOCATION	UNITS	RADIONUCLIDE Be-7	Na-22	Mn-54	Co-57	Co-60	H-3*
Indian Creek	µCi/g / Bq/g	ND	ND	ND	ND	ND	NA
Kress Creek on-site	µCi/g / Bq/g	ND	ND	ND	ND	ND	NA
Kress Creek off-site	µCi/g / Bq/g	ND	ND	ND	ND	ND	NA
Ferry Creek	µCi/g / Bq/g	ND	ND	ND	ND	ND	NA
CUB Tile Field	µCi/g / Bq/g	7.52E-06 / 2.78E-01	ND	ND	ND	3.80E-07 / 1.41E-02	NA
AP0 Stack	µCi/g / Bq/g	ND	ND	ND	ND	ND	ND
M05 Stack	µCi/g / Bq/g	ND	ND	ND	ND	ND	ND
NM2 Stack	µCi/g / Bq/g	1.13E-05 / 4.18E-01	ND	ND	ND	ND	7.70E-06 / 2.85E-01
NW8 Stack	µCi/g / Bq/g	ND	ND	ND	ND	ND	ND
PB4 Stack	µCi/g / Bq/g	ND	ND	ND	ND	ND	2.80E-06 / 1.04E-01
M01SP3	µCi/g / Bq/g	ND	1.20E-07 / 4.44E-03	ND	ND	ND	NA
N01SP4	µCi/g / Bq/g	ND	3.40E-07 / 1.26E-02	ND	ND	ND	NA
NW4SP1	µCi/g / Bq/g	ND	5.40E-07 / 2.00E-02	1.60E-07 / 5.92E-03	5.00E-08 / 1.85E-03	ND	NA

All analyses were performed at the Fermilab Activation Analysis Laboratory.
* Tritium values are reported as µCi/ml and Bq/ml of soil moisture.
NA - Not Available.
ND - Not Detected.

Table 14

Pesticide Applications to Surface Waters at FNAL in CY-1992

Treatment Area	Acres	Cutrine Plus		Aquazine	
		# of Applications	Total Applied (l)	# of Applications	Total Applied (lbs)
Booster Pond	1.6	0	0	0	0
Center Reflecting Pond	1.3	3	34.1	1	15.0
East Reflecting Pond	1.5	0	0	1	11.5
Booster Feed Ditch CP-3	1.0	0	0	0	0
Swan Lake	7.8	1	28.4	0	0
Swan Lake Ditch	1.5	0	0	0	0
West Pond	1.3	0	0	0	0

1992

Table 15

Pesticides Applied by Licensed Contractor in CY-1992

Pesticide	EPA Reg No.	Active Ingredient
AC Formula	56-56	Chlorophacinone 0.005%
Contrac Pellets	12455-36	Bromodiolone 0.005%
Talon-G Pellets	10182-38&40	Brodifacoum 0.005%
Weather-Blok	10182-48	Brodifacoum 0.005%
Baygon 2% Bait	3125-121	Propoxur 2.0%
Maxforce Bait	1730-67	Hydramethylnon 1.65%
Combat Bait	1730-68	Hydramethylnon 0.9%
Pro Roach Kill	45385-20203	Boric Acid 99.0%
Ficam D	45639-3	Bendiocarb 1.0%
Ficam W	45639-1	Bendiocarb 0.5 & 0.25%
Demon WP	10182-71	Cypermethrin .2 & .1%
Tempo 20 WP	3125-380	Cyfluthrin 0.1 & 0.05%
Empire 20	464-629	Chlorpyrifos 0.4 & 0.2%
Dursban LO	464-571	Chlorpyrifos 0.5 & 0.25%
Gencor 9%	2724-351-50809	Hydroprene 0.07%
PT230 Tri-Die	499-223-AA	Pyrethrins Silica Gel 0.3%
PT240 Permadust	499-220-AA	Boric Acid 20.0%
PT250 Baygon	499-157-ZA	Propoxur 1.0%
PT270 Dursban	499-147	Chlorpyrifos 0.5%
PT280 Orthene	499-230	Acephate 1.0%
PT265A Knoxout	499-228	Diazinon 1.0%
PT515 Waspfreeze	499-240	Phenothrin 0.25%
PT565 Plus	499-285	Pyrethrins D-Trans Allenthrin 0.25%
ZP Tracking Powder	12455-16AA	Zinc Phosphide 10.0%
Rozol Tracking Powder	7173-172	Chlorophacinone 0.2%

1992

Table 16

Pesticides Applied to Leased Farm Tracts CY-1992

Pesticide	EPA Reg. No.	Active Ingredient
Aatrex 9-0	100-585	Atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) 85.5%
Accent	352-534	Nicosulfuron 3-pyridimecarboxamide,2[[(4,6-dimethoxypyrimidin-2-yl))amino-carbonyl]aminosulfony]-N,N-dimethyl 75%
Lasso	524-314	Alachlor [2-chloro-2,6-diethyl-N-(methoxymethyl) acetanilide] 45.1%
Lasso-Micro	524-344	Alachlor [2-chloro-2,6-diethyl-N-(methoxymethyl) acetanilide] 41.5%
Force	10182-130	Tefluthrin 1.7%
Thimet	241-257	Phorate [0,0-diethyl S-((ethylthio) methyl) phosphorodithioate] 20%
Marksman	55947-39	Potassium salt of dicamba (3,6-dichloro-o-anisic acid) 13.4% Atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) 22.2%
Pursuit	241-310	Imazethapyr [Ammonium Salt of (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]] 21%
Roundup	524-308	Isopropylamine Salt of [N-(phosphonomethylglycine)] Glyphosate, 41.0%
Basagran	7969-45	Sodium salt of bentazon (3-(1-methylethyl)-1H-2,1,3-benzothiadiazin-4 (3H)-one 2,2 dioxide) 42%

1992

Table 17

1992 Pesticide Application Summary for Leased Farm Tracts at Fermilab

Tract #	Acres	Farmer	Crop(s)	Pesticide	RUP	Application Rate (per acre)	Acres Treated
B1	110.7	T. Flanders	Corn	Lasso	Y	3 qts	110.7
				Aatrex	Y	1 lb	110.7
				Thimet	Y	6.7 lbs	110.7
C	305.7	R. Mueller	Corn	Lasso-Micro	Y	2 qts	305.7
				Marksman	Y	1 pt	305.7
				Force	Y	9 lbs	305.7
				Accent	Y	0.75 oz	305.7
C-2	34.2	R. Mueller	Beans	Lasso-Micro	Y	2 qts	34.2
C-3	66.5	R. Mueller	Corn	Lasso-Micro	Y	2 qts	66.5
				Marksman	Y	1 pt	66.5
				Force	Y	9 lbs	66.5
C-4	135.1	R. Mueller	Corn	Lasso-Micro	Y	2 qts	135.1
				Marksman	Y	1 pt	135.1
				Force	Y	9 lbs	135.1
C-5	28.2	R. Mueller	Corn	Lasso-Micro	Y	2 qts	28.2
				Marksman	Y	1 pt	28.2
				Force	Y	9 lbs	28.2
C-6	11.9	R. Mueller	Corn	Lasso-Micro	Y	2 qts	11.9
				Marksman	Y	1 pt	11.9
				Force	Y	9 lbs	11.9
CA-1A	86.8	M. Pitstick	Corn	Marksman	Y	3.5 pts	86.8
				Force	Y	8.7 lbs	86.8
				Lasso-Micro	Y	2 qts	86.8
CA-1B	82.1	M. Pitstick	Beans	Roundup	N	1 pt	82.1
				Pursuit	N	4 ozs	82.1
N-1	181.6	T. Flanders	Beans	Pursuit	N	2.5 pts	181.6
				Basagran	N	1 pt	spot
D-6	56.0	T. Flanders	Beans	Pursuit	N	2.5 pts	56.0
				Basagran	N	1 pt	spot
N-2	283.1	M. Pitstick	Corn	Marksman	Y	3.5 pts	178.1
				Roundup	N	1 pt	178.1
				Pursuit	N	4 ozs	178.1
				Force	Y	8.7 lbs	178.1
				Lasso-Micro	Y	2 qts	178.1
			Beans	Roundup	N	1 pt	105.0
				Pursuit	N	4 ozs	105.0
D-2	69.6	M. Pitstick	Corn	Marksman	Y	3.5 pts	50.0
				Force	Y	8.7 lbs	50.0
				Lasso-Micro	Y	2 qts	50.0
N-3	229.3	M. Pitstick	Beans	Roundup	N	1 pt	229.3
				Pursuit	N	4 ozs	229.3

1992

Table 18

LARGE QUANTITY CHEMICAL MATERIALS IN THE SARA TITLE III INVENTORY FOR CY-1992

Material Category	Amount
Heat Transfer/Antifreeze Liquids	22,247 pounds
Ethylene glycol	
Flammable Gases	
Ethane	153,344 SCF
Argon/Ethane (50/50)	720,074 SCF
Propane	75,099 gallons
Oxidizers	
Oxygen Gas (Compressed)	61,990 SCF
Compressed Gas	
Argon/CO_2	428,286 SCF
Argon/CO_2/CF4	415,071 SCF
Nitrogen	311,904 SCF
Argon	196,800
Liquified Gases	
Argon	359,200 SCF
Nitrogen	1,146,837,578 SCF
Corrosives	
Hydrochloric Acid	27,720 pounds
Sodium Hydroxide	19,600 pounds
Toxics (extremely hazardous)	
Chlorine	4,500 pounds
Polychlorinated Biphenyls	15,000 pounds
Scintillation Fluid (contains 1,2,4-Trimethyl Benzene)	32,400 pounds
Other Ozone-Depleting Substances	
Halon 1301	10,000 pounds
Freon 11	18,000 pounds

1992

Table 19

EML Quality Assurance Program Results for TMA/Eberline
(Sa92)

Sample Date	Sample Type	Isotype	Ser	Reported Value	Reported % Error	EML Value	Rp/EML	Ratio +/-	Units
03/92	Air	^{7}Be	1	0.383E+02	9	0.286E+02	1.34	0.16	Bq/Filter
"	"	^{54}Mn	1	0.756E+01	4	0.597E+01	1.27	0.09	"
"	"	^{57}Co	1	0.909E+01	2	0.793E+01	1.15	0.04	"
"	"	^{60}Co	1	0.680E+01	6	0.581E+01	1.17	0.09	"
"	"	^{90}Sr	1	0.245E+00	14	0.207E+00	1.18	0.18	"
"	"	^{134}Cs	1	0.520E+01	5	0.444E+01	1.17	0.08	"
"	"	^{137}Cs	1	0.740E+01	5	0.576E+01	1.28	0.09	"
"	"	^{144}Ce	1	0.869E+02	1	0.639E+02	1.36	0.07	"
"	"	^{238}Pu	1	0.218E+00	14	0.270E+00	0.81	0.12	"
"	"	^{239}Pu	1	0.236E+00	14	0.285E+00	0.83	0.15	"
"	"	^{241}Am	1	0.383E+00	19	0.334E+00	1.15	0.23	"
"	"	^{234}U	1	0.903E-01	13	0.100E+00	0.90	0.13	"
"	"	^{238}U	1	0.833E-01	14	0.100E+00	0.83	0.13	"
"	Soil	^{40}K	1	0.621E+03	6	0.719E+03	0.86	0.06	Bq/kg
"		^{90}Sr	1	0.256E+01	75	0.450E+01	0.57	0.43	"
"	"	^{137}Cs	1	0.452E+01	49	0.523E+01	0.86	0.43	"
"	"	^{239}Pu	1	0.309E+02	29	0.255E+02	1.21	0.37	"
"	"	^{239}Pu	2	0.309E+02	29	0.255E+02	1.21	0.37	"
"	"	^{234}U	1	0.277E+02	17	0.297E+02	0.93	0.17	"
"	"	^{238}U	1	0.275E+02	18	0.296E+02	0.93	0.17	"
"	Veg.	^{40}K	1	0.263E+03	15	0.294E+03	0.89	0.15	"
"	"	^{90}Sr	1	0.279E+03	7	0.376E+03	0.74	0.08	"
"	"	^{137}Cs	1	0.242E+02	12	0.246E+02	0.98	0.13	"
"	"	^{238}Pu	1	0.869E+00	21	0.108E+01	0.80	0.18	"
"	"	^{239}Pu	1	0.352E+00	31	0.311E+00	1.13	0.36	"
"	"	^{241}Am	1	0.270E+00	72	0.210E+00	1.29	1.00	"
"	Water	^{3}H	1	0.229E+03	6	0.227E+03	1.01	0.07	Bq/liter
"	"	^{54}Mn	1	0.543E+02	3	0.566E+02	0.96	0.04	"
"	"	^{55}Fe	1	0.126E+03	1	0.133E+03	0.95	0.02	"
"	"	^{60}Co	1	0.974E+02	2	0.940E+02	1.04	0.03	"
"	"	^{90}Sr	1	0.148E+01	13	0.213E+01	0.69	0.10	"
"	"	^{134}Cs	1	0.703E+02	2	0.718E+02	0.98	0.03	"
"	"	^{137}Cs	1	0.861E+02	2	0.846E+02	1.02	0.03	"
"	"	^{144}Ce	1	0.181E+03	3	0.189E+03	0.96	0.03	"
"	"	^{238}Pu	1	0.421E+00	19	0.450E+00	0.94	0.20	"
"	"	^{239}Pu	1	0.499E+00	18	0.580E+00	0.86	0.17	"
"	"	^{241}Am	1	0.375E+00	17	0.510E+00	0.74	0.13	"
"	"	^{234}U	1	0.394E+00	15	0.415E+00	0.95	0.15	"
"	"	^{238}U	1	0.354E+00	15	0.423E+00	0.84	0.17	"

1992

Table 20
EML Quality Assurance Program Results for Fermilab Activation Analysis Lab
(Sa92,Sa93)

Sample Date	Sample Type	Isotype	Ser	Reported Value	% Error	EML Value	Ratio Rp/EML	+/-	Units
03/92	Air	^{7}Be	1	0.268E+02	12	0.286E+02	0.94	0.14	Bq/filter
"	"	^{7}Be	2	0.287E+02	13	0.286E+02	1.00	0.16	"
"	"	^{54}Mn	1	0.553E+01	9	0.597E+01	0.93	0.10	"
"	"	^{54}Mn	2	0.552E+01	9	0.597E+01	0.92	0.10	"
"	"	^{57}Co	1	0.646E+01	8	0.793E+01	0.81	0.07	"
"	"	^{57}Co	2	0.654E+01	8	0.793E+01	0.82	0.07	"
"	"	^{60}Co	1	0.566E+01	6	0.581E+01	0.97	0.08	"
"	"	^{60}Co	2	0.541E+01	6	0.581E+01	0.93	0.07	"
"	"	^{134}Cs	1	0.480E+01	6	0.444E+01	1.08	0.09	"
"	"	^{134}Cs	2	0.438E+01	6	0.444E+01	0.99	0.08	"
"	"	^{137}Cs	1	0.582E+01	9	0.576E+01	1.01	0.10	"
"	"	^{137}Cs	2	0.556E+01	9	0.576E+01	0.97	0.10	"
"	"	^{144}Ce	1	0.651E+02	8	0.639E+02	1.02	0.10	"
"	"	^{144}Ce	2	0.663E+02	8	0.639E+02	1.04	0.10	"
"	Soil	^{40}K	1	0.798E+03	10	0.719E+03	1.11	0.12	Bq/kg
"	"	^{137}Cs	1	0.624E+01	12	0.523E+01	1.19	0.17	"
"	"	^{238}U	1	0.531E+02	25	0.296E+02	1.79	0.45	"
"	Veg.	^{40}K	1	0.292E+03	11	0.294E+03	0.99	0.13	"
"	"	^{137}Cs	1	0.277E+02	10	0.246E+02	1.13	0.13	"
"	Water	^{3}H	1	0.264E+03	21	0.227E+03	1.16	0.26	Bq/liter
"	"	^{54}Mn	1	0.579E+02	10	0.566E+02	1.02	0.11	"
"	"	^{60}Co	1	0.102E+03	6	0.940E+02	1.09	0.08	"
"	"	^{134}CS	1	0.798E+02	5	0.718E+02	1.11	0.07	"
"	"	^{137}Cs	1	0.930E+02	10	0.846E+02	1.10	0.11	"
"	"	^{144}Ce	1	0.175E+03	9	0.189E+03	0.93	0.09	"
09/92	Air	^{7}Be	1	0.309E+03	8	0.308E+03	1.00	0.09	Bq/filter
"	"	^{7}Be	2	0.308E+03	8	0.308E+03	1.00	0.09	"
"	"	^{54}Mn	1	0.245E+02	8	0.259E+02	0.95	0.08	"
"	"	^{54}Mn	2	0.248E+02	8	0.259E+02	0.96	0.09	"
"	"	^{57}Co	1	0.535E+01	8	0.640E+01	0.84	0.08	"
"	"	^{57}Co	2	0.548E+01	8	0.640E+01	0.86	0.08	"
"	"	^{60}Co	1	0.299E+01	7	0.306E+01	0.98	0.10	"
"	"	^{60}Co	2	0.316E+01	7	0.306E+01	1.03	0.10	"
"	"	^{134}Cs	1	0.389E+01	6	0.372E+01	1.05	0.08	"
"	"	^{134}Cs	2	0.376E+01	6	0.372E+01	1.01	0.07	"
"	"	^{137}Cs	1	0.556E+01	9	0.582E+01	0.96	0.10	"
"	"	^{137}Cs	2	0.610E+01	9	0.582E+01	1.05	0.11	"
"	"	^{144}Ce	1	0.364E+02	8	0.433E+02	0.84	0.08	"
"	"	^{144}Ce	2	0.390E+02	8	0.433E+02	0.90	0.08	"
"	Soil	^{40}K	1	0.410E+03	10	0.384E+03	1.07	0.12	Bq/kg
"	"	^{137}Cs	1	0.316E+03	10	0.285E+03	1.11	0.11	"
"	Veg.	^{40}K	1	0.103E+04	10	0.101E+04	1.02	0.11	"
"	"	^{137}Cs	1	0.302E+02	10	0.292E+02	1.03	0.12	"
"	Water	^{3}H	1	0.155E+03	15	0.118E+03	1.31	0.21	Bq/liter
		^{54}Mn	1	0.352E+02	10	0.333E+02	1.06	0.11	"
"	"	^{60}Co	1	0.310E+02	7	0.278E+02	1.12	0.09	"
"	"	^{134}Cs	1	0.561E+02	4	0.441E+02	1.27	0.09	"
"	"	^{137}Cs	1	0.350E+02	10	0.290E+02	1.21	0.13	"
"	"	^{144}Ce	1	0.551E+02	10	0.512E+02	1.08	0.12	"

1992

Table 21

EML Quality Assurance Program Results for TMA/Eberline
(Sa93)

Sample Date	Sample Type	Isotype	Ser	Reported Value	Reported % Error	EML Value	Rp/EML	Ratio +/-	Units
09/92	Air	^{7}Be	1	0.345E+03	1	0.308E+03	1.12	0.04	Bq/Filter
"	"	^{54}Mn	1	0.285E+02	1	0.259E+02	1.10	0.04	"
"	"	^{57}Co	1	0.664E+01	2	0.640E+01	1.04	0.06	"
"	"	^{60}Co	1	0.332E+01	9	0.306E+01	1.08	0.12	"
"	"	^{90}Sr	1	0.281E+00	25	0.137E+00	2.05	0.55	"
"	"	^{134}Cs	1	0.353E+01	8	0.372E+01	0.95	0.08	"
"	"	^{137}Cs	1	0.642E+01	5	0.582E+01	1.10	0.09	"
"	"	^{144}Ce	1	0.422E+02	2	0.433E+02	0.97	0.04	"
"	"	^{238}Pu	1	0.211E-01	31	0.420E-01	0.50	0.16	"
"	"	^{239}Pu	1	0.253E-01	28	0.450E-01	0.56	0.16	"
"	"	^{241}Am	1	0.203E-01	32	0.320E-01	0.63	0.21	"
"	"	^{234}U	1	0.899E-02	44	0.166E-01	0.54	0.24	"
"	"	^{238}U	1	0.755E-02	44	0.160E-01	0.47	0.22	"
"	Soil	^{40}K	1	0.300E+03	9	0.384E+03	0.78	0.08	Bq/kg
"	"	^{90}Sr	1	0.112E+02	28	0.957E+01	1.17	0.36	"
"	"	^{137}Cs	1	0.244E+03	1	0.285E+03	0.86	0.02	"
"	"	^{238}Pu	1	0.173E+02	12	0.219E+02	0.79	0.11	"
"	"	^{239}Pu	1	0.622E+01	19	0.776E+01	0.85	0.17	"
"	"	^{241}Am	1	0.192E+01	26	0.185E+01	1.05	0.31	"
"	"	^{234}U	1	0.227E+02	12	0.292E+02	0.78	0.11	"
"	"	^{238}U	1	0.226E+02	11	0.296E+02	0.76	0.10	"
"	Veg.	^{40}K	1	0.832E+03	5	0.101E+04	0.82	0.05	"
"	"	^{90}Sr	1	0.383E+03	5	0.489E+03	0.78	0.08	"
"	"	^{137}Cs	1	0.246E+02	12	0.292E+02	0.84	0.11	"
"	"	^{238}Pu	1	0.100E+01	22	0.125E+01	0.80	0.18	"
"	"	^{239}Pu	1	0.333E+00	44	0.376E+00	0.88	0.40	"
"	"	^{241}Am	1	0.333E+00	44	0.242E+00	1.38	0.64	"
"	Water	^{3}H	1	0.101E+03	14	0.118E+03	0.86	0.12	Bq/liter
"	"	^{54}Mn	1	0.377E+02	4	0.333E+02	1.13	0.06	"
"	"	^{55}Fe	1	0.755E+02	8	0.529E+02	1.43	0.14	"
"	"	^{60}Co	1	0.307E+02	6	0.278E+02	1.10	0.08	"
"	"	^{90}Sr	1	0.213E+01	17	0.220E+01	0.97	0.19	"
"	"	^{134}Cs	1	0.546E+02	3	0.441E+02	1.24	0.07	"
"	"	^{137}Cs	1	0.346E+02	5	0.290E+02	1.26	0.08	"
"	"	^{144}Ce	1	0.640E+02	10	0.512E+02	1.25	0.14	"
"	"	^{238}Pu	1	0.188E+01	7	0.197E+01	0.95	0.09	"
"	"	^{239}Pu	1	0.240E+00	15	0.238E+00	1.01	0.18	"
"	"	^{241}Am	1	0.138E+00	25	0.205E+00	0.67	0.17	"
"	"	^{234}U	1	0.108E+00	30	0.115E00	0.94	0.28	"
"	"	^{238}U	1	0.874E-01	29	0.115E+00	0.76	0.23	"

1992

Table 22

Fermilab QA Program Results for TMA/Eberline and Fermilab AAL

Sample Number	Radionuclide	AAL *$T_{1/2}$ conc. (pCi/ml)	TMA *$T_{1/2}$ conc. (pCi/ml)	TMA Conc. (pCi/ml)	AAL Conc. (pCi/ml)	Ratio of Prepared to TMA	Ratio of Prepared to AAL
9201	H-3	129.54	129.76	121.1	125.7	0.93	0.97
	Na-22	1.14	1.14	1.029	1.37	0.90	1.20
	Mn-54	1.01	1.02	1.068	1.02	1.05	1.01
	Co-60	0.17	0.17	0.179	0.14	1.05	0.82
9202	H-3	6.42	6.43	7.925	10.9	1.23	1.70
	Na-22	11.05	11.04	10.16	11.2	0.92	1.01
	Mn-54	4.54	4.55	4.956	4.97	1.09	1.09
	Co-60	3.42	3.41	3.556	3.49	1.04	1.02
9203	H-3	1.28	1.28	1.57	2.1	1.23	1.64
	Na-22	0.33	0.33	0.316	0.25	0.96	0.76
	Mn-54	0.09	0.09	0.069	0.11	0.77	1.22
	Co-60	0.05	0.05	0.09	0.08	1.80	1.60
9213	H-3	1.28	1.28	1.368	<2	1.07	NA
	Na-22	0.33	0.33	0.306	0.39	0.93	1.18
	Mn-54	0.09	0.09	0.1	ND	1.11	NA
	Co-60	0.05	0.05	0.053	ND	1.06	NA
9204	H-3	51.13	51.22	47.603	46.5	0.93	0.91
	Na-22	0.43	0.43	0.37	0.3	0.86	0.70
9214	H-3	51.13	51.22	47.2	47.2	0.92	0.92
	Na-22	0.43	0.43	0.388	0.44	0.90	1.02
9205	H-3	101.82	102	92.396	97.8	0.91	0.96
9215	H-3	101.82	102	91.471	98.1	0.90	0.96
9206	H-3	12.65	12.68	11.881	12.9	0.94	1.02
	Na-22	1.02	1.02	0.91	0.98	0.89	0.96
	Mn-54	1.45	1.46	1.6	1.61	1.10	1.11
	Co-60	0.16	0.16	0.149	0.24	0.93	1.50
9216	H-3	12.65	12.68	11.979	13.1	0.94	1.04
	Na-22	1.02	1.02	0.964	1.12	0.95	1.10
	Mn-54	1.45	1.46	1.535	1.66	1.05	1.14
	Co-60	0.16	0.16	0.165	0.14	1.03	0.88
9207	H-3	503.72	504.67	434.536	478.9	0.86	0.95
9217	H-3	503.72	504.67	450.536	495	0.89	0.98
9208	H-3	5.03	5.06	5.132	5.2	1.01	1.03
9218	H-3	5.03	5.06	5.541	5.1	1.10	1.01
9209	H-3	99.91	100.1	101.012	99.7	1.01	1.00
9219	H-3	99.91	100.1	102.138	99.7	1.02	1.00
9210	H-3	2.48	2.48	2.571	2.8	1.04	1.13
9220	H-3	2.48	2.48	2.715	2.9	1.09	1.17
9211	H-3	0.494	0.494	0.464	<2	0.94	NA
9221	H-3	0.495	0.495	<0.438	<2	NA	NA
9212	H-3	24.69	24.74	26.014	25.6	1.05	1.04
	Na-22	0.45	0.45	0.424	0.42	0.94	0.93
	Mn-54	1.53	1.53	1.682	1.86	1.10	1.22
	Co-60	0.31	0.31	0.311	0.4	1.00	1.29
9222	H-3	24.69	24.74	25.763	25.9	1.04	1.05
	Na-22	0.45	0.45	0.431	0.38	0.96	0.84
	Mn-54	1.53	1.53	1.65	1.64	1.08	1.07
	Co-60	0.31	0.31	0.302	0.3	0.97	0.97

NA - Not Available ND - Not Detected

*The AAL and TMA use slightly different half-lives ($T_{1/2}$)

1992

Table 23

1992 Radiochemical Results for 45-Degree Boring Holes at Fixed Target Beamline Activation Areas (Figure 11)

			H-3				Na-22			
			pCi/ml		Bq/ml		pCi/ml		Bq/ml	
Boring Hole	Sample Date	Purge	Result	Error	Result	Error	Result	Error	Result	Error
S-1059	23-Apr	Pre	4.04E+01	8.82E-01	1.49E+00	3.26E-02	0.00E+00	3.20E-02	0.00E+00	1.18E-03
	29-Apr	Post	2.92E+01	7.55E-01	1.08E+00	2.79E-02	0.00E+00	3.20E-02	0.00E+00	1.18E-03
	18-Jun	Pre	3.51E+01	2.47E+00	1.30E+00	9.12E-02	0.00E+00	2.10E-02	0.00E+00	7.77E-04
	22-Jun	Post	2.37E+01	1.73E+00	8.78E-01	6.39E-02	0.00E+00	3.30E-02	0.00E+00	1.22E-03
	11-Aug	Pre	3.01E+01	2.14E+00	1.11E+00	7.93E-02	0.00E+00	1.30E-02	0.00E+00	4.81E-04
	17-Aug	Post	2.15E+01	1.58E+00	7.94E-01	5.86E-02	0.00E+00	1.40E-02	0.00E+00	5.18E-04
S-1060	23-Apr	Pre	4.77E-01	2.07E-01	1.76E-02	7.66E-03	0.00E+00	2.00E-02	0.00E+00	7.40E-04
	11-Aug	Pre	0.00E+00	3.50E-01	0.00E+00	1.30E-02	0.00E+00	1.40E-02	0.00E+00	5.18E-04
	17-Aug	Post	0.00E+00	3.57E-01	0.00E+00	1.32E-02	0.00E+00	1.30E-02	0.00E+00	4.81E-04
S-1061	21-May	Pre	0.00E+00	3.17E-01	0.00E+00	1.17E-02	0.00E+00	2.80E-02	0.00E+00	1.04E-03
	22-May	Post	0.00E+00	3.17E-01	0.00E+00	1.17E-02	0.00E+00	2.20E-02	0.00E+00	8.14E-04
	12-Aug	Pre	0.00E+00	3.46E-01	0.00E+00	1.28E-02	0.00E+00	1.30E-02	0.00E+00	4.81E-04
S-1087	23-Apr	Pre	7.50E-01	2.20E-01	2.78E-02	8.14E-03	0.00E+00	3.00E-02	0.00E+00	1.11E-03
	29-Apr	Post	5.16E-01	2.10E-01	1.91E-02	7.77E-03	0.00E+00	3.10E-02	0.00E+00	1.15E-03
	18-Jun	Pre	5.01E-01	2.22E-01	1.85E-02	8.21E-03	0.00E+00	2.80E-02	0.00E+00	1.04E-03
	22-Jun	Post	4.13E-01	2.16E-01	1.53E-02	7.99E-03	0.00E+00	2.50E-02	0.00E+00	9.25E-04
	11-Aug	Pre	0.00E+00	3.46E-01	0.00E+00	1.28E-02	0.00E+00	1.30E-02	0.00E+00	4.81E-04
	17-Aug	Post	0.00E+00	3.48E-01	0.00E+00	1.29E-02	0.00E+00	1.20E-02	0.00E+00	4.44E-04
S-1088	23-Apr	Pre	2.04E+00	2.67E-01	7.56E-02	9.88E-03	0.00E+00	2.50E-02	0.00E+00	9.25E-04
	29-Apr	Post	1.82E+00	2.60E-01	6.73E-02	9.62E-03	0.00E+00	3.10E-02	0.00E+00	1.15E-03
	18-May	Pre	2.03E+00	3.21E-01	7.50E-02	1.19E-02	0.00E+00	2.70E-02	0.00E+00	9.99E-04
	21-May	Post	1.50E+00	2.86E-01	5.56E-02	1.06E-02	0.00E+00	3.90E-02	0.00E+00	1.44E-03
	11-Aug	Pre	1.19E+00	2.79E-01	4.40E-02	1.03E-02	0.00E+00	1.50E-02	0.00E+00	5.55E-04
	17-Aug	Post	1.49E+00	2.79E-01	5.52E-02	1.03E-02	0.00E+00	1.50E-02	0.00E+00	5.55E-04
S-1089	23-Apr	Pre	2.90E+00	2.96E-01	1.07E-01	1.10E-02	0.00E+00	3.30E-02	0.00E+00	1.22E-03
	11-Aug	Pre	4.96E-01	2.43E-01	1.84E-02	8.99E-03	0.00E+00	1.20E-02	0.00E+00	4.44E-04

1992

Table 24

EIS/ODIS Activity (mCi Of H-3) Summary Report for Liquid Releases in CY 1988 - 1992

Sump		CY 92	CY 91	CY 90	CY 89	CY 88
M01SP3	DISCHARGE	39	79	46	28	109
	EFFLUENT	12	59	37	17	56
N01SP4	DISCHARGE	499	447	245	273	372
	EFFLUENT	160	300	174	194	180
NW4SP1	DISCHARGE	78	134	1650	612	190
	EFFLUENT	23	87	1370	432	96
N01RP1	DISCHARGE	26	-	-	-	-
	EFFLUENT	8	-	-	-	-

1992

FIGURES

Figure 1

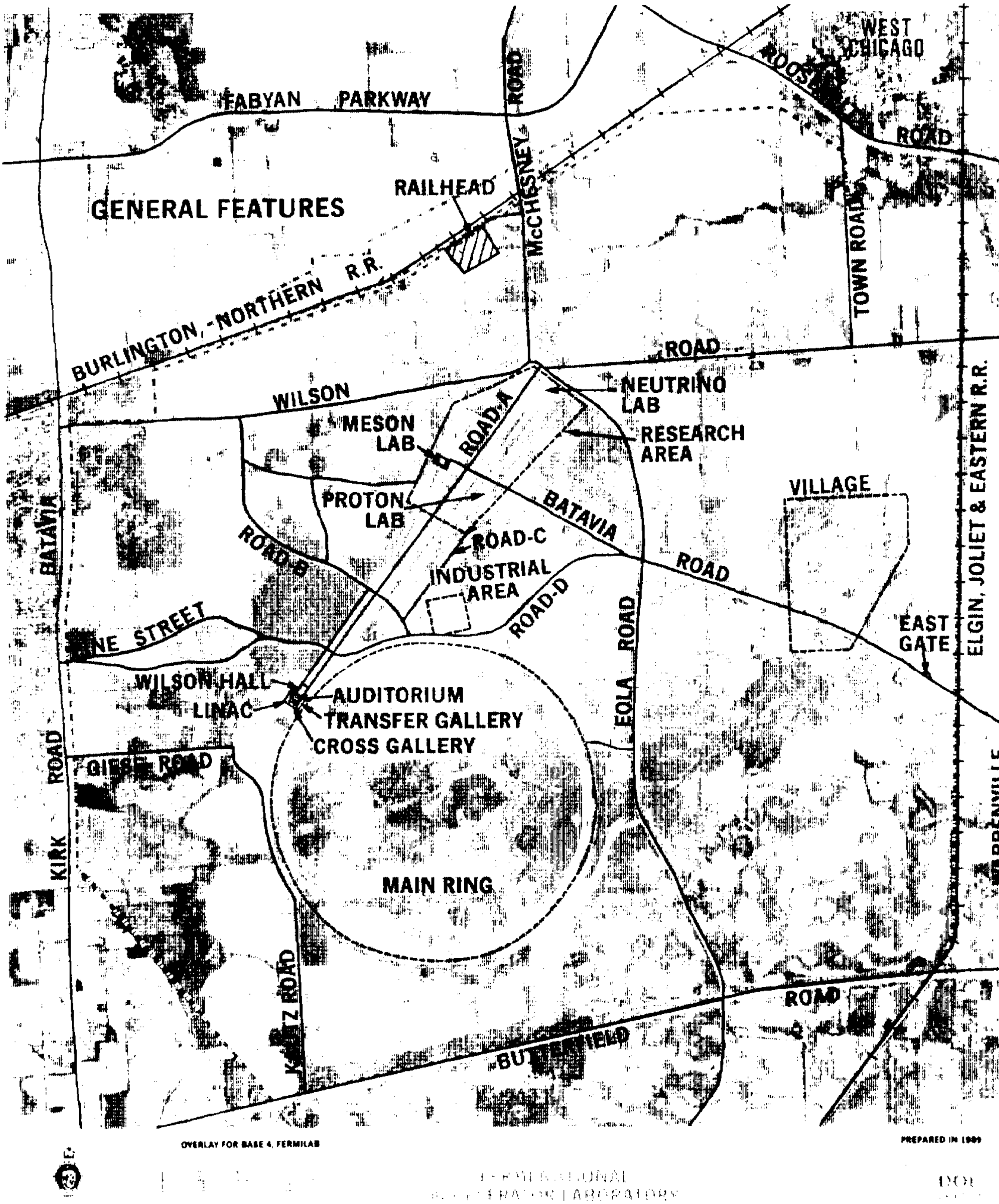
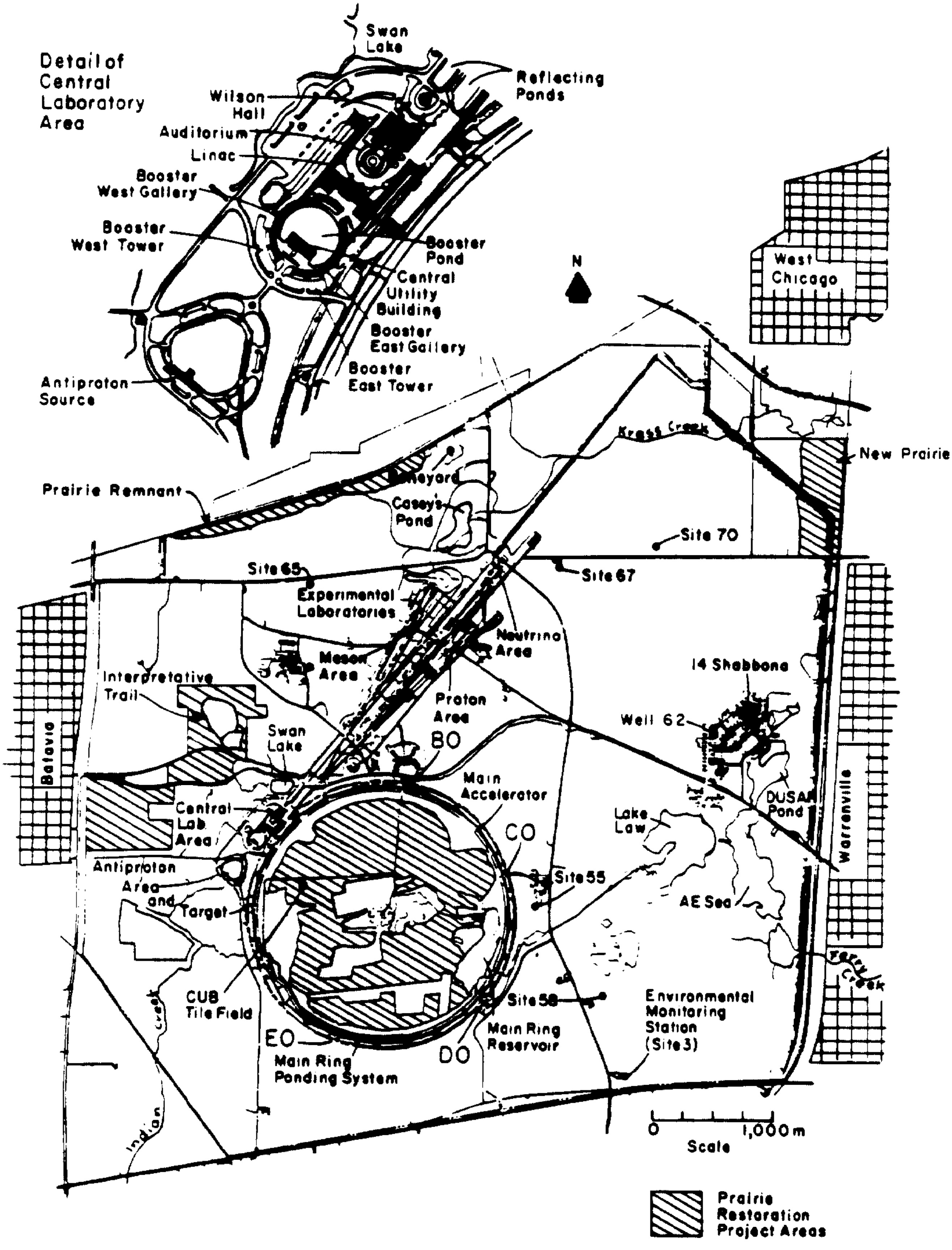

GENERAL FEATURES
FABYAN PARKWAY
RAILHEAD
McCHESNEY ROAD
WEST CHICAGO
ROOSEVELT ROAD
TOWN ROAD
BURLINGTON-NORTHERN R.R.
WILSON ROAD
NEUTRINO LAB
MESON LAB
ROAD-A
RESEARCH AREA
PROTON LAB
BATAVIA ROAD
ROAD-C
VILLAGE
ROAD-B
INDUSTRIAL AREA
ROAD-D
EOLA ROAD
EAST GATE
ELGIN, JOLIET & EASTERN R.R.
BATAVIA
STREET
WILSON HALL
LINAC
AUDITORIUM
TRANSFER GALLERY
CROSS GALLERY
KIRK ROAD
GIESE ROAD
MAIN RING
WARRENVILLE ROAD
KRAFTZ ROAD
BUTTERFIELD
OVERLAY FOR BASE 4, FERMILAB
PREPARED IN 1989

Figure 2

Figure 2 - Fermilab Site



1992

Figure 3

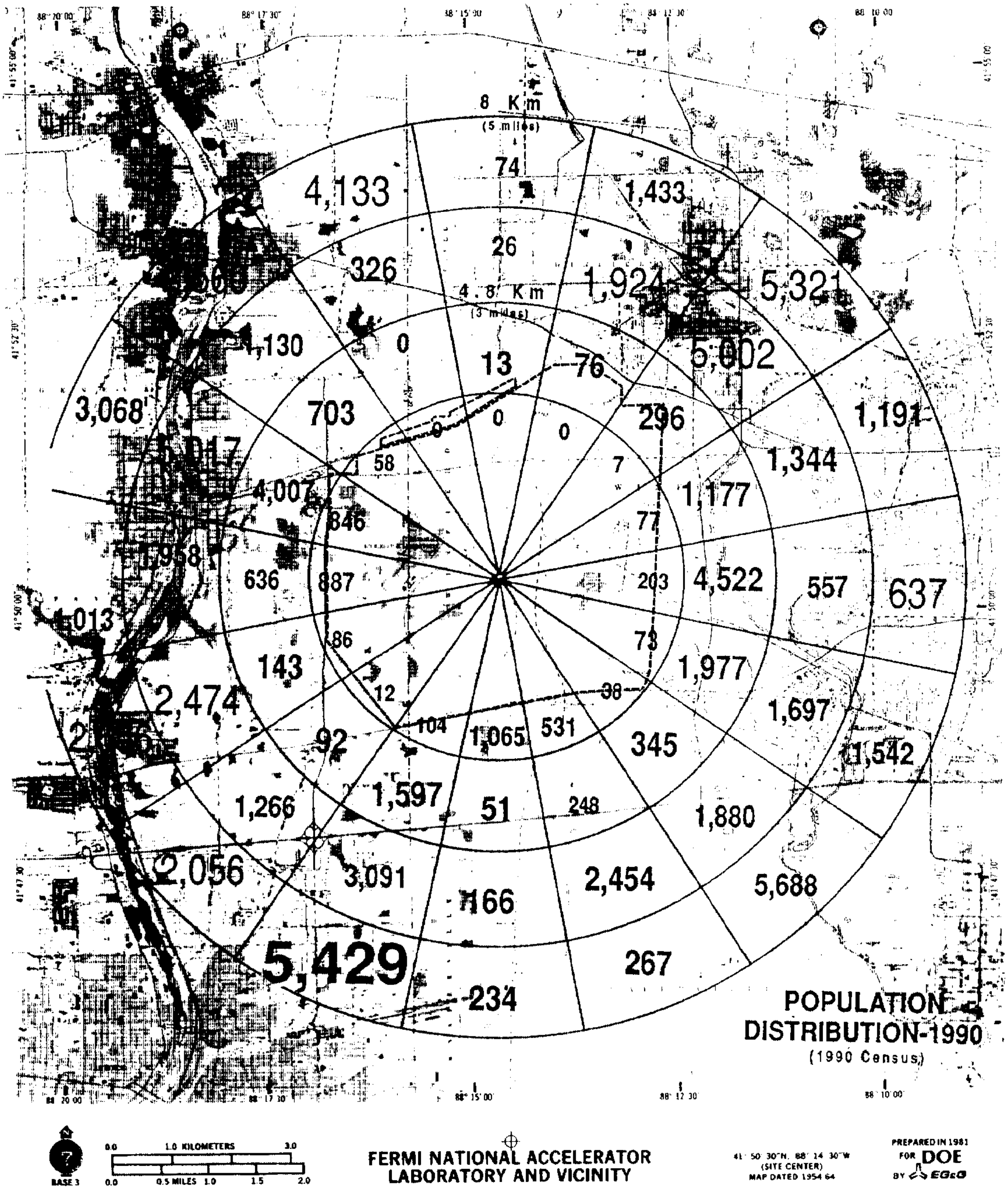

8 Km
(5 miles)
4.8 Km
(3 miles)
4,133
74
1,433
326
26
1,924
5,321
1,130
0
13
76
5,002
3,068
703
0
0
296
1,191
58
7
1,344
4,007
846
77
1,177
636
887
203
4,522
557
637
143
86
73
1,977
2,474
12
38
1,697
92
104
1,065
531
345
1,542
1,266
1,597
51
248
1,880
2,056
3,091
166
2,454
5,688
5,429
267
234
POPULATION DISTRIBUTION-1990
(1990 Census)
FERMI NATIONAL ACCELERATOR LABORATORY AND VICINITY
PREPARED IN 1981 FOR DOE BY EG&G

Figure 4

Population Distribution
(In Thousands)

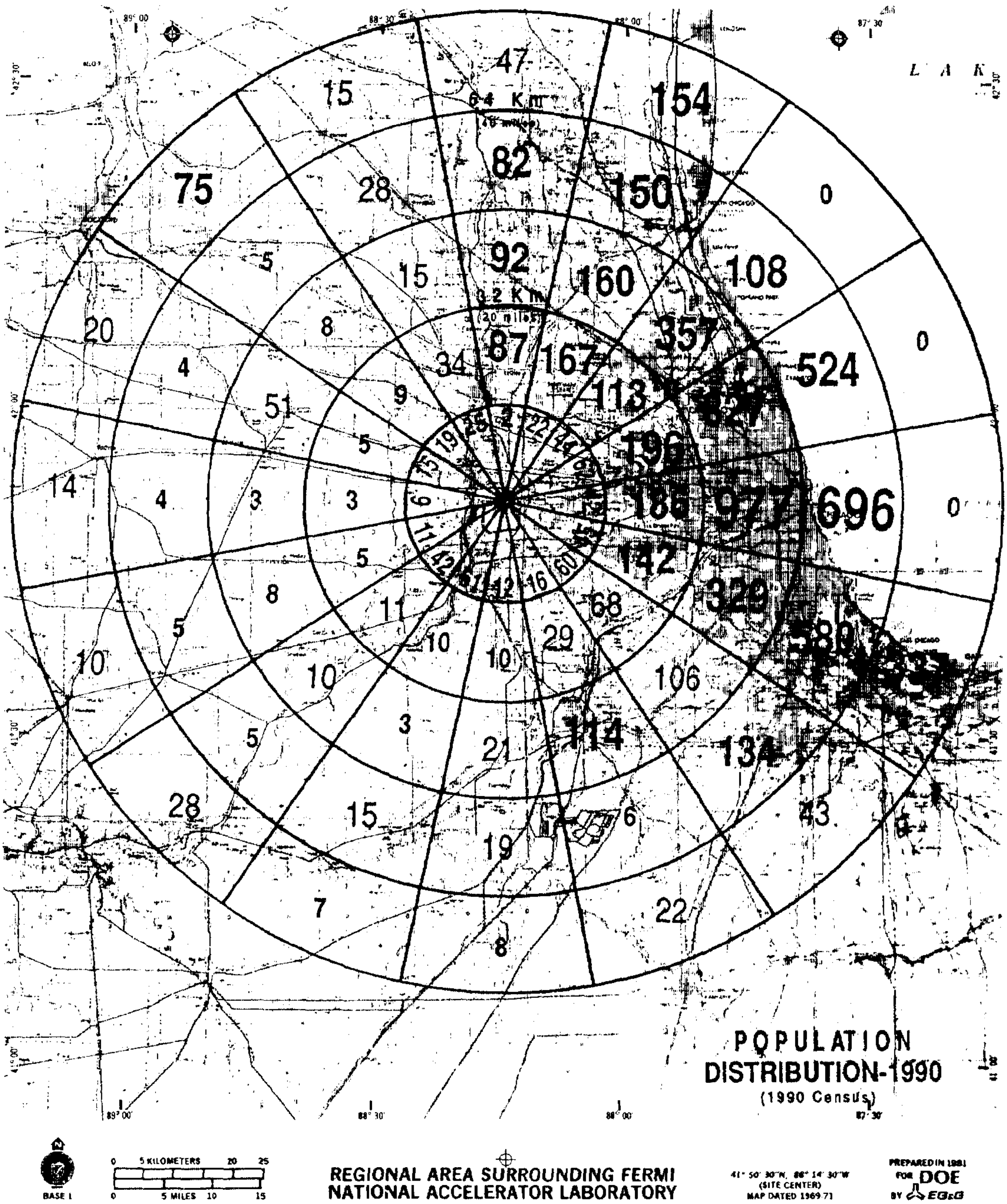


Figure 5

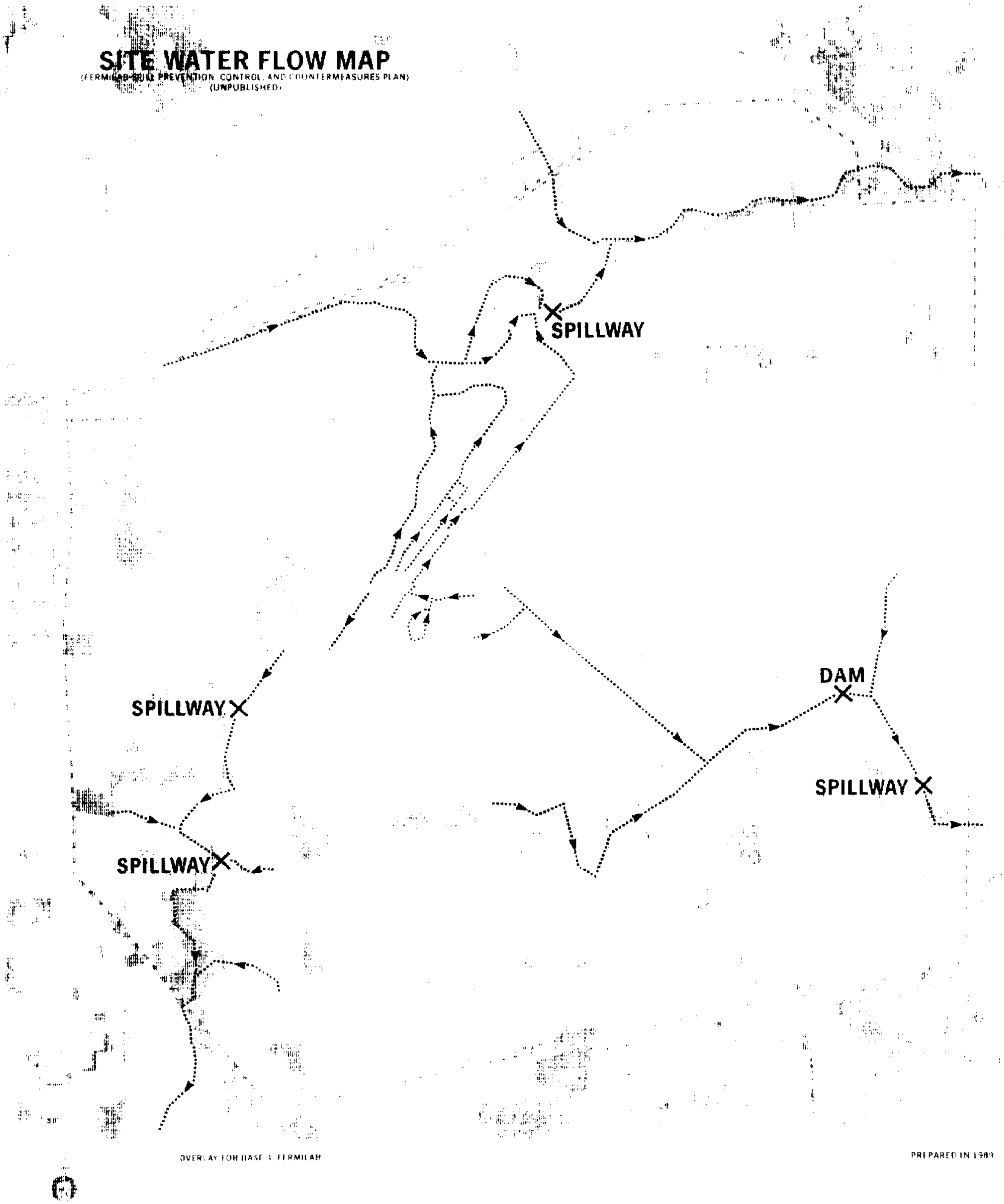

SITE WATER FLOW MAP
(FERMILAB SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN)
(UNPUBLISHED)
SPILLWAY
SPILLWAY
SPILLWAY
DAM
SPILLWAY
OVERLAY FOR BASE 1 FERMILAB
PREPARED IN 1989

Figure 6

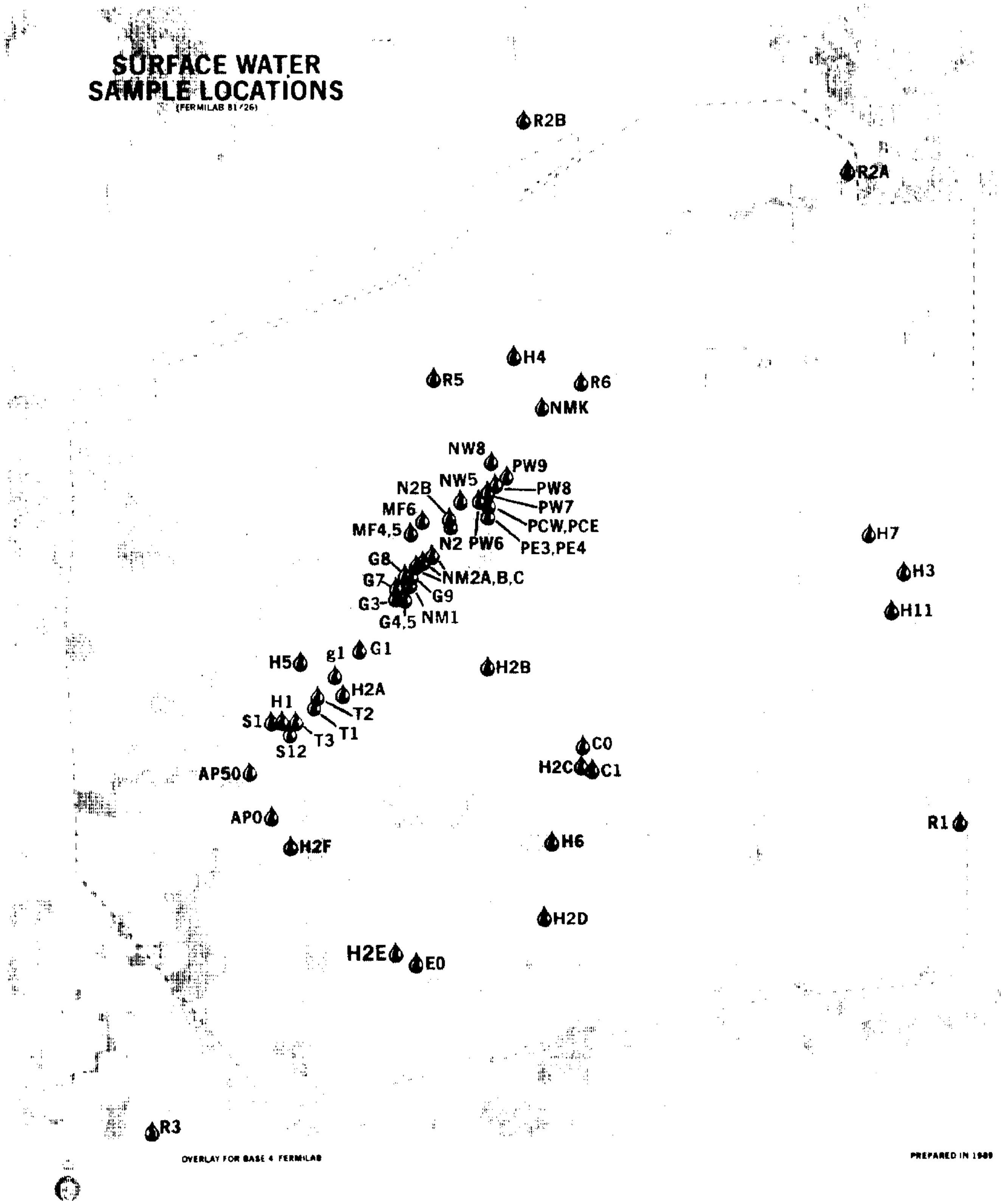
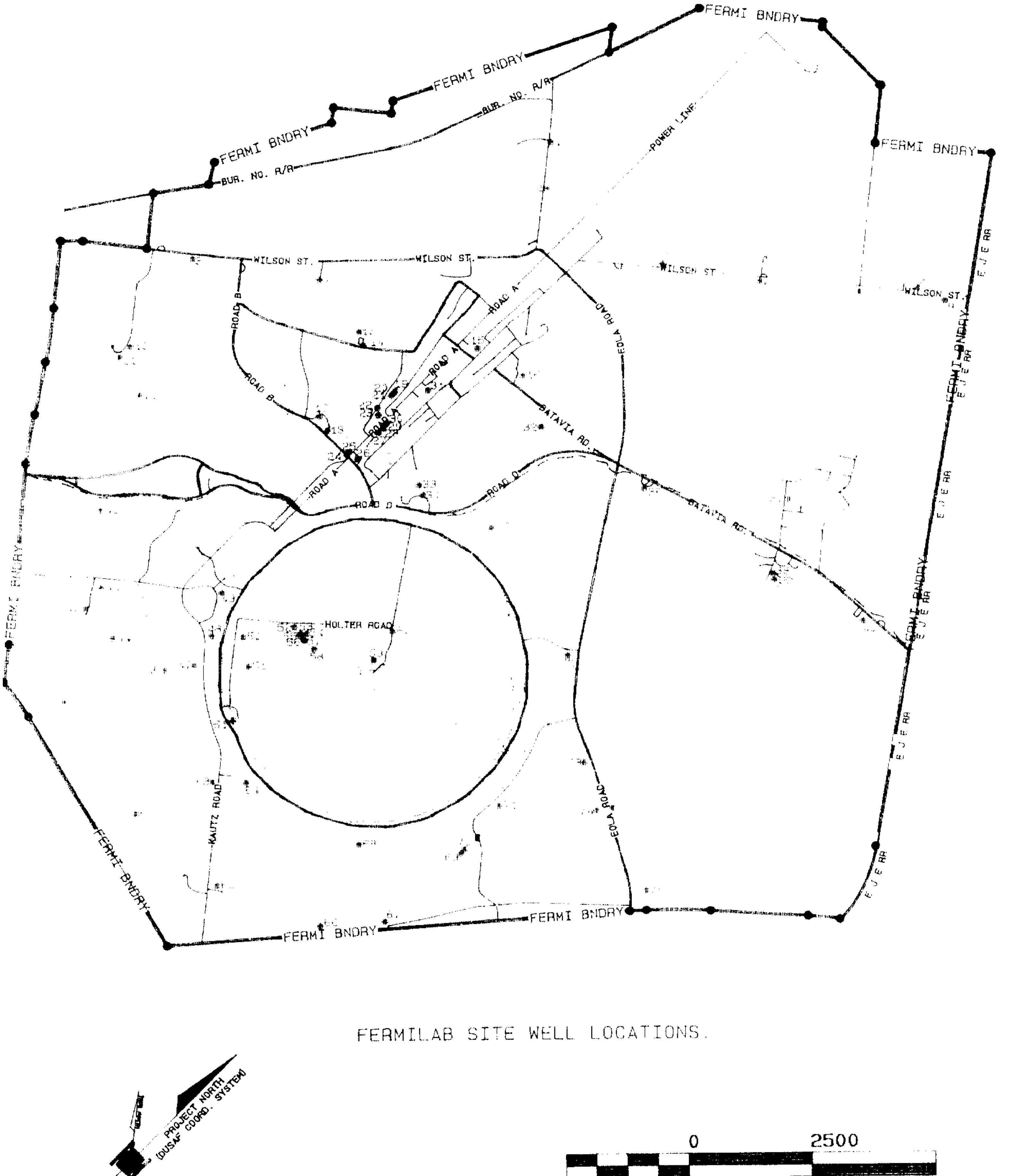

SURFACE WATER
SAMPLE LOCATIONS
(FERMILAB 81/26)
R2B
R2A
H4
R5
R6
NMK
NW8
PW9
N2B
NW5
PW8
MF6
PW7
MF4,5
PCW,PCE
N2
PW6
PE3,PE4
H7
G8
H3
G7
NM2A,B,C
G9
G3
NM1
G4,5
H11
g1
G1
H5
H2B
H2A
H1
T2
S1
T1
T3
S12
C0
AP50
H2C
C1
AP0
R1
H2F
H6
H2D
H2E
E0
R3
OVERLAY FOR BASE 4 FERMILAB
PREPARED IN 1980

Figure 7



FERMILAB SITE WELL LOCATIONS.

PLOT SITE WELLS, 8X11 SIZE, 2500 SCALE - 5545[0,3]PF: UG3WEL 15100 14-Sep-93 02:53 PM / 4007-3

Key for Figure 7

Fermilab Wells 1992

Well #	Map Number	County	Use	Depth (ft)
3	76	DuPage	Monitoring	120
5	69	DuPage	Monitoring	110
7	67	DuPage	Monitoring	122
8	66	DuPage	Monitoring	68
12	65	DuPage	Monitoring	80
16	64	DuPage	Monitoring	90
19	51	DuPage	Monitoring	115
20	50	DuPage	Monitoring	120
39	14	DuPage	Monitoring	170
43	34	DuPage	Monitoring	100
45	60	DuPage	Monitoring	100
49	15	DuPage	Monitoring	95
50	16	DuPage	Monitoring	80
57	74	DuPage	Monitoring	66
59	36	DuPage	Monitoring	80
62	37	DuPage	Monitoring	261
64	40	DuPage	Monitoring	90
65	4	DuPage	Monitoring	165
69	6	DuPage	Monitoring	120
72	7	DuPage	Monitoring	90
73	8	DuPage	Monitoring	120
74	9	DuPage	Monitoring	85
75	1	DuPage	Monitoring	80
76	2	DuPage	Monitoring	75
78	23	DuPage	Monitoring	160
79	22	DuPage	Monitoring	81.5
80	26	DuPage	Monitoring	71
39d	15	DuPage	Monitoring	25
61b	39	DuPage	Monitoring	70
61c	38	DuPage	Monitoring	243
B56	68	DuPage	Monitoring	63
B59	35	DuPage	Monitoring	82
MSS 5S	24	DuPage	Monitoring	16
MSS 5D	24	DuPage	Monitoring	40
MSS B6	25	DuPage	Monitoring	28
MWD1	56	DuPage	Monitoring	43
MWD2	57	DuPage	Monitoring	41
MWS1	52	DuPage	Monitoring	15
MWS2	55	DuPage	Monitoring	17
MWS3	64	DuPage	Monitoring	16
MWS4	53	DuPage	Monitoring	15
MWS5	58	DuPage	Monitoring	15
S-1058	27	DuPage	Monitoring	60
S-1059	28	DuPage	Monitoring	62
S-1060	31	DuPage	Monitoring	62
S-1061	21	DuPage	Monitoring	57
S-1062	20	DuPage	Monitoring	60
S-1063	19	DuPage	Monitoring	66
S-1087	28	DuPage	Monitoring	61
S-1088	29	DuPage	Monitoring	22
S-1089	30	DuPage	Monitoring	32
S35	59	DuPage	Monitoring	83
SSC2	70	DuPage	Monitoring	317,417,517
W-2	33	DuPage	Monitoring	326
W-4	18	DuPage	Monitoring	1432
23	41	Kane	Monitoring	110
30	3	Kane	Monitoring	135
31	12	Kane	Monitoring	210
24a	42	Kane	Monitoring	100
24b	43	Kane	Monitoring	80
B54	10	Kane	Monitoring	117
BH13	48	Kane	Monitoring	70
BH15	46	Kane	Monitoring	55
S-1111	62	Kane	Monitoring	27
S-1115	45	Kane	Monitoring	30
S-1118	47	Kane	Monitoring	33.5
S-1124	63	Kane	Monitoring	50
S-1126	44	Kane	Monitoring	42.5
W-3	17	DuPage	NCNT	222
W-5	71	DuPage	NCNT	220
W-1	49	Kane	NCNT	224
17	61	DuPage	Semi-private	114
52	32	DuPage	Semi-private	100
55	72	DuPage	Semi-private	145
56	73	DuPage	Semi-private	174
58	75	DuPage	Semi-private	140
68	5	DuPage	Semi-private	169
29	11	Kane	Semi-private	130

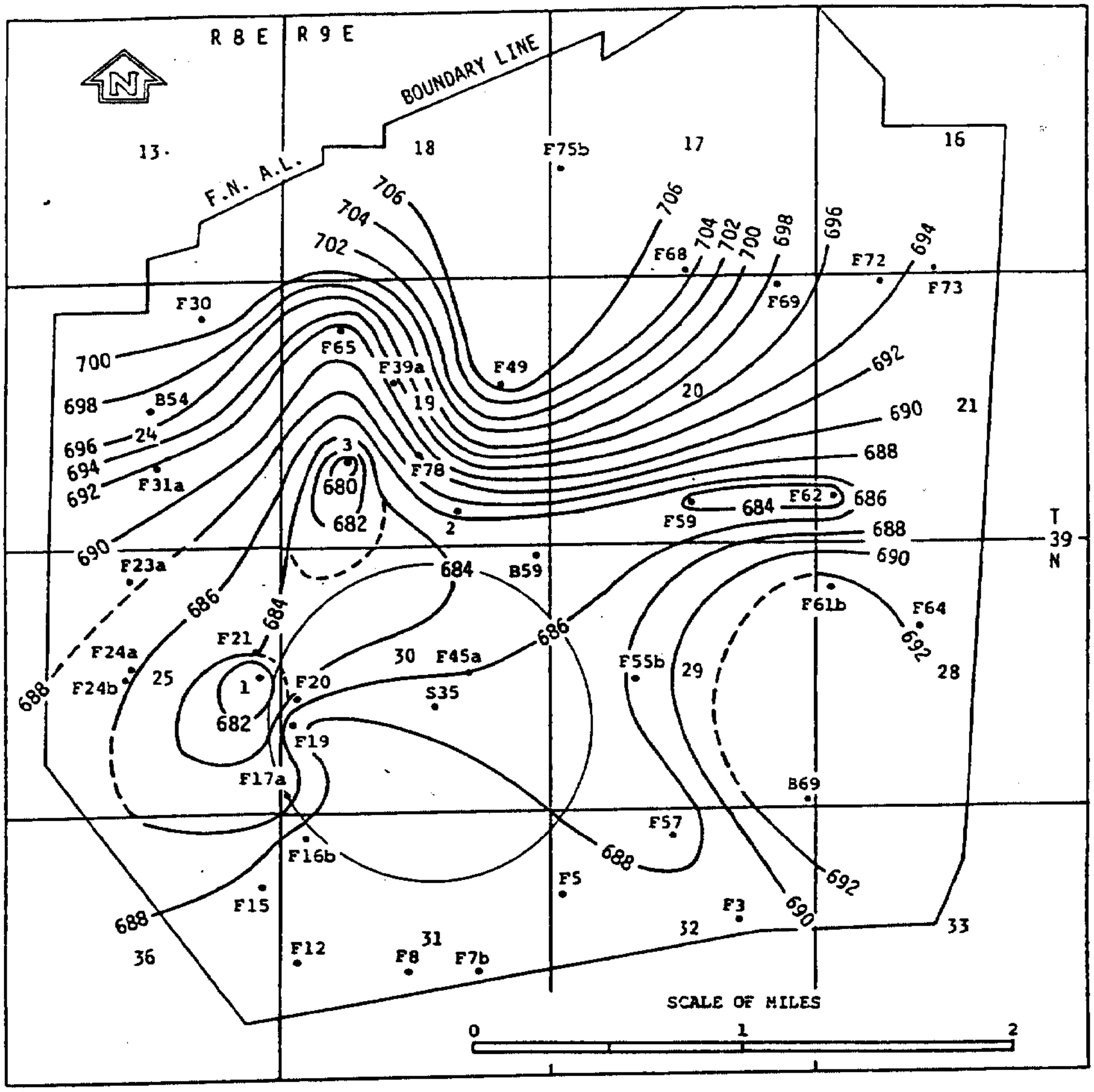
NTNC = Non-Community, Non-Transient

1912

Figure 8

FERMI NATIONAL ACCELERATOR LABORATORY

DuPage & Kane Counties, Illinois



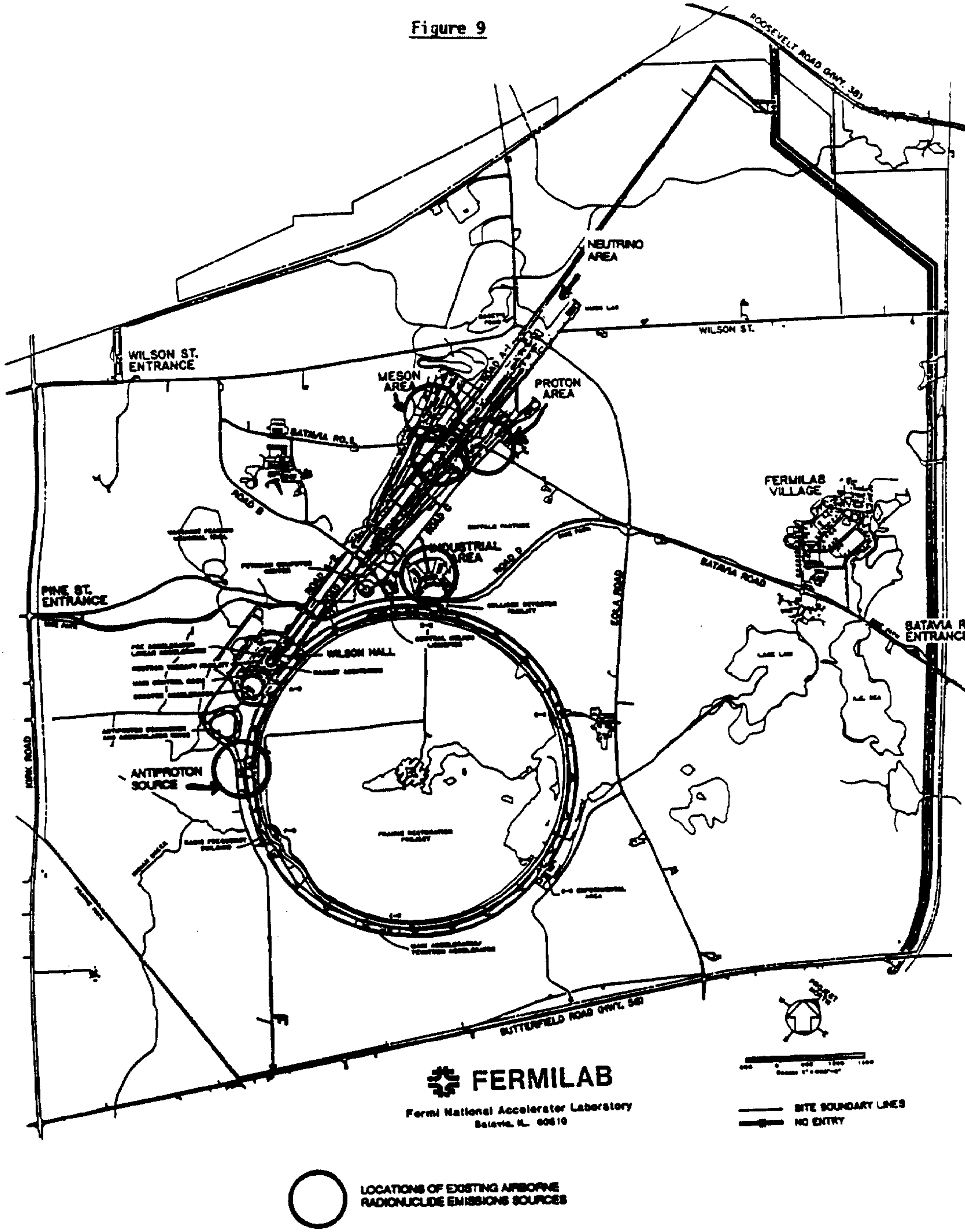
SHALLOW DOLOMITE AQUIFER

PIEZOMETRIC SURFACE

Elevations in feet above mean sea level

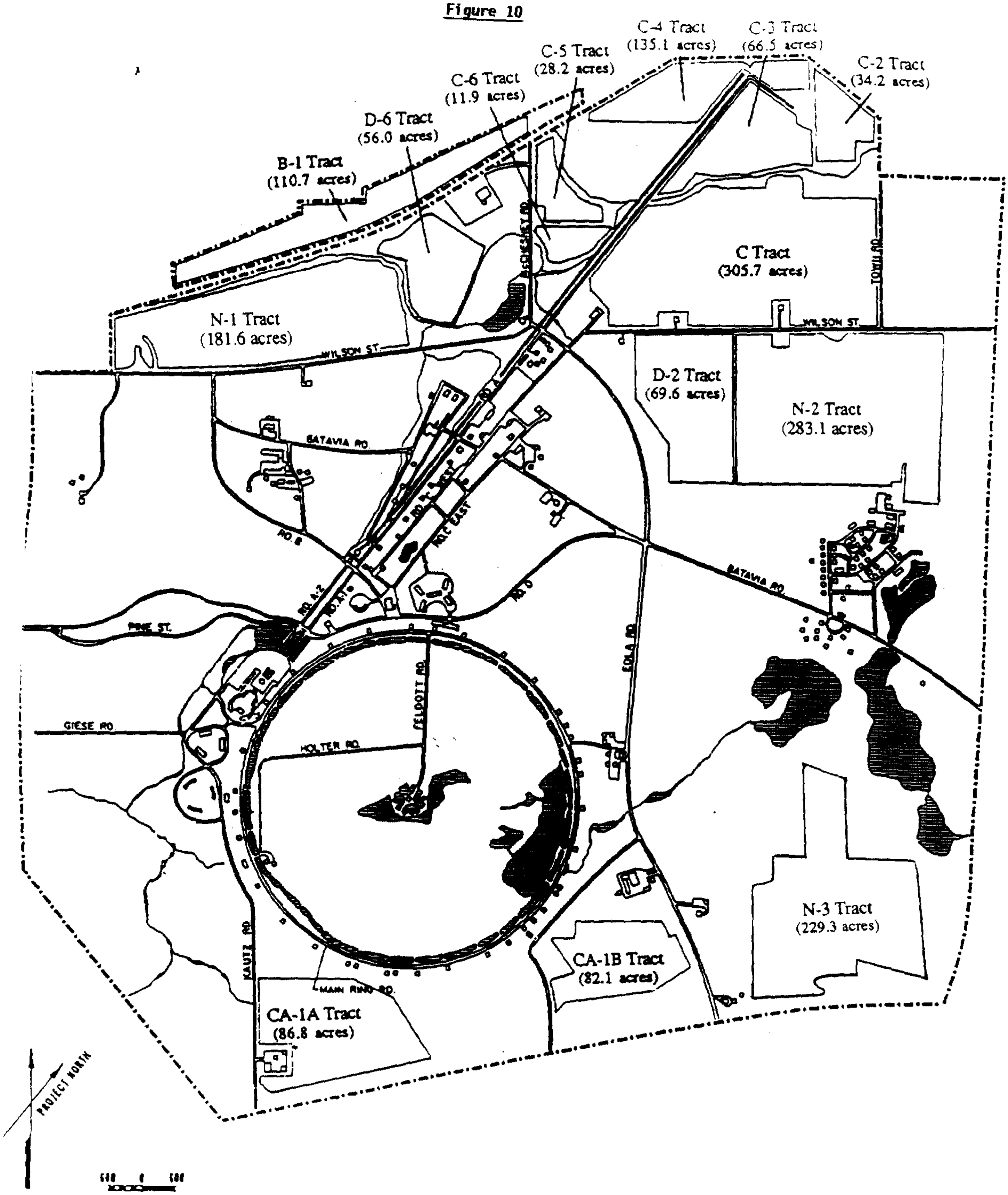
Illinois State Water Survey
June 1978

Figure 9



Map of the Fermilab site showing existing facilities including locations of existing sources of radionuclide emissions.

Figure 10



Leased Farm Tracts CY 1992
Fermi National Accelerator Laboratory

Appendix C

ACRONYMS

AAL	Activation Analysis Laboratory (Fermilab)
ALARA	As Low As Reasonably Achievable
ASTM	American Society for Testing and Materials
BAT	Best Available Technology
BETX	Benzene, Ethylbenzene, Toluene, and Xylene
BOD	Biological Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COD	Chemical Oxygen Demand
CUB	Central Utilities Building
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year
D&D	Decontamination and Decommissioning
DCG	Derived Concentration Guides
DOE	U.S. Department of Energy
EA	Environmental Assessment
EE	Environmental Evaluation
EIS/ODIS	Effluent Information System/Offsite Discharge Information System
EML	Environmental Measurements Laboratory
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
EPPM	Environmental Protection Procedures Manual
ESA	Endangered Species Act
ES&H	Environment, Safety and Health
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FWS	Fish and Wildlife Service
HSWA	Hazardous and Solid Waste Amendments
HWSF	Hazardous Waste Storage Facility
IAC	Illinois Administrative Code
ICRP	International Commission on Radiation Protection
ICW	Industrial Cooling Water
IEPA	Illinois Environmental Protection Agency
NCRP	National Commission of Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Act
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyls
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RFI	RCRA Facilities Investigation
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SPCC	Spill Prevention Control and Countermeasures
SWMU	Solid Waste Management Unit
TLD	Thermoluminescent Dosimeter
TSCA	Toxic Substances Control Act
UIC	Underground Injection Control Well
UST	Underground Storage Tank
VOC	Volatile Organic Compounds