SITE INSPECTION
FIELD SAMPLING PLAN

NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
PLUM BROOK STATION

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SECTION 1
INTRODUCTION

This document is a part of a comprehensive package of Site Inspection (SI) plans developed to ensure that all planning has been completed prior to beginning field activities at the National Aeronautics and Space Administration, Plum Brook Station (PBS). These plans define procedures to be used, resources needed, and the rationale behind the tasks which will be performed as a part of the SI. This Field Sampling Plan sets forth the protocol to be utilized during the field data gathering efforts associated with the SI.

1.1 Site Background

Plum Brook Station is a satellite operation of NASA's LeRC in Cleveland, Ohio. Most of the aerospace test facilities established in the 1960s at Plum Brook Station are in standby or inactive condition. This section of the PA report includes a description and history of Plum Brook Station.

1.2 Site Description and History

Plum Brook Station is a satellite operation of NASA's Lewis Research Center (LeRC). NASA LeRC is located adjacent to Hopkins Airport in Cleveland, Ohio. Plum Brook Station is located 50 miles west of LeRC and approximately 4 miles south of the Lake Erie port of Sandusky, Ohio. Areas surrounding Plum Brook Station are primarily agricultural and rural. Much of the agricultural lands are used for crop production. Much of PBS is situated on undisturbed forested land, located in Perkins and Oxford townships. However, the eastern edge of the site extends into Huron and Milan townships (See Figure 1-1).

The site is served by an internal paved road system totaling 62.5 miles and a currently unused 15.7-mile rail system. The site is bounded on the north by Bogart Road, on the south by Mason Road, on the east by U.S. Highway 250, and on the west by County Road 43.

Plum Brook Station is located on what was a flat lake bottom from glacial melt waters. The original Plum Brook Station consisted of 9,009 acres, approximately 6,500 acres of which currently make up the station. The northern most boundary of Plum Brook Station occurs at latitude 41°23'39" and extends as far south as latitude 41°20'04'. The westernmost longitude occurs at 82°43'12" and extends as far east as 82°38'39". NASA's LeRC controls the land associated with Plum Brook Station through ownership of title, use of easements, leases, permits, and ownership of development rights.

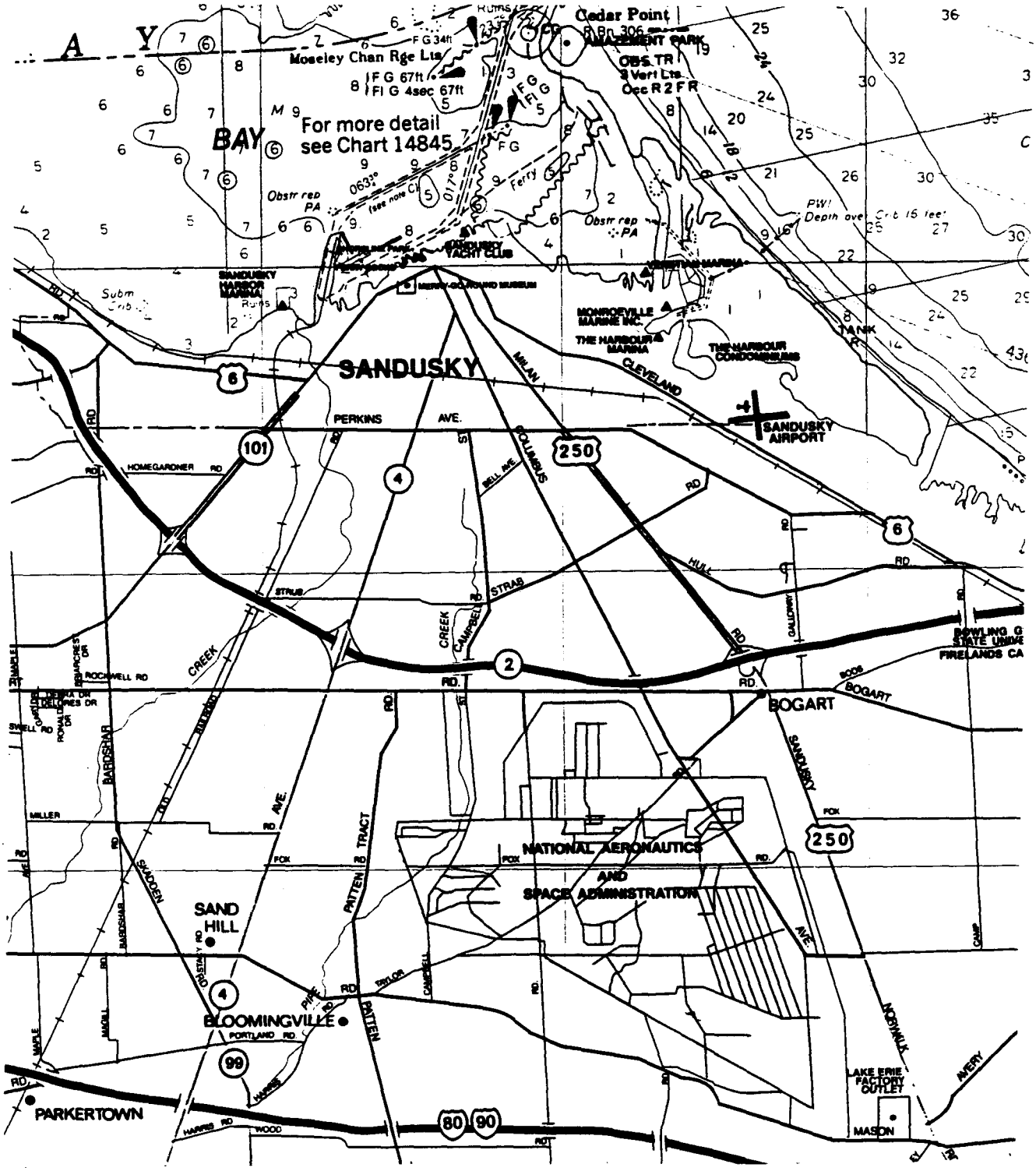


FIGURE 1.1
FACILITY LOCATION MAP

The U.S. Army established the Plum Brook Ordnance Works (PBOW) in the early 1940s to manufacture ordnance [trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite] for World War II, pursuant to a contract between the U.S. Army and Trojan Powder Company. Production began on December 16, 1941, and continued throughout late 1945. The official title for the site during this time was the PBOW. Production ceased two weeks after V-J Day. During the production period more than one billion pounds of ordnance were manufactured.

PBOW was in standby condition from 1945 to 1946. During this time the Army conducted decontamination and decommissioning (D&D) of many of the buildings and structures associated with the manufacturing of ordnance. Decontamination efforts on all TNT and DNT lines began in September 1945. Decontamination of TNT lines, acid lines, pentolite lines, and DNT lines was halted during the last quarter of 1945. Typical D&D methods for buildings and structures involved removal and relocation of all explosives to a burning ground where they were burned. Where possible, remaining buildings and structures were burned to the ground. Steam lines, drain lines, etc., were flushed and dismantled. There is no indication in PBOW historical records of where lines were flushed. It is estimated that 65 percent of the necessary decontamination of PBOW was completed by December 1945. Physical custody of the PBS was transferred from Trojan Powder Company to the U.S. Army Ordnance Department in December 1945.

The Ordnance Department became the accountable agency and the U.S. Army Corps of Engineers assumed responsibility for maintenance and custodial duties at the PBOW from January 1 through June 30, 1946. After further decontamination efforts were completed and the extent of contamination certified, PBOW was transferred to the War Assets Administration in August 1946. Matthew-Levio and Sons protected and maintained the property from 1946 to 1949. In 1949 PBS was transferred to the General Services Administration (GSA), which maintained oversight of the facility until August 1954. Ravenna Arsenal conducted further decontamination efforts from 1954 to 1958. NASA accepted the facility in 1963 after Ravenna Arsenal certified that the PBOW had been completely decontaminated and was suitable for unrestricted future use. After acceptance of the PBOW, NASA identified further areas that required decontamination. In 1964, NASA continued site decontamination and the removal of structures. NASA operated the PBRF from 1963 to 1973 under a license agreement with the Atomic Energy Commission (AEC). NASA currently has a license agreement with the Nuclear Regulatory Commission (NRC) for the safe protective storage of the PBRF. The site remained virtually "mothballed" from 1945 until 1956, when the National Advisory Committee for Aeronautics (NACA) determined that the former PBOW was a suitable site to locate a new test reactor. An agreement was made in 1956 for a lease of 500 acres of the north portion of the site to construct and operate the Plum Brook Reactor Facility (PBRF). In October 1958, NACA became the National Aeronautics and Space Administration (NASA).

NASA operated the PBRF from 1963-1973 under a license agreement with the Atomic Energy Commission (AEC). NASA currently has a license agreement with the Nuclear Regulatory Commission (NRC) for the safe protection and storage of the PBRF. NASA acquired an additional 6,000 acres of the former PBOW on March 15, 1963, for the purpose of conducting various aerospace research activities. Throughout the 1960s, NASA constructed various test and research facilities at Plum Brook Station to support their aerospace program. The major research facilities that evolved in the 1960s are:

- *Liquid Hydrogen Pump Site (A Site Complex)* - This facility was utilized to test liquid hydrogen research pumps of various designs up to pump speeds of 60,000 revolutions per minute.

- *High Energy Rocket Engine Research Facility (B1 Site Complex)* - This facility was designed to test propellant systems at altitude conditions.

- *Space Propulsion Research Facility (B2 Site Complex)* - This facility was utilized to test space vehicles and upper stage rocket engines in a simulated space environment.

- *Rocket Dynamics and Control Facility (B3 Site Complex)* - This facility was utilized for altitude tests on various components for large rocket engines as well as for other research and development projects.

- *Turbo Pump Site (C Site Complex)* - This facility was utilized for research on liquid hydrogen turbo pumps and pump inducers.

- *Controls and Turbine Test Site (D Site Complex)* - This facility was utilized to test research turbines in order to design drive turbines for rocket propellant pumps for chemical and nuclear engines.

- *Dynamics Stand (E Site Complex) Space Power Facility* - This facility is a 144 feet test stand equipped with electromagnetic shake devices. It was used to simulate forces spacecraft are expected to encounter during launch and in flight.

- *Hydraulics Lab (F Site Complex)* - At this test site, cryogenic liquid such as liquid hydrogen was passed through test set-ups to obtain data on various fluid flow conditions.

- *G Site Complex* - This test site was utilized to test turbo pumps. During a 1964 test, hydrogen leaking from a pump caused an explosion and the complete destruction of the G Site Complex. The research being conducted at the site was near completion at that time. The site was demolished and has been used since.

- *Fluorine Pump Site (I Site Complex)* - At this site, liquid fluorine pumps with speeds up to 20,000 revolutions per minute and flow rates of 50 pounds per second were tested.

- *Oxidizer Hydraulics Lab (J Site Complex)* - Rocket engine oxidizer system components were tested at this facility to determine how they reacted with other materials.

- *Cryogenic Propellant Tank Site (K Site Complex)* - This facility was used to test propellant tank insulation systems and to determine pressurizing gas requirements during propellant outflow. The tank served as a research test chamber where liquid hydrogen rocket fuel tanks were tested.

- *Hypersonic Tunnel Facility (HTF)* - In this facility, air velocities and temperatures were created to simulate rocket flight speeds up to seven times the speed of sound and altitude conditions up to 120,000 feet.

- *Space Power Facility (SPF)* - This facility is a very large vacuum tank used for the testing of spacecraft and/or their subsystems and components in a simulated space environment. The vacuum chamber is the largest ever built. It was also designed to accommodate tests involving reactor operations but was never utilized for that purpose. In 1979, the facility was modified for use by Garrett Corporation to produce uranium hexafluoride gas centrifuges for the Department of Energy (DOE). The facility was utilized for this purpose from August 1979 through November 1986. The facility has since been restored to support additional NASA vacuum tests and is currently in use today.

On June 30, 1974, Plum Brook Station was placed in a standby condition. A skeleton crew of NASA personnel provided maintenance and oversight of Plum Brook Station during its standby period. NASA declared approximately 2,152 acres of the original 9,009 acres as excess in April 1978. The Perkins Township Board of Education received 46 of the excess acres, which included buildings 7142, 7144, 7191, 7192, 7193, 7231, 7232, 8191, 8232, and 8431. The Perkins Township Board of Education uses the land as a bus transportation center.

From 1980 through 1986, the Space Power Facility (SPF) was utilized by Garrett Corporation to produce uranium hexafluoride gas centrifuges for the Department of Energy (DOE). In 1988 Plum Brook Station began emerging from standby status and utilizing the following major aerospace facilities: SPF, Space Propulsion Research Facility (B-2 Facility), the Cryogenic Propellant Tank Site (K-Site), and Hypersonic Tunnel Facility (HTF).

NASA presently controls approximately 6,400 acres at the site. Additionally, NASA has a use permit with the Ohio Air National Guard for 604 acres. Local farmers lease approximately 900 acres.

There are approximately 106 permanent buildings and structures on the Plum Brook Station site and 99 munitions bunkers which were constructed when the facility was an ordnance plant. The munitions bunkers are currently used for the storage of materials, equipment, and records. The remaining buildings and structures include offices, test facilities, mechanical or process equipment, and shipping and receiving areas. An additional 28 structures on the site include substations, sanitary wastewater treatment facilities, and cooling towers. All the test facilities located at the site are remotely located from each other.

Electric power is provided to the facility by Ohio Edison Company. Potable water is supplied by the City of Sandusky. Raw water, used for cooling, testing, and fire protection, is provided by the City of Sandusky-owned intake in Lake Erie (Big Island Pump Station). Another raw water intake (Rye Beach Pump Station) was also used until 1985, when use was discontinued due to a blocked line. Plum Brook Station has five sanitary waste treatment systems. Three are currently operating; the largest of which is a 110,000-gallon-per-day high-rate trickling-filter secondary treatment plant located on Taylor Road.

In addition to NASA activities currently conducted at Plum Brook Station, the Department of Agriculture, Department of Interior, Department of Labor, the Immigration and Naturalization Services, and the Federal Bureau of Investigation have offices at Plum Brook Station for non-aerospace activities.

1.3 Site Regulatory History

This section of the PA report contains information on environmental permits, known hazardous material releases, and remediation activities.

1.3.1 Environmental Permits Issued or Applied For/Other Environmental Considerations

Environmental Permits currently held by NASA LeRC Plum Brook Station are as follows:

- Open Burning Permit
- National Pollutant Discharge Elimination System (NPDES) Permit

Open Burning Permit

The Plum Brook Station Open Burning Permit is actually a written authorization obtained on a yearly basis from the Ohio Environmental Protection Agency (OEPA) Northwest District Office. The Open Burning Permit is requested by Plum Brook Station yearly in writing to allow the burning of open fields each spring. The field burning is conducted in order to eradicate noxious weeds and to propagate field grasses that the site wildlife feed upon. A burn campaign, lasting approximately three months, is conducted and terminated prior to the nesting of Plum Brook Station wildlife. Each year, alternating northern and southern halves of the station are burned. The northern half was burned in the spring of 1991.

NPDES Permit

NASA LeRC Plum Brook Station has a NPDES permit (application no. OH0001392) for nine outfalls. The permit was originally issued by USEPA for seven outfalls. In March 1993, USEPA transferred primary authority for the NPDES permit program for federal facilities in Ohio to OEPA. Two new outfalls were added to the permit in April 1991. Three of the nine permitted outfalls are process/stormwater discharges to Kuebeler Ditch (outfall 001), Ransom Brook (outfall 002), and Plum Brook at Pentolite Road (outfall 003). Four outfalls (004-007) are effluent from Plum Brook Station sewage treatment plants, which also discharge to Kuebeler Ditch, Ransom Brook, and the Plum Brook. Outfall 008 is effluent from the B Control Building sewage package plant which ultimately discharges to the Box Factory Road Ditch. Outfall 009 is non-contact cooling water from K Site that is discharged onto the ground 100 feet from the building. The most recent NPDES permit granted to Plum Brook Station by the OEPA (OEPA Permit No. 21000002*CD) has an effective date of December 22, 1988, and will expire at midnight on December 13, 1993. OEPA's Northwest District Office in Bowling Green is the administrative and enforcement agency of Plum Brook Station's permit.

Other Permit Considerations and Environmental Documentation

Resource Conservation and Recovery Act

NASA LeRC Plum Brook Station has registered with the OEPA as a generator of Resource Conservation and Recovery Act (RCRA) hazardous waste and has received an EPA identification number (#OH3800015379). Plum Brook Station operations (with the exception of ongoing underground storage tank removal projects) generate significant quantities of RCRA hazardous waste. Wastes generated from routine operations are stored in Building 9206, which is managed as a less-than-90-day storage area. As no RCRA hazardous wastes are treated or disposed of on-site, Plum Brook Station is not required to submit either a RCRA Part A or Part B permit application.

Air Permits

In order to comply with the Federal Clean Air Act (CAA), the State of Ohio through its CAA State Implementation Program requires Permits to Install (PTI) New Sources of Pollution for sources installed since 1974, and Permits to Operate (PTO) for all air pollution sources. Small emissions sources (typically less than 10 tons/year) often receive "Registration Status" or "T Status" on the OEPA records. In response to a 1972 request from the Ohio Board of Health, Plum Brook Station pre-registered potential air pollution sources with the Ohio Air Pollution Control Board for information purposes only. Plum Brook Station did not and has not applied for any OEPA air permits to date, as the facility was placed in standby condition in 1974. Many of the test facilities remain inactive today; therefore, many potential air emission sources are not operating at this time. Potential sources include rocket testing activities, gas/liquid storage, cooling towers, boilers, paint-spray booth, incinerator, and construction activities. Plum Brook

Station is planning to conduct an air pollution source inventory in the near future. Additionally, if a significant portion of Plum Brook Station were reactivated or a significant new source were installed, emissions would be evaluated to determine, what, if any, air emissions required permitting.

Permission to Use Chemicals in Cooling Tower

Plum Brook Station has applied to OEPA for permission to use additives (algicide and corrosion inhibitors) in the two SPF cooling towers. A list of the proposed chemicals to be used in the cooling towers was provided to the OEPA on September 25, 1989. The OEPA approved some of the chemicals for use, but has yet to approve the use of all the proposed chemicals. Plum Brook Station is currently gathering data in order to resubmit its request for permission to use additives in the cooling towers.

National Environmental Policy Act Documentation

NASA LeRC prepared an environmental impact statement (EIS) in 1971 for both the Cleveland and Plum Brook Station sites. The 1971 EIS was superseded by a 1978 EIS which NASA submitted to the OEPA. Currently, Environmental Resources Documents (ERDs) are prepared to supplement the 1978 EIS. The current ERD was prepared in August 1990 and addresses management of hazardous substances and hazardous wastes in the Cleveland site and Plum Brook Station.

1.3.2 Environmental Remediation History

The OEPA conducted a PA of the Plum Brook Station in 1983. The areas of interest were the red water ponds and the 1981 spill of approximately 170 gallons of polychlorinated biphenyls (PCBs) that occurred at Building 9206. An on-site inspection of these sites was conducted by the OEPA Division of Solid and Hazardous Waste Management (DSHWM). The potential for groundwater and surface water contamination from the Army's production of explosives in the 1940s was assessed at that time as well as the possibility for the spilled PCBs to contaminate soil and groundwater. DSHWM recommended that further sampling be conducted at the areas of concern due to the limited amount of information available.

Red Water Discharges

Throughout the years that NASA has operated Plum Brook Station, leakage/seepage has been observed from the red water ponds. On the afternoon of April 13, 1977, a small surface ditch adjacent to the Pentolite Road Red Water Pond was observed to contain localized pockets of reddish-brown water. It was discovered that one of the drain tiles on the southeast corner of the spoils area associated with the red water pond had broken. The spoils area were created by the Army in the early 1940s by spreading neutralized chemical waste from the production of explosives onto the ground. Retention dikes and sump pits were excavated immediately to

prevent leakage of the red water to surface streams. The surface ditch was diverted. Approximately 60,000 gallons of red water were removed from the pond by a private disposal contractor and hauled off-site. The pond was backfilled and measures were taken to eliminate ponding and to provide better surface drainage to local drainage ditches.

On April 3, 1990 and again on February 19, 1991, reddish-brown water was observed discharging into the Pentolite Ditch from an underground discharge pipe. It was assumed that the source of the red water was runoff. In both instances, the OEPA and the National Response Center (NReC) were contacted. The amount of red water released to the Pentolite Ditch is unknown, but the estimated flow rate during the April 1990 incident was 5 gallons per minute. Water samples were taken upstream of the discharge, at the discharge point, and downstream of the discharge at the Plum Brook weir but no toxic or hazardous substances were detected in the analysis.

The red water ponds are not inspected on a routine basis for overflow or discharge into the onsite steams or ditches. If a heavy rainfall occurs, it is possible that these areas will be inspected at that time, particularly the discharge pipe into the Pentolite Ditch.

The U.S. Army Corps of Engineers under the Defense Environmental Restoration Program conducted an environmental assessment in 1989 of the potential areas of contamination caused by PBOW. The assessment involved an investigation of remaining Department of Defense structures and the contiguous groundwater, surface water, and soil for possible contamination by any hazardous substance associated with the PBOW. The U.S. Army has committed to remediate any sites identified as contaminated from PBOW operations.

PCB Spill at Building 9206

In 1981, a spill of approximately 170 gallons of PCB-contaminated oil occurred on the concrete floor of Building 9206 while a contractor was moving a PCB-contaminated transformer. One hundred twenty gallons of the spilled oil were recovered from the warehouse floor. The remaining PCB oil leaked under the concrete floor and contaminated the soil. Concentrations of PCBs were found in the soil up to 2,400 ppm. Some contaminated soil and all free liquids were removed, and four monitoring wells were installed to detect groundwater contamination. After several years of groundwater monitoring, no contamination was found. Total decontamination was performed in 1989. Post decontamination groundwater monitoring showed no PCB concentrations. The decision to discontinue groundwater monitoring was made in 1990 after discussions with USEPA.

Other Releases

Although the above releases were the focus of the OEPA's 1983 PA of Plum Brook Station, other releases of petroleum materials have been observed and documented as discussed below. The releases discussed below are not considered to include all releases that may have occurred

at Plum Brook Station; however, they are of large volumes and were recorded or reported to NASA officials or federal and state agencies.

Spill of Diesel Fuel at Space Power Facility

On October 4, 1980, a spill of several thousand gallons of diesel oil occurred at the SPF while Garrett Corporation was using the facility. The source of the spill was an underground tank which had overflowed. Diesel fuel was siphoning from a 100,000-gallon above-ground tank to the smaller underground tank, causing it to overflow. The spilled oil was released to the SPF sewage treatment plant, which discharges to Kuebeler Ditch, and was also found in a sump pit at SPF. Dams were constructed to preclude further release to the ditch; oil was skimmed from the STP and pumped from the sump pit; straw bales were brought in to absorb the oil from the ditch water; other on-site ditches that became contaminated were cleaned by means of a backhoe. All contaminated dirt and straw were disposed of at the county landfill. Recovered diesel fuel and contaminated water were collected and hauled off-site for disposal.

A Garrett Corporation employee, acting as a private citizen, contacted the U.S. Coast Guard and reported the spill. The Coast Guard investigated the spill on October 6, 1980. The Coast Guard was satisfied that no pollution had occurred. Due to the classified nature of Garrett Corporation's activities at the SPF, NASA had no involvement in the cleanup efforts or notification to federal, state, or local agencies.

Naphtha Spill at "A" Site Complex

On August 5, 1978, approximately 1600 gallons of raw, untreated coal tar-derived naphtha leaked from a fuel storage trailer at "A" Site Complex. The trailer was located at the site in an excavated earthen retention basin. The base of the retention basin was hard clay and considered to be impermeable. The spilled naphtha was contained in the retention basin and therefore did not result in a release to surface waters. An off-site disposal company was contracted to pump the spilled naphtha from the retention basin the same day the spill was discovered. Approximately 900 gallons of raw material were removed by the disposal company from the basin and hauled off-site for disposal. An unknown amount of naphtha was pumped into drums for use in fire training exercises conducted in the burn pit on Snake Road. After all the raw material had been removed from the basin, the basin was flushed with water.

No. 2 Fuel Oil Spill at PBRF

On December 28, 1976, 50 - 75 gallons of No. 2 fuel oil leaked from a 200-gallons above-ground tank which fed fuel to a boiler in the PBRF service building. The above-ground tank failed and contents were released to a concrete catch basin that flows to the Pentolite Ditch. approximately 1,000 feet of the ditch were contaminated with the released oil. Containment dams were constructed at the ditch to prevent the oil from flowing further down the ditch. Oil-contaminated water was pumped from the catch basin, and absorbent pillows were used to

absorb small pockets of oil in the ditch. All brush and reeds contaminated with the oil were excavated and removed and surface area of the ditch cultivated for degradation. The catch basin and culvert were flushed with high-pressure hoses. Water samples were obtained daily from the ditch for a three-month period and analyzed to monitor the plume and to ensure that clean-up efforts were effective. The U.S. Coast Guard and USEPA were notified of the release. It was determined that there was no release to public streams or waterways.

Asbestos Abatement

A 1986 environmental audit of Plum Brook Station showed that there was considerable degradation of the asbestos insulation on outside steam pipes and associated system throughout the facility. It was apparent from the audit that an extensive asbestos abatement program needed to be implemented in order to remove or encapsulate asbestos-containing material (ACM). An area of particular concern was the ACM on the pipes from the B-boiler building (Building 5221) to the steam accumulators, at the accumulators, and from the accumulators to the B-2 Facility (Building 3211). Also of concern were the accumulator tanks, headers, transfer lines, and valves at the accumulator system. Large pieces of asbestos insulation were observed lying on the ground beneath the 30-inch steam line and around the associated system components. Air samples were taken downwind of the contaminated systems. Asbestos was detected in the samples. Visual observations indicated contamination in the soil and ponds in the area.

As asbestos abatement program was implemented at Plum Brook Station in 1988. The program's purposed was to identify the extent of asbestos contamination at the facility and to identify areas requiring immediate abatement. In the abatement program, asbestos insulation was removed from the 30-inch steam line, the accumulators, and the associated systems. Asbestos insulation that had fallen to the ground or accumulated in the trenches at the B test site was removed and disposed of by the abatement contractor. Soil samples collected before removal indicated asbestos contamination. Top soil beneath the steam line was removed from the areas where asbestos was observed on the soil and disposed of off-site with asbestos.

Underground Storage Tank Program

Following a 1989 assessment of the 19 underground storage tanks (USTs) associated with Plum Brook Station operations, 15 tanks were identified for removal. These tanks were removed during July through December 1989. The 15 tanks were removed in the following order:

- 9 tanks at the Garage and Maintenance Area (Buildings 7121, 7131, and 7132);
- 2 tanks at the Space Power Facility (Building 1411);
- 1 tank at the Pump Station (Building 8133);
- 3 tanks at the Plum Brook Reactor Facility (Building 1131).

Six of the tanks removed contained waste oil mixed with solvents or petroleum products (gasoline or diesel fuel). The remaining tanks contained water prior to their removal, but at some point during their operating lifetime contained solvents, gasoline, or diesel fuel. All the tanks showed evidence of leaking while in the ground. All excavations exhibited some amount of visible contamination. All visibly contaminated soil was removed from the excavations, and the excavations were backfilled with clean sand. Based on preliminary post-removal sampling, further soil remediation at the tank removal sites are being initiated at this time.

SECTION 2
ENVIRONMENTAL SETTING

This section of the PA report describes the environmental setting at Plum Brook Station. Information provided herein includes descriptions of general environmental conditions and target populations.

2.1 Environmental Media Surrounding Facility

2.1.1 Climatic Data

The climate of northern Ohio is continental in character but is strongly influenced by Lake Erie. In north-central Ohio (Erie County) predominant westerly winds parallel the lake shore and do not come inland as frequently as they do on eastern reaches of Lake Erie. The weather changes every few days when warm and cold fronts move through the area.

Summers are moderately warm and humid. Temperatures occasionally exceed 90°F. Temperatures rarely exceed 100°F. Winters are cold and cloudy. Temperatures are sub-zero an average of five days per winter. Daily temperature range is greatest in summer and least in winter. Annual temperature extremes usually occur after late June and in December. On an average, the temperature falls to freezing first in October. The last freezing temperature occurs in April.

2.1.1.1 Precipitation

Climatic data prepared by NOAA are available for the City of Sandusky, 3.5 miles to the north of Plum Brook Station. The normal annual precipitation at Sandusky is 33.90 inches, based on the 1951-1980 record. The two year-24 hour rainfall event for Sandusky is 2.45 inches.

Average annual water loss is estimated to be 22.5 inches for Plum Brook Station. This figure is based on data compiled from 1931-1980. Water loss is defined as the difference between precipitation over a drainage area and stream flow from the drainage area. Water is lost through evapotranspiration, infiltration, and evaporation.

2.1.1.2 Flood Plain Data

Peak discharges for Pipe Creek, Plum Brook, and Storrs-Hemminger Ditch are presented in Table 2-1. The data were obtained from the National Flood Insurance Program.

Two operable units are within the 100-year and 500-year floodplains: Unit 2, West Area Red Water Ponds A-1 and A-2 and Unit 12, Disposal Area 2A. Red Water Pond A-2 is entirely within both the 100-year and 500-year floodplains. Red Water Pond A-1 is within the 500-year

floodplain. Approximately half of Disposal Area 2A is within both the 100-year and 500-year floodplains.

2.1.1.3 Monthly Wind Rose Data

The NOAA does not prepare a monthly wind rose diagram for Sandusky or Erie County. The most current wind rose for the Plum Brook Station area was prepared in 1956 by NACA. This wind rose is presented in Figure 2-1. It is known that wind direction is southwest 55 percent of the time through all 12 months. There is an increased frequency of northerly and northeasterly winds during spring and summer months due to onshore lake breezes created by temperature inversions.

TABLE 2-1
PEAK DISCHARGES

Flooding Source and Location	Drainage Area (mi^2)	Peak Discharges (cfs)		
		10-year	100-year	500-year
Pipe Cr. above Taylor Ditch	23.6	2110	2525	2790
Storrs-Hemminger at Rte. 2	0.4	93	164	200
Plum Brook at Perkins Avenue	7.1	901	1603	1955

2.1.2 Geologic Setting

2.1.2.1 Soil Formations Underlying Area

Two soil associations are present at Plum Brook Station based on mapping by the Ohio Department of Natural Resources (ODNR) in cooperation with the U.S. Department of Agriculture. The Arkport-Galen association occurs in the northern and western portions of Plum Brook Station, and the Prout association occurs in the southern and eastern portions of the site.

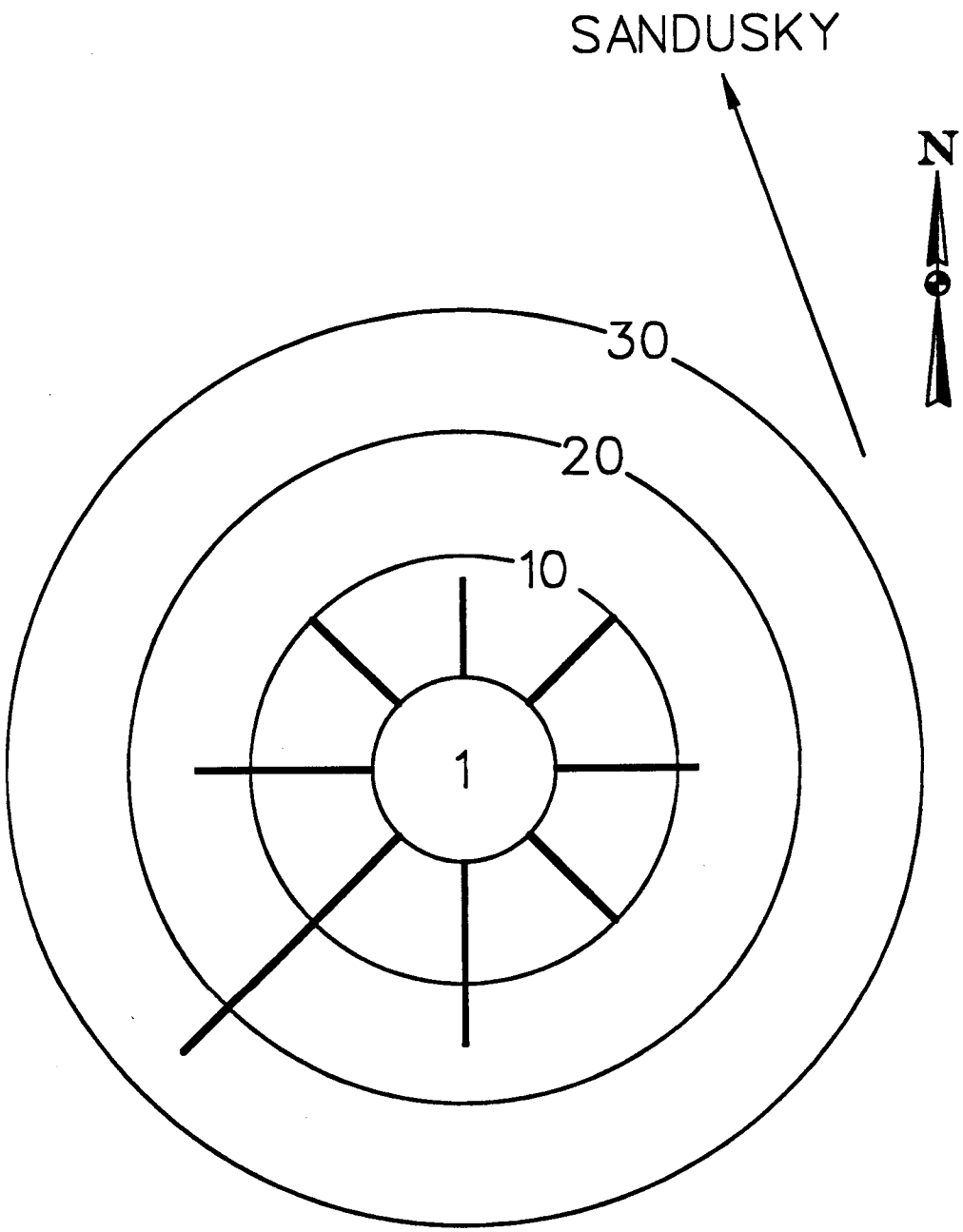


FIGURE 2-1
SANDUSKY WIND ROSE

The Arkport-Galen association is characterized by deep, nearly level to moderately sloping, well drained to moderately well drained soils that have a subsoil of loamy fine sand and fine sand and occur on sandhills and ridges. These soils are formed in very fine sand and deposited by wind and water as beaches, sand bars, and sand dunes. This association is made up of about 40 percent Arkport soils, 30 percent Galen soils, and 30 percent minor soils.

The Arkport soils are gently to moderately sloping and well drained. The Galen soils are nearly level and moderately well drained. The minor soils occur in level to depressional areas and in the flat areas between the sandhills and ridges. The minor soil associations are either very poorly or somewhat poorly drained.

The Prout association, characteristic of the eastern and southern portion of Plum Brook Station, has moderately deep to deep, nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of heavy silt loam to silty clay loam. This association occurs on uplands such as the sides of stream valleys, shale outcrop ridges, along drainageways and in some steeper areas.

The Prout soils are nearly level to gently sloping, dark colored, and somewhat poorly drained. These soils are underlain by shale bedrock at a depth ranging from 20 to 40 inches for the Prout soils, and at a depth ranging from 40 to 60 inches for the Prout soils, deep variant. The minor soils in this association include a broad spectrum of nearly level to depressional and very poorly drained to nearly level to gently sloping and well drained.

Soils across Plum Brook Station are highly variable in terms of thicknesses and permeabilities. The Arkport soils are loamy fine sands with very high permeabilities. The Galen soils are loamy fine sands with high permeabilities. The Prout soils are very sandy loams with moderately low permeabilities. Estimated ranges for these parameters are provided in Table 2-2.

2.1.2.2 Bedrock Geology

The bedrock formations of northwestern Ohio consist of carbonates (limestone and dolomite) and clastics (sandstones and shales) that regionally dip to the east. The study area is underlain by a relatively flat-lying sequence of Paleozoic sedimentary rocks which range in age from Precambrian to Devonia. The Silurian and Devonian formations that outcrop in Erie County are illustrated on Figure 2-2. The approximate thickness of formations that underlay Plum Brook Station is also illustrated on Figure 2-2. Bedrock at Plum Brook Station consists of four Devonian Formations (from oldest to youngest): the columbus Limestone, the Delaware Limestone, the Plum Brook Shale/Prout Limestone, and the Ohio Shale. the Columbus and Delaware Limestones occur in the northern and western portions of the study area, and the Plum Brook Shale/Prout Limestone and Ohio Shale occur in the southern portion of the site.

The Columbus Limestone consists of dolomite and limestone. The Delaware Limestone consists of finely crystalline, thin-bedded brown to gray fossiliferous limestone and dolomite. Karst topography has developed in some of the Silurian and Devonian carbonate bedrock in the northern and western portion of Erie County, resulting in cavernous porosity.

TABLE 2-2
ESTIMATED SOIL THICKNESSES AND PERMEABILITIES

Soil Type	Soil Description	Thickness (feet)	Permeability (In./hour)
Arkport	Loamy fine sand	0 - 5	12
Galen	Loamy fine sand	0 - 5	6.3 - 12
Prout	Very sand loam	0 - 5	0.2 - 0.63

The Plum Brook Shale/Prout Limestone sequence consists of a blue-gray, calcareous shale or mudstone overlain by a thin, fossiliferous limestone or dolomitic mudstone. The Ohio Shale is black and thin-bedded. The lithologic changes in the bedrock across the site affect the groundwater potential of the area. The depth to bedrock across Plum Brook Station is highly variable based on data obtained from soil borings and monitoring wells. Limestone bedrock was encountered at a depth of 25 feet below the surface at the PBRF. A monitoring well installed in the vicinity of the red water ponds located in the western portion of the site encountered limestone bedrock at an approximate depth of 19 feet. Shale bedrock in the southern portion of the station has been encountered from depths of 2 to 12 feet.

Age	Formation/Group	Depth to Top (ft)	Thickness (ft) a	Hydrologic Unit b	Rock Description
DEVONIAN	Ohio Shale	c	300	Zone 3	Shale : *black, thin-bedded with bituminous and carbonaceous material.*
	Prout Limestone/ Plum Brook Shale	Surface	210		Shale : *light grey, calcareous.*
	Delaware Limestone	40	50	Zone 1 and Zone 2	Limestone : *buff, earthy, foss. interbedded with brown crystalline dolomite.*
	Columbus Limestone	90	110		Limestone : *brown to grey, fine crystalline, foss. with tan to buff-grey, partly sandy dolomite at base.*
	Lucas Dolomite	200	70		Dolomite : *brown, crystalline, porous, chert.*
SILURIAN	Amherstburg Dolomite	270	20		Dolomite : *tan to grey, microcrystalline, sl. argillaceous.*
	Bass Island Dolomite	290	30		
	Salina	320	590'		Dolomite : *anhydrite and shale sequence. Interbedded and intercalated. Dolomite is tan to brown and mostly tight. Scattered shale laminae. Few scattered oil stains. Some dolomite is shaly. few massive beds of dolomite and anhydrite.*

a. Depth to formation, formation thickness, and lithology based on deep borehole located at N 288+68, E 155+54.

b. Refer to Figure 5. for areal distribution of Zones 1, 2, and 3.

c. The Ohio shale was not encountered in the deep borehole, it outcrops in the southeasternmost portion of Plum Brook Station.

FIGURE 2-2
GENERALIZED STRATIGRAPHIC SECTION OF SILURIAN AND DEVONIAN STRATA UNDERLYING PLUM BROOK STATION

2.1.2.3 Site Topography

Plum Brook Station is located on relatively flat country characterized by topography that slopes gently northward towards Lake Erie. The ground surface has an average slope of less than six percent. The surficial deposits and landforms were produced by glacial processes. The elevation of the site ranges from approximately 625 feet in the northern portion of Plum Brook Station to approximately 675 feet at the southern and western boundaries of the site. Locally, the bedrock surface at Plum Brook Station dips to the northeast towards Lake Erie.

2.1.3 Hydrologic Setting

2.1.3.1 Surface Water Hydrology

Numerous ponds (man-made and natural) and streams lie within a 15-mile radius of Plum Brook Station. Lake Erie and Sandusky Bay are the largest surface water bodies within that radius (approximately 4.5 miles to the north). Bellevue Reservoir #5 is approximately 14 miles to the SSW. The Huron River and its branches, located approximately 3.5 miles east of Plum Brook Station, are the major streams (refer to Figure 2-3).

The dominant surface water feature in northern Ohio is Lake Erie. The lake has an area 9919 square miles and a volume of 113 cubic miles.

Eleven streams pass through or originate on Plum Brook Station (Figure 2-4). Each of these streams could receive contaminants from runoff and groundwater discharge in the event of a spill at Plum Brook Station. They flow north and northeastward to converge into Ransom Creek, Storrs Ditch, Plum Brook, and Sawmill Creek, which flow to Lake Erie. Additionally, ditches totaling approximately 380,000 lineal feet are within Plum Brook Station. Seventeen isolated ponds and reservoirs and three red water ponds are located on Plum Brook Station (Figure 2-5). The ponds are probably fed by shallow surficial groundwater. Pond water levels remain high even during dry months.

Drainage is north to Lake Erie. The drainage pattern is dendritic where streams are incised to bedrock; the drainage pattern on glacial material is erratic and poorly to moderately developed.

Points of run-off entry to surface water bodies are at heads of streams and overland flow along their lengths. The level topography of the site would not facilitate a great amount of run-off, and the streams could receive part of their volume from groundwater discharge. There are no catch basins on site specifically constructed to collect run-off.

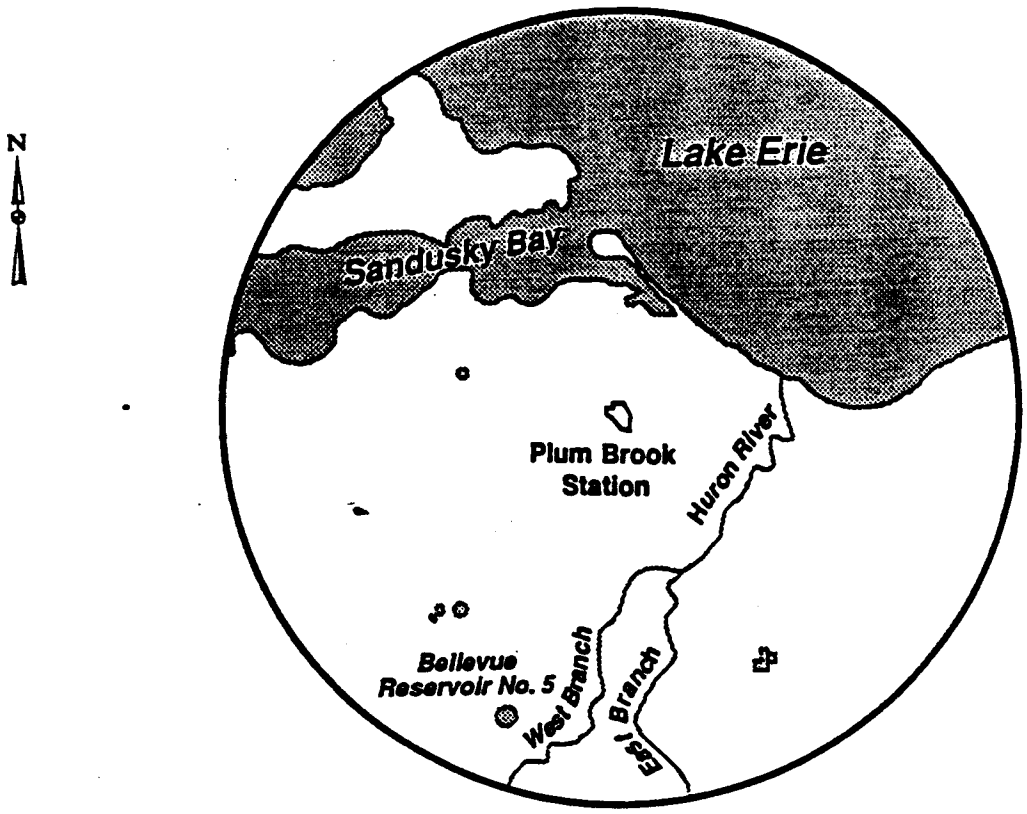
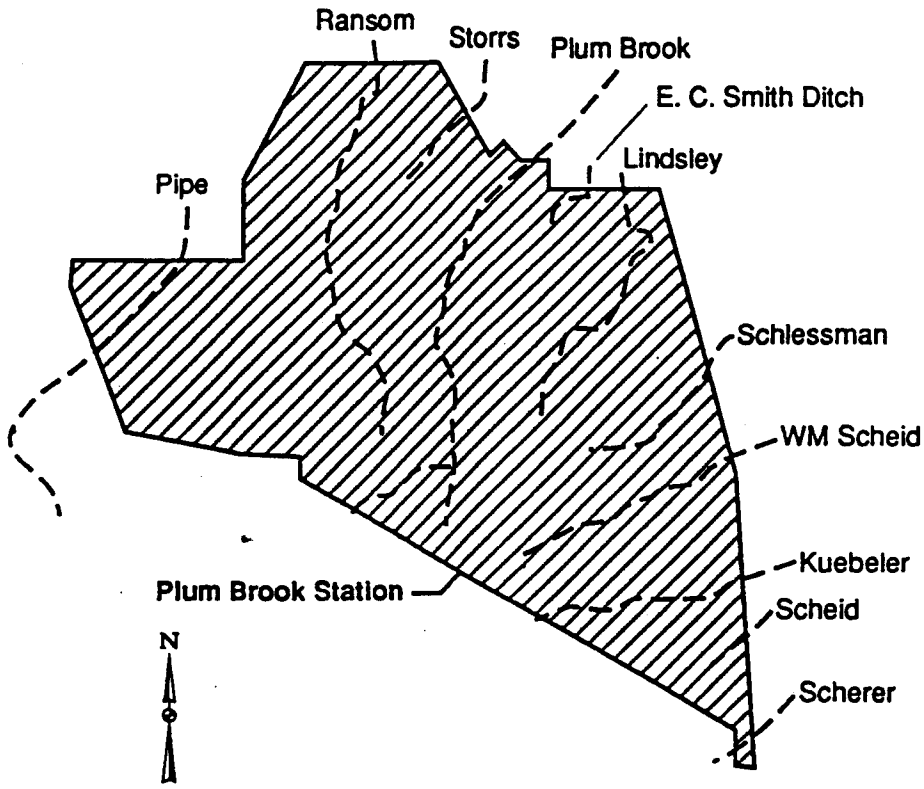


FIGURE 2-3
MAJOR SURFACE WATER BODIES WITHIN A 15-MILE RADIUS OF PLUM BROOK STATION



Stream	Drainage Areas in Acres	
	Entering	*Leaving*
Pipe Creek	11,800	12,600
Ransom Brook	*	824
Storrs-Hemminger Ditch	*	130
Plum Brook	260	1,960
E.C. Smith Ditch	*	44
Lindsley Ditch	*	722
Schlessman Ditch	*	238
William Scheid Ditch	*	505
Kuebeler Ditch	148	658
Scheid-Ohlemacher Ditch	40	273
Scherer Ditch	754	778

PBF-01

* Stream originates within station boundaries.

Surface drainage watershed boundaries

FIGURE 2-4
MAP SHOWING STREAMS THROUGH PBS

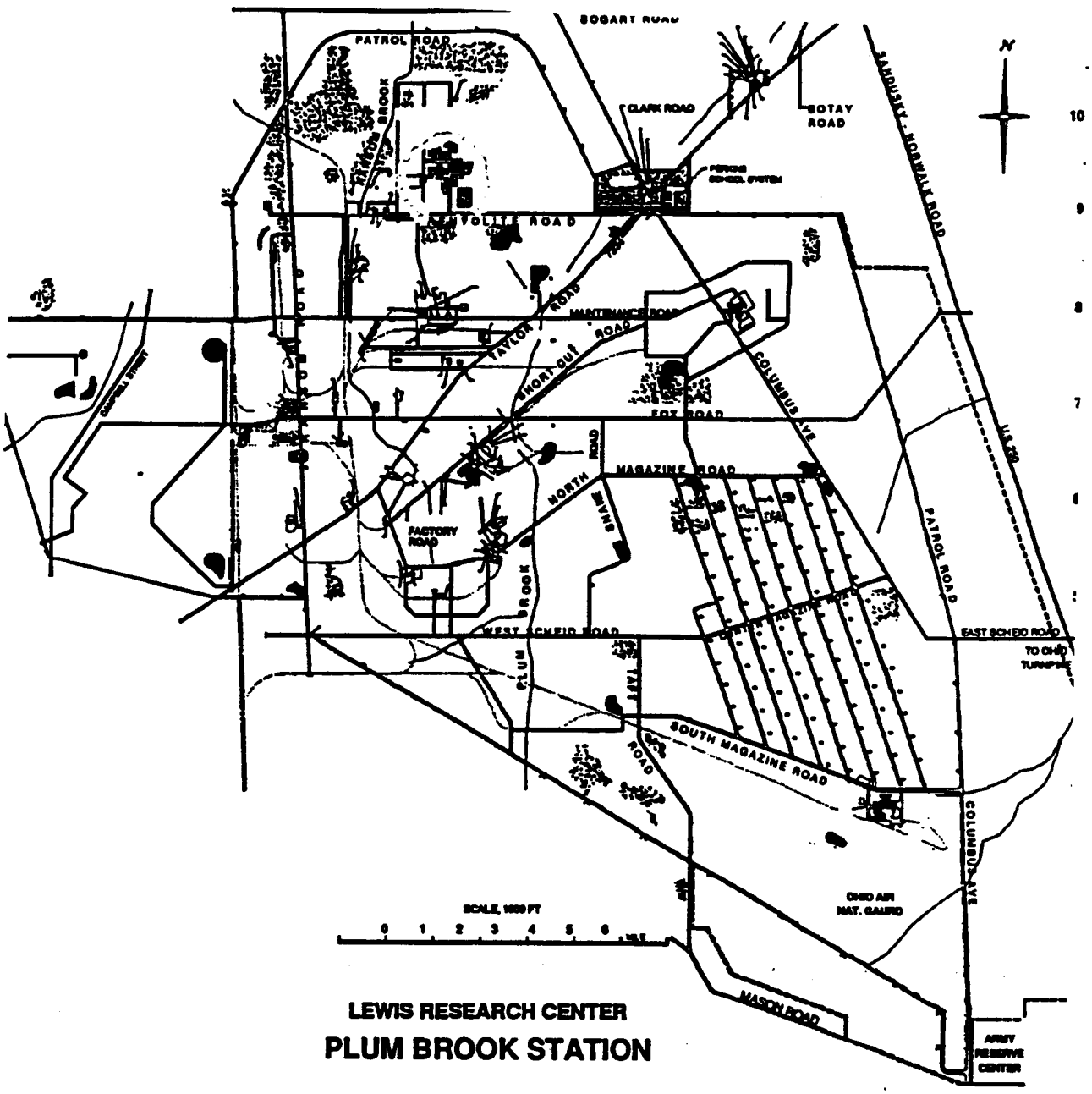


FIGURE 2-5
LOCATIONS OF PONDS AND RESERVOIRS

Table 2-3 present upgradient and downgradient drainage areas (in acres) for the 11 streams.

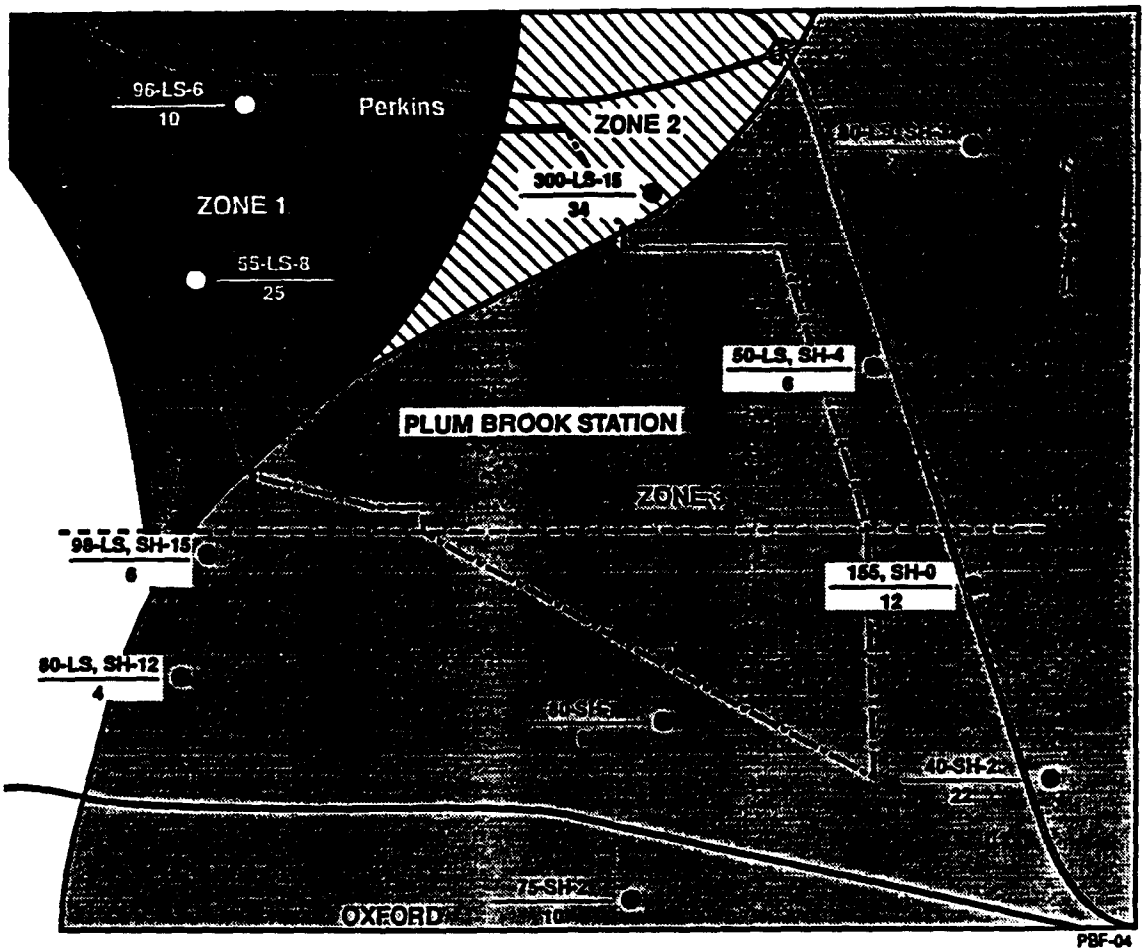
TABLE 2-3
UPGRADIENT AND DOWNGRADIENT DRAINAGE AREAS (ACRES)

Stream	Entering	Leaving
Pipe Creek	11,800	12,600
Ransom Brook	--	824
Storrs-Hemminger Ditch	--	130
Plum Brook	260	1,960
E.C. Smith Ditch	--	44
Lindsley Ditch	--	722
Schlessman Ditch	--	238
Wm. Scheid Ditch	--	505
Kuebler Ditch	148	658
Scheid-Ohlemacher Ditch	40	273
Scherer Ditch	754	778

Lake Erie is within 15 miles of the Plum Brook Station boundary. Lake Erie is a major fresh water fishery. The annual sports fish catch is estimated to exceed 12 million fish. The commercial catch is estimated to be greater than 10 million fish. Sandusky Bay and Lake Erie are both fished commercially. Most commercial fishing occurs in Sandusky Bay. Yields for 1990 were as follows: 400,000 - 500,000 pounds from open Lake Erie in the vicinity of Cedar Point; and approximately 1.3 million pounds from Sandusky Bay.

2.1.3.2 Groundwater Hydrology

Two principal bedrock aquifers occur in the study area. These aquifers supply drinking water to portions of Erie County. A highly productive limestone aquifer (Zone 1, Figure 2-6) is used in the western portion of the county, and a poorly productive shale aquifer (Zone 3, Figure 2-6) is used to the east. Plum Brook Station overlies the transition from the western carbonate aquifer to the eastern clastic aquifer (Figure 2-6). A glacial drift overlays both aquifers.



LEGEND

ZONE 1

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

Yields of more than 500 gallons per minute have been developed at depths of less than 200 feet in cavernous limestone and dolomite. Domestic supplies are generally obtained at depths of around 100 feet.

Hydrogen sulfide, in varying amounts, may be encountered in the bedrock.

ZONE 2

AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE MAY BE DEVELOPED.

Yields of 15, or less, gallons per minute are developed from wells drilled into the limestone. Hydrogen sulfide may be present in varying amounts.

ZONE 3

AREAS IN WHICH YIELDS SELDOM EXCEED 3 GALLONS PER MINUTE

Limited quantities of ground water are obtained from thin, discontinuous sand and gravel deposits interbedded in fine, sandy clay or from the underlying shale. Drilling deeper than 30 feet into the shale is not recommended. Occasional gas or salt noted in the eastern half of the county.

Larger yields may be obtained in western Huron and Oxford townships and southeastern Perkins Township. Wells may encounter water-bearing limestone beneath as much as 60 feet of impervious shale.

SCALE

1 0 1 mile

Depth (ft)

75-SH-2 → Yield (gpm)

10 → Depth to bedrock (ft.)

● Existing Domestic Wells

→ Water-bearing formation

FIGURE 2-6
REGIONAL WATER BEARING ZONES IN THE BEDROCK AQUIFERS (Modified from Walker, 1986)

Groundwater within the carbonate (limestone and dolomite) aquifer occurs in a network of interconnected fractures, bedding planes, and solution channels comprising the subterranean karst terrain. Well yields in the carbonate aquifer are highest to the west and decrease to the east as the transition to the sandstone and shale aquifer is approached. The direction of groundwater flow in the carbonate aquifer is to the north to points of discharge in Lake Erie. The shale aquifer that occurs in central Erie County and the southeastern portion of Plum Brook Station has low yields because of the fine-grained texture of the shale. Locally, shales outcropping at the surface may be highly fractured from weathering, providing the shale with some capacity to store and transmit water.

The ODNR mapped three groundwater zones within the principal aquifers based on well yield. These zones are informally referred to as Zones 1, 2, and 3 on Figure 2-6. Zones 1 and 2 are developed in the carbonate aquifer, and Zone 3 is developed in either discontinuous sand and gravel deposits interbedded in sandy clay or from the underlying shale. Zone 1 occurs in the northwestern and western portion of Plum Brook Station and includes well with yields of 100 to 500 gallons per minute (gpm) developed in cavernous limestone and dolomite encountered at depths of less than 100 feet. However, development of cavernous porosity within this zone is highly erratic as indicated by a well located just outside of the Plum Brook Station boundary, which had a yield of 8 gpm in the same aquifer.

The second groundwater zone mapped by ODNR (Zone 2) occurs deeper in the carbonate aquifer at an approximate depth of 300 feet near Plum Brook with well yields of 15 gpm or less. This area encompasses the northeastern portion of the station inclusive of the PBRF area. Limited quantities of groundwater are obtained from Zone 3 groundwater resources which are developed over the southern and eastern portions of Plum Brook Station. Depth to this zone varies from 50 to 100 feet. Well yields rarely exceed 3 gpm.

A thin layer of glacial drift consisting of both glacial till and lacustrine deposits covers the bedrock surface. Glacial drift is not considered to be a major aquifer, although it does contain discontinuous lenses of sand and gravel which may be water-bearing. Numerous shallow water-bearing sand lenses have been encountered in the drift deposits at Plum Brook Station at depths of less than 10 feet. These shallow surficial aquifers would be classified as Zone 3 in the ODNR classification. Glacial till generally has a low hydraulic conductivity because of the high clay/silt content, thus making it a poor source of groundwater. However, it frequently has an interconnected network of vertical fractures that may enhance the capability for vertical groundwater flow. Sand and gravel lenses in glacial till may also be a source of recharge for bedrock aquifers and a source of groundwater for domestic wells.

2.1.4 Air Quality Data for Surrounding Area

Erie County is in compliance with all the Natural Ambient Air Quality Standards primarily because of the rural character of the area. The OEPA operates one monitoring station for total

suspended particulates in the county that consistently is in compliance with particulate standards. The major emission sources for the county include the Ford Motor Company in Sandusky, several greenhouses, and some larger coal-fired, institutional boilers. Erie County is classified as an attainment area for all air quality parameters.

2.2 Target Populations

2.2.1 Area Demographics

The population of Erie County in 1990 was 76,779 with 32,827 total housing units. Total populations of geographic entities bordering or near Plum Brook Station are presented in Table 2-4.

TABLE 2-4
AREA DEMOGRAPHICS IN PLUM BROOK STATION VICINITY

Entity	Population	Total Households
Huron City	7030	3204
Huron Twp (excluding Huron City)	2267	958
Sandusky City	29,764	13,416
Perkins Twp (excluding Sandusky City)	10,793	3895
Groton Twp	1245	438
Margaretta Twp	6255	2419
Oxford Twp	1150	400
Milan Twp	3149	1234
Total	**61,653**	**25,964**

2.2.1.1 Population Distributions Within Four Miles

Table 2-5 lists the population distributions within a 4-mile radius of the Plum Brook Station boundary.

TABLE 2-5
ESTIMATED POPULATION DISTRIBUTIONS
IN PLUM BROOK STATION VICINITY

Distance (miles)	Population
0 to 0.25	600
0.25 to 0.50	450
0.50 to 1.0	2150
1.0 to 2.0	5500
2.0 to 3.0	9100
3.0 to 4.0	13,450

There is no permanent resident population within Plum Brook Station boundaries. Plum Brook Station currently employs 150 people. The employees work for various organizations as listed below:

- NASA - 13
- Sverdrup - 110
- Department of Agriculture, Interior, and Labor, Federal Bureau of Investigation, Immigration and Naturalization Services - 27.

The 1990 census figures are preliminary. Data distinguishing singe- versus multi-family dwellings will become available in June 1991. No data regarding schools and day care center enrollments were collected in 1980 or 1990. However, it is known that children under seven years old do not live or attend school on Plum Brook Station or anywhere near suspected contamination caused by Plum Brook Station operations within 2 feet of ground surface. Business and industrial populations are not known. On any given day in the summer months, the population of Sandusky is estimated to be 50 percent higher due to tourism. Tourist traffic to Cedar Point approaches 50,000 to 60,000 cars per day on some summer weekends.

2.2.1.2 Land Use in Vicinity

Land usage within a 4-mile radius of Plum Brook Station is primarily residential and agricultural. Several commercial food processing plants are located within 4 miles of Plum Brook Station: Toft Dairy, Sandusky Dressed Beef Co., Routh Packing (Huron Twp.), and Prepared Foods of Sandusky. The Sandusky area supports a large amount of tourism and recreational use during summer months.

2.2.2 Water Utilization

2.2.2.1 Location and Usage of Surface Water Intakes Within 15 Miles

The city of Sandusky uses Lake Erie as its public, commercial, and industrial water supply. The city sells water to the Erie County Water Department which distributes water to the villages of Castalia and Bay View (pop. 915 and 522, respectively). In addition, county water lines extend south to Bogart Road, and south on State Route 250 as far as Milan's water lines. The villages of Castalia and Bay View also utilize water from this system. Plum Brook Station obtains its drinking water from the city of Sandusky.

Plum Brook Station maintains two raw water intakes: one at Rye Beach (near Huron), the other (Big Island, off Cedar Point) an intake shared with the Sandusky city water plant. The Big Island intake is 3,000 feet offshore in 25 feet of water. The Station's Rye Beach intake is 3,000 feet offshore in 30 feet of water. It has been plugged since 1985 with no immediate plans for repair.

The Lorain/Elyria Rural Water Authority offers water service to parts of Huron, Avery, Mud Brook, Scheid, Rye Beach, and Bogart Roads. Their intake is in Lorain/Elyria. This service is new. The water lines have been installed and are functional. Residents have been give sixty days to complete tie-ins.

The cities of Bellevue, Norwalk, Monroeville, Lakeside, Marblehead, and Huron also use surface water as a public water supply. Bellevue's reservoir is approximately 14.5 miles SSW of Plum Brook Station. Huron obtains its water from intakes in Lake Erie. Huron's intake is located 2,200 feet offshore, due north of its water plant. Huron's intake supports 2,500 distribution system tie-ins.

Bellevue's reservoirs are approximately 14.5 miles south-southwest of Plum Brook Station and are fed by tributaries to the west branch of the Huron River. Norwalk has three reservoirs, also fed by the west branch of the Huron River. Monroeville has an intake in the Huron River (see Figure 2-7).

Huron sells water to the Erie County Water Department which supplies outlying areas of Huron, including the village of Berlin Heights. Marblehead's water supply system uses a rock channel leading to a shore well on the northwest side of town. Lakeside has its own intake in Lake Erie.

The Erie County Health Department does not permit surface water to be used as a private drinking water supply. No surface water within Plum Brook Station is used as a drinking water supply. It is not known if ponds are used to water livestock in the area. Lake Erie and Sandusky Bay support a great deal of recreational boating, fishing, and swimming during summer months. Crop irrigation is not common in Ohio.

Figure 2-7 provides a map showing known surface water intakes described in this section.

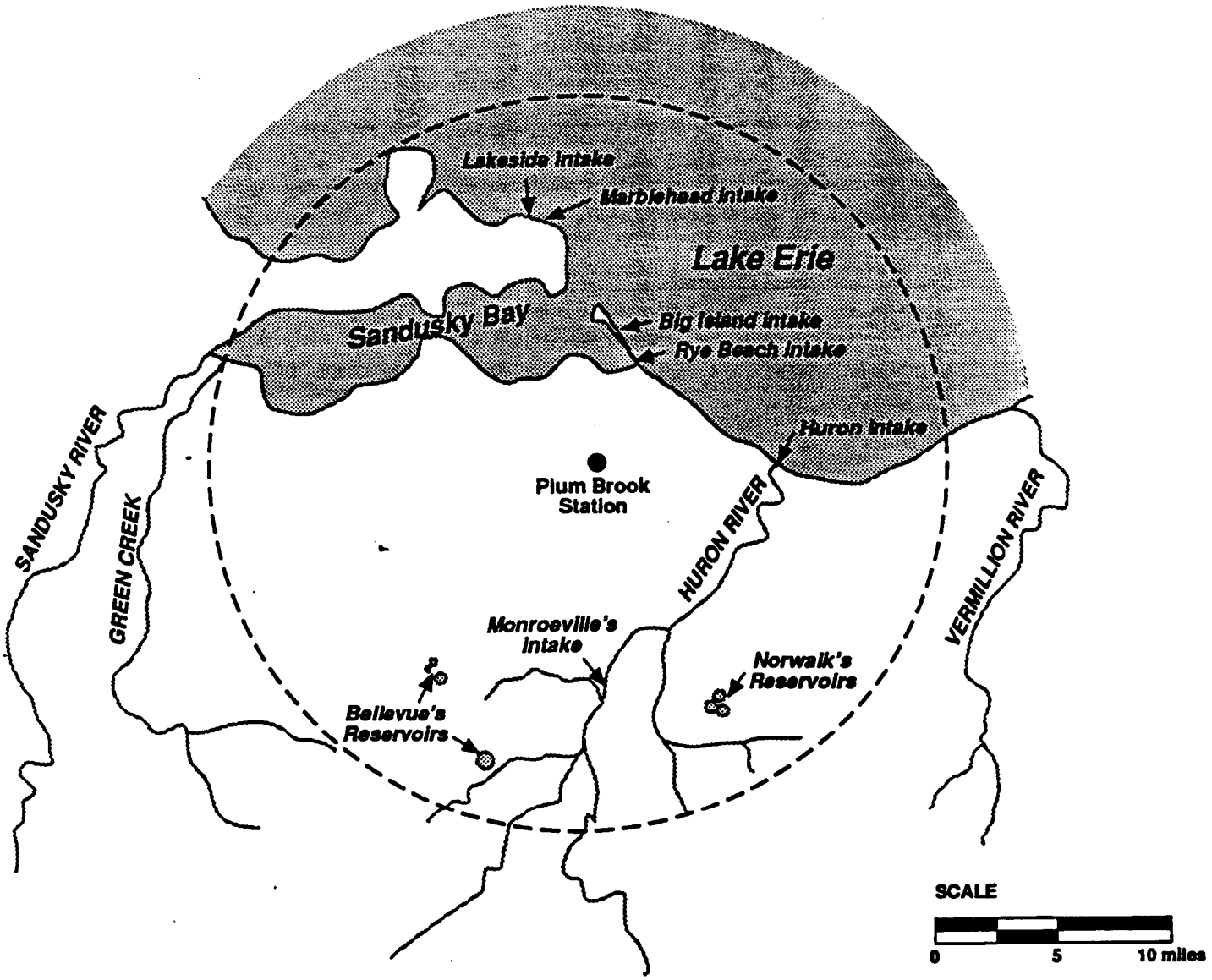


FIGURE 2-7
SURFACE WATER INTAKES

2.2.2.2 Location and Usage of Groundwater Within 4 Miles

There are 179 permitted private drinking water wells within a 4-mile radius of Plum Brook Station on record at the Erie County Health Department. The Erie County Health Department does not require a permit for wells intended for agricultural use. Figure 2-8 shows the location of wells in the area that are known drinking water suppliers.

At this time, city and rural water systems serve residences north and east of Plum Brook Station. Residences south and west of the Station continue to rely on wells and/or cisterns. The nearest recorded downgradient well is at 6115 Schenk Road; a closer well was observed at 1810 Schenk Road, but no located log has been obtained for this well. No well within Plum Brook Station is used as a drinking water supply.

Two wells serve as public (used by 25 or more people at least 60 days per year) drinking water supplies: Woussickett Golf Course clubhouse (6311 Mason Road) and Stanley's Tavern (4408 Mason Road). All commercial and industrial water is obtained from the City of Sandusky. Groundwater yields (at 20 gpm in limestone and <2 gpm in shale) are too low to support large-scale production. Finally, no wells are used solely for crop irrigation, as Ohio's climate is humid with adequate precipitation.

All aquifers in the area of Plum Brook Station are used as sources of drinking water.

2.2.3 Potential Impacted Wetlands, Parks, Protected or Sensitive Areas, Endangered Species

Milan State Wildlife Area is located three miles south (upgradient) of Plum Brook Station in Oxford and Milan townships, at the juncture of the West Branch and the East Branch of the Huron River. It is upstream of Plum Brook Station. The Erie Sand Barrens State Nature Preserve is approximately 1,000 feet south of Plum Brook Station, at the intersection of Taylor and Scheid Roads. It is upstream of Plum Brook Station.

Sheldon's Marsh State Natural Preserve is approximately 3.75 miles northwest of Plum Brook Station. It is downstream of Plum Brook Station in an "intra-basin" area between Plum Brook and Sawmill Creek at their discharges to Lake Erie.

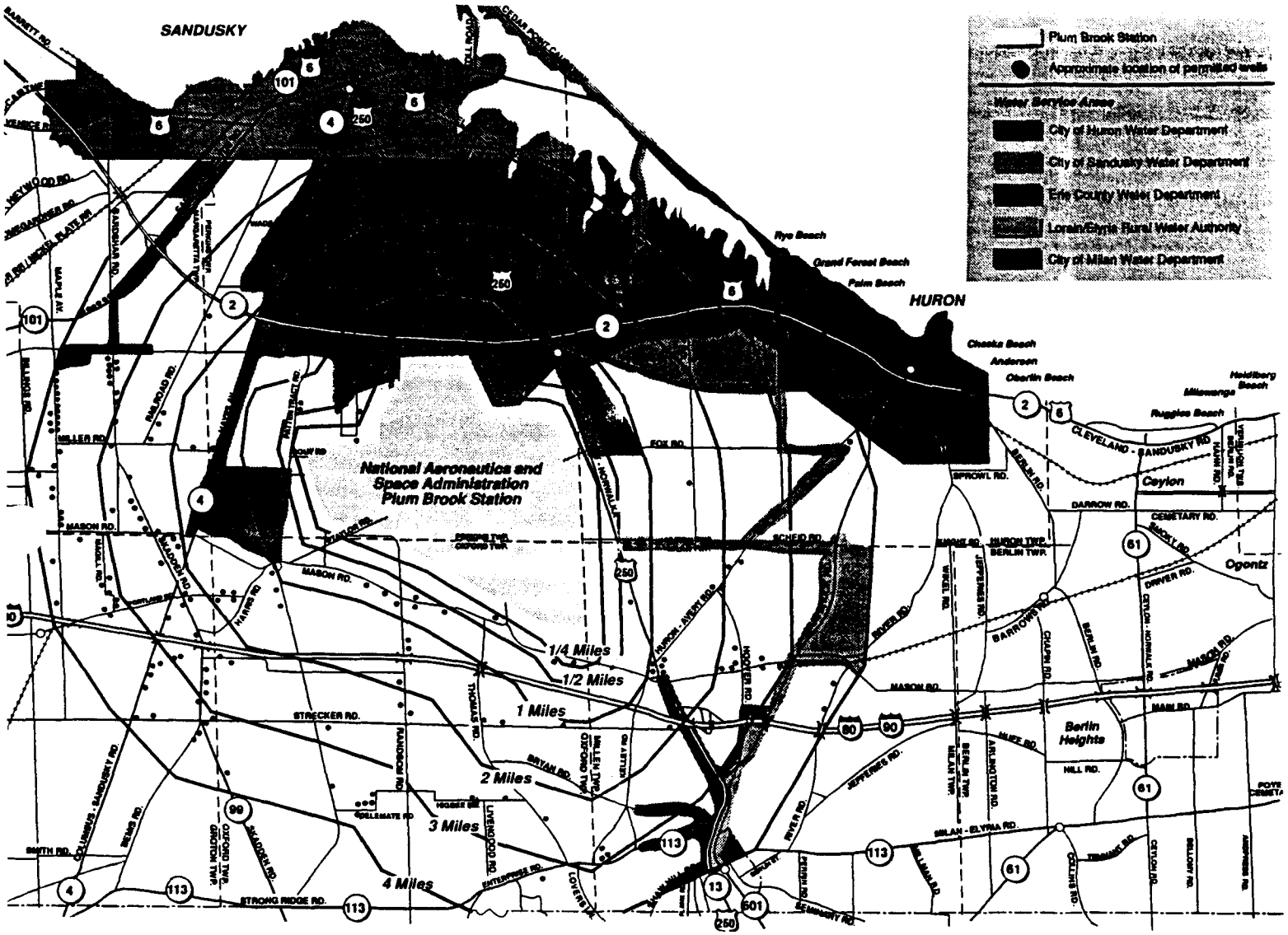


FIGURE 2-8
PERMITTED DRINKING WATER WELL LOCATIONS WITHIN A FOUR-MILE RADIUS OF PLUM BROOK STATION, AND WATER SERVICE AREAS

Federally endangered animal species in Erie County are the Indiana bat (Myotis sodalis) and the bald eagle (Haliaeetus leucocephalus). Approximately four breeding pairs of bald eagles occur within 5 to 10 miles of Plum Brook Station. No survey has been conducted to identify habitats of the Indiana bat in the Plum Brook area. The Indiana bat is listed as a state-endangered species.

The following seven state-endangered moth species have been collected from Rest Haen Wildlife Area and Old Woman's Creek State Natural Preserve.

- Speyeria idalia (Regal Fritillary) - its locale is listed only as "Erie Co., ";
- Papaipema silphii - associated with Prairie Dock (a prairie grass);
- Spartiniphaga inops - associated with wetlands;
- Hypocoena enervata - associated with wetlands;
- Trichoclea artesta - collected from Old Woman's Creek;
- Tricolita notata - collected from Rest Haven; and
- Papaipema beeriana - collected from Rest Haven.

Three of these species (Papaipema silphii, Spartiniphaga inops, and Hypocoena enervata) are associated with habitats (wetlands and Prairie Dock) that exist on Plum Brook Station.

There are several state-designated threatened and potentially threatened plant communities on and near Plum Brook Station. The species are listed in Table 2-6. There are no federally-endangered fish, or shellfish species in Erie County.

TABLE 2-6
THREATENED (T), OR POTENTIALLY-THREATENED (P)
PLANT COMMUNITIES ON OR NEAR PLUM BROOK STATION

Equisetum variegatum - variegated scouring rush (T)
Xyris torta - twisted yellow-eyed grass (T)
Carex conoidea - field sedge (T)
Eleocharis Olivacea - olivaceoius spikerush (T)
Hemicarpha micrantha - dwarf bullrush (T)
Hypericum gymnanthum - least St. John's wort (E)
Hypericum majus - tall St. John's wort (T)
Juncus platyphyllus - flat-leaved rush (T)
Linum sulcatum - grooved flax (P)
Rhexia virginica - Virginia meadow beauty (P)
Viola lanceolata - lance-leaved violet (T)
Xyris torta - twisted yellow-eyed grass (T)
Hemicarpha micrantha - dwarf bullrush (T)
Baptisia lactea - prairie false indigo (T)
Gratiola virginiana - round-fruited hedge hyssop (T)
Helianthus mollis - ashy sunflower (T)
Carex alata - broad-winged sedge (T)

SECTION 3.0
SAMPLING PROCEDURES

Morrison Knudsen Ferguson Group (MK) will base the sampling procedures upon the guidelines set forth in USEPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November, 1986 and Morrison Knudsen's Standard Operating Procedures (See Appendix A). Table 3-1 is a summary of the sampling activities which will occur during the sampling effort. The summary identifies the sample matrix, the number of samples, the approximate sample locations, and rationale for sample selection. In the tables a "full suite" includes analysis for volatiles, semi-volatiles, nitro-explosives, and total metals. Pesticides/PCB analysis will be covered under the SW 846 method.

3.1 Monitoring Well Installation

3.1.1 Number and Location of Wells

MK will install monitoring wells within PMU source areas from which there have been observed or suspected releases to the groundwater. Table 3-2 lists the approximate locations of new and existing monitoring wells within the PMUs. These monitoring wells will determine whether the observed surface release has impacted the groundwater. All of the monitoring wells installed as a part of this field effort will be sampled. The groundwater sampling effort is discussed below in Section 3.2.

3.1.2 Field Procedures

Drilling for monitoring wells will be conducted in accordance with MK's Standard Procedures. This procedure addresses drilling, development and installation of groundwater monitoring wells (See Appendix A, Section 2). The monitoring wells will be installed through 6-inch ID hollow stem augers. If there is sampling at the boring location, it will be obtained using a 2-inch diameter by 24-inch long, split barrel sampler. MK will follow ASTM D-1596 procedures with the exception that the sampler will be driven 24 inches rather than the standard 18 inches. The first sample (0 to 24 inches) will be the only soil sample obtained from each boring. The remainder of the boring will be advanced without additional sampling.

Each boring will be advanced to auger refusal. Based upon the available data, the estimated depth of the borings are between 15 to 30 feet. Each boring will be classified using the appropriate Unified Soil Classification System (USCS) description. Because there will be no samples after the first few feet, MK will classify the boring based upon the drilling cuttings.

The sampler will procure the soil sample for the laboratory analysis using a stainless steel spatula or spoon. The sample for VOC analysis will be placed immediately in a 4-ounce laboratory-cleaned glass jar and packed to minimize headspace. Cuttings from the soil borings will be placed in drums which will be labelled to identify the boring number(s)

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
1	Upgradient	Install and sample monitoring well along Pipe Creek upgradient of PMU.	1 (well) 1 (gw)	Determine background quality of groundwater aquifer.
		Obtain soil sample above source area. Sample will be taken randomly.	1 (ss)	Determine background quality of soil.
	TNT Area "C"	Obtain soil samples in three locations within source area. Samples will be taken equal distance apart.	3 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Pipe Creek from source area.
	Disposal Area 2A/Lime Sludge	Obtain soil samples in three locations within source area. Samples will be taken randomly.	3 (ss)	Determine if there is soil contamination within the source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Pipe Creek from source area.
		Install and sample monitoring well along Pipe Creek near source area.	1 (well) 1 (gw)	Determine if observed release from source area has impacted groundwater.
	Disposal Area 2B	Obtain soil samples in two locations within source area. Samples will be taken randomly.	2 (ss)	Determine if there is soil contamination within the source area.
		Install and sample monitoring well along Pipe Creek near source area.	1 (well) 1 (gw)	Determine if observed release from source area has impacted groundwater.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
1	Burn Pit 1	Obtain soil samples in two locations within source area.	2 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Document migration in intermittent stream from source area.
		Install and sample monitoring well near source area.	1 (well) 1 (gw)	Determine if observed release from source area has impacted groundwater.
	Burn Pit 2	Obtain soil samples in two locations within source area.	2 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Install and sample monitoring well along Pipe Creek near source area.	1 (well) 1 (gw)	Determine if observed release from source area has impacted groundwater.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Pipe Creek from source area.
	Fly Ash Areas	Obtain soil samples in three locations within source area. Samples will be taken in each fly ash pile.	3 (ss)	Document the presence of metal components in each of the three fly ash areas.
	Lower Toluene Tanks	Obtain soil samples in two locations within source area.	2 (ss)	Test for the presence of observed release to soil from source area.
		Install and sample monitoring wells along Pipe Creek near source area.	2 (well) 2 (gw)	Determine if observed release from source area has impacted groundwater.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
1	Red Water Ponds	Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Pipe Creek from source area.
2	TNT Area "B"	Obtain soil samples in three locations within source area. Samples will be taken equal distance apart.	3 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Ransom Brook from source area.
		Install and sample monitoring wells along Ransom Brook near source area.	2 (well) 2 (gw)	Determine if observed release from source area has impacted groundwater.
	Rail Unloading Area	Obtain soil samples in three locations within source area. Samples will be taken randomly.	3 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Ransom Brook from source area.
		Install and sample monitoring wells along Ransom Brook near source area.	2 (well) 2 (gw)	Determine if observed release from source area has impacted groundwater.
	Middle Toluene Tanks	Obtain soil samples in two locations within source area.	2 (ss)	Test for the presence of observed release to soil from source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Ransom Brook from source area.
		Install and sample monitoring well along Ransom Brook near source area.	1 (well) 1 (gw)	Determine if observed release from source area has impacted groundwater.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
2	Reactor Area	Sample existing monitoring well in source area.	1 (gw)	Determine if there is contamination of aquifer in source area.
	Patrol and Ransom Roads	Sample existing background monitoring well.	1 (gw)	Determine background quality of groundwater aquifer.
	Wetland Target	Sample surface water and sediment from sampling station located near target area.	2 (sd) 2 (sw)	Test for the presence of on site Level I/Level II target downstream of PPEs.
3	Upgradient	Sample surface water and sediment from sampling station located upgradient of PMU.	1 (sd) 1 (sw)	Document background/upgradient quality of Plum Brook.
	Fly Ash Areas	Obtain soil samples in three locations within source area. Two samples will be taken in large fly ash area and one in small area.	3 (ss)	Document metal components of two fly ash areas.
	Upper Toluene Tanks	Obtain soil samples in two locations within source area.	2 (ss)	Test for the presence of observed release to soil from source area.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Plum Brook from source area.
	Boiler Complex Ponds	Obtain sediment samples in two locations within source area.	2 (sd)	Determine if there are metals present in the pond sediment.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the presence of observed release to Plum Brook from source area.
	Reactor Facility	Obtain soil samples in two locations within source area. Samples will be taken at the retention basin in the source area.	2 (ss)	Determine if there is residual contamination in the source area retention basins.
		Sample surface water and sediment from sampling station located near source area.	1 (sd) 1 (sw)	Test for the migration of contaminants into intermittent ditch flowing NE of source area.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
3	Pentolite Red Water Pond	Sample surface water and sediment from sampling station located near target area.	1 (sd) 1 (gw)	Test for the presence of observed release to Plum Brook from source area.
4	TNT Area "A"	Obtain soil samples in four locations within source area.	4 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near target area.	1 (sd) 1 (sw)	Test for observed release to Lindsley Ditch and potential migration of pesticides from Disposal Area 1B.
		Install and sample monitoring wells along Lindsley Ditch near source area.	2 (well) 2 (gw)	Determine if observed release from source area has impacted groundwater.
	Disposal Area 1B/Burn Pit 5	Obtain soil samples in two locations within source area. One sample will be taken in each potential source within the source area.	3 (ss)	Determine if there is residual contamination present in the upper two feet of soil within the source area.
		Sample surface water and sediment from sampling station located near target area.	1 (sd) 1 (sw)	Test for observed release to Lindsley Ditch and potential migration of pesticides from Disposal Area 1B.
		Install and sample monitoring well along Lindsley Ditch near source area.	1 (well) 1 (gw)	Test for the presence of observed release to Lindsley Ditch from source area.
	North Magazine	Install and sample monitoring well along Lindsley Ditch near source area.	1 (well) 1 (gw)	Test for the presence of observed release to Lindsley Ditch from source area.
5	SPF Rubble Pile	Obtain soil samples in two locations within source area.	2 (ss)	Determine if there is soil contamination within the source area.
		Sample surface water and sediment from sampling station located near target area.	1 (sd) 1 (sw)	Test for observed release to Keubler Ditch from source area.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-1
SI FIELD ACTIVITIES

PMU	Source	Activity	Max Data Points	Rationale
5	Bunker Area	Obtain soil samples in four locations within source area. Samples will be taken where determined to be appropriate by visual examination.	4 (ss)	Opportunity samples obtained in order to located possible alternate contaminant sources.
		Sample surface water and sediment from sampling station located near target area.	2 (sd) 2 (gw)	Test for the presence of observed release to WM Shield & Schlessman from source area.

KEY: ss - soil sample sw - surface water sample sd - sediment sample gw - groundwater sample well - monitoring well

TABLE 3-2
MONITORING WELL INSTALLATION/GROUNDWATER SAMPLES

PMU	Number of New Wells	Number of Existing Wells	Full Suite	PCB/ Pesticide	Approximate Location
1	7	1	7	2	Background, Pipe Creek & Patrol Road
					Burn Pit #2
					Disposal Area #2B
					Disposal Area #2A
					Burn Pit #1
					Red Water Ponds (MW-02)
					Lower Toluene Tanks (2 wells)
2	5	17	7	0	TNT Area "B" (2 wells)
					Middle Toluene Tanks
					Rail Unloading (2 wells)
					Patrol and Ransome Road (MW-01)
					Reactor Area (PBS-RA-01 and 5 wells)
					Maintenance Garage (10 wells)
3	0	8	0	0	Burn Pit #4 (4 wells)
					Pump Storage (3 wells)
					Red Water Ponds (1 well, MW-05)
4	4	0	4	1	TNT Area "A" (2 wells)
					Burn Pit 5 (1 well)
					North Magazine
5	0	5	0	0	SPF (5 wells)
TOTAL	18	31	18	3	

NOTE: Elevation reading will be taken in all wells within individual PMU's over a 12 hour period from which the cuttings were generated. Final dispose and handling of soil cutting is detailed in the Investigation Derived Waste (IDW) Plan.

3.1.2.a Well Installation

MK will install new monitoring wells utilizing 6-inch ID hollow stem augers. The monitoring wells will have a 2-inch diameter, 0.020 slot, PVC screen; the typical length will be 10 feet. An appropriate length of 2-inch diameter, schedule 40, flush coupling PVC casing will be inserted to extend from the top of the screened interval to a height of 2 to 3 feet above the ground surface. It is important that no glue will be used in the joining screen and casing sections to preclude the potential for analytical interference.

MK will place a graded sand pack in the annulus around the well screen to a height of approximately 2 feet above the screened interval. A 2-foot thick bentonite seal will be placed above the sand pack and the remainder of the annular space filled with a cement/bentonite grout. Each well will be completed by cementing in place a cast-iron standpipe with locking cap. The cement will be mounded slightly around the stand pipe to promote stormwater drainage away from the well.

All sampled wells, new and established, will be surveyed relative to top of casing (TOC) elevation above mean sea level (MSL) and ground elevation. This provides a common elevation datum to correlate ground water elevation measurements. The casing of each well will be marked or notched at the point where the elevation is established to provide consistency in groundwater measurements. In addition, all monitoring wells will be located horizontally so that the wells can be located on a scaled site map.

3.1.2.b Well Development

Following monitoring well installation, all new wells and existing wells to be sampled will be developed. The objective of the well development will be to remove sediments from the bottom of the well and screened interval, thereby restoring the natural hydraulic properties of the geologic formation that may become disturbed during well installation. This helps provide for the collection of representative groundwater samples.

Well development will be accomplished by a surge and bail/pump technique. Purge water resulting from well development and groundwater sampling will be placed into drums. Analysis and final disposal will be done in accordance with the IDW Plan. Each well will be developed until no sediments are observed in the expelled water, and the pH, specific conductance, and temperature of the purged water become steady. Following development, the wells will be permitted to stabilize for a period of 24 hours before a sample is obtained.

3.1.3 Contingency Plan

If the drilling rig auger encounters refusal during the first three feet of the drilling operation, the hole will be abandoned and a new location selected approximately two to ten feet from the original location. The new location will be selected such that it is located within the source area. The abandoned hole will be filled with either hydrated bentonite chips or a cement/bentonite slurry. The location of the drilling site will be recorded in the Field Manager's field logbook. All well drilling locations will require a digging permit prior to any drilling. Any modifications to the drilling locations must be reflected in the permit.

3.2 Groundwater Sampling

3.2.1 Number and Location of Samples

MK will perform groundwater sampling to determine whether observed releases have impacted groundwater in the source area. Additionally, three existing groundwater (IT-MW-01, EB-RA-01 and EB-SP-01) will be sampled in order to determine potential groundwater contamination within the source area. The water level will be taken in all new and existing groundwater wells. Table 3-2 lists the number of wells which will be sampled and the analyses which will be performed on the groundwater samples. IT-MW-01 and MK-01-MW01 will be regarded as background water wells. These two wells are being assumed to be upgradient to the flow of groundwater at PBS.

3.2.2 Field Procedures

Prior to collection of the sample from the monitoring well, the well will be purged to remove standing water in order to ensure that the sample collected is representative of the aquifer water. The depth to groundwater will be measured to calculate the volume of groundwater in the well. Groundwater level measurements will be obtained with an electrical depth probe. The probe is capable of detecting the depth of ground water to the nearest 0.01 foot. These measurements will be used to construct a ground water table contour map.

Three to five volumes of groundwater, or until the well goes dry, will be removed from the well. The volume of water purged from each well will be calculated according to the equation presented below:

$$3x\ (\Pi \times r^2 \times h \times 7.48\ \text{gallons/ft}^3)$$

where:

Π = 3.14
r = radius of casing in feet
h = number of linear feet of static water

The actual number of well volumes removed will be determined by field measurements. The pH, temperature and specific conductance will be measured during well sampling and logged. The wells will be evacuated using a decontaminated, bottom loading, 3 inch diameter teflon bailer. After the well has been purged, the well will be allowed to recharge before a clean bailer is lowered into the well to withdraw groundwater for a sample. Teflon-coated single strand stainless steel wire or polypropylene monofilament rope will be used to raise and lower the bailer. Samples will be collected within two hours of the well evacuation when possible. If well yields are low at the site, the samples will be collected as the well recovers and provides a sufficient volume of water for sample collection. Groundwater will be collected for total metal analyses and therefore will not be field-filtered prior to transfer to the sample container. A grab sample collected in a clean glass container will be used to measure for pH, specific conductance, and temperature. The measurement probes will be rinsed with distilled water between samples. Groundwater sampling procedures will be in accordance with MK Standard Procedures.

3.2.3 Contingency Plan

It is possible that during monitoring well purging, the well may be pumped dry. If the well is pumped dry, the next well will be sampled in order to allow ample time for recharge. Pumping the well dry, while increasing the time necessary for obtaining the sample, will not affect the integrity of the groundwater sample.

3.3 Surface Water

3.3.1 Number and Location of Samples

Surface water samples will be obtained during the sampling effort to determine the impact, if any, of known or suspected releases to nearby surface water bodies. In addition, upstream samples will be taken in Plum Brook and Pipe Creek to determine the existing water quality entering PBS in the streams. These two water bodies are the most significant surface water pathways at Plum Brook Station. Table 3-3 lists the approximate location of each surface water/sediment sampling station, analytical parameters, and justification for obtaining each sample.

3.3.2 Field Procedures

A person will collect surface water samples either wading to the sample location or using a boat. Surface water sampling will be conducted from the furthest downstream location and proceed to the upstream location to minimize the potential for cross-contamination. Sampling activities may deposit suspended material in the stream. In addition, surface water samples will be collected at each location prior to the collection of the sediment sample at that location to further minimize cross-contamination. The water sample will be collected by immersing a laboratory-cleaned glass jar (sampling tool) immediately below the surface of the water and transferring the water to the appropriate sample container(s). A separate clean glass jar will be used as a sampling tool at each station to eliminate potential cross-contamination. Samples will be

collected from the middle of the creek, depending upon the depth.

Field water quality parameters such as pH, specific conductivity, and temperature will be measured in-situ at each sampling station.

When a sample collection device is used to obtain the surface water sample, the samples will be placed in the sample bottle directly from the sampling device. If the volume required to fill the sample bottle exceeds the volume contained in the collection device, an aliquot from each sample retrieved will be placed in each sample bottle until all the bottles are filled. The sampling device will be lowered to the same depth when it takes more than one volume of the sample collection device to fill the bottles.

TABLE 3-3
SURFACE WATER/SEDIMENT SAMPLES

PMU	SOURCE	NUMBER OF STATIONS	FULL SUITE	OTHER	RATIONALE
1	TNT Area "C"	1	Y		Test for observed release to Pipe Creek
	Disposal Area 2A/ Lime Sludge	1	Y	Pesticide/PCB	Test for observed release to Pipe Creek
	Disposal Area 2B	1	Y	Pesticide/PCB	Test for observed release to Pipe Creek
	Burn Pit 1	1	Y		Document migration in intermittent stream from Burn Pit 1
	Burn Pit 2	1	Y		Test for observed release to Pipe Creek
	Red Water Ponds	1	Y		Test for observed release to Pipe Creek
	Background	1	Y	Pesticide/PCB	Document background/upgradient quality of Pipe Creek
2	TNT Area "B"	1	Y		Test for observed release to Ransom Brook
	Rail Unloading Area	1	Y		Test for observed release to Ransom Brook
	Toluene Tanks	1	Y		Test for observed release to Ransom Brook
	Wetland Target	1	Y		Test for onsite Level I/Level II target downstream of PPEs
3	Background	1	Y	Radioactivity	Document background/upgradient quality of Plum Brook
	Upper Toluene Tanks	1	Y		Test for observed release to Plum Brook
	Boiler Complex Ponds	1	Y		Test for observed release to Plum Brook
	Reactor Facility	1	Y	Radioactivity	Test for migration into intermittent ditch flowing NE of RF area
	Pentolite Red Water	1	Y		Test for observed release to Plum Brook
4	TNT Area "A"	1	Y	Pesticide/PCB	Test for observed release to Lindsley and potential migration of pesticides from Disposal Area 1B
	Disposal Area 1B	1	Y		Test for observed release to Lindsley and potential migration of pesticides from Disposal Area 1B
5	SPF Rubble Pile	1	Y	Pesticide/PCB	Test for observed release to Kuebler
	Bunkers	2	Y	Pesticide/PCB	Test for observed release to WM Sheid & Schlessman
	Opportunity	5	Y	Pest/PCB/Radioactiv ity	

The approximate distances from permanent structures such as bridges and powerline supports will be determined from each sampling location for future reference. In addition, a fluorescent painted stake or plastic flag will be placed alongside the stream bank at each location, if possible, and labeled with the station number. Water sampling procedures will follow MK's Standard Procedures.

3.4 Sediment Sampling

Sediment samples will generally be collected at locations corresponding to surface water sample locations, as described above. The sample will be collected by a person either wading into the stream or using a boat. The samples will be collected from depositional areas to ensure that areas with potential for constituent accumulation are sampled. Sediment samples will be collected from the sediment bed surface to a maximum depth of 12 inches.

In shallow samples, samples will be collected utilizing a decontaminated stainless steel trowel. If the water column above the sediments at the sample location is flowing or greater than 6 inches in depth, a hand auger will be used to collect the sample. A hand auger consists of a sample bucket attached to the bottom of a length of pipe that has a crossbar at the tip. A hole is drilled by turning this crossbar at the same time the operator presses the auger into the ground. The hand auger is taken to the desired depth to obtain the sample. Standing water from the top of the sampling tool will be decanted off prior to obtaining the sample. When the hand auger is withdrawn from the sample area, a stainless steel spoon is used to obtain a sample from the sample bucket. The sample is then placed directly into the proper sample container or stainless steel bowl. If the sediment consistency will not allow a sample to be obtained by the hand auger, a trier will be used. Decontaminated equipment will be used to collect the sediment samples.

A relatively undisturbed sediment sample should be obtained for volatile organics analysis (VOA), as volatiles are easily lost during sample handling. VOA samples will be collected by filling the sample container with sediment, being careful to leave no headspace in the container. This sample will not be mixed since it is very important to obtain the VOA sample as quickly as possible to minimize the off-gassing of volatile constituents.
Sediment color, texture, and odor will be noted upon collection of all samples.

The stream sediment location will be denoted in the field for future reference by fluorescent painted stake or plastic flagging along the stream bank at each location, as described above in the surface water sampling procedures.

3.4.1 Contingency Plan

In sampling surface water and sediment from the same area, care must be taken to ensure that surface water samples do not contain an excessive amount of sediment. In order to reduce the amount of sediment that may be captured with the surface water samples, the water samples will be collected prior to the sediment sample at each location. In the event that the sediment sample is collected first, the surface water sample will not be collected until the water clears.

3.5 Soil Sampling

3.5.1 Number and Location of Samples

The purpose of the soil sampling effort at the PBS is to identify the existence of soil contamination; the soil sampling will not determine the extent of any contamination which may be present. Normally, two or three samples will be obtained from each source area. Only one soil sample will be taken in the Fly Ash areas. Table 3-4 lists each source area, the number of samples proposed, the parameters for which the samples will be analyzed, and the justification for obtaining the samples.

3.5.2 Field Procedures

All soil samples will be collected using a hand auger and/or trowel, depending upon depth. A hand auger consists of a sample bucket attached to the bottom of a length of pipe that has a crossbar at the tip. A hole is drilled by turning this crossbar at the same time the operator presses the auger into the ground. The hand auger is taken to the desired depth of two feet from the ground surface. When the hand auger is withdrawn from the sample area, a stainless steel spoon is used to obtain a sample from the sample bucket. The sample is then placed into the proper sample container. Decontaminated equipment will be used to collect the soil samples.

A relatively undisturbed soil sample shall be obtained for volatile organics analysis (VOA), as volatiles are easily lost during sample handling. VOA samples will be collected by filling the sample container with soil, being careful to leave no headspace in the container. This sample should not be mixed since it is very important to obtain the VOA sample as quickly as possible to minimize the off-gassing of volatile constituents.

Soil samples that are not to be analyzed for volatile organics may be composited for analysis, as determined by the Team Leader. Soil samples will be composited by placing all samples obtained for a given source area into a stainless steel bowl and homogenizing with a stainless steel spoon or Teflon™ spatula. Large pebbles and cobbles will be removed from the sample. Composite samples for chemical analyses will be collected in the appropriate containers. Sample containers will be maintained and documented as described in Section 3.9 - Documentation and Chain-of-Custody Procedures.

3.5.3 Contingency Plan

The primary foreseeable obstacle in soil sampling is the hand auger encountering refusal. However, due to the shallow sampling depths (approximately two feet below ground surface), the probability of encountering refusal is low. In the event that refusal is encountered, the hand auger will be removed and the partial sample replaced. A new sampling location will be chosen within a five foot radius of the original sample. The new sample location will be chosen such that it remains within the potential source area. Both the original sample site and the new sample site will be noted in the field documentation.

3.6 Quality Assurance/Quality Control Samples

Quality Assurance/Quality Control (QA/QC) sample checks will be utilized during the sampling effort. The QA/QC sample results will serve as checks on the quality of the performance of the sampling and analysis program during the Site Investigation. The types of QA/QC samples which will be utilized are discussed below.

TABLE 3-4
SOIL/SOURCE SAMPLES

PMU	SOURCE	MATRIX L/S	NUMBER	FULL SUITE	OTHER	RATIONALE
1	TNT Area "C"	S	3	Y		Test for residual contamination in upper 2'
	Disposal Area 2A/ Lime Sludge	S	3	Y	Pesticide/PCB/pH	Test for soil contamination within source area
	Disposal Area 2B	S	2	Y	Pesticide/PCB	Test for soil contamination within source area
	Burn Pit 1	S	2	Y		Test for residual contamination in upper 2'
	Burn Pit 2	S	2	Y		Test for residual contamination in upper 2'
	Fly Ash	S	3	N	Metals	Document metal components of 3 fly ash areas
	Lower Toluene Tank	S	2	Y		Test for observed release to the soil
	Background	S	1	Y	Pest./PCB/Radioact.	Document background soil composition
2	TNT Area "B"	S	3	Y		Test for residual contamination in upper 2'
	Rail Unloading Area	S	3	Y		Test for observed release to the soil
	Middle Toluene Tank	S	2	Y		Test for observed release to the soil
3	Fly Ash	S	3	N	Metals	Document metal components of 2 fly ash areas
	Upper Toluene Tanks	S	2	Y		Test for observed release to the soil
	Boiler Complex & Ponds	Sed.	2	N	Metals	Test for heavy metals in each pond
	Reactor Retention Basin	S	2	Y	Radioactivity	Test for residual contamination in retention basin
4	TNT Area "A"	S	4	Y		Test for residual contamination in upper 2'
	Disposal Area 1B/Burn Pit 5	S	3	Y		Test for residual contamination in upper 2'
5	Rubble Pile	S	2	Y	Pesticide/PCB	Test for soil contamination within source area
	Bunker Area (Opportunity)	-	4	Y		Opportunity samples to locate possible alternate sources
	Opportunity	-	20	Y	Pest./PCB/Radioactivity	

3.6.1 Trip Blanks

Analysis of the trip blanks will be used to assess contamination of sample containers during storage at the site and contamination of samples during transport back to the laboratory. Trip blanks consist of ASTM Type II reagent water poured into prepared sample bottles. These sample bottles will be randomly selected from the supply of prepared sample bottles. Sample containers will be filled to yield an appropriate sample volume (ie. four 40- mL vials) for the VOC analysis and matrix spike/matrix spike duplicates (MS/MSD) analyses, if required. These trip blanks will be prepared at the laboratory, shipped to NASA PBS, stored with the unused bottles, transported to the sampling site, and then shipped for analysis with the samples collected during the sampling event. The trip blanks will remain unopened throughout the sampling event. One trip blank will be included in each shipping container containing soil and groundwater samples for VOC analysis.

3.6.2 Equipment Rinsate Blank

An equipment rinsate blank will be collected to ensure that sampling equipment is clean and that the potential for cross contamination has been minimized by the equipment decontamination procedures. This blank will be collected by decontaminating the sampling device and then pouring ASTM Type II reagent water over the cleaned sampling device. This rinsate water will be collected into a clean stainless steel bowl and then transferred to the appropriate sample containers, or by direct collection in the sample containers. The equipment rinsate blank will be analyzed for parameters identical to those analyzed in environmental media samples. Equipment blanks will be collected during the sampling day at a rate of one per every ten environmental media samples. These sample bottles will be randomly selected from the supply of prepared sample bottles.

3.6.3 Duplicate Samples

Blind duplicate samples will be collected to allow determination of analytical and sampling precision and representation. One duplicate sample in every twenty (20) field samples will be collected and tested for parameters identical to those tested in the true sample. Field duplicate samples will be labeled as to be distinguishable by the laboratory from other samples. The designated replicate identifier "D" will be written at the end of the sample identification number (e.g. SB-01D).

3.6.4 Field Blanks

Field Blanks will be prepared at the beginning of each sampling day by pouring ASTM Type II reagent water or potable water (e.g., water used in the steam cleaner and to decontaminate water measuring devices) used for equipment decontamination into prepared sample bottles. These sample bottles will be randomly selected from the supply of prepared sample bottles. The field blanks will be handled and analyzed in the same manner as the environmental samples. Field blank analyses are used to indicate the baseline contamination that may be introduced by the use of reagent-grade or potable-quality water during the field effort.

3.6.5 Matrix Spike Samples

MS/MSD samples will also be submitted as further QC checks. These samples will be spiked at the laboratory. These will be collected at the frequency of one MS and MSD for every twenty (20) field samples (including trip blanks, field blanks, and blind duplicates). These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by comparison of matrix spike duplicate recoveries. The purpose of these laboratory spikes is to monitor any possible matrix effects specific to samples collected from the site. The addition of known concentrations of compounds/constituents to the sample also monitors extraction/digestion efficiency.

Matrix spike/matrix spike duplicate sample aliquot will be acquired by providing triple the necessary sample volume for the location identified for these QC samples. Matrix spike/matrix spike duplicate sample aliquot for solid/soil analyses will be split from the designated sample location at the laboratory. The laboratory will select aliquot that are as homogeneous with respect to one another as possible to avoid precision problems related to sample in homogeneity. The specific sample location which will be used for matrix spikes and blind duplicates will be chosen by the Team Leaders with direction from the Quality Assurance Manager. Homogenizing is discouraged prior to splitting duplicates to avoid the loss of volatile organic compounds.

3.7 Decontamination and Post-Sampling Procedures

Decontamination of equipment will take place at a specific decontamination zone designed at the site. This site will be chosen during meetings with on-site personnel prior to the mobilization of MK's field personnel.

3.7.1 Sampling Equipment Decontamination

All non-disposable equipment (*i.e.*, hand auger, stainless steel spoons, trowels) will be decontaminated according to the procedures summarized below:

- Manual scrub with non-phosphate soap solution plus tap water wash
- Tap water rinse
- Distilled/Deionized water rinse
- 10% nitric acid rinse (for metals only)
- Distilled/Deionized water rinse

Add Methanol Rinse

Further decontamination procedures are outlined in MK's Standard Operating Procedures.

3.8 Sample Preparation and Preservations

3.8.1 Bottle Preparation

All sample containers will be provided by the analytical laboratory. The containers provided will be those described in 40 CFR 136 and cleaned in accordance with EPA protocols. Preparation certification and lot numbers will accompany all sample containers shipped to PBS from the laboratory.

3.8.2 Sample Containment and Preservation

Sample containers will be selected to ensure compatibility with the waste and to minimize brakeage during transportation. Preservatives will be added to the appropriate sample container by the laboratory prior to shipment. If preservation by the laboratory is not possible, the field team will be responsible for sample preservation prior to initiating the daily sample collection activities. Sample labels will be filled out at the time of sampling and will be attached to each container to identify the sample number, collector's nane, date and time of collection, location of sampling point, and preservative added.

3.8.3 Sample Packaging and Shipping

The following summarizes the procedures that will be followed when transporting environmental samples and field QC blanks from PBS to the analytical laboratory:

- the outer surface of all containers will be cleaned with potable water and paper towels;
- sample collection points, depth increments, and sampling devices documented in the field logbook will be verified with information written on the sample label and chain-of-custody form;
- logbook entries, sample tags, chain-of-custody forms, and field record sheets with sample identification points, date, time, and names or initials of all persons handling the sample in the field will be completed;
- custody tape or seal will be placed around the cap and neck of each sample container;
- environmental samples and field QC blanks will be placed into a sample cooler along with sufficient ice packs to maintain all samples at 4 C. After the cooler is filled, the appropriate chain-of-custody form will be placed inside a recloseable plastic bag and taped to the inside of the cooler. The outside surface of the cooler will be cleaned; and
- custody tape or seal will be attached in two separate location on the outside of each cooler.

After the jars and bottles for a given sample site have been filled, they will be placed in a shipping container. Those containers requiring preservation at 4 C will be placed in a cooler and covered with sufficient blue ice packs or crushed ice in plastic bags to maintain the required temperature. Field sampling personnel will provide crushed ice or ice packs to add to the shipping cooler as the samples are collected. Each sample container will be cushioned and sealed in a cooler for shipment to the designated laboratory. Ths sample cooler will be shipped to the laboratory by overnight delivery. Daily sample collection activities will terminate in time to ensure overnight delivery. A complete chain-of-custody will accompany each sample shipment to provide documentation and trace sample possession.

Table 3-6 lists the proper container material, volume requirement, and preservation needed for the site investigation. Samples requiring refrigeration for preservation will be immediately transferred to coolers packed with ice or ice packs. Proper chain-of-custody documentation will be maintained as discussed below in Section 3.9.

3.9 Documentation and Chain-of-Custody Procedures

Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if it is: 1) in the physical procession or view of the responsible party, 2) secured to prevent tampering, or 3) placed in the restricted area by the responsible party. The Senior sampling team member is responsible for the custody of the collected samples in the field until they have been transferred to the Field Operation Manager responsible for the sample custody until the samples are properly packaged, documented, and released to a courier or directly to the analytical laboratory. The laboratory is responsible for custody thereafter. Custody will be documented throughout the investigation by the chain-of-custody record initiated for each day in which samples are collected. This record will accompany the samples from the site to the laboratory, and will be returned to the Field Operations Manager with the final analytical report. All personnel with sample custody responsibility are required to sign, date, and note the time on the record when relinquishing samples from their immediate custody. Any discrepancies will be noted at the time and resolved by verifying correct information in the field log book.

3.9.1 Sample Labels

A label will be attached to all sample containers at the time of collection. The label will be completed in indelible ink and will contain the following information:

- date and time collected
- analysis requested
- sample number
- source and location of the sample
- project number and title
- collection method and purge volume (if applicable)
- preservative (if applicable)
- name of collector

3.9.2 Field Sample Identification Procedures

A sample identification system will be used to identify each environmental sample collected and field QC blank prepared during the field investigation. This identification system will provide a tracking procedure to allow information concerning a particular sample location to be easily and accurately retrieved. This system will also ensure that each sample is unique and will not be confused with any other sample. A Field Operations Manager will maintain a complete list of sample numbers. Each sample number will follow the format described below:

Sample Location Identification- This will be an alpha-numeric identification code unique to each sample. The code will consist of a eight alpha-numeric number. The first two letters will identify which company took the sample. In this case the letter "MK" will precede all sample numbers. The following two numbers will identify which PMU the sample was obtained. These numbers will be 01 through 05. The last four number will identify the type of sample and its number. The table below shows the sample identification numbers.

CODE	SAMPLE SOURCE DESCRIPTION
SB01	Soil Boring, sample number 1
SS01	Surface soil, sample number 1
MW01	Monitoring Well, sample number 1
SD01	Sediment sample, sample number 1
SW01	Surface water, sample number 1

The numeric character associated with these codes will vary according to the sample location and type. For example, a sediment sample take in PMU 3 could be coded as MK-03-SD01.

Replicate and Field QC Blanks - The following codes will be used to identify replicate environmental and field QC samples:

- "R" is a replicate sample
- "FB" is a field blank
- "TB" is a trip blank
- "EB" is an equipment blank

The designated identifier will be written at the end of the sample identification number. Field blanks, equipment blanks, and trip blanks will be further described with the date the blank's preparation date following the acronym above. For example a field blank prepared on April 22, 1993 would have the following sample number MK-01-01FB042293.

3.9.3 Chain of Custody

Chain-of-custody forms will be used to document the integrity of all samples. A chain-of-custody form will be filled out for each sample set at each sampling location to maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory,

The chain-of-custody form for each sample shipment will contain the following information.

- Sample number (for each sample in shipment)
- Collection date (for each sample in shipment)
- Time shipment was packed
- Number of containers of each sample (for each sample container in shipment)
- Sample description (environmental medium)
- Analyses required for each sample
- Preservative added, if any (for each sample container in shipment)
- Shipment number
- Shipping address of the laboratory
- Date, time, and method of shipment
- Container lot numbers
- Spaces to be signed as custody is transferred between individuals
- Date the data package is to be delivered from the laboratory
- Temperature of coolant blank upon arrival at the laboratory

The contractor Field Operations Manager who is shipping the samples from the field to the laboratory also is responsible for completing the chain-of-custody form, signing the form, and noting the date and time of shipment. This individual also will inspect the form for completeness and accuracy. Any corrections to the chain-of-custody form entries will be made by a single-line through the incorrect item and entering the correct entry adjacent to the strikeout item. Corrections will be initialed and dated by the person making the change. The contractor Field Operations Manager or his designated representative will sign, date, and note the time of transferal on the forms after the form has been inspected and determined to be satisfactorily complete. The chain-of-custody form will be placed in a recloseable plastic bag and taped to the inside of the cooler lid after the contractor Field Operation Manager has detached the appropriate copy of the form. This copy will be appropriately filed and kept onsite for the duration of the investigations at PBS.

3.9.4 Transfer of Custody and Shipment

The following summarizes the procedures that will be used in transferring and shipping samples:

- Samples will be accompanied by a chain-of-custody form at all times. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the form. This form documents transfer of sample custody from the sampler to another person or to the laboratory.

- Samples will be properly packaged for shipment and dispatched to the analytical laboratory for analysis with a separate signed chain-of-custody form enclosed in each sample cooler. Shipping containers will be sealed with custody tape.

- Whenever samples are split with a facility or government agency, a separate chain-of-custody form will be prepared for those samples.

- Whenever samples are split with a facility or government agency, a separate chain-of-custody form will be prepared for those samples.

- All packages will be accompanied by the chain-of-custody form showing identification of the contents. The original form will accompany the shipment, and the goldenrod copy will be retained by the Field Operations Manager.

- When sent by common carrier, a copy of the bill of lading will be retained as part of the permanent custody documentation.

Samples will be accompanied by a chain-of-custody form. When possession of samples is transferred, the individual relinquishing the samples and the individual receiving the samples will sign, date, and note the time of transferal on the chain-of-custody document. This record will represent the official documentation for all transferal of sample custody until the samples have arrived at the laboratory.

Samples will be wrapped will plastic packing material and packed with crushed ice or blue ice® in sturdy, thermally insulated coolers. Sealed coolers will be transported to a shipping company for overnight delivery to the analytical laboratory. The chain-of-custody record will be available for the courier when required by the courier organization to maintain chain-of-custody protocols within their own organizations during their time of possession. In this situation, the chain-of-custody form will be attached to the outside of the shipping containers during transportation. In all other situations, the chain-of-custody form will be placed in a recloseable plastic bag and taped to the inside lid of the cooler.

If samples are to be divided with another laboratory facility or governmental agency, a separate chain-of-custody record will be prepared for those samples. This chain-of-custody record will indicated with whom the samples have been split, and will be appropriately signed and dated with the time of transfer of split samples.

3.9.4.1 Sample Packaging

Samples will be packed according to the following procedures:

- Custody tape will be wrapped over the neck and cap of each container

- Glass sample containers will be wrapped will plastic insulating material to prevent contact with other sample containers or the inner walls of the cooler

- Samples will be classified according to the U.S. Department of Transportation (DOT) regulations pursuant to Title 49 CFR

- Samples suspected to be contaminants at elevated concentrations will be shipped separately

3.9.4.2 Shipping Containers

Samples will be packaged in thermally insulated, rigid coolers, according to DOT specifications 173.510 and 172 Subparts B, C, and D, and Subparts A and B of Part 173. The cooler then will be sealed.

3.9.4.3 Marking and Labeling

The cooler will be marked as follows:

- Proper shipping name: Hazardous Substance, Liquid, or Solid.
- Hazardous class: To be determined (label placed in upper left corner of the outer container).
- Labels: "This Side Up" or arrows placed on the opposite side of the outer container if a liquid is to be shipped.
- Two strips of custody tape placed on each cooler, with at least one strip at the front and one at the back. Custody seals will be located in a manner that will indicate tampering, should any occur.

A hazardous material shippers certification will be filled out and will accompany the shipment. The container will be secured with strapping tape to prevent leakage and accidental opening. After the samples is logged in, an internal chain-of-custody/tracking form will be generated. This internal chain-of-custody document requires that the samples be formally relinquished by one party and accepted by other at each step of the analytical process. This document accompanies the sample through each step of the analytical process. When the analytical activities are complete, internal and external chain-of-custody documents will be completed and filed in the appropriate project file. Based on specific contract requirements, any remaining samples will be either archived in locked storage areas or properly disposed of.

In addition to the external and internal chain-of-custody documents, a computer generated listing of the various parameters for sample analysis will be used to control sample flow and facilitate tracking within the laboratory. Each laboratory unit participating in the analyses will be given the list of parameters and will be responsible for maintaining sample integrity, fulfilling chain-of-custody requirements, scheduling sample flow, and tracking sample status. All sample data will be entered into the LIMS in accordance with the established protocols for sample control chain-of-custody requirements.

3.9.5 Field Logbook

The site logbook is the master field investigation document and is required for the investigations at PBS. The logbook is a bound book with a hard cover and sequentially numbered pages. The primary purpose of this document is to contain the actual field data or references to other field

documents that contain a specific description of every activity that has occurred during the investigation on any given day in one location. The site logbook will contain any administrative occurrences, conditions, or activities that may have affected the field work or data quality of any environmental samples or field QC blanks on any given day or during a given field task. The front of the logbook will list the project number and project name; the names of the subcontracting company performing the field investigation (e.g., drilling, soil gas surveys); the service client; the contract under which the investigation is being conducted; and the dates of duration of the investigations at PBS. The site logbook will be kept up-to-date on a daily basis.

The site logbook will contain the following information, as a minimum:

- Day, date, time entered onsite, temperature, weather conditions, and names and titles of personnel present onsite
- Names, titles, and organizations of any visitors who entered the site during the day
- Chain-of-custody details, including traffic report, air bill numbers, chain-of-custody form, and sample label; types of samples; and laboratories to which samples were sent
- Arrival time of any subcontractors onsite, number of feet drilled, total feet of casing installed, screen lengths, number of samples per borehole, number of duplicate samples, number of split samples, laboratory to which split samples were sent, depth of pit or length of trench excavated, and references to field logbook(s) or field forms that contain more specific field information for any of the above tasks
- Number of samples by matrix that were collected and any field tests that may have occurred during the day's events, including a reference to the field logbook or the field forms that contain more specific information on all sampling that has occurred.
- Decontamination iterations, equipment decontaminated, and procedures used
- Specific comments relative to any problem areas that occurred during the day's activities, the final resolution, and the anticipated impact on the outcome of the field investigation or on data quality
- Instruments calibrated during the day, the individual who performed the calibration, and reference to the page number in the calibration log that provides more specific information on calibration procedures and results
- A record of telephone calls (incoming or outgoing) pertaining directly to the decision making process of the field investigation, along with the outcome of each conversation, and a reference to the telephone log to obtain more specific information on the call.

The Field Operations Manager will sign the bottom of each page of the site logbook.

3.9.6 Daily Log

Daily logs will be kept during field activities by the Field Operations Manager. These daily logs will be kept in a bound field notebook of water-resistant paper. All entries will be made legibly in indelible ink, signed, and dated. Information that will be recorded in the field notebook includes:

- Date, time, and place sampling
- Applicable field QC samples
- Weather conditions at time of sampling, including ambient temperature and approximate wind direction and speed
- Data from field analyses (i.e., temperature, specific conductivity, and pH of water samples, if applicable)
- Turbidity of water samples
- Data from physical tests (e.g., slug tests)
- Observations about site and samples (e.g., odors, appearance)
- Information concerning any activities, extraneous to sampling activities, that may affect the integrity of the samples (such as low-flying aircraft nearby, fossil-fueled motors being used nearby, painting operations being carried out upwind of sampling sites)
- Analyses, required sample treatment techniques, and solution preparation

3.9.7 Field Equipment Logbook

The Field Equipment Logbook (FEL) will document the proper use, maintenance, and calibration of all field testing equipment used during the investigations at PBS. Before using field equipment, the Field Operations Manager will inspect and approve the use of the field testing equipment by initialing the appropriate form in this document. A calibration log sheet will be maintained for each instrument use during the investigations and will be kept in the log. The following items shall be tracked in the FEL, as a minimum, during the investigation at PBS:

- Name and signature of person making entry
- Date of entry
- Name of equipment and its identifying number
- Decontamination status
- Nature of work conducted
- List of reference of procedures used for calibration or maintenance

- Manufacturer, lot number, and expiration date of calibration standards
- Names of all persons conducting work
- Measurement results (acceptable or unacceptable).

Entries in the logbook will be signed and dated by the person making the entry. Every page in the log will be signed and dated by the Field Operations Manager.

3.10 Analytical List

The analytical methods which are to be performed on all samples are detailed in Table 3-7. Table 3-7 is a summary of the number of samples which will be analyzed, broken down by matrix and analytical parameters. The parameters selected are based upon historical site operations and professional judgment. The target compounds and the contract required quantitation limits (QLs) are listed in Table 3-8.

TABLE 3-6
ANALYTICAL METHODS

PARAMETER	METHOD NUMBER	SAMPLE SIZE/ CONTAINER	PRESERVATION	HOLDING TIME
VOLATILES	8240	3 x 40ml VOA 1 x 40oz. GA Jar	4°C[1]	14 days
SEMI-VOLATILES	8270	2 x 1L GA Bottle 1 x 8oz. GA Jar	4°C 4°C	7/40 days[2] 14/40 days[3]
TOTAL METALS	6010/7000 series or 200.7 200 series	water: 1000ml P/G Bottle soil: 4oz. G Jar	4°C pH<2HNO_3 4°C	6 months 6 months
NITROEXPLOSIVES	8330	water: 1 x 40 ml GA Vial soil: 1 x 60ml GA Bottle	4°C 4°C	7 days 14/40 days[3]
PESTICIDES	8080 8140	2 x 1L GA Bottle 1 x 8oz. GA Jar 2 x 1L GA Bottle 1 x 8oz. GA Jar	4°C 4°C 4°C 4°C	7/14 days[2] 14/40 days[3] 7/40 days[2] 14/40 days[3]
PCB	8080	2 x 1L GA Bottle 1 x 8oz. GA Jar	4°C 4°C	7/40 days[2] 14/40 days[3]
RADIOACTIVITY	900.0, 903.1, 904.0	2 x 1L Plastic	HNO_3 to pH<2	N.A.

G = Glass bottles with teflon lined cap
GA = Glass amber bottles with teflon lined cap
P = Plastic bottles with cap
VOA = 40 ml glass vial with teflon septum
[1] = If residual chlorine present in water than preserve with 0.008% $Na^2S^2O^3$ of 0.5g ascorbic acid.
[2] = 7 days for extraction and 40 days from extraction to analysis for water.
[3] = 14 days for extraction and 40 days from extraction to analysis for soil.

TABLE 3-7
SAMPLE SUMMARY TABLE

	pH	VOLATILES	SEMI-VOLATILES	TOTAL METALS	NITRO-EXPLO-SIVES	PESTICIDES	PCB	RADIO-ACTIVITY
SOIL	6	60	60	68	60	35	35	5
SURFACE WATER	0	26	26	26	26	11	11	4
SEDIMENT	0	26	26	26	26	11	11	4
GROUNDWATER	0	18	18	18	18	3	3	0
FIELD BLANKS		20						
TRIP BLANKS		20						
EQUIP. BLANKS		20	20	20				
MS/MSD								
DUPLICATES								

TABLE 3-8
TARGET COMPOUNDS AND CONTRACT REQUIRED QUANTITATION LIMITS
VOLATILE COMPOUNDS

NAME	CAS RN	QL[1] ug/L	NAME	CAS RN	QL ug/L
Chloromethane	74-87-3	10	Chloroethane	75-00-3	10
Bromomethane	74-83-9	10	Methylene chloride	75-09-2	10
Vinyl chloride	5-01-4	10	Acetone	67-64-1	10
Carbon Disulfide	75-15-0	10	1,1-Dichloroethene	75-35-4	10
1,1-Dichloroethane	75-34-3	10	1,2-Dichloroethene(total)	540-59-0	10
Chloroform	67-66-3	10	1,2-Dichloroethane	107-06-2	10
2-Butanone	78-93-3	10	1,1,1-Trichloroethane	71-55-6	10
Carbon tetrachloride	56-23-5	10	Bromodichloromethane	75-27-4	10
1,2-Dichloropropane	78-87-5	10	cis-1,3-Dichloropropene	10061-01-5	10
Trichloroethene	79-01-6	10	Dibromochloromethane	124-48-1	10
1,1,2-Trichloroethane	79-00-5	10	Benzene	71-43-2	10
trans-1,3-Dichloropropene	10061-02-6	10	Bromoform	75-25-2	10
4-Methyl-2-pentanone	108-10-1	10	2-Hexanone	591-78-6	10
Tetrachloroethene	127-18-4	10	Toluene	108-88-3	10
1,1,2,2-Tetrachloroethane	79-34-5	10	Chlorobenzene	108-90-7	10
Ethyl benzene	100-41-4	10	Styrene	100-42-5	10
Xylenes(total)	1330-20-7	10			

[1]Quantitation limits (QL) are highly matrix dependent. The contract required quantitation limits listed here for water (ug/L) are provided for guidance and are not always achievable.

TABLE 3-8
TARGET COMPOUNDS AND CONTRACT REQUIRED QUANTITATION LIMITS
SEMI-VOLATILE COMPOUNDS

NAME	CAS RN	QL[1] ug/L	NAME	CAS RN	QL ug/L
Phenol	108-95-2	10	bis(2-Chloroethyl) ether	111-44-4	10
2-Chlorophenol	95-57-8	10	1,3-Dichlorobenzene	541-73-1	10
1,4-Dichlorobenzene	106-47-7	10	1,2-Dichlorobenzene	95-50-1	10
2-Methylphenol	95-48-7	10	2,2'-Oxybis(1-Chloropropane)	108-60-1	10
4-Methylphenol	106-44-5	10	N-Nitrosodi-n-propylamine	621-64-7	10
Hexachloroethane	67-72-1	10	Nitrobenzene	98-95-3	10
Isophorone	78-59-1	10	2-Nitrophenol	88-75-5	10
2,4-Dimethylphenol	105-67-9	10	bis(2-Chloroethoxy) methane	111-91-1	10
2,4-Dichlorophenol	120-83-2	10	1,2,4-Trichlorobenzene	120-82-1	10
Naphthalene	91-20-3	10	4-Chloroaniline	106-47-8	10
Hexachlorobutadiene	87-68-3	10	4-Chloro-3-methylphenol	59-50-7	10
2-Methylnapthalene	91-57-6	10	Hexachlorocyclopentadiene	77-47-4	10
2,4,6-Trichlorophenol	88-06-2	10	2,4,5-Trichlorophenol	95-95-4	25
2-Chloronaphthalene	91-58-7	10	2-Nitroaniline	88-74-4	25
Dimethylphthalate	131-11-3	10	Acenaphthene	83-32-9	10
2,4-Dinitrophenol	51-28-5	25	4-Nitrophenol	100-02-7	25
Dibenzofuran	132-64-9	10	2,4-Dinitrotoluene	121-14-2	10
Diethylphthalate	84-66-2	10	4-Chlorophenylphenyl ether	7005-72-3	10
Fluorene	86-73-7	10	4-Nitroaniline	100-01-6	25

TABLE 3-8
TARGET COMPOUNDS AND CONTRACT REQUIRED QUANTITATION LIMITS
SEMI-VOLATILE COMPOUNDS

NAME	CAS RN	QL[1] ug/L	NAME	CAS RN	QL ug/L
4,6-Dinitro-2-methylphenol	534-52-1	25	N-Nitrosodiphenylamine	86-30-6	10
4-Bromophenylphenylether	101-55-3	10	Hexachlorobenzene	118-74-1	10
Pentachlorophenol	87-86-5	25	Phenanthrene	85-01-8	10
Anthracene	120-12-7	10	Carbazole	86-74-8	10
Di-n-butylphthalate	84-74-2	10	Fluoranthene	206-44-0	10
Pyrene	129-00-0	10	Butylbenzylphthalate	85-68-7	10
3,3'-Dichlorobenzidine	91-94-1	10	Benzo(a)anthracene	56-55-3	10
Chrysene	218-01-9	10	bis(2-Ethylhexyl)phthalate	117-81-7	10
Di-n-octylphthalate	117-84-0	10	Benzo(b)fluoranthene	205-99-2	10
Benzo(k)fluoranthene	207-08-9	10	Benzo(a)pyrene	50-32-8	10
Ideno(1,2,3-cd)pyrene	193-39-5	10	Dibenz(a,h)anthracene	53-70-3	10
Benzo(g,h,i) perylene	191-24-2	10			

TABLE 3-8
TARGET COMPOUNDS AND CONTRACT REQUIRED QUANTITATION LIMITS
PESTICIDES/PCBS

NAME	CAS RN	QL[1] ug/L	NAME	CAS RN	QL ug/L
alpha-BHC	319-84-6	0.05	beta-BHC	319-85-7	0.05
delta-BHC	319-86-8	0.05	gamma-BHC (Lindane)	58-89-9	0.05
Heptachlor	76-44-8	0.05	Aldrin	309-00-2	0.05
Heptachlor epoxide	1024-57-3	0.05	Endosulfan I	59-98-8	0.05
Dieldrin	60-57-1	0.10	4.4'-DDE	72-55-9	0.10
Endrin	72-20-8	0.10	Endosulfan II	33213-65-9	0.10
4,4'-DDD	72-54-8	0.10	Endosulfan sulfate	1031-07-8	0.10
4,4'-DDT	50-29-3	0.10	Methoxychlor	72-43-5	0.50
Endrin ketone	53494-70-5	0.10	Endrin aldehyde	7421-36-3	0.10
alpha-Chlordane	5103-71-9	0.05	gamma-Chlordane	5103-74-2	0.05
Toxaphene	8001-35-2	5.0	Aroclor-1016	12674-11-2	1.0
Aroclor-1221	11104-28-2	2.0	Aroclor-1232	11141-16-5	1.0
Aroclor-1242	53469-21-9	1.0	Aroclor-1248	12672-29-6	1.0
Aroclor-1254	11097-69-1	1.0	Aroclor-1260	11096-82-5	1.0

TABLE 3-8
TARGET COMPOUNDS AND CONTRACT REQUIRED QUANTITATION LIMITS
INORGANICS

NAME	CAS RN	QL[1] ug/L	NAME	CAS RN	QL ug/L
Aluminum	(total)	200	Antimony	(total)	60
Arsenic	(total)	10	Barium	(total)	200
Beryllium	(total)	5	Cadmium	(total)	5
Calcium	(total)	5000	Chromium	(total)	10
Cobalt	(total)	50	Copper	(total)	25
Iron	(total)	100	Lead	(total)	3
Magnesium	(total)	5000	Manganese	(total)	15
Mercury	(total)	0.20	Nickel	(total)	40
Potassium	(total)	5000	Selenium	(total)	5
Silver	(total)	10	Sodium	(total)	5000
Thallium	(total)	10	Vanadium	(total)	50
Zinc	(total)	20	Cyanide	(total)	10

TABLE 3-9
TARGET COMPOUNDS AND DETECTION LIMITS
NITROEXPLOSIVES (Draft EPA Method 8330)

NAME	CAS RN	DETECTION LIMIT (SOIL) ppm	DETECTION LIMIT (WATER) ppb
HMX	2691-82-4	2.2	13
RDX	121-82-4	1.0	12
1,3,5-Trinitrobenzene	99-35-4	0.25	12
1,3-Dinitrobenzene	99-65-0	0.25	12
Nitrobenzene	98-95-3	0.26	14
Tetryl	479-45-8	0.65	13
2,4,6-Trinitrotoluene	118-96-7	0.26	12
2,6-Dinitrotoluene	606-20-2	0.25	12
2,4-Dinitrotoluene	121-14-2	0.25	13
2-Nitrotoluene	88-72-2	0.25	13
3-Nitrotoluene	99-08-1	0.25	14
4-Nitrotoluene	99-99-0		12

SECTION 4
PROJECT ORGANIZATION AND RESPONSIBILITY

The overall project organization and lines of authority are presented in Figure 4-1. The MK Quality Assurance Officer, Mr. Timothy Troutman, will be responsible for all of the administrative phases and the technical direction of the SI implementation, including verification that all activities are completed in accordance with all technical and QA/QC requirements. He is responsible for ensuring the collection of valid measurement data and the routine assessment of measurement systems for precision and accuracy.

The MK Project Manager (PM), Ms. Elise Allen, will be the primary interface with NASA management and will represent MK at all review meetings. She will review and approve all deliverables and information transmitted to NASA and will be ultimately responsible for the contents of all documents. The PM is also responsible for assuring adherence to health and safety requirements, schedules, and budgets.

The Project Manager will be assisted by a Field Operations Manager. The Field Operations Manager will primarily be responsible for the logistics and QA requirements associated with the field investigations. This includes day-to-day scheduling and coordination of all sampling activities, coordination between field operations and laboratory support, and acquisition of the necessary sampling materials. Additional duties include overall supervision of MK sampling teams and initial validation of field data. Primary responsibilities of the Field Operations Manager include:

- Updating the Project Manager on implementation progress;
- Establishing exact sampling locations, including borehole locations;
- Verifying, in conjunction with NASA, that proposed boring locations have been cleared for underground utilities;
- Coordinating field activities with potentially affected NASA offices and operations; and
- Ensuring that the QAPjP is followed by all team members, including detecting and resolving potential instances of non-conformance.

Following completion of field activities, the Field Operations Manager will be the focal point for reduction and evaluation of the data from the laboratory after validation. The Field Operations Manager will also be responsible for hazard ranking system scoring of the respective units.

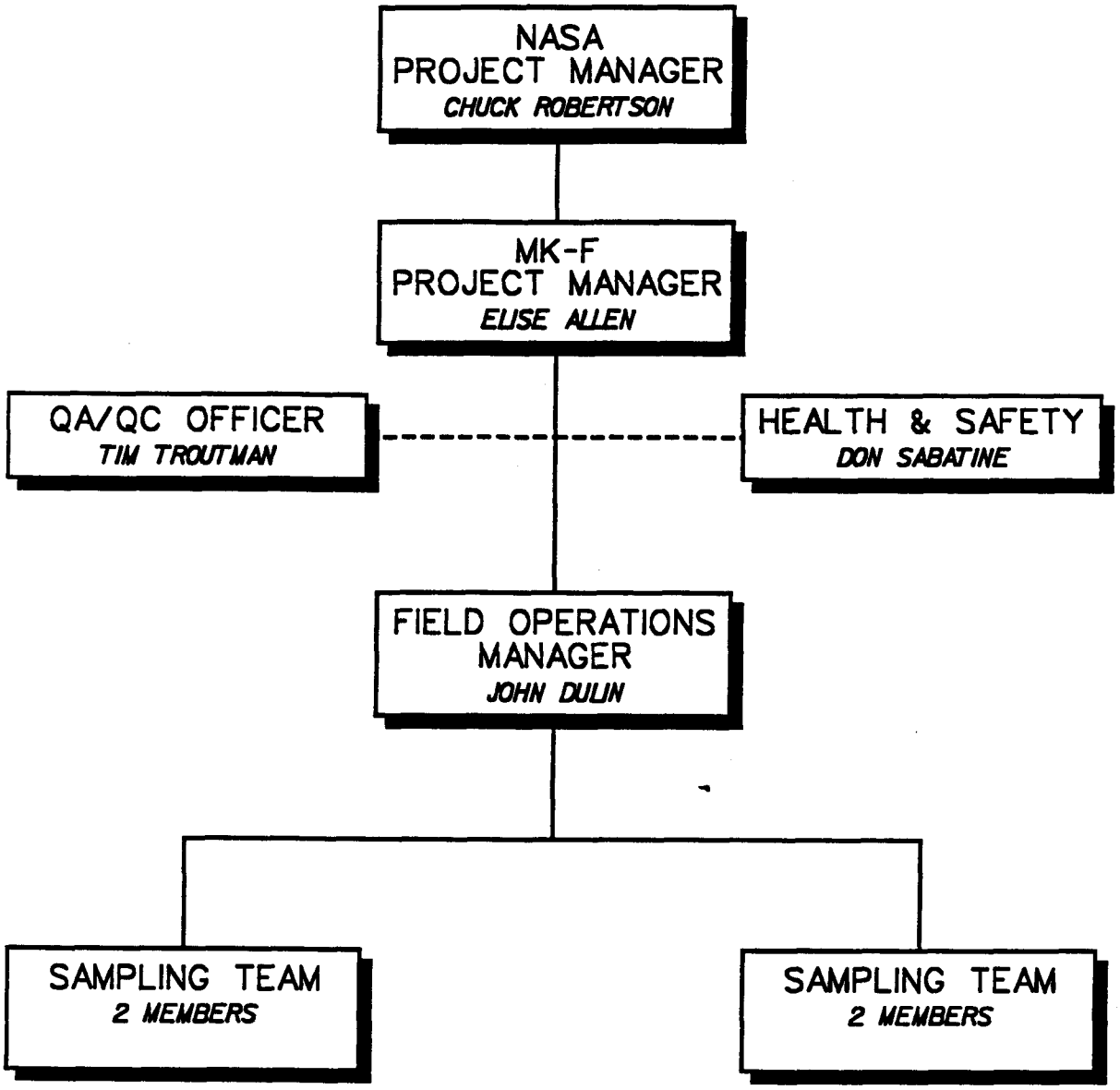


FIGURE 4-1
ORGANIZATION CHART

The Field Operations Manager or a smapling team member will be designated as the Site Health and Safety Officer and will have primary responsibility for ensuring that all field activities are conducted in conformance with the requirements of the site-specific Health and Safety Plan. Specific duties include, but are not limited to:

- Monitoring personnel and operations for existence of hazardous conditions;
- Ensuring that proper personal protective equipment is worn;
- Ensuring that monitoring operations are carried out according to stated specifications and procedures;
- Evaluating monitoring program results and making changes as appropriate; and
- Conducting site safety briefings.