SITE INSPECTION
QUALITY ASSURANCE PROJECT PLAN

NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
PLUM BROOK STATION

April 29, 1993

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SECTION 1
QUALITY ASSURANCE PROJECT PLAN APPROVAL

This Quality Assurance Project Plan (QAPjP) was developed to ensure that all environmental data generated during the Site Inspection at the NASA Lewis Research Center (LeRC) Plum Brook Station (PBS) are scientifically valid, defensible, comparable, complete, and of known and acceptable precision and accuracy. The signatures of key project personnel provided below indicate their concurrence with the procedures specified in this plan and their intent to ensure that all activities conducted as part of the hazardous waste investigations at PBS are performed in strict accordance with this document.

	Signature	Date
C. Robertson, NASA Project ~~Program~~ Manager	_____	_____
K. Smith ~~D. Esterling~~, NASA Technical Project Manager	_____	_____
T. Troutman, MK Quality Assurance Officer	_____	_____
E. Allen, MK Project Manager	_____	_____
J. Dulin, MK Field Operations Manager	_____	_____

This plan is approved for use during the Site Inspection at PBS, Sandusky, Ohio.

Should Watson sign instead of Kathy?

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SECTION 3
PROJECT DESCRIPTION

3.1 Introduction

The strategy for data collection is established through the development of project specific Data Quality Objectives (DQOs). The primary purpose of this Quality Assurance Project Plan (QAPjP) is to define the quality assurance (QA) procedures and quality control (QC) requirements that will be implemented to ensure that the quality and integrity of samples, the accuracy and precision of analyses, the representativeness of results, and the completeness of information collected during the Site Inspection (SI) meet the DQOs established. The information gathered during this investigation will enable NASA and Morrison Knudsen Environmental Services (MK) to assess the potential nature and extent of any contamination detected and determine the need for further investigations. Descriptions of all Data Quality Objectives and procedures associated with sample collection, laboratory analysis, sample custody, initial and continuing instrument/equipment calibration, internal QC checks, performance and system audits, preventive maintenance and scheduling, data quality assessment, corrective action, and QA reports to management applicable to the SI at Plum Brook Station (PBS) are contained within this document. As additional SI investigations are initiated at PBS, the specific QA procedures and QC requirements necessary to ensure that the DQOs established in this QAPjP are met will be included as an attachment(s) to this document.

Data Quality Objectives are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQOs define the total uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent, however, the variables inherently associated with the process (field and laboratory) contribute to uncertainty in the data. It is the overall project objective to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. In order to achieve this objective, data quality requirements such as quantitation limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness are specified. The overall Data Quality Objectives and requirements are established so that there is a high degree of confidence in the measurements performed during the project. The sampling and analysis Data Quality Objectives for the Plum Brook Station SI are presented in Table 5-1 in terms of the field sampling activities, data gathering techniques, intended data uses and data quality level.

This QAPjP was developed using the guidelines and specification elements contained in "Interim Guidelines and Specifications For Preparing Quality Assurance Project Plans," QAMS-005/80, U.S. Environmental Protection Agency (EPA) Office of Exploratory Research, February 1983; "Content Requirements For Quality Assurance Project Plans," EPA Region V, February 1987, with January 1989 revisions; and "Guidelines and Specifications For Preparing Quality Assurance Project Plans," Ohio Environmental Protection Agency (OEPA), February 1990.

For the investigations conducted at PBS, NASA has the responsibility for setting the DQO's and the corresponding QA standards by which the sampling and analysis effort will be conducted, while MK will ensure that these standards are met by all participants. This QAPjP represents the implementation of EPA and OEPA requirements for quality assurance and quality control. The QA/QC procedures and standard operating procedures (SOPs) presented in this document and in the Field Sampling Plan (FSP) are unique to the investigations being conducted at PBS and represent complete instructions for data collection and data quality during the investigations.

QA/QC is a critical process that encompasses all health and safety, risk, liability, and indemnity issues directly related to the project. This QAPjP was developed not only to ensure that data of known and acceptable quality will be collected during the investigations conducted at PBS, but also to minimize the risk and liability factors likely to be encountered during the investigations.

3.2 Site Description

Plum Brook Station is a satellite operation of NASA's Lewis Research Center in Cleveland, Ohio. Most of the aerospace test facilities established in the 1960s are in standby or inactive condition. It is located 50 miles west of LeRC, approximately 4 miles south of the Lake Erie port of Sandusky, Ohio, in an area that is primarily agricultural and rural. Plum Brook Station consists primarily of undisturbed forested land. Areas surrounding Plum Brook Station are used for crop production. Plum Brook Station is located in Perkins and Oxford townships and extends to the east into Huron and Milan townships.

The original Plum Brook Station consisted of 9,009 acres. Approximately 6,500 acres of the original site constitute the station as it exists today. The northern boundary is at latitude 41°23'39" and the southern at latitude 41°20'04'. The western boundary longitude is at 82°43'12" and the eastern at 82°38'39". NASA's LeRC controls the land associated with Plum Brook Station through the following: ownership of title; use of easements, leases, and permits; and ownership of development rights. NASA LeRC management has responsibility for both the Cleveland Center and Plum Brook Station.

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 electrical substations, sanitary wastewater treatment facilities, and cooling towers. All of the test facilities located at the site are remotely located from each other, as original use dictated hazard-exclusion distances.

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 a Plum Brook Station-owned intake in Lake Erie (Big Island Pump Station). Another raw water intake (Rye Beach Pump Station) was used until 1985, when use was discontinued due to a blocked line. Plum Brook Station has five domestic waste water 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.

An 8-foot-high security fence surrounds Plum Brook Station. Unauthorized site access is prohibited. Access to the site is gained through a security guard house located on Columbus Avenue. The guard house is manned by armed guards 24 hours a day. During each eight-hour shift, a security guard patrols the inside perimeter road (Patrol Road) of the facility. All persons entering Plum Brook Station must enter through the guard house. Persons gain access to the station by showing the guard a badge that authorizes entry into the station. Persons not holding badges are issued a badge by a guard after the guard verifies with Plum Brook personnel that entry is authorized.

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.

3.3 Site Ownership History

Plum Brook Station was established by the U.S. Army in the early 1940s to manufacture ordnance [trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite] for World War II. The U.S. Army entered into a contract with Trojan Powder Company for the purpose of manufacturing this ordnance. The official title for the site during this time was the Plum Brook Ordnance Works (PBOW). Ground-breaking to construct facilities to support the manufacturing of ordnance began on April 15, 1941. Production began on December 16, 1941 and continued throughout late 1945. Production ceased two weeks after V-J Day. During the production period more than one billion pounds of ordnance was manufactured.

PBOW was placed in standby condition from 1945 to 1946. Throughout 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. On midnight of December 17, physical custody of the PBOW was transferred from Trojan Powder Company to the U.S. Army Ordnance Department. The Ordnance Department became the accountable agency and the U.S. Army Corps of Engineers assumed responsibility for maintenance and custodial duties 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. From 1946 to 1949 the property was protected and maintained by Matthew-Levio and Sons. In 1949 it 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 NASA identified further areas that required decontamination.

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 Plum Brook Reactor Facility 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 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. NASA continues to use the site today. Throughout the 1960s, various test and research facilities were constructed at Plum Brook Station to support NASA's 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 Space Power Facility (E Site Complex)* - 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 liquids such as liquid hydrogen were 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 not 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 during this standby period. NASA declared approximately 2,152 acres of the original 9,009 acres as excess in April 1978. The Perkins 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 Board of Education uses the land as a bus transportation center.

NASA manages the remaining excess land and has a use permit with the Ohio National Guard for 604 acres. Approximately 900 acres are leased to local farmers. NASA presently controls 6,435.5 acres.

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 for non-aerospace activities. Table 3-1 summarizes the current and historical uses of the major Plum Brook Station aerospace research facilities.

3.4 Environmental Permits Issued or Applied For/Other Environmental Considerations

3.4.1 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 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.

3.4.2 NPDES Permit

NASA LeRC Plum Brook Station has an NPDES permit (application no. OH0001392) for nine outfalls. The permit was originally issued by USEPA for seven outfalls. In March 1983, 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) for effluent from Plum Brook Station sewage treatment plants discharge to Kuebeler Ditch, Ransom Brook, and Plum Brook. Outfall 008 is for effluent from the B Control Building sewage package plant and ultimately discharges to the Box Factory Road Ditch. Outfall 009 is for 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.

TABLE 3-1

HISTORICAL USE AND CURRENT STATUS OF PLUM BROOK STATION NASA FACILITIES 1963-PRESENT

FACILITY	HISTORICAL USE	AGENCY	CURRENT STATUS/USE	AGENCY
Plum Brook Reactor Facility	1963-1973/Nuclear reactor.	NASA	Inactive, licensed through NRC for safe protection and storage.	NASA
Space Power Facility	1960s-1974/Environmental test chamber. 1979-1986/Production of uranium hexafluoride gas centrifuges.	NASA Garrett Corporation	1988-Present/Environmental test chamber. See Above.	NASA
A Site Complex. Liquid Hydrogen Pump Site	1960s-1974/Testing of liquid hydrogen research pumps.	NASA	Inactive.	NASA
B1 Site Complex. High Energy Rocket Engine Research Facility	1960s-1974/Testing of rocket propellant systems at altitude conditions.	NASA	Inactive.	NASA
B2 Site Complex. Spacecraft Propulsion Research Facility	1960s-1974/Testing of space vehicles and upper stage rocket engines in simulated space environments.	NASA	1988-Present/Environmental test chamber. Plan to fully reactivate in 1994.	NASA
B3 Site Complex. Rocket Dynamics and Control Facility	1960s-1974/Altitude tests on large rocket engines.	NASA	Inactive.	NASA

TABLE 3-1 (cont.)

HISTORICAL USE AND CURRENT STATUS OF
PLUM BROOK STATION NASA FACILITIES 1963-PRESENT

FACILITY	HISTORICAL USE	AGENCY	CURRENT STATUS/USE	AGENCY
B Control and Instrument Building	1960s-1974/Control and instrument area for HTF, B-1, B-2, B-3.	NASA	Operational - Being revamped to support HTF activities.	NASA
C Site Complex. Turbo Pump Site	1960s-1974/Research on liquid hydrogen turbo pumps and pump inducers.	NASA	Inactive - Used in the past to store chemicals and waste. May be modified to store F-Site materials.	NASA
D Site Complex. Controls and Turbine Test Site	1960s-1974/Research turbines and develop and test control systems for use at PBS test sites.	NASA	Used by Departments of Agriculture and Interior for storage and work areas.	NASA
E Site Complex. Dynamics Stand	1960s-1974/Simulation of forces encountered during launching and landing of spacecraft.	NASA	Inactive.	NASA
F Site Complex Hydraulics Lab	1960s-1974/Testing of cryogenic and other fluids to support rocket engine concepts.	NASA	Inactive - Except for crate storage. May be used in future to support K-Site Activities.	NASA
G Site Complex	1960s-1964/Testing of turbo pumps using liquid hydrogen.	NASA	Facility is nonexistent. Demolished in 1965.	NASA
H Control and Instrument Building	1960s-1974/Control and instrument area for Plum Brook Station research sites.	NASA	Inactive.	NASA

TABLE 3-1 (cont.)

HISTORICAL USE AND CURRENT STATUS OF PLUM BROOK STATION NASA FACILITIES 1963-PRESENT

FACILITY	HISTORICAL USE	AGENCY	CURRENT STATUS/USE	AGENCY
I Site Complex. Fluorine Pump Site	1960s-1974/Testing of liquid fluorine pumps.	NASA	Inactive.	NASA
J Site Complex. Oxidizer Hydraulics Lab	1960s-1974/Evaluation of oxidizing system components for rocket engine systems.	NASA	Inactive.	NASA
K Site Complex. Cryogenic Propellant Tank Site	1960s-1974/Testing of super propellant tank insulation systems.	NASA	Active-Used to conduct liquid and slush hydrogen propellant research.	NASA
Hypersonic Tunnel Facility	1960s-1974/Simulation of flight speeds and altitude conditions.	NASA	Being revamped for future use.	NASA

3.4.3 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 insignificant 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 stored on-site for greater than 90 days, and no 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.

3.4.4 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 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, a paint-spray booth, an incinerator, and construction activities. Even if these activities were occurring, emissions would be very small. 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, emission sources required permitting.

3.4.5 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.

3.4.6 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 was submitted to the OEPA. Currently, Environmental Resources Documents (ERDs) are being

prepared to supplement the 1978 EIS. The most recent ERD was prepared in August 1990 and addresses management of hazardous substances and hazardous wastes at the Cleveland site and Plum Brook Station.

3.5 Project Objectives and Intended Data Usage

The objective of the SI at PBS is to determine the presence, type, extent, and approximate concentration of any contamination. This process involves using the characterization data from the PBS Preliminary Assessment to provide potential locations of contaminates that may have migrated. The sampling and analysis approach is described in the Field Sampling Plan.

3.6 Target Compounds and Elements

A Preliminary Assessment (PA) of the PBS was completed in June 1991. The PA identified 14 operable units, several of which include more than one potential source of environmental contamination. The operable units have been grouped together for ease of investigation and future remedial action. The operable units were identified as follows:

Unit 1:	TNT Areas A, B, and C
Unit 2:	Red Water Ponds
Unit 3:	Underground Waste Water Flumes
Unit 4:	Burning Grounds
Unit 5:	Waste Lagoon in the Pentolite Area
Unit 6:	Fly Ash Spoil Piles
Unit 7:	Toluene Storage Tanks
Unit 8:	UST Removal Areas
Unit 9:	Asbestos Contamination
Unit 10:	SPF Rubble Pile
Unit 11:	Disposal Area 1B
Unit 12:	Disposal Area 2
Unit 13:	Rail Car Unloading Area
Unit 14:	Lime Sludge Disposal Area

The SI will address each of these operable units, with the exception of the asbestos contamination, the Red Water Ponds, the burning grounds at Taylor and Snake Road, and the UST removal areas. The asbestos contamination and the UST removal areas are being remediated under separate programs. The Red Water ponds were investigated by IT Corporation for the Corps of Engineers. Additional studies have already been conducted at the burn pits and the information generated during these studies will be incorporated into the SI. The operable units and their corresponding locations were plotted on a large scale map in order to determine possible Project Management Units (PMUs). Identification of PMUs allows the characterization, and remediation if necessary, of these potential sources of environmental contamination to proceed in an organized manner.

The development of the PMUs and the assignment of sources were based on four principal criteria:

1. Geographic layout of the PBS site and proximity of sources;

2. Similarities in suspected types of contamination and affected environmental media;

3. Existing level of knowledge regarding nature of contamination source and anticipated priority for further remedial response actions; and

4. Similarity in age of operable units, unit types and usage.

Five Project Management Units were established for the PBS along the various drainage channels on the site (see Figure 3-1), as the PA identifies the streams as the principal means of contaminant transport from the contamination sources to the potential receptors. The PMU's established are as follows:

PMU 1 - Pipe Creek
PMU 2 - Ransom Ditch/Brook
PMU 3 - Plum Brook
PMU 4 - Lindsley Ditch
PMU 5 - Ammo Row/SPF

3.6.1 Preliminary Pathway Analysis

The PA conducted at PBS during 1991 presented the following hypotheses regarding PBS's potential to impact the surrounding environment:

1. The potential exists for release and migration of a hazardous substance to drinking water wells or intakes;

2. The potential exists for release and migration of a hazardous substance to surface water sensitive environments; and

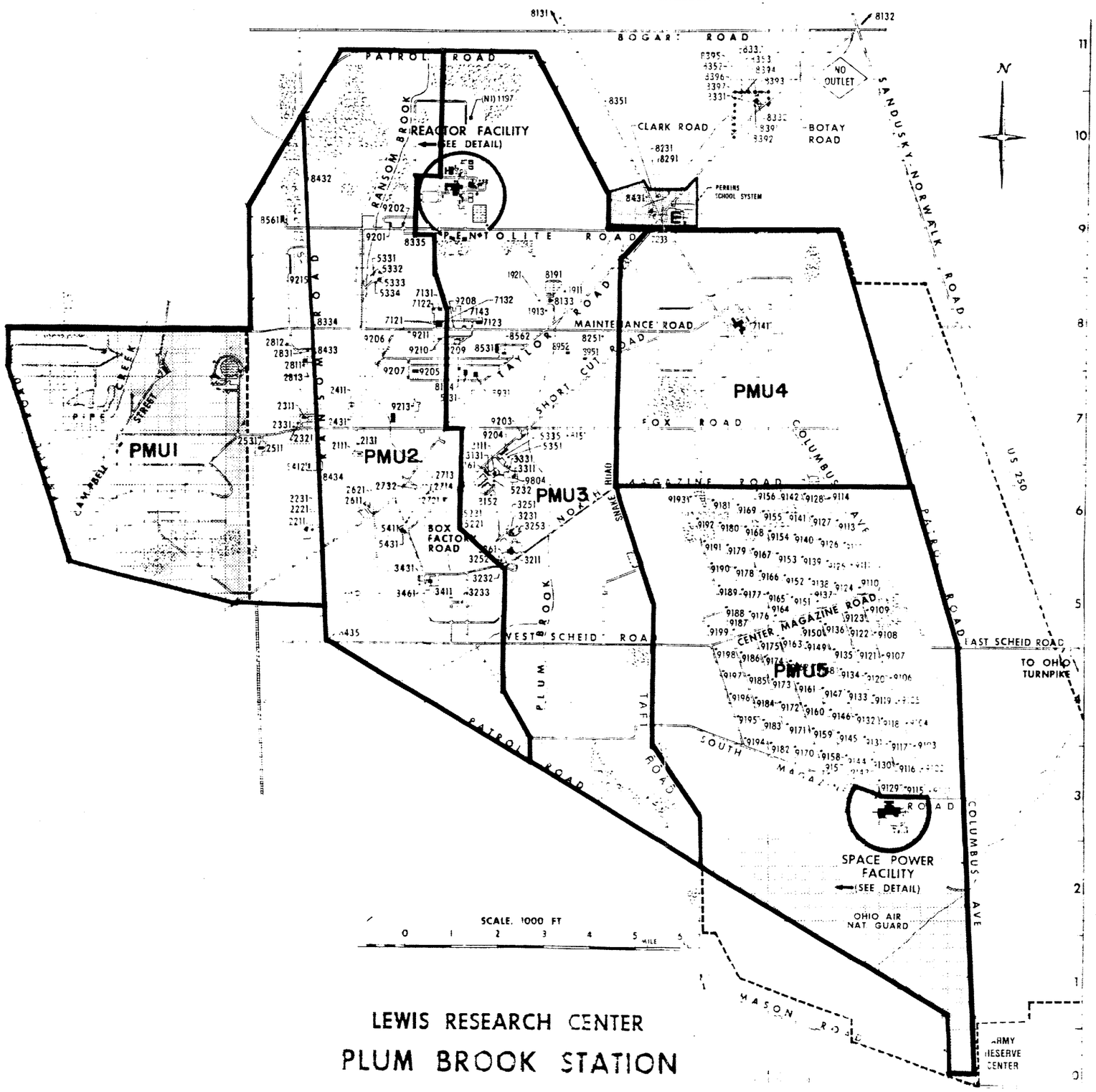
3. The potential exists for release of a hazardous substance into the air.

For the migration pathways evaluated during the PA, the Red Water Ponds resulted in the highest potential for impact to human health and the environment. The Corps of Engineers study conducted by IT Corporation resulted in the identification of releases to the environment of volatiles, semi-volatiles, metals, and nitroexplosives. The releases were to the soil and groundwater. Because of the nature of the volatiles found there are expected releases to the air.

FIGURE 3-1
PMU BOUNDARIES

MK - FERGUSON

REV	DATE	DESCRIPTION	BY	SR ENGR	DEPT MGR.	PE



LEWIS RESEARCH CENTER

PLUM BROOK STATION

NASA PLUM BROOK STATION
SITE INVESTIGATION

PMU BONDARIES

MK-FERGUSON
A DIVISION OF MORRISON KNUDSEN CORPORATION
1500 WEST 3RD ST. • CLEVELAND, OHIO 44113 • 216-523-5600

DRAWN BY	APPROVED BY	WORK ORDER NUMBER 4065-6128-004	
CHECKED BY	SCALE	DRAWING NUMBER	REV.

MK - FERGUSON

MK - FERGUSON

073334

Four migration pathways were considered and evaluated by Hazard Ranking System (HRS) scoring in the PA. These pathways were surface water, soil exposure, air release, and groundwater.

3.6.2 Surface Water Pathway

Surface water can potentially be impacted by most of the operating units through direct runoff, discharge via storm sewers, or groundwater discharge. The proximity of surface water to its ecological and human receptors increases the potential hazard through the surface water pathway. Although the Plum Brook Station units are within the 15-mile target distance of the Sandusky and Huron municipal water supply intakes on Lake Erie, the realistic potential of releases to impact these water supply systems appears to be remote. Releases to the environment have been sporadic and generally of short duration. The dilution factors of several miles of river and of Lake Erie seem to be adequate to absorb these types of releases.

3.6.3 Soil Exposure Pathway

All of the documented and suspected releases to the environment at Plum Brook Station have impacted soil. The majority of the soil contamination problems appear to identify soil exposure and groundwater migration routes as the principal pathways of concern.

3.6.4 Air Release Pathway

Little information exists with respect to airborne contamination. However, none of the identified potential contaminant sources are expected to have a significant potential for future airborne releases. A review of historical site activities indicates that there may have been airborne releases in the past. In addition to possible historical airborne releases, the air pathway scoring method includes the total estimated worker population as on-site secondary air targets. Consequently, the air pathway scores tend to be elevated relative to other pathway scores.

3.6.5 Groundwater Pathway

As discussed under the soil pathway, all of the releases to the environment at Plum Brook Station have impacted soil and consequently have the potential to impact groundwater. The groundwater migration route has been identified as one of the principal pathways of concern. However, several factors, including the lack of groundwater receptors and the restricted access to most contaminated areas, minimize much of this hazard potential.

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.

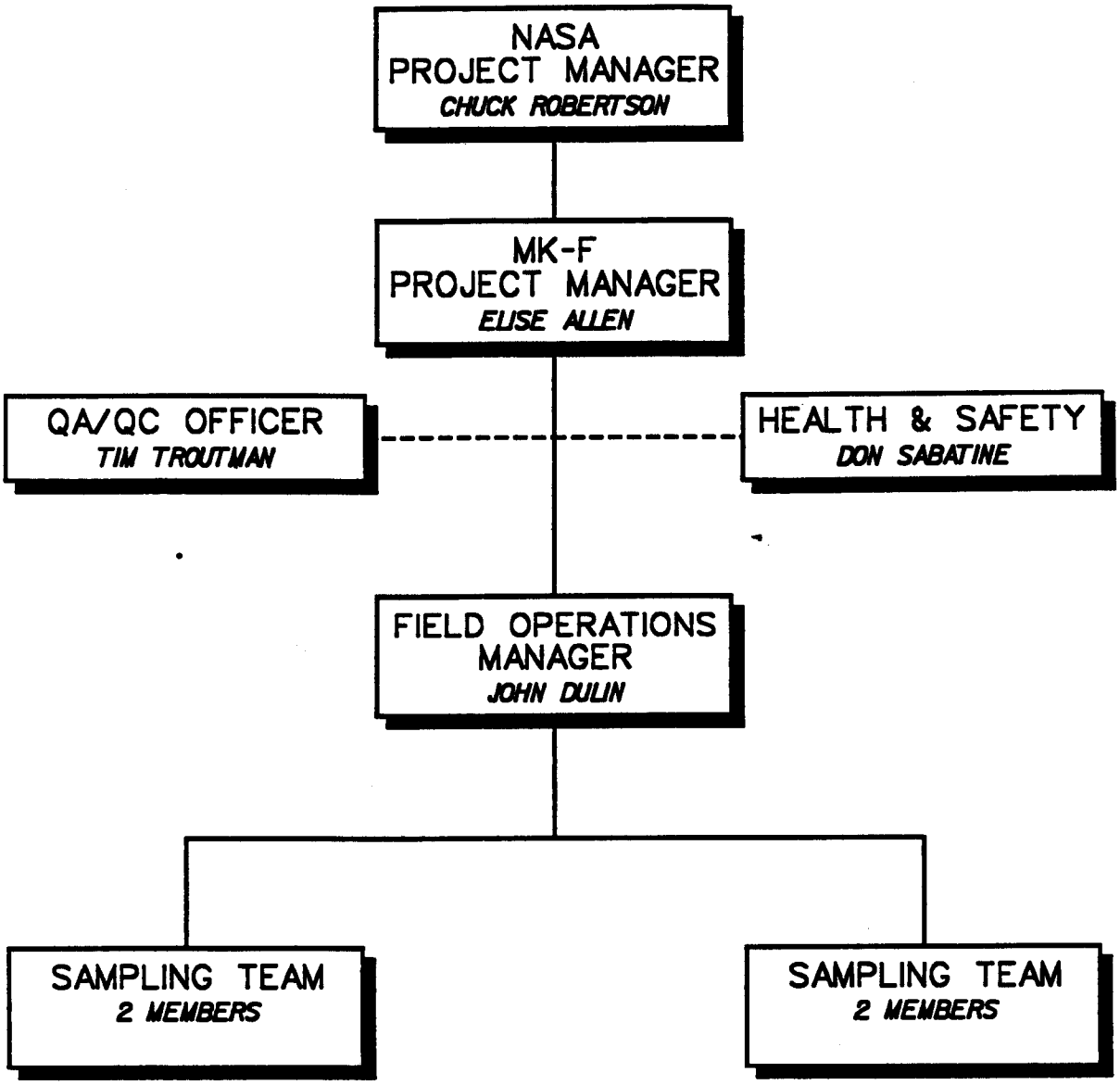
The MK Project Manager (PM), Ms. Elise Allen, will be the primary interface with NASA management and will represent MK at all review meetings. She will review and approve all deliverables and information transmitted to NASA and will be ultimately responsible for the contents of all documents. The PM 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
PROPOSED 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.

SECTION 5
DATA QUALITY OBJECTIVES

5.1 Introduction

The strategy for data collection is established through the development of Data Quality Objectives. At stated earlier, the parameters that will be used to specify data quality requirements and to evaluate the analytical system performance are precision, accuracy, representativeness, completeness, and comparability. All soil, ground water, stream sediment, surface water and associated QC samples collected during the SI will be analyzed and reported according to the DQOs presented in Table 5-1. During the course of the investigations at PBS, all activities and analyses will be conducted using standard procedures so that known and acceptable levels of PARCC are documented.

Table 5-1
Plum Brook Station Site Investigation
Data Quality Objectives

Activity	Type of Analysis	Data Use	Level
Soil Borings	Field Screening	To select samples for laboratory analysis.	II
	Chemical Analysis	To assess presence and vertical extent of constituents.	III
Sample Ground Water in New and Existing Wells	Field Screening	To select samples for laboratory analysis.	II
	Chemical Analysis	To assess presence and extent of constituents.	III
Surface Soil	Field Screening	To select samples for laboratory analysis.	II
	Chemical Analysis	To evaluate presence of residual surface constituents.	III
Surface Water	Field Screening	To select samples for laboratory analysis.	II
	Chemical Analysis	To evaluate presence of constituents in surface water.	III
Sediment	Field Screening	To select samples for laboratory analysis.	II
	Chemical Analysis	To evaluate presence of residual constituents in stream bed	III

Definitions of Data Quality Levels:

Level II Field screening using portable analytical instruments.
Level III Analysis performed by an off-site analytical laboratory.

Precision - is a measure of the agreement among a set of replicate measurements without assumption of knowledge of the true value (for inorganics) or between matrix spike/matrix spike duplicates (for organics). The estimate of precision used when only a single replicate is analyzed is the relative percent difference which is calculated as follows:

$$RPD = \{(X_1 - X_2)/[(X_1 + X_2)/2]\} *100$$

where X_1 and X_2 are the measurements for the sample and the replicate.

Accuracy - is a measure of the degree of agreement of a measurement with an accepted reference or true value, usually expressed as the percent recovery. Percent recovery is calculated as follows:

$$\% \text{ Rec} = [(\text{Measured Value})/(\text{Known Value})] * 100$$

Accuracy will be measured using matrix spikes, where an aliquot of the sample is spiked in the laboratory with known quantities of the target analytes and is then analyzed in a routine manner. Accuracy as measured by matrix spike recovery is a measurement of the bias of a specific method for the sample matrix analyzed.

Representativeness - is an expression of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. The sampling procedures have been designed so that the results are representative of each area of concern, each matrix being investigated (ground water, surface water, soils, sediment, and waste), and each condition being investigated.

Comparability - expresses the confidence with which one data set can be compared with another. Comparability is important to assure that data from any single investigation can be compared with data from past or future sampling programs. All data will be reported in units consistent with the specifications of the applicable method of analysis to allow for data comparisons. All data will be screened for comparability prior to use. Data that appears to be noncomparable will be evaluated as such and a decision will be made as to whether resampling and reanalysis is necessary to fulfill the completeness criteria.

Completeness - is a measure of the quantity of valid data obtained from the sampling program compared to the total amount of data collected. It is calculated by dividing the number of useable data points by the total number of data points planned to be collected. Typically, 90 to 95% of data planned to be collected must be complete (and useable).

The DQO's established for the tasks performed and the data collected during the SI activities at Plum Brook Station will ensure:

1) That the highest possible scientific/professional standards for each task and/or procedure shall be adhered to;

2) That all data collected meet or exceed the referenced guidelines and requirements developed and/or approved by USEPA, or other appropriate standard scientific methods where EPA methods do not exist; and

3) That the data generated is of such quality that it is legally defensible.

5.2 Field Investigation Quality Objective

The objective with respect to the field investigation is to maximize the confidence in the data in terms of PARCC.

Section 11 presents the frequency with which trip blanks, field duplicates, field blanks, and matrix spikes will be collected such that a specific degree of precision and accuracy can be calculated for analytical data. The data quality objective for field duplicates is to achieve precision equal to or greater than that summarized on Table 5-2.

Precision will be calculated as the relative percent difference (RPD) if there are only two (2) analytical points, and as relative standard deviation (RSD) if there are more than two (2) analytical points. The submission of trip blanks and field blanks will provide a check on accuracy. Although accuracy is best assessed by evaluating the results of blanks, blanks do not monitor analyte losses. The submission of blanks will, however, monitor contaminants introduced with the sampling process, preservation, handling, shipping, and the analytical process. The data quality objective for trip blanks and field blanks is to not exceed the quantitation limit (QL) for all analyses. In the event that the blanks are contaminated and/or poor field duplicate precision is obtained, the associated data will be qualified as described in Section 10. Through the submission of field quality control samples, the distinction can be made between laboratory problems, sampling techniques, and sample matrix variability.

Precision and accuracy for the field pH and conductivity measurements are dependent on the type and condition of the instrument used and the care used in standardization and operation. The precision and accuracy objectives for the instrumentation to be used for this project are as follows:

- pH precision will be ± 0.3 pH standard units and accuracy will be ± 0.3 pH standard units. The pH measurements will be reported to two (2) significant figures.

- Conductivity precision will be ± 3 μmhos/cm on the 500 μmhos/cm range, ± 25 μmhos/cm on the 5,000 μmhos/cm range, and ± 250 μmhos/cm on the 50,000 μmhos/cm range. Accuracy for the conductivity measurements is a function of the conductivity reading for the probe and instrument combined. Conductivity measurements will be reported to one (1) significant figure for values below ten and to two (2) significant figures for values above ten.

Table 5-2
Criteria Objectives

LABORATORY ANALYSES

Precision Objectives	Aqueous	Solid/Other
Field Duplicate/Replicates (Blind or labeled)		
PPL VOA	within 20% RPD	within 30% RPD
PPL BNA	within 25% RPD	within 40% RPD
Metals	within 25% RPD	within 40% RPD
Wet Chemistry Parameters	within 25% RPD	within 40% RPD
Laboratory Duplicates (Unspiked)		
Metals	As specified in Attachment A	As specified in Attachment A
Wet Chemistry Parameters	As specified in Attachment A	As specified in Attachment A
Laboratory Duplicate (MSD)		
PPL VOA	As specified in Attachment A	As specified in Attachment A
PPL BNA	As specified in Attachment A	As specified in Attachment A
Accuracy Objectives		
Field or trip blanks		
PPL VOA	Less than the QL	Less than the QL
PPL BNA	Less than the QL	Less than the QL
Metals	Less than the QL	Less than the QL
Wet Chemistry Parameters	As specified in Attachment A	As specified in Attachment A
Laboratory Blanks		
PPL VOA	As specified in Attachment A	As specified in Attachment A
PPL BNA	As specified in Attachment A	As specified in Attachment A
Metals	As specified in Attachment A	As specified in Attachment A
Wet Chemistry Parameters	Less than the QL	Less than the QL
Matrix spikes/surrogate spikes		
All PPL Fractions	As specified in Attachment A	As specified in Attachment A
Wet Chemistry Parameters	As specified in Attachment A	As specified in Attachment A
Pre & Post - digestion spikes		
Metals	As specified in Attachment A	As specified in Attachment A

PPL - Priority Pollutant List (Solid Waste)

To ensure sample representativeness, all sample collection will be performed in strict accordance with EPA-recommended procedures for collection and preservation. EPA-recommended holding times specified in EPA 600/4-79-020 (Methods for Chemical Analysis of Water and Wastes); the Federal Register, 26 October 1984; and EPA SW-846 (Test Methods for Evaluating Solid Waste) will be met.

The data quality objective for the completeness of data with respect to sampling (field investigation) is 100%. In the event 100% is not obtained, the effect of the uncollected data will be evaluated by the Project Manager as to its impact (if any) on project objectives. Corrective actions will be initiated to resolve any data gaps from the original objectives, found as a result of less than 100% data completeness. Every effort will be made to obtain valid data for all sampling points, particularly those considered to be critical points.

Standardized methods of field analysis, sample collection, holding times, and preservation will be used during the investigation to establish a degree of comparability such that observations and conclusions can be directly compared with all historical data. In addition, field conditions will be considered in evaluating sampling results in order to attain a high degree of data comparability.

5.3 Laboratory Data Quality Objectives

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and matrix spike duplicates. Precision (as well as instrument stability) will also be demonstrated by comparison of response factors for calibration standards. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spike compounds. Accuracy will be presented as percent recovery. Precision will be presented as relative percent differences (RPD), relative standard deviation (RSD), or percent difference (%D), whichever is applicable to the type of QC samples involved. Laboratory method blanks will also demonstrate accuracy with respect to the analyses. The frequencies of laboratory duplicates, matrix spikes and laboratory blanks are specified in Section 11.

The analytical laboratory will be expected to process (purge, extract, distill or digest) an aliquot of each sample such that the analytical results will provide a high degree of representation with respect to the sampling point. In addition, the analytical laboratory will be expected to document all analytical problems encountered during the course of the investigation. Communication will be maintained with the laboratory so that analytical problems encountered with critical sample points will allow these samples to be re-collected, if necessary. Further, the laboratory will be required to provide all data packages in CLP-equivalent deliverable formats to ensure that analytical methods, parameters, and reporting units are compatible throughout the investigation.

The Laboratory's QAPjP is included as Attachment A.

will be using a CLP Lab

The quantitative objectives (criteria) that will be required for both field and laboratory accuracy and precision are summarized in Table 5-2. The laboratory will be expected (as an ideal objective) to report the QL for all samples in the appropriate statistical reporting units for all analyses. However, it should be noted that actual quantitation limits are sample specific and depend on variables such as dilution factors, sample matrices, percent moisture, and the specific analyte. The data reported at or near the QL will be handled cautiously since the stated data quality objectives for accuracy and precision may not "translate" well in some situations (i.e., accuracy and precision suffer for results near the QL).

5.4 Data Management Objectives

It is a data management objective that all aspects of the investigation from sample design, collection, shipment, and analysis, to use/decision be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document.

It is expected that by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any problems found in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherent to the overall system.

The overall data management objective is to provide a complete data base with a high degree of confidence through the use of a phased approach of sampling, analysis, data assessment (data review), data qualification and feedback.

SECTION 6
SAMPLING PROCEDURES

6.1 Introduction

The numbers of samples, locations, and justification for each sample media to be collected are presented in the Field Sampling Plan. Procedures associated with surface soil sampling, soil borings, waste borings, and ground water sampling are described below. Table 6-1 presents an Analytical Methods Matrix for the PBS Site Investigation.

6.2 Surface Soil Sampling

Surface soil samples will be collected using a hand-driven bucket auger or a stainless steel trowel, depending on the depth. The soil samples will be removed from the bucket auger using a pre-cleaned stainless steel scoop or spoon. Soil samples collected using the bucket auger or stainless steel trowels will be placed directly into a sample container. An appropriately sized volume will be transferred to a one liter laboratory-cleaned glass jar and a visual description of the soil will be logged. The sample will be packaged and submitted to the laboratory as described in Section 7.

6.2.1 Soil Boring Program

All drilling activities will incorporate hollow stem auger techniques to facilitate the collection of soil and waste samples. A 6-inch I.D. hollow stem auger will be used to advance the borehole. The borings will be logged based on samples collected using a 2-inch diameter by 2-foot-long, split-barrel sampler.

ASTM D-1596 procedures will be followed with the exception that the sampler will be driven 24 inches rather than the 18 inches which is standard to the testing procedures. 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 and 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, the boring will be classified based upon the drilling cuttings.

The soil sample for laboratory analysis will be procured from the sampler using a stainless steel spatula or spoon. The sample for VOC analysis will be immediately placed 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) from which the cuttings were generated. Final dispose and handling of soil cuttings is detailed in the Investigation Derived Waste (IDW) Plan.

TABLE 6-1
ANALYTICAL METHODS

PARAMETER	METHOD NUMBER	SAMPLE SIZE/ CONTAINER	PRESERVATION	HOLDING TIME
VOLATILES	8240	3 x 40ml VOA 1 x 40oz. GA Jar	4oC[1]	14 days
SEMI-VOLATILES	8270	2 x 1L GA Bottle 1 x 8oz. GA Jar	4oC 4oC	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	4oC, pH<2HNO_3 4oC	6 months 6 months
NITROEXPLOSIVES	8330	water: 1 x 40 ml GA Vial soil: 1 x 60ml GA Bottle	4oC 4oC	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	4oC 4oC 4oC 4oC	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	4oC 4oC	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.

6.3 Ground Water Sampling Procedures

The assessment of ground water quality will involve the following activities: inspection of existing monitoring wells; installation of new monitoring wells; developing of monitoring wells; surveying of wells; measurements of depth to water; and collection of ground water samples. The procedures for performing these activities are presented in this section.

6.3.1 Inspection of Existing Monitoring Wells

Existing monitoring wells will be inspected prior to their use during the SI. The inspection process will include a review of the well logs to assess the construction of the wells and identify the stratigraphic zone(s) in which the wells are screened; redevelopment of the wells; and performance of hydraulic conductivity tests to characterize hydraulic properties of the wells and the screened stratigraphic zone(s).

6.3.2 Well Installation

Drilling for monitoring wells will be conducted in accordance with MK's Standard Procedures. These procedures address drilling, development and installation of groundwater monitoring wells. The monitoring wells will be installed through 6-inch ID hollow stem augers. The monitoring wells will be screened using 2-inch diameter, 0.020 slot, PVC screen; the typical length being 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 be used in joining the screen and casing sections to preclude the potential for analytical interference.

A graded sand pack will be placed 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 will be 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 new wells and sampled established wells will be surveyed relative to the top of casing (TOC) elevation above mean seal level (MSL) and ground elevation. This will provide a common elevation datum from which ground water elevation measurements can be correlated. To provide accuracy and consistency in groundwater measurements, the casing of each well will be marked or notched at the point where the elevation is established. In addition, all monitoring wells will be located by latitude and longitude so that they can be located on a scaled site map.

6.3.3 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 have become disturbed during well installation. This helps provide for the collection of representative groundwater samples.

Development of wells 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.

6.3.4 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.

6.3.5 Groundwater Sampling

Prior to collection of the sample from the monitoring well, the well will be purged to remove the standing water to ensure that the sample collected is representative of the aquifier water. The depth to groundwater will be measured so that the volume of groundwater in the well may be calculated. 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 for the construction of a ground water table contour map.

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

$$3 \times (\pi \times r^2 \times h \times 7.48\ gallons/ft^3)$$

where:

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

The actual number of well volumes to be removed will be determined by field measurements. The pH, temperature and specific conductance will be measured and logged during well sampling. 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 the 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 analyzed for total metals only, therefore, samples 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 obtain measurements 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.

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.

6.4 Surface Water

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 of the water entering PBS in these streams. These two water bodies are the most significant

surface water pathways at Plum Brook Station. The Field Sampling Plan lists the approximate location of each surface water/sediment sampling station, analytical parameters, and justification for obtaining each sample.

Surface water samples will be collected by a person 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 due to suspended material in the stream caused by the sampling activities. 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 where possible, depending upon the depth.

Field water quality parameters such as pH, specific conductivity, and temperature will be measured in-situ at each sampling location. A visual assessment of water color, odor, and turbidity will be made and recorded upon collection of all surface water samples.

When a sample collection device is used to obtain the surface water sample, the analytical sample bottles will be filled 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 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.

The approximate distances from permanent structures such as bridges and powerline supports will be determined and recorded for 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.

6.5 Sediment Sampling

Sediment samples will generally be collected at locations corresponding to the surface water sample locations 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 the sample from the sample bucket. The sample is then placed directly into the proper sample container or stainless steel bowl. Decontaminated equipment will be used to collect the sediment samples.

A relatively undisturbed sediment 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 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 off-gassing of volatile constituents. Sediment color, texture, and odor will be noted and recorded upon collection of all samples.

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

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 appears clear upon visual examination.

6.6 Soil Sampling

The purpose of the soil sampling effort at PBS is to identify the existence of any soil contamination; the soil sampling will not determine the extent of the 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. The Field Sampling Plan 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.

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(s). 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 off-gassing of volatile constituents.

Soil samples that are not to be analyzed for volatile organics may be composited for analysis. 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 7.

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 location will be noted in the field documentation.

6.7 Decontamination and Post-Sampling Procedures

Decontamination of equipment will take place at specific decontamination zones designed at the site.

Drilling equipment will be decontaminated prior to initial use, between boring locations, and at the completion of drilling activities. Items necessary to decontaminate include:

- Back of drilling rig;
- Auger flights;
- Down-hole equipment; and
- Well casing and screen.

A manual scrubbing to remove foreign material followed by a thorough steam cleaning will be used for decontamination of the above items. Drilling equipment, well screen, and well casing will be stored in a contaminant-free location above ground on wooden supports after decontamination and covered with plastic until use.

All non-disposable equipment (bailers, split barrel samplers, hand trowels, etc.) will be decontaminated according to the procedures summarized below:

- Manual scrub with non-phosphate soap solution plus tap water wash;
- Tap water rinse;
- 10% nitric acid rinse (for metals only);
- Pesticide grade methanol rinse (for organics only);
- Distilled/Deionized water rinse; and
- Air dry.

Following decontamination, each dedicated bailer will be individually wrapped in plastic liners, sealed, and stored on-site at a contaminant-free location for future use.

The submersible pump system will be decontaminated between wells by flushing with approximately 50 gallons of clean tap water. The outside of the pump, discharge tubing and power line will be thoroughly rinsed with distilled water using a hand-held pressure sprayer.

SECTION 7
SAMPLE CUSTODY

7.1 Introduction

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of all samples from the moment of collection, through analysis, until final disposition. Custody for samples collected during this investigation will be maintained by the Field Operations Manager or the field personnel collecting the samples. The Field Operations Manager or the field personnel will be responsible for documenting each sample transfer and maintaining custody of all samples until they are shipped to the laboratory.

A sample is considered to be under custody if:

1. It is in your possession, or
2. It is in your view after being in your possession, or
3. It was in your possession and you locked it up, or
4. It is in a designated secure area.

MK will use laboratory-supplied bottles appropriate for each media as sample containers. All necessary chemical preservatives will be added to the bottles prior to the sampling event, where appropriate. Custody of the sample bottles will be maintained by the Field Operations Manager. Sample bottles needed for a specific sampling task will be relinquished by the Field Operations Manager to the sampling team after the Field Operations Manager has verified the integrity of the bottles and ensured that the proper bottles have been assigned to the task to be conducted.

A self-adhesive sample label will be affixed to each container during sample collection. At a minimum, the sample label will contain the following information, as shown on Figure 7-1:

- Client - Job Name (Occidental Chemical);
- MK Traffic Report Number;
- Sample identification - place of sampling;
- Date and time collected;
- Sampler's initials;
- Testing required; and
- Preservatives added.

7.2 Chain of Custody

Immediately after sample collection, each sample bottle will be sealed in an individual plastic bag. Samples will then be immediately placed into an insulated cooler for shipment to the laboratory. MK field Chain-of-Custody records (Figure 7-2) completed at the time of sample collection will accompany the samples inside the cooler for shipment to the laboratory. The samples will be properly relinquished on the field Chain-of-Custody record by the sampling team. These record forms will be sealed in a ziploc plastic bag to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to ensure that proper temperature is maintained and will be packed in a manner to prevent damage to sample containers. The field Operations Manager will then initial and attach a custody seal (Figure 7-3) to each sample cooler. All coolers will be shipped by an overnight courier according to current US DOT regulations or delivered directly to the laboratory via a courier.

A critical aspect of sound sample collection and analysis protocols is the maintenance of strict chain-of-custody procedures. Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing. Custody will be documented throughout all investigations by the chain-of-custody record initiated for each day in which samples are collected. The record will accompany the samples from the site to the laboratory, and will return with the final analytical report. All personnel with sample custody responsibilities are required to date, sign, and note the time on the record when relinquishing samples from their custody.

Chain of custody forms will contain the following information:

1. Sample Number
2. Collection Date
3. Project Number
4. Date/Time of Shipment Packing
5. Samplers' names
6. Sample Preservation (if any)
7. Analysis Required
8. Shipping Address of the Laboratory

At the time of sampling, the field technician will also record sample information in a logbook and on a chain-of-custody form, noting on each any difficulties encountered in sampling. All label, logbook, and chain-of-custody form entries shall be made in waterproof ink. The sample information recorded in the logbooks should be at least as detailed as that recorded on labels, and should indicate the type of sample (e.g., groundwater, soil, waste, etc.), preservation technique, and sampling location, in sufficient detail as to allow resampling at the same location.

7.3 Field Documentation

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which require reduction. All the field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Field Operations Manager will proof at least 10% of all data transfers.

The documentation of sample collection will include the use of project-dedicated bound field logbooks in which all information on sample collection and field instrument calibration will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including site name (top of each page), sample identification, brief description of sample, data and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

Samples shall be accompanied by the chain-of-custody documentation. When transferring the possession of the samples, the individual relinquishing and receiving will sign, date, and note the time on the chain-of-custody form.

Samples should be packaged so as to preserve but not destroy the samples in shipment. Samples will be dispatched to the appropriate laboratory for analysis with a separate chain-of-custody accompanying each shipment. Shipping documentation will be retained in the project file to support chain-of-custody procedures. Sample packaging will be in accordance with DOT regulations. Shipping containers will be sealed with custody seals to indicate possible tampering.

One copy of the chain-of-custody will be retained from the three part form. The two other copies will accompany the samples to the laboratory.

DATE:		PUMP ID#:	MORRISON KNUDSEN CORPORATION
SAMPLE #:		FLOW:	
TIME ON:	TIME OFF:	PROJECT NO.:	

Sample ID:	MORRISON KNUDSEN CORPORATION
Sample Description:	
Location:	
Sample Date/Time:	Project No.
Sampler's Signature:	

Sample ID:	
Sample Description:	
Sample Date/Time:	
Requested Analyses:	Project Number:
	Task Number:
Preservative:	
Submission Date to Lab:	Phone Number:
Sampler's Signature:	

FIGURE 7-1
MK SAMPLE LABELS

FIGURE 7-2
MK CHAIN-OF-CUSTODY RECORD

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

CHAIN OF CUSTODY RECORD

720 Park Blvd., P.O. Box 79
Boise, Idaho 83707
(208) 386-6971

Project No.:

Project Name:

Samplers: (Signature)

Sampler: (Print)

Sample Type	Sampling Point Description	Sample Date	Time	Sample I.D. Number	Split Samples Yes	Split Samples No	Analysis Required																	Remarks

Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:	Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:
Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:	Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:
Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:	Received for Laboratory By: (Signature) Company:	Date / Time	Total No. Samples this Shipping Container:
Relinquished By: (Signature) Company:	Date / Time	Received By: (Signature) Company:		Date / Time	

#10155-96

MORRISON KNUDSEN CORPORATION

CUSTODY SEAL

DATE

SIGNATURE

MORRISON KNUDSEN CORPORATION

CUSTODY SEAL

DATE

SIGNATURE

FIGURE 7-3
MK CUSTODY SEAL

SECTION 8
CALIBRATION PROCEDURES AND FREQUENCY

8.1 Introduction

SI activities will include measurement of certain field parameters. The methods for implementing these investigative techniques and assuring the quality of subsequent results are presented in this section.

8.2 Calibration of ~~Ground~~ Water Instrumentation

Field measurements include pH, specific conductance, and temperature for ground water samples. Calibration procedures for these field measurement techniques are present below.

The frequency of field calibration procedures will, at a minimum, include the following:

- The specific conductance and pH meters will be calibrated a minimum of once daily and documented in the calibrator's field book. Calibration will be checked as necessary to ensure proper measurements are taken.

- pH meters will be calibrated using specific techniques according to the manufacturer's instructions and two standard buffer solutions (either pH4 and 7, or 7 and 10) obtained from chemical supply houses. The pH value of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for temperature on the meter.

- Temperature measurements will be obtained using a field thermometer (Thomas Science No. 9329A10, or equivalent) and recorded to +/- 0.2 degrees Celsius.

Field Sampling Plan - include calibration req'ts

- Specific conductance meters will be calibrated using a 1,000 μmhos/cm potassium chloride (KCI) solution obtained from a chemical supply house. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{ET}{CT}$$

Where:

K = probe cell constant (unitless)
ET = expected value of standard at temperature T (°C)
CT = measured conductance value of standard at temperature T (°C)

Using the cell constant calculated above and the following formula, field specific conductance measurements will be corrected to 25°C.

$$S = \frac{K \times C}{(1 + 0.02\ (T - 25))}$$

Where:

S = Specific conductance at 25°C (μmhos/cm)
K = calculated cell constant
C = field specific conductance (μmhos/cm)
T = temperature (°C) of sample at which conductance was measured

SECTION 9
ANALYTICAL PROCEDURES

9.1 Introduction

All analytical procedures to be used are officially approved EPA procedures. The appropriate methods and required holding times to be met are given in Table 6-1.

9.2 Laboratory Test Methods

The primary analyte list will be the Priority Pollutant List (PPL) for organics and metals analyses for samples collected from areas suspected of containing these analytes. The analytical methods which are to be used for the analysis of the sample media collected at the site are referenced from "Test Methods for the Evaluation of Solid Wastes, SW-846, third edition". The methods to be used are presented in Table 6-1. Analyses for Toxicity Characteristic Leaching Procedure (TCLP) volatile, semivolatile, and metal constituents, as referenced in the 29 June 1990 Federal Register, will be performed on select waste boring samples.

The methods selected for the PBS Site Inspection are chosen to provide comparability with other data typically collected for RCRA investigations and to meet the project DQOs. These methods are the most appropriate to achieve all DQOs.

Laboratory quantitation limits for organic and inorganic constituents are presented in Table 9-1.

9.3 Laboratory Sample Custody

Upon receiving the samples, the Laboratory Sample Custodian will inspect the condition of the samples, compare the information on the sample labels against the field Chain-of-Custody record, assign a laboratory control identification number, and log the control number into the computer sample inventory system.

The preparation of all sample bottles (cleaning technique, preservative added, etc.) will be documented. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented. The Laboratory Sample Custodian will then store the sample in a secure sample storage cooler maintained at 4° C and maintain custody until the sample is assigned to an analyst for analysis. Custody will be maintained until disposal of the analyzed samples.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information from the field Chain-of-Custody record logging the sample and will note any discrepancies. This information will also be communicated to the Field

Operations Manager or field personnel at the earliest possible convenience so that proper action can be taken. The Chain-of-Custody form will be signed by both the relinquishing and receiving parties each time the sample changes hands, with the reason for transfer indicated.

An internal Chain-of-Custody form will be used by the laboratory to document sample possession form the Laboratory Sample Custodian to analysts and final disposition. All Chain-of-Custody information will be supplied with the data packages for inclusion in the document control file.

9.4 Laboratory Data Reduction and Reporting

Analytical data for aqueous matrices will be reported in μg/L (organic and metals parameters) and mg/L (wet chemistry parameters). Analytical data for soil/solid matrices will be reported as μg/Kg (organic parameters) and mg/Kg (inorganic and wet chemistry parameters). Results for TCLP analyses will be reported in mg/L. Data packages associated with the analyses of samples collected during the site inspection will be prepared utilizing USEPA CLP-equivalent deliverable formats. The data deliverables which will be required from the laboratory are presented in Table 10-1. Turnaround time for data deliverables will be within thirty-five days of laboratory receipt of samples. All laboratory analytical data will be summarized and tabulated upon receipt. The data will be validated and qualified by MK and the final data submitted to the project team for use in the site inspection reports.

TABLE 9-1
PLUM BROOK SITE INSPECTION, ORGANIC COMPOUNDS, ORGANIC CONSTITUENTS, AND QUANTITATION LIMITS

PPL Volatiles	Quantitation Limits* Low Water ug/L	Low Soil/ Sediment ug/Kg
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,3-Dichloropropene	5	5
Bromoform	5	5
Tetrachloroethene	5	5
Toluene	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5

TABLE 9-1
PLUM BROOK SITE INSPECTION, ORGANIC COMPOUNDS, ORGANIC CONSTITUENTS, AND QUANTITATION LIMITS (CONTINUED)

PPL Volatiles	Quantitation Limits* Low Water ug/L	Low Soil/ Sediment ug/Kg
Acrolein	5	5
Acylonitrile	5	5
Trichlorofluoromethane	5	5
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropane	5	5
2-Chloroethylvinylether	10	10
1,1,2,2-Tetrachloroethane	5	5
Phenol	10	330
bis(2-Chloroethyl) ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
N-Nitroso-Dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330

TABLE 9-1
PLUM BROOK SITE INSPECTION, ORGANIC COMPOUNDS, ORGANIC CONSTITUENTS, AND QUANTITATION LIMITS (CONTINUED)

PPL Volatiles	Quantitation Limits* Low Water ug/L	Low Soil/ Sediment ug/Kg
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2-Chloronapthalene	10	330
Dimethyl Phthalate	10	330
Acenaphythylene	10	330
Acenaphthene	10	330
2,4-Dinitrophenol	10	330
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
Diethylphthalate	10	330
Dimethyl phthalate	10	330
4-Chlorophenyl Phenyl ether	10	330
Fluorene	10	330
N-Nitrosodimethylamine	10	330
4-Nitrophenol	20	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylamine	10	330
4-Bromophenyl Phenyl ether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330

TABLE 9-1
PLUM BROOK SITE INSPECTION, ORGANIC COMPOUNDS, ORGANIC CONSTITUENTS, AND QUANTITATION LIMITS (CONTINUED)

PPL Volatiles	Quantitation Limits* Low Water ug/L	Low Soil/ Sediment ug/Kg
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butyl Benzyl Phthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
bis(2-ethylhexyl)phthalate	10	330
Chrysene	10	330
Di-n-octyl Phthalate	10	330
Benzol(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330
1,2-Diphenylhydrazine	10	330
Benzidine	50	16000
Antimony	200	4
Arsenic	10	1
Barium	200	20
Beryllium	5	0.5
Cadmium	10	0.5
Chromium	20	2.5
Copper	50	10
Iron	100	10

TABLE 9-1
PLUM BROOK SITE INSPECTION, ORGANIC COMPOUNDS, ORGANIC CONSTITUENTS, AND QUANTITATION LIMITS (CONTINUED)

PPL Volatiles	Quantitation Limits* Low Water ug/L	Low Soil/ Sediment ug/Kg
Lead	2	0.2
Manganese	15	3
Mercury	0.5	0.25
Nickel	5	2.5
Selenium	5	0.5
Silver	10	1
Sodium	100	10
Thallium	10	1
Zinc	20	1
Chloride	1000	----
Total Organic Carbon	1000	10
Total Phenolics	200	30
Total Suspended Solids	1000	----
Sulfate	1000	----
pH (standard units)	0.01	0.01

SECTION 10
DATA REDUCTION, VALIDATION AND REPORTING

10.1 Laboratory Data Quality Assessment

Laboratory personnel are responsible for assuring the quality of the analytical data generated. The laboratory analyst evaluates the data at the bench or instrument, making sure that specific quality control acceptance criteria are met. All data will be reviewed by the laboratory group leader prior to data deliverable generation to check for transcription errors and to ensure that specific quality control acceptance criteria are met and that corrective actions have been taken when necessary. All data deliverables will be reviewed by both the quality assurance manager and the laboratory manager prior to release to the client. The deliverables required from the laboratory are presented in Table 10-1. The laboratory QAPjP is included as Attachment A.

10.2 MK Data Validation

The analytical data generated for the samples collected during the inspection will undergo a rigorous data validation review. This review will be performed in general accordance with the "Laboratory Data Validation Functional Guidelines for the Evaluation of Organic (and Inorganic) Analysis" (USEPA Data Review Work Group, 2/88 for Organics and 7/88 for Inorganics).

A preliminary review will be performed to verify that all necessary paperwork (chain-of-custodies, analytical reports, laboratory personnel signatures) and deliverables as stated in Table 10-1 are provided by the laboratory. CLP-equivalent deliverables will be provided by the laboratory for all analyses.

A detailed quality assurance review of the analytical data will be performed by the MK Quality Assurance Chemist to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a detailed review and interpretation of all data generated by the laboratory. The primary tools which will be used by experienced data review chemists will be guidance documents, established (contractual) criteria, and professional judgement. Table 10-2 presents the items that will be examined during the comprehensive quality assurance review of the data.

Based upon the review of the analytical data, an organic and inorganic quality assurance report will be prepared as an appendix to the SI Report, which will state in a technical, yet "user friendly," fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that discuss the usability of the analytical results. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data table. These qualifier codes will serve as an indication of the qualitative and quantitative reliability.

During the course of the data review, an organic and inorganic support documentation package will be prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the Quality Assurance Officer will verify the accuracy of the review and will then submit these data to the Project Manger. These approved data tables and quality assurance reviews will be signed and dated by the Quality Assurance Officer.

TABLE 10-1
REQUIRED DELIVERABLES FOR CLP-EQUIVALENT FORMAT

- **Title Page** - present site name, field sample numbers and corresponding laboratory control numbers and the appropriate laboratory manager's signature authorizing release of the data.

- **Table of Contents** - list all major sections of the delivered document with the referenced page numbers. This can be incorporated onto the Title Page.

- **MK Chain-of-Custody Forms** - copies of the documents signed by the laboratory sample log-in personnel.

- **Laboratory Chronicle** - supply the dates of preparation and analysis for each analysis fraction and sample.

- **Methodology Summary** - present a brief summary of the method used and the appropriate method reference.

- **Analysis Reports** - present the analyte and indicate the values for positive hits, the quantitation limit, and moisture content for soil samples. Report an individual analysis report for each sample. Soil sample results must be reported on a dry weight basis. For TCLP analyses, actual and matrix-corrected results must be reported. Matrix spike recoveries must be tabulated on analysis report for each sample.

- **Quality Control Summary** - present summary forms tabulating all QC results. Provide acceptance criteria and indicate whether criteria was met.

TABLE 10-1
REQUIRED DELIVERABLES FOR CLP-EQUIVALENT FORMAT
(CONTINUED)

GC/MS Analysis Data

- **Raw Sample Data** - provide reconstructed ion chromatograms and instrument quantitation reports which include library list of compounds, quantitation ions, peak retention times, peak areas counts, peak heights and raw concentration. Raw and background-subtracted supportive mass (sample and standard) must be provided for both confirmed and negated target compounds. Provide soil sample extraction or preparation logs.

- **Standard Data Package**

  - **Initial Calibration** - provide reconstructed ion chromatograms and instrument quantitation reports which include library list of compounds, quantitation ions, peak retention times, peak areas counts, peak heights and raw concentration for each level standard associated with the initial calibration. Provide response factors for each standard, along with average response factor and %RSD.

  - **Continuing Calibration** - provide reconstructed ion chromatograms and instrument quantitation reports which include library list of compounds, quantitation ions, peak retention times, peak area counts, peak heights and raw concentration for all continuing calibration standards. Provide response factors and indicate if acceptance criteria was met for the continuing calibration.

- **Raw Quality Control Data** - provide reconstructed ion chromatograms and instrument quantitation reports which include library list of compounds, quantitation ions, peak retention times, peak areas counts, peak heights and raw concentration for each method blank and the matrix spike and matrix spike duplicate. Provide mass listing and bar spectra for each instrument tune.

Metals Data

- **Raw Sample Data** - provide ICP instrument printouts for each sample, quality control sample and blank.

- **Standards Data** - for the Initial and Continuing calibrations, provide CLP Form II or the equivalent. Provide associated raw data.

TABLE 10-1
REQUIRED DELIVERABLES FOR CLP-EQUIVALENT FORMAT
(CONTINUED)

- **Miscellaneous Quality Control Data** - provide CLP Form IV or the equivalent for ICP interference checks, CLP Form VII for laboratory control samples, and CLP Form IX or the equivalent for ICP serial dilution analyses.

Wet Chemistry Data

- **Raw Sample Data** - provide instrument printouts or photocopies of laboratory notebook records of raw sample data. Provide soil sample extraction or preparation logs.

- **Standard Data** - provide instrument printout or laboratory notebook records associated with the initial and continuing calibrations.

- **Miscellaneous Quality Control Data** - provide tabulations of method blank, laboratory duplicate, and matrix spike analysis results.

TABLE 10-2
ITEMS REVIEWED DURING THE MK DATA VALIDATION

Area Examined	Applicability (organic, inorganic, both)
MK and Laboratory Chain of Custodies (Traffic Reports, Field Notes, etc.)	Both
Holding Times	Both
Extraction/Digestion Logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument Tune	Organic
Standards	Both
Linearity	Both
Sensitivity/Stability	Both
Selectivity/Specificity	Both
Variability of Technique (internal standards)	Organic
Analyte Breakdown	Both
Analytical Sequence	Both
ICP Interference	Inorganic
Control Standards	Both
Samples	
Detection Limits	Both
Instrument Printouts	Both
ICP data	Inorganic
AA data	Inorganic
GG/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative Identification	Both
Mass spectra	
Quantitative Reliability	Both
Calculations/Equations	Both
Matrix spikes (accuracy)	Both
Bias	
Matrix spikes duplicated	Organic
Bias	
Accuracy & Precision	
Surrogate Spikes	Organic
Bias	
Duplicated (field and laboratory)	Both
Precision	
Representativeness	
Post-Digestion Spikes	Inorganic
Matrix Effects	

SECTION 11
INTERNAL QUALITY CONTROL CHECKS

11.1 Field Checks

Field Internal Quality Control will be monitored during the investigation through the use of the following:

- Trip Blanks - These blanks consist of ultrapure, deionized water contained in individual sample containers with any preservatives required for that analysis. These blanks will accompany the samplers during the sampling process and will serve as QC checks on container cleanliness, external contamination, and the analytical method. Pretested (known to be analytically clean), sterilized sand will be used as trip blank material for solid/soil analyses. Trip blanks will be submitted blind using a fictitious sample location. The trip blanks will only be submitted for volatile analyses and will be at a frequency of once per day for the ground water, surface soil, and soil boring samples.

- Equipment Rinsate Blanks - Equipment rinsate blanks 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. These blanks will be collected by decontaminating the sampling device and then pouring ultrapure deionized water or distilled water over the device. This rinsate water will be collected into a clean stainless steel bowl, if necessary, and then transferred to the appropriate sample containers or directly into the sample container. One equipment rinsate blank will be collected every day that samples are collected for each sampling device associated with the ground water, surface soil, and soil boring sampling activities. The equipment rinsate blanks will be analyzed for parameters identical to the associated samples.

- Field Blanks - Field blanks consist of the source water used in decontamination and steam cleaning. One field blank will be collected for each sampling event associated with the ground water, surface soil, and soil boring sampling activities. The field blank will be analyzed for parameters identical to the associated samples.

- Duplicate Samples - Blind duplicate samples will be collected to allow determination of analytical and sampling precision. One duplicate sample in every twenty (20) ground water, surface soil, and soil boring samples will be collected and submitted for the parameters identical to the true sample.

- Matrix Spike Samples - Matrix spike/matrix spike duplicate (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 Plum Brook Site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

MS/MSD sample aliquots will be acquired for ground water analyses by providing triple the necessary sample volume for the location identified for these QC samples. MS/MSD sample aliquots for solid/soil analyses will be split from the designated sample location at the laboratory. The laboratory will select aliquots that are as homogeneous with respect to one another as possible to avoid precision problems related to sample inhomogeneity. Homogenizing is discouraged prior to splitting duplicates to avoid loss of volatile organic compounds. The specific sample locations which will be used for matrix spikes and blind duplicates will be chosen by the Field Operations Manger with direction from the Quality Assurance Officer.

11.2 Laboratory Checks

The laboratory QAPjP is attached as Attachment A.

SECTION 12
PERFORMANCE AND SYSTEM AUDITS

12.1 On-Site Field Audit

An on-site system audit will be performed during the initial sampling event to review all field-related quality assurance activities. The system audit will be conducted by the Field Operations Manager. The acceptance criteria for the field audit will be adherence to the protocols presented throughout the work plan. Deficiencies found during the audits will be brought to the attention of the responsible individuals and corrective action will be initiated.

Specific elements of the on-site audit will include the verification of the following:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.

- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required.

- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling.

- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan including wearing of proper protective clothing.

- Adherence to decontamination procedures outlined in the work plan, including proper documentation of pumps and pump tubing, bailers, and sampling equipment.

- Adherence to sample collection, preparation, preservation, and storage procedures.

12.2 Internal Laboratory Audits

The laboratory will perform regular systems and performance audits. These are described in Appendix A.

An on-site system audit will be performed by MK prior to shipment of samples for analysis. Additionally, MK's Quality Assurance Officer will perform an on-site audit at the laboratory facility during the initial stages of the SI to ensure that sample analyses are performed according to procedures specified in the work plan. Acceptance criteria for MK's performance audit of the laboratory will be adherence to the procedures by EPA in the work plan.

12.3 Audit Results

Results of the evaluation of both the field and laboratory audits will be submitted to MK's Project Manager for review. If the results of the audit necessitate further action, the MK Project Manager and NASA will be notified of such and will be apprised of any corrective action taken.

SECTION 13
CORRECTIVE ACTION

13.1 MK's Corrective Action

Field quality assurance activities will be reported to MK's Project Manger. Problems affecting quality assurance that are encountered during the study will be reported on a Nonconformance/Corrective Action Report as presented on Figure 13-1. The Project Manager will report to the Quality Assurance Officer on all necessary corrective actions taken, the outcome of these actions, and their effect on data produced.

13.2 Laboratory Corrective Action

Correction action Procedures for the laboratory are presented the Laboratory QAPjP which is included as Attachment A. The laboratory will provide documentation as to what, if any, corrective actions were initiated concerning this study and report them to MK's Quality Assurance Officer.

NONCONFORMANCE/CORRECTIVE ACTION REPORT

Document ID # _____

NONCONFORMANCE REPORT	Date	Task No.
Issued to	Prepared by	

CONDITION DESCRIPTION

RECOMMENDED DISPOSITION

Signature	Title	Date
Signature	Title	Date

CORRECTIVE ACTION REPORT

Prepared by	Authorized by

ACTION TAKEN

Verified by	Signature	Title	Date
Follow-Up	Signature	Title	Date
Reviewed by	Signature	Title	Date